

## Thematic Opinion

# Options for teaching-learning and research in higher education: coping strategies for Environmental Science studies during COVID-19 pandemic

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**Abstract:** Online teaching-learning and virtual classrooms have been the choice of many academia across the globe, when there are lockdown uncertainties, preventing the students for real classroom learnings, due to pandemic. When academic institutions are attempting to adopt online teaching-learning and research, there is need to search the possibilities of improving such approaches. In this context, this paper attempts to provide approaches on how the online teaching-learning and research activities under Environmental Science subject can be strengthened. The paper has identified that in addition to online platforms and virtual classrooms, careful collection of field data de-facto and send to the class for discussion and analysis can open wide array of possibilities to learn distantly. Government-academia partnership and coordination among academic institutions and other relevant stakeholders during the pandemic break, help in providing two-way benefits, viz. academic requirement fulfillment of the academic institutions and reference documents development for the data providing institutions. However, in attempting remote teaching-learning and research, every activities of students are required to be assessed by developing clear and unambiguous evaluation rubric. Strengthening online teaching-learning and research can be one of the avenues for developing future education strategies in academic institutions of Nepal.

**Keywords:** academic exercises; Environmental Science; online learning; pandemic

**सारांश:** अनलाईन शिक्षा तथा भरचुवल कक्षाकोठा विश्वका विभिन्न देशहरूका शैक्षिक संस्थाहरू बन्द र कक्षाकोठाको पहुँच नहुने महामारीको समय जस्तै कोभिड-१९ सङ्क्रमणका समयका लागि उपयुक्त विधि हो। शैक्षिक संस्थाहरू अनलाईन शिक्षाका लागि अग्रसर भईरहेको परिस्थितिमा कसरी यो विधिलाई बलबुन्द बनाई, बन्द अवस्थामा रहेको शैक्षिक कार्यक्रमहरू सुचारु बनाउन कसरी सकिन्छ भनेर प्रयासहरू भईरहेका छन्। यसै सन्दर्भमा वातावरण विज्ञान विषयको अध्ययन, अध्यापन र अनुसन्धान कार्यलाई व्यवस्थित गर्न केहि उपायहरूको बारेमा यस लेखमा प्रस्तुत गरिएको छ। इन्टरनेट तथा सूचना सञ्चार प्रविधिको माध्यमबाट अनलाईन शिक्षा वा भरचुवल कक्षाकोठा निर्माण गरी वातावरण विषय सम्बन्धि मुद्दाहरू अध्यापन गराउन सकिने कुरा यस लेखमा व्यक्त गरिएको छ। सुरक्षित तवर अपनाई विद्यार्थीहरू हाल रहेका प्रदेश तथा स्थानिय तहबाट तथ्यहरू संकलन गर्न लगाई भरचुवल कक्षाकोठामा विविध वातावरणीय विषयहरूमा विभिन्न ठाँउको जानकारी छलफल गराउन सकिन्छ। त्यस्तै विभिन्न राष्ट्रिय तथा अन्तर्राष्ट्रिय सरकारी, गैरसरकारी संघ संस्थाहरूसँग साजेदारी र सहकार्य गर्दै उक्त संस्थाहरूले निर्माण गरेका डिजिटल आकडा, खुला स्रोतमा उपलब्ध शैक्षिक सामग्रीहरूको उपयोग गरेर पनि कक्षाकोठाको पहुँच नहुने समयसम्मको लागि अध्ययन, अध्यापन र अनुसन्धानका कार्य गर्न सकिन्छ। यस्ता कार्यहरूबाट विद्यार्थीहरू र संघ संस्थाहरू दुवै पक्ष लाभान्वित हुन्छन्। अनलाईन तथा भरचुवल कक्षाकोठाको प्रयोग गर्दा विद्यार्थीहरूको शैक्षिक गतिविधिको अनुगमन तथा मूल्याङ्कन चाहि चुस्त दुरुस्त बनाउन पर्दछ। यसरी कक्षाकोठाको पहुँच नहुने समय सम्मका लागि अनलाईन तथा भरचुवल कक्षाकोठाको व्यवस्थितिकरण वैकल्पिक प्रणालीबाट विद्यार्थीको सिकाई सहजिकरण गर्ने उपयुक्त विधि हुन सक्दछ।

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## 1. Introduction

Coronaviruses are human and animal pathogens. A novel coronavirus was identified as the cause of a cluster of pneumonia cases in Wuhan, a city in the Hubei Province of China, at the end of 2019 (<https://www.who.int/csr/don/05-january-2020-pneumonia-of-unknown-cause-china/en/>). It rapidly spread, resulting in an epidemic throughout China, followed by an increasing number of cases in other countries throughout the world (Huang et al., 2020; Chan et al., 2020). In February 2020, the World Health Organization designated the disease COVID-19, which stands for coronavirus disease 2019 and called for public health emergency of global concern ([https://www.who.int/news-room/detail/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-\(2005\)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-\(2019-ncov\)](https://www.who.int/news-room/detail/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov))).

Due to coronavirus pandemic many sectors such as economic, livelihood, agriculture, tourism, trade, industry are being badly affected, including the academic sector. The pandemic is affecting not only the developed countries but also the developing countries of the globe. Millions of students globally are having their education disrupted by the spread of coronavirus. Academic institutions haven't faced this level of disruption in generations (Viner et al., 2020). In Nepal, universities are also being closed

due to the lockdown called from government to address the coronavirus pandemic. Tribhuvan University, first national institution of higher education in Nepal, is facing challenges for teaching-learning and research activities in its central, constituent and affiliated campuses. Environmental Science study of Institute of Science and Technology, Tribhuvan University is also getting affected, and so are the studies of Environmental Science in other universities. This paper therefore aims to find how the situation of the pandemic can be coped during this lockdown break forced by the COVID-19 pandemic.

Environmental Science studies under Tribhuvan University, Nepal has offered courses in Bachelor of Science (BSc), Master of Science (MSc) and Doctor of Philosophy (PhD) programs. PhD students need to complete 18 course credits in addition to their research. MSc students are required to take 64 course credits including thesis research in four semesters (Table 1) and BSc course is divided into four academic years with compulsory, interdisciplinary, practical and research project course modules. Environmental Science study therefore has to consider combination of theoretical and research delivery approaches and require multidisciplinary research framework for their academic fulfillment.

**Table 1:** Framework of courses of MSc Environmental Science and the assigned credits.

SN	Papers	Credits				
		Sem I	Sem II	Sem III	Sem IV	Total
1.	Theory (Compulsory)	12	9	6	3	30
2.	Theory (Elective)	0	3	6	0	9
3.	Practical	6	2	2	1	11
4.	Field Work	0	2	2	0	4
5.	Case Study	0	1	0	0	1
6.	Community Work/ Internship	0	0	1	0	1
7.	Thesis	0	0	0	8	8
	Grand Total	18	17	17	12	64

*(Environmental Science Subject Committee, 2019)*

However, teaching-learning and research approaches at all levels under Environmental Science studies has not been designed to cope such COVID -19 and lockdown situations. University system is still required to get capacitated for online modules because of different constraints, such as access of technology, infrastructure, financial resources and trained human resources. Moreover, the university wills to adopt

the distance teaching-learning and research to its best capacity during pandemics and lockdown situations. In this uncertainty, Environmental Science studies require attempt to strengthen distance teaching-learning and research approaches for continuing its academic and research programs and partly handle the situations created by the lockdown situations. With simultaneous

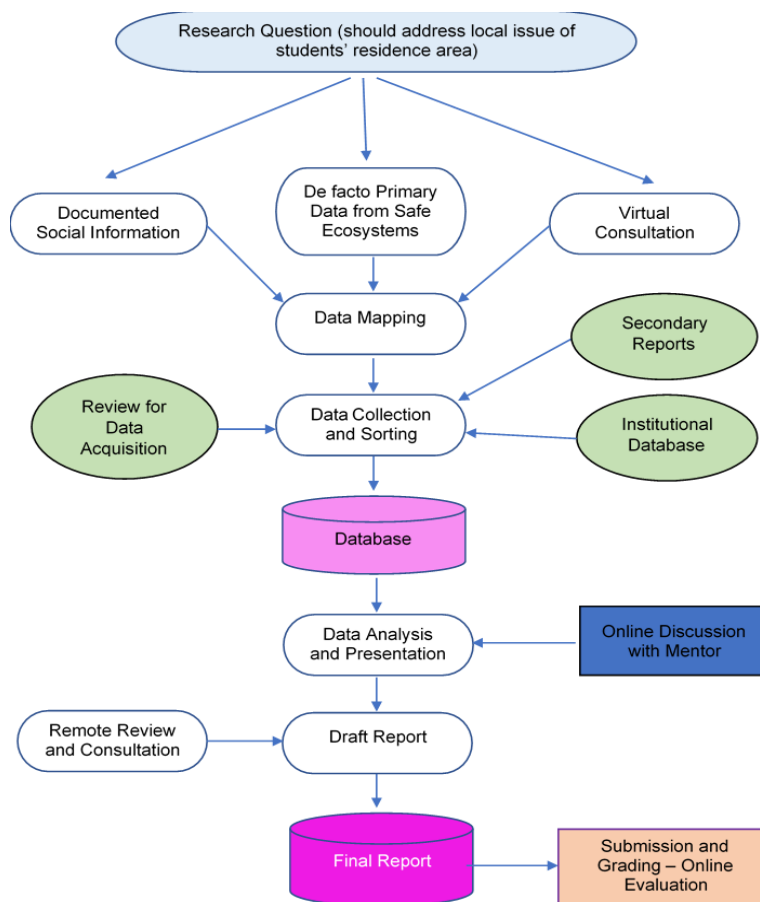
strengthening need to adopt online teaching-learning, research and evaluation systems, Environmental Science studies need to get prepared to address such circumstances. Therefore, some of the techniques described in this paper can guide for future academic exercises.

## 2. Remote or Virtual Classrooms

Online teaching-learning and virtual classrooms can offer more advanced, and extremely flexible functionalities, if can be bended to the needs of the learners. When used properly, remote learning offers the students with new means of acquiring knowledge that is designed to enrich the teaching-learning and research activities during pandemic. Online and distance learning, which has both positive and negative sides (Table 2), offer a new dimension of combining innovative teaching-learning and interactions remotely with tutor and fellow students from different parts of the country. Environmental Science study in this regard can be partly managed through different online teaching-learning platforms.

## 2.1 De-facto Field Data Collection and Research Plans

Wherever are the students, i.e. in different parts of the country, they can attempt to generate and gather field data, use online data collection tools and skills and send to virtual class for further online discussion and analysis, and the respective teacher can perform data analysis and interpretation online. This will provide students to work with multiple issues and themes that are prevalent in different parts of the country. In doing so, utmost care should be taken during data collection from field with being safe and following ethical guidelines while interacting with others. Data can also be collected online or virtually from local level representatives. The framework for research works (case study, field study, community work, internship and thesis) during pandemic has been given in Figure 1, and this is applicable for Environmental Science study at universities, including Tribhuvan University, Nepal.



**Figure 1.** Framework for research work during pandemic

**Table 2:** Pros and cons of online teaching-learning

Pros	Cons
Online courses are considered less costly and of easy access	Internet connection issues in remote areas
Convenient and flexible method – spatially and temporally	Accreditation problems might come up
Focus on improving and learning newer skills	Lack of face to face interaction
Improves of digital skills of the attendees	Comparatively more self-dependent
Fosters time management ability	Need self-regulation and self-direction
Can be an effective tool during pandemic and lockdown situations	Limited time for interaction

## 2.2 Collaboration with Government and Other Organizations

Framework for research work (case study, field study, community work, internship and thesis) during pandemic, in cases, can be changed from real field data collection to data collection from secondary and existing sources. There is also increasing need of government organizations for data handling and management. In this context, lockdown and pandemic situations can be used for utilizing working in data of governmental agencies. In doing so, students can benefit in attaining their academic requirements of doing research work and government agencies will have their data analyzed, otherwise sometimes data are in stack since a long period of time in those organizations. This dual benefit fosters academia-government partnership and streamlines academic research on policy formulation (Figure 2). The approach can be one of the strategies for doing partnership between Government-Academic in days to come. Similarly, collaboration can be made with GOs, NGOs, INGOs and other concerned stakeholders. This collaborating modality for research can be an approach for Environmental Science research, which provides opportunities for future research collaborations and working together to address national priority issues.

## 2.3 Capacity Building of the Faculties and Staff

Faculties and staffs need to be exposed to newer online concepts and update skills for research and development to broaden their vision to remote teaching-learning practices during pandemic. Capacity of the faculties can be improved with trainings/seminars/workshops using online and remote teaching-learning platforms. Similarly, the facilities and services that foster online teaching-learning needs are required to be provided.

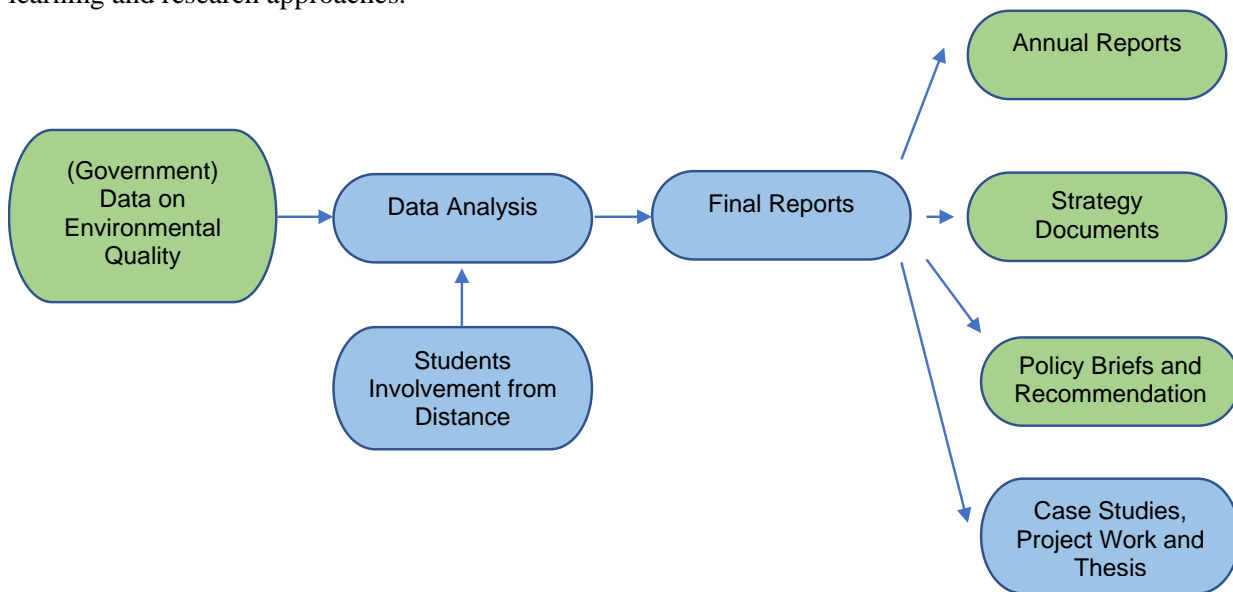
## 2.4 Resource Management and Availability

E-resources need be provided to students during pandemic like COVID-19, and accessibility of the resources are required to be facilitated by existing faculties and staff. Institution chair need to find the ways of providing resources to the university students. These situations also provide universities to think and act for providing access to journal papers, and work towards making availability of such resources to students and faculties. COVID-19 situation is compelling to all academic institutions and stakeholders for redesigning and rethinking in their teaching-learning and research approaches, which might lead to good opportunities for higher education in Nepal and get access to newer global education system.

## 2.5 Exam Management and Evaluation Modality

Open book exam and evaluation based on e-assignments can be initiated. Equal distribution of marks from the start of the classes and students' participation to it can be practiced. Exam modalities can be increased with quizzes and some portion of evaluation based on active participation of students in online class. Remote writing sessions can also be used for evaluating the students. However, detail rubrics are needed for facilitating the teaching-learning processes (Table 3), so that the students don't have any questions regarding evaluation made on their work. This sort of modality can also work well for Environmental Science studies at Tribhuvan University and other universities of Nepal. Systematic and proper record keeping of documents, such as attendance of students, assignments given and submitted, records of evaluations etc. are also

required to be maintained under the online teaching-learning and research approaches.



**Figure 2.** Approach to academic-government partnership during pandemic

**Table 3:** Example evaluation rubric for online assessment

<b>Title &amp; Introduction (20%)</b>	(2) Title is descriptive and represents experimental question and/or findings. (2) Descriptive title;(1) Title not descriptive/representative; (0) No title
	(4) Relevant background information is included (4) Relevant background provided; (2) Background lacks relevance; (0) No background
	(4) Literature citations are included to support background information where appropriate. (4) Ten or more references cited; (2) Less than ten reference cited; (0) No citations
	(4) Purpose and experimental question are clearly stated. (4) Clearly stated; (2) Unclearly or incompletely stated; (0) Not stated
	(4) Null and alternative hypotheses are both clearly stated. (4) Both hypotheses are clearly stated; (2) Hypothesis missing or incorrectly stated;(0) No hypotheses are stated
	(2) Prediction of outcome is given. (2) Prediction of outcome is given; (0) No prediction is given
	<b>Methods (20%)</b>
	(4) Methods are clear: (4) Methods are clear; (2) Methods are generally clear, but confusing in one or two places (0) Methods are confusing and unclear
(4) Methods are complete: (1) Preparation of pots; (1) Watering and light conditions; (1) Measurements; (1) Statistical tests	
4) Methods provide enough detail that the study could be duplicated (steps to detail) (1) Preparation of pots; (1) Watering and light conditions; (1) Measurements; (1) Statistical tests	
(4) Descriptions of controls, sample size, and replication are included. (2) Controls and treatment groups are differentiated; (1) Incorrectly described;(0) Not described (2) Sample size is properly described; (1) Incorrectly described; (0) Not described	
(4) Written in past tense and in paragraph form. (2) Written in paragraph form; (1) Some lists are included; (0) Not in paragraph form	

	(2) Written in past; (1) Breaks tense in one or more places; (0) Not in past tense	
<b>Results (20%)</b>	(6) All results are clearly described in writing. (3) Averages and standard deviations for all measured variables (3) p-values and statement of which differences were observed for all measurements	
	(2) Any trends, outliers, or interesting relationships are identified but not interpreted. (2) Trends/outliers/relationships have been identified but not interpreted; (1) Some trends/outliers/relationships not identified, and/or results are interpreted; (0) Trends/outliers/relationships not identified	
	(2) Figures and/or tables are referred to in the text with figure/table numbers. (2) Figures/tables referenced properly; (1.5) Figures/tables referenced improperly; (1) Some figures/tables not referenced; (0) No figures/tables referenced	
	(3) All figures and/or tables clearly and correctly represent data. (3) Figures/tables clearly & correctly present data; (2) Some data not clearly or correctly presented; (1) All figures/tables unclear or incorrect; (0) No figures/tables	
	(3) Figure axes are correctly labeled and include proper units and/or columns and rows in tables are clearly labeled with proper units. (3) All labels and units correct; (2) Some labels and units missing or incorrect; (1) Many labels and units missing or incorrect; (0) Axes not labeled.	
	(4) Each figure and/or table has a descriptive caption (legend) that provides enough information for a reader to understand and interpret the figure or table without referring to the written report. (4) All figures/tables have clear and complete legend; (3) Some legends are missing information (2) Multiple legends are missing information; (1) Some legends are missing entirely; (0) No legends	
	<b>Discussion (20%)</b>	(4) Results are summarized and interpreted in light of the original experimental question and background information. (4) Results summarized and interpreted in light of question and background; (3) Results summarized and interpreted, but without clear reference to question or background; (2) Results incompletely summarized or interpreted; (1) Results barely summarized and not interpreted
		(4) Hypotheses (both null and experimental) are accepted or rejected with explanation. (2) Null hypothesis evaluated with support; (1) Without support or incorrectly; (0) N/A (2) Experimental hypothesis evaluated with support; (1) Without support or incorrectly; (0) N/A
		(4) Literature is cited to help explain data or conclusions, for comparison, or to suggest modifications. (4) At least two sources are cited; (2) Only one source cited; (0) No citations
		(4) Potential sources of error or bias are identified and their impacts on the results are discussed. (2) Any plausible source of error or bias is identified (2) Potential impact is discussed
(4) Relevant additional research questions arising from results are posed and further studies suggested. (4) Questions and studies are thoughtfully suggested; (2) Suggestions are superficial; (0) N/A		
<b>Writing &amp; Citations (20%)</b>		(8) Lab report is clear, concise, and easy to read with complete sentences and few spelling or grammatical errors. Paper has been proofread and edited. (8) Well-written; (6) A few errors; (4) Multiple errors; (2) Many errors

	(2) Lab report includes section titles (i.e., Introduction, Methods, etc.), and is double-spaced. (1) Section titles; (1) Double-spaced
	(2) Scientific species names are properly given (e.g. <i>Homo sapiens</i> ), and any abbreviations used are appropriately defined (1) Scientific names given; (1) Correct format
	(2) At least 10 peer-review journal articles are cited. (1) Less than articles; (0) No articles
	(2) Each in-text citation is included in the literature cited section and vice versa. (1) Correct format (as described below) is used for both in-text citations and literature cited section.
	(2) No direct quotes are used.

(Figure in parenthesis indicate proposed full marks/weightage)

### 3. Conclusion

Distance teaching-learning, research and virtual classrooms have been the choice of many academia across the globe, especially during pandemic like COVID-19, and can be wisely utilized in teaching-learning and research exercises. Safely gathering field data and sending them to virtual classrooms for discussion and analysis can open wide array of possibilities to learn remotely. Government-academia partnership can result in two-way benefits among institutions and help in synchronizing research performed at academia with government requirement for plans and policies formulation. Moreover, each and every activity of students while evaluating from remote, are required to be examined by developing clear and unambiguous evaluation rubric. Distance teaching-learning and research can be one of the avenues for rethinking and redesigning the existing higher education systems.

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**Conflicts of interest:** The authors declare no conflicts of interest

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