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Practice and Challenges of Online Science Teaching at Higher Education during COVID-19 Pandemic

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Abstract

The education system is adversely affected by COVID-19 pandemic in Nepal. This study particularly focused to find the existing ICT competencies of science teachers in online teaching-learning, and challenges faced to teach during COVID-19.The study followed the quantitative descriptive research design in which all teachers of science of constituent and affiliated campuses of Siraha that run science and technology, and science education were selected through census method. A total of 36 science teachers were selected from 3 campuses, one constituent, two affiliated campus. Closed and structured questionnaire were used for the collection of data. The obtained data were interpreted by using statistical tools like percentage, mean, standard deviation, correlation, significance through Spearman's rho rank-order correlation coefficient bivariate analysis between independent and dependents variables by using Statistical Package for Social Science (SPSS) version 20. The result showed that almost all teachers had basic requirement of ICT tools and their operating knowledge. One-third had ICT training/certificate of ICT but only below twenty percentages really practiced it in teaching learning. The traditional concept of physical mode of teaching, ICT infrastructures, poor ICT capacity, lack of incentives and inadequate ICT friendly environment are major challenges for effective online teaching.

Keywords: COVID-19, pandemic, online teaching, physical mode of teaching, competency

Introduction

Patients of pneumonia with unknown causes were detected at the last days of 2019 in Wuhan city of China (https://www.who.int/csr/don/05-january-2020), and after further investigation it was detected as Corona virus disease (COVID) pathogen. The public places, schools and recreational facilities can be managed by local administrators and national government

for the adverse effects of COVID (grc-747257, WHO, 2021).This pandemic has affected different aspects of people including educational aspect. Millions of students and institutes are globally disrupted and their academic activities also too. Educational sectors haven't met such a destructive situation for a long time yet (Viner et al., 2020), and similar situation has developed for campuses of Nepal. This study tried to describe the teaching-learning method that is suitable to cope this period of COVID-19 pandemic in the study area.

According to UNESCO report, almost all universities and campuses were closed at the initial days of April 2020 that affected nearly 1.6 billion (above 90%) students of 194 countries (UNESCO, 2020). In such situations, schools and universities demanded that education policymakers and authorities of school should adopt options of direct teaching-learning through online teaching to save in the learner's right to education. Thus, different ICT tools and process have followed to online teaching and learning. It is worth to coin policies that maximize the usefulness of virtual teaching-learning against such condition of pandemic and emphasize it as need of today.

Distance and online mode of education depends on technologies such as internet and Wi-Fi, however, its unequal availability is creating a gap in its access and quality education (Dawadi, Giri & Sinkhnda, 2020). The situation indicates that the COVID 19 has not only effects on learning and health of students but also it is increasing gap in equitable access of quality education between students from advantageous and disadvantageous group. Online and distance mode of teaching-learning has both pros and cons that offers innovative and interactive teaching-learning methods to students. Means of online teaching-learning partially help to manage classes of Science Education Faculty.

The 21st century, the era of Science & Technology, is promoting teaching-learning in both schools and universities through advanced information communication technology (ICT) facilities. Science involves a lot of content of a theoretical and practical subject (Gupta & KPN, 2012). The schools/campuses need to incorporate ICT facilities to replace teacher centered method into student-centered method, and to increase participation of Nepal in worlds' developments and to enhance competency

to involve in worldwide markets (Yadav, 2019). However, there is no facility of technology and ICT training for teacher from government side (except admin Microsoft team training T.U. 2020), the government has provided approval to NGOs to maintain and conduct short ICT trainings (Rana et al., 2018). The Tribhuvan University has provided opportunities for virtual classes to their students by developing its own Moodle, LMS and cloud systems and by providing them individual email ID. Teachers, students and personnel of these campuses can join together through such facilities for online classes (Azzi-Huck & Shmis, 2020) but they did not found their impact.

The existing situation sign posting that COVID 19 has effects on students of Nepal in many ways. For example, although some schools and colleges of urban areas have started virtual classes, it is not practicable to most of the schools of rural areas of Nepal. Internet facility is available to only 56% people of Nepal. Although internet facilities are available to 35% schools of Nepal, only 13% schools are capable to conduct virtual classes (Pandit, 2020). It indicates that the availability and accessibility of ICT facilities is creating two-tiers between urban and rural, and rich and poor. In this regard, the Human Rights Commission of Nepal has appealed that students should not be compelled in the name of virtual classes to the authorities (Kantipur News, 2020).

It means that virtual classes are conducting in some institutes without planning, and teachers are only forced to conduct it. It raises some questions regarding ability of teachers to conduct virtual classes, need of training to teachers, and accessibility of students and teachers to ICT facilities. In this scenario, Phuyal (2020) suggests such circumstances; the research is tended to focus on the existing COVID 19 situation of the use of ICT tools in campus level science teaching. The study focused on common use of ICT tools in online Science classroom, science teachers' knowledge and skills of handling ICT tools and its pedagogical impact on teaching-learning. In the study area, it is seen that inadequate access of ICT facilities, less competency and motivation in teacher and student, poor management aspects, lack of proper fund are seen that create problem in using ICT for classroom instruction. Acharya, Budhathoki, Bjonness, and Devkota (2020) researched that the use of school garden is the possible method for activity-

based science learning. The above all study focused on either urban areas or schools sectors, no address on campus level especially science education this will be research gap my study.

Objectives of the study

The main objective of this study was to find out teachers' existing ICT competencies in online science teaching during COVID-19 and their challenges at higher level education.

Method

The study followed Quantitative research design that utilized, processed and applied techniques to decide what to study, asks specific and closed questions, and collected quantifiable data from participants. The study followed the quantitative descriptive research design in which all teachers of science of constituency and affiliated campuses that run science and technology, and science education were selected through census method. A total of 36 science teachers were selected from 3 campuses, one constituent two affiliated campus who taught Physics, Chemistry, Botany, Zoology and Mathematics. Data were entered in Statistical Package for Social Science (SPSS) (Muijs, 2004) software version 20, and the statistical tools such as percentage, dependent variables Likert's scale compute and convert into sum of the total score through mean, standard deviation with non-parametric tests. Spearman's correlation test were used to analyze and interpret data.

Result

The demographic questionnaire contained sex, age, education, teaching experience, qualification related to ICT and competencies of ICT use that have direct or indirect effects on the competency of ICT, Online supportive activities and challenges faced during online science teaching.

Table 1 represented demographic background of 36 teachers who responded to the questions; more than 90% teachers were male whereas only 8.3% were female. Similarly, 16.7% teachers fell in the age group less than 30 years, and majority (44.4%) of them fell in age group 31 to 45 years, and 36.1% fell in age group over 46 years. Among them 44.4% were below ten years' experience and 55.6 % were more than ten years, however the rate

of younger teachers were more in community-campus than constitutional campus. The data also represented that most teachers 19(52.8%) had without any teaching training only 36.1% had ICT training. Similarly, 36.1% were never experience of ICT before online teaching and only 19.4% were daily use of ICT in teaching learning and rest have little beat experience about previous use of ICT before online teaching. The result showed that the age, ICT training and previous ICT experience factors also had correlated in online teaching-learning activities (Table 4).

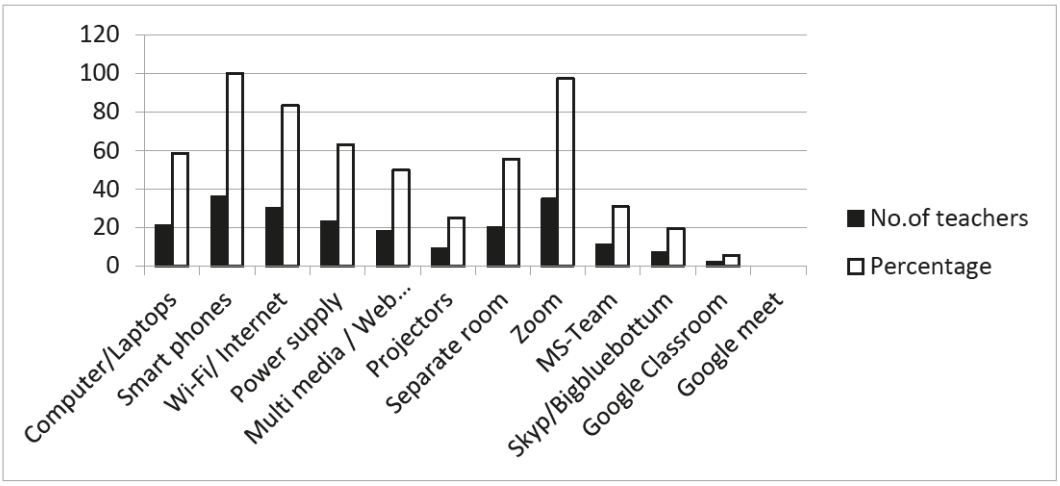
Table1. *Demographic aspects of Teachers of Science*

Aspect	Description	Frequency	%
Teachers' gender	Male	33	91.7
	Female	3	8.3
Teachers' qualification	Masters	34	94.4
	Above masters	2	5.6
Age of Teacher	30 years or fewer	6	16.7
	31 to 45 years	16	44.4
	46 years or more	14	38.9
Specialization subjects	Physics	9	25.0
	Chemistry	5	13.9
	Botany	5	13.9
	Zoology	6	16.7
	Math	11	30.6
Teaching Experience	10 years or fewer	16	44.4
	11 years or more	20	55.6
Training of teachers	Without any training	19	52.8
	With ICT training	13	36.1
	With pedagogy training	4	11.1
Previous use of ICT	Never	13	36.1
	Some days per month	7	19.4
	Some days per weak	9	25.0
	Everyday	7	19.4

Availability and use of ICT tools and Facilities in Online Teaching during COVID-19

Figure 1 showed that both constitute and communities campuses had ICT related tools and facilities. The data also showed that almost all campus science teachers had android mobiles, and majority had computers/laptops and internet/Wi-Fi common tools access at campus as well as home. Similarly, only 50% teachers were used multimedia or webcam during online and virtual lab teaching but majority of teachers were out of practiced from virtual lab facilities in the schools due to lack of ICT competency. However 55.6% teachers used separate room for teaching learning purpose was strong point in the findings.

Figure 1. *Use of ICT Tools and Facilities during Online Teaching*



According to findings, all most all teachers (97.2%) from both constitutional and community campus used Zoom, but only 30.6% used MS-team, which provided by central administration of T.U. who are only constitute campus teachers. The interest finding that most of the younger, females and science teachers having ICT skills were found in community than constitutional campus, but senior teachers were found in constitutional campus that had inadequate ICT Access. But they had also tried to create ICT access friendly.

ICT Competencies of Science Teachers used in online teaching

The ICT competencies related to use of Ms-applications, social sites and LMS items that were measured by using 3-pointLikert's type scale. Table 2 shows that Ms Office application package preferred more than two- thirds science teachers but especially face book and email used almost all teachers had more or less skill of social sites. As a result more than 75% teachers were not used of SLMs as Moodle, Skype or others as integrated in online science teaching learning for effective modern practices. However, more than two thirds teachers were used as e-books and e-library as e-sources of learning. Similarly YouTube (75%) and Websites (47.2%) as a learning platforms were preferred.

Table 2. *Existing Practices of Campus Science teachers during use of Online Teaching*

Description	Good		Fair		Not at all	
	Frequency	%	Frequency	%	Frequency	%
Use of Ms-Office Package						
Use of Ms-Word	15	41.7	19	52.8	2	5.6
Use of Ms-Excel	15	41.7	11	30.6	10	27.8
Use of Ms-PPT	18	50.0	14	38.9	4	11.1
Use of Web-browser	21	58.3	11	30.6	4	11.1
Skills of Social sites						
Skill of Face book	31	86.1	5	13.9	0	0.0
Skill of Email	31	86.1	5	13.9	0	0.0
Skill of Instagram	5	13.9	8	22.2	23	63.9
Skill of Imo/ WhatsApp	31	86.1	4	11.1	1	2.8
Use of Learning Management System during Online						
LMS-Moodle	0	0.0	9	25.0	27	75.0
LMS-Sky prop	0	0.0	10	27.8	26	72.2
LMS-BigBlueButtom	0	0.0	0	0.0	36	100.0
LMS-Schoology	0	0.0	0	0.0	36	100.0
Use as Sources of Learning						
Learning source of E-Book	15	41.7	18	50.0	3	8.3
Learning source of E-Library	11	30.6	17	47.2	8	22.2
Learning source of Google search	9	25.0	16	44.4	11	30.6
Learning sources as Open Books	9	25.0	16	44.4	11	30.6

Use of Learning Platforms						
Learning Platform of You-Tube	27	75.0	9	25.0	0	0.0
Learning Platform of Websites	17	47.2	17	47.2	2	5.6
Learning Platform of Udemy	0	0.0	2	5.6	34	94.4
Learning Platform of Coursera	0	0.0	4	11.1	32	88.9

Teachers' ICT Competencies Association with Independents Variables in Online Teaching

Table 3 expresses the correlation between teachers ICT competency (dependent variable) and teaching experience, training qualifications and previous use of ICT in teaching learning procedure (independent variables). The applied of Spearman's rho rank-order correlation coefficient of Bivariate analysis of statistical (Muijs, 2004) methods through convert into continuous data of total scores of science teachers competency, supportive online activities and challenges (table 3) factors.

Table 3. *Descriptive Statistics of Total Scores of Science Teachers Competencies during Online Teaching*

Description	N	Range	Maximum	Minimum	Mean	Std. Deviation
Total score of teachers ICT competencies	36	26.00	30.00	4.00	18.7500	7.32657
Total Score of supportive online activities	36	18.00	18.00	.00	9.2222	4.87038
Total score of Online Challenges	36	10.00	20.00	10.00	15.5000	2.75162

Table 4: *Correlations of Teachers' ICT Competencies with Independent Variables*

Spearman's Correlations Teachers Total Score of ICT Competency	Rho	p	n
Age of Teachers	-.336*	.045	36
Training Qualification	.674**	.000	36
Previous use of ICT	.833**	.000	36

Table 4 expresses the correlation between teachers ICT competencies (independent variable) and other three dependent variables like age of teacher, training qualification and previous use of ICT in science teachers. According to Spearman's rho correlation, ICT competencies have modest negative relation (rho is -0.336) with age of teachers. But the result was

significant as p was 0.045 i.e., ($p<0.05$). Similarly, the training qualifications of teachers and previous use of ICT had strong correlation with ICT competencies following the values of rho as 0.674 and 0.833, respectively, that was highly significant ($p = 0.000$).

Supportive Activities of Online Teaching during COVID Pandemic

As table 5 indicated that around one-fourth teachers were done good supportive activities like technical ICT skills, class preparations, methodology, ICT training etc. However as the same number of teachers had not done the above activities and rest around 50% of teachers done these activities rarely due to inadequate practices.

Table 5. *Online Supportive Activities / Practice of Science Teachers during COVID*

Description	Good		Fair		Not at all	
	Frequency	%	Frequency	%	Frequency	%
Technical skills	9	25.0	19	52.8	8	22.2
Content Preparation	10	27.8	17	47.2	9	25.0
Time Schedule	6	16.7	20	55.6	10	27.8
Pedagogy / Teaching Methods	8	22.2	20	55.6	8	22.2
Training of ICTs	7	19.4	15	41.7	14	38.9
Participation of Learners	2	5.6	23	63.9	11	30.6
Interactions with students	2	5.6	25	69.4	9	25.0
Submission of Online Task	0	0.0	8	22.2	28	77.8
Supporting Role of faculty	2	5.6	27	75.0	7	19.4
Teachers Incentives	0	0.0	25	69.4	11	30.6
Update than previous ICT skills	6	16.7	29	80.6	1	2.8

Similarly more than two-thirds science teachers expressed that poor interaction with students, not submission of online task, lack of ICT skills, poor support of faculty and poor incentive were inhibit factors for negative role for effective online teaching learning. However they tried to update than previous ICT skills.

Table 6. *Teachers Total Score of OnlineSupportive activities Correlations with Independent Variables*

Spearman's CorrelationsTeachers Total Score of Online Supportive activities	rho	P	N
Age of Teachers	-.233	.172	36
Training Qualification	.652**	.000	36
Previous use of ICT	.826**	.000	36

**significant at 0.01

According to Spearman's rho correlation, online supportive activities have modest negative relation (rho is -0.233) with age of teachers. But the result was not significant as p was 0.172 i.e., (p>0.05). Similarly the training qualifications of teachers and previous use of ICT had strong correlation with ICT competencies following the values of rho as 0.652 and 0.826 respectively that was highly significant (p= 0.000).

Teachers Facing Challenges of Online Teaching

Total 11 indicators were used to analyze the challenges faced to conduct online teaching. Table 7 shows that traditional concept of physical class, time management; technical management, poor ICT knowledge and skills were major challenges during online teaching expressed by 41.7 to 97.2% teachers. Similarly, slow internet, poor infrastructure, continuous power supply were moderate problem and lack of capacity building training, administrative support and poor incentives were also online teaching problems faced by campus science teaching in Siraha district. The result shows that more than 36.1% teachers total unknown about virtual science lab practiced due to lack of knowledge, skills and poor ICT Friendly environment.

Table 7. *Challenges of Online Teaching*

Challenges Face During Online Teaching	Agree		Least Agree		Don't Know	
	Frequency	%	Frequency	%	Frequency	%
Poor Infrastructure	12	33.3	24	66.7	0	0.0
Inadequate ICT Knowledge And Skills	15	41.7	21	58.3	0	0.0
Slow Speed of Internet	11	30.6	25	69.4	0	0.0
Poor Power supply	11	30.6	23	63.9	2	5.6
Time Management	22	61.1	12	33.3	2	5.6
Lack of Technical Management	24	66.7	11	30.6	1	2.8
Lack of Capacity Building Training	10	27.8	10	27.8	0	0.0
Lack of Virtual Science Lab	11	30.6	12	33.3	13	36.1
Poor Administrative Support	7	19.4	28	77.8	1	2.8
Lack of Incentive	8	22.2	27	75.0	1	2.8
Traditional Concept of Physical Class	35	97.2	1	2.8	0	0.0

Table 8. *Correlation between difference Independent variables with Teachers total score of Online Challenges*

Spearman's Correlations Teachers Total Score of Online Challenges in teaching	rho	p	N
Age of Teachers	-.116	.502	36
Training Qualification	-.599**	.000	36
Previous use of ICT	-.392*	.018	36

**Significant at 0.01

*Significant at 0.05

Table 8 indicates weak positive correlation of teachers ICT Challenges with age of teachers, training qualification and previous use of ICT having values of rho as -0.116, -0.599 and -0.392 respectively. All indicators were correlation with values of rho as negative modest, strongand moderate and value of p were not significant and significant respectively. It means science

teachers realized the ICT related challenges in online teaching learning. They faced, ICT barriers try to minimize in campuses and improvement of traditional pattern of teaching.

Discussion

Study found that almost all campuses had internet facility, almost all teachers of community campuses had android mobile. Although almost all teacher of both community and constitutional campuses used zoom for online class, only nearly one-third teachers used MS-team who were from constitutional campus. Unlike to this findings Pandit (2020) shows that more than half of the people of have internet facility but it is accessible only one-third of school and only more than one in ten (13%) are able to conduct virtual classes. Mohite (2020) has highlighted the need of zoom and Google-meet as teaching-learning tool. Similarly, Bansal (2016) found that nearly two-third schools have internet facility.

Internet which are common facilities available at campus as well as home. The study also indicates that majority of teachers are using separate room for online teaching as well as further preparation of teaching learning. Both constitute and community campus teacher prefers Zoom facility however only one campus used MS-Team for online teaching. Arguing this finding, Nadezhda, (2020) researched that the use of zoom is the most effective way of teaching and learning during pandemic time. Online teaching is better to impart the concept to students who are far and in the remote areas (Verma et al., 2020). This research is supported this finding.

In this study, more than two-third of teachers were able to work on MS Office application whereas almost all teachers were knowledgeable and skilled on social media, only one-fourth used SLM and more than two-third used eBooks and e-library as e-sources of learning. Likewise, one-third and nearly half of teachers preferred YouTube and Websites as a learning platforms. In contrary to this findings, Azzi-Huck & Shmis (2020) mentioned that all related person involved to develop alternative ways such as online sources and materials through zoom, MS team and digital rooms.

The result shows that competency of ICT of teachers strongly associated with age of them with ICT qualification and previous use of ICT access in

teaching. Thus competencies of ICT directly effects to improvement of modern need of online pattern of teaching practice. The assumption age would be could be correlated between university teachers (Kerzic, Danko, Zorko, Decman, 2021) age and their self-reported use of ICT, and that younger teachers would be more- likely for educational and personal purpose.The Morocco upper school teachers (Krumsvik et al., 2016) are 50 or older have less digital competencies due to lack of supportive environments. Etiubon and Akpan (2017) indicated in their result that online supportive activities had not association with age of teachers strong association and significant with ICT qualification and previous use of ICT access in teaching.

Acquiring skills and knowledge on evolving ICT technologies will enable the science teacher find creative ways to make science learning a pleasure. This will require training and retraining which may be achieved through capacity building workshops (Etiubon & Akpan, 2017).The result indicated that online supportive activities had not association with age of teachers strong association and significant with ICT qualification and previous use of ICT acccss in tcaching. Thus onlinc supportivc activitics havc donc vital rolc to improvement of modern need of online pattern of teaching practice.

This study found that majority of teachers mentioned that traditional concept of physical class, lack of technical management, and time management were the main challenges of conducting online class. The schools of Nepal (Dhital, 2018), competencies of ICT have not been used a way of acquiring new knowledge and skills due to limited access. All stakeholders, teachers and students (Azzi-Huck &Shmis,2020) have joined hands together to create digital resources and e- materials delivers through virtual rooms and use of Zoom and Microsoft Team. The secondary schools of Kenya (Odhiambo & Onayngo, 2015) report, 83.3% teachers and 82.5% Principals revealed that lack of ICT equipment and 75% had ICT infrastructures in the institute, technical support and skills were major challenges.

Conclusions

Online mode of teaching learning is integral part of alternative way of teaching in recent time. Both uses of ICT and online teaching are too much helpful during COVID-19 pandemic. Through the use of digital tools we can contact each other and continue demand in the educational process. Almost all campus teachers have Android mobile, Computer/ laptops, Wi-Fi/ Internet which are common facilities available at campus as well as home. The study also indicates that majority of teachers are using separate room for online teaching as well as further preparation of teaching learning. Both constitute and community campus teacher prefers Zoom facility however only Siraha campus used MS-Team for online teaching as provided by central administration of T.U. Most of the teachers have better competencies of MS-Office package, social sites and YouTube due to the use in daily life. Similarly ICT skills, teaching techniques, time managements etc. activities are pre-requisites for effective online teaching. The science teachers have their own concept about the traditional pattern of physical mode of teaching. ICT infra-structure and lack of ICT capacity building training are major personal challenges and poor incentives, passive motivation of students, inadequate ICT friendly environment are institutional challenges for effective online teaching-learning. In conclusion, teachers tried to change and minimize the traditional teaching pattern into modern digitalized way of science teaching (Yadav, 2019). Age group of teachers, ICT training, and previous use of ICT had significant positive strong correlation with online teaching-learning. To overcome the problem, these tools are very much helpful. Mohite (2020) also stated in his research ICT is nowadays on demand.

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