ANALYSIS OF ONLINE TEACHING AND LEARNING BY THE TEACHERS AND STUDENTS OF ACHARYA N G RANGA AGRICULTURAL UNIVERSITY – AN EXPLORATORY STUDY

CHUNCHU RAMYA

B.Sc. (Ag.)

MASTER OF SCIENCE IN AGRICULTURE
(Agricultural Extension)

ANGRAU

2021

ANALYSIS OF ONLINE TEACHING AND LEARNING BY THE TEACHERS AND STUDENTS OF ACHARYA N G RANGA AGRICULTURAL UNIVERSITY – AN EXPLORATORY STUDY

By
CHUNCHU RAMYA
B.Sc. (Ag.)

THESIS SUBMITTED TO THE
ACHARYA N.G. RANGA AGRICULTURAL UNIVERSITY
IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE AWARD OF THE DEGREE OF

MASTER OF SCIENCE IN AGRICULTURE
(Agricultural Extension)

CHAIRPERSON: Dr. V. JYOTHI

ANGRAU

DEPARTMENT OF AGRICULTURAL EXTENSION
AGRICULTURAL COLLEGE, BAPATLA
ACHARYA N.G. RANGA AGRICULTURAL UNIVERSITY
GUNTUR – 522 101. A.P.
2021

DECLARATION

I**, CHUNCHU RAMYA,** hereby declare that the thesis entitled, **"ANALYSIS OF ONLINE TEACHING AND LEARNING BY THE TEACHERS AND STUDENTS OF ACHARYA N G RANGA AGRICULTURAL UNIVERSITY – AN EXPLORATORY STUDY"** submitted to the **Acharya N.G. Ranga Agricultural University** for the degree of **Master of Science in Agriculture** in the major field of Agricultural Extension is the result of original research work done by me. I also declared that no material contained in the thesis has been published earlier in any manner.

Place: **(CH. RAMYA)**

Date: **I.D. No. BAM-19-57**

CERTIFICATE

Ms. **CHUNCHU RAMYA** has satisfactorily prosecuted the course of research and the thesis entitled **"ANALYSIS OF ONLINE TEACHING AND LEARNING BY THE TEACHERS AND STUDENTS OF ACHARYA N G RANGA AGRICULTURAL UNIVERSITY – AN EXPLORATORY STUDY"** submitted is the result of original research work and is of sufficiently high standard to warrant its presentation to the examination. I also certify that neither the thesis nor its part thereof has been previously submitted by her for a degree of any university.

Date:

(V. JYOTHI)
Chairperson

Place:

CERTIFICATE

This is to certify that the thesis entitled **"ANALYSIS OF ONLINE TEACHING AND LEARNING BY THE TEACHERS AND STUDENTS OF ACHARYA N G RANGA AGRICULTURAL UNIVERSITY – AN EXPLORATORY STUDY"** submitted in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE IN AGRICULTURE** of the Acharya N.G. Ranga Agricultural University, Lam, Guntur is a record of the bonafide original research work carried out by **CHUNCHU RAMYA** under our guidance and supervision.

No part of the thesis has been submitted by the student for any other degree or diploma. The published part and all assistance and help received during the course of the investigations have been duly acknowledged by the author of the thesis.

Thesis approved by the Student's Advisory Committee

Chairperson : **Dr. V. JYOTHI**
Associate Professor
Dept. of Agricultural Extension
Agricultural College, Bapatla.

Member : **Dr. B. VIJAYABHINANDANA**
Professor and University Head
Dept. of Agricultural Extension
Agricultural College, Bapatla.

Member : **Dr. P. V. N. PRASAD**
Professor
Dept. of Agronomy
Agricultural College, Bapatla.

Date of final viva-voce:

ACKNOWLEDGEMENT

Firstly, I owe my sincere prayers to the almighty for solemn blessings upon me. His grace gives me patience and fortitude, which was indeed required in this endeavor. I pray to bless me always to give me courage in all my future endeavors.

At the very outset, whole heartedly I wish to express my fidelity and deep sense of gratitude to the chairman of my advisory committee ***Dr. V. Jyothi, Associate Professor,*** *Dept. of Agricultural Extension, Agricultural College, Bapatla for her inspiring guidance, timely advice, constant supervision, constructive criticism, boundless help, vivid encouragement & affectionate dealing through the period of investigation and during preparation of the manuscript. I feel elated to express my heartfelt thanks for her immense patience, keen interest in planning and execution of research, transcendent suggestions, affectionate encouragement and adroitness in handling the research work in all its stages.*

I deem it a great pleasure to exhibit my inexplicable gratitude to ***Dr. B. Vijayabhinandana, Professor and University Head,*** *Department of Agricultural Extension, Agricultural College, Bapatla member of my advisory committee, for his scholastic guidance, perceptive criticism, valuable comments and meticulous reasoning to refine the dissertation to reckon with set standards during the course of investigation and preparation of the thesis and expeditious co-operation during the whole course of my research work.*

I feel inadequacy of words to express my deep sense of gratitude & profound indebtedness to ***Dr. P. V. N. Prasad, Professor****, Department of Agronomy and member of my advisory committee for his valuable advice, thought provoking and inspiring guidance, kind help and co-operation during my course of study and my research work.*

I am thankful to ***Dr. K. Mosha, Professor****, Department of Agronomy, Agricultural College, Bapatla for his discerning comments, valuable suggestions co-operations and helpful attitude during my course of study and my research work.*

I humbly express my sincere thanks to the members of the Department of Agricultural Extension viz., ***Dr. M. Ramadevy, Professor, Dr. M. Srinivasa Rao, Associate Professor*** *for their valuable suggestions and cooperation during my research work.*

*I am quite unable to find appropriate words as to express my deepest sense of gratitude to my beloved parents **Sri CH. Srinivas** and **Smt. CH. Mamatha** who inculcated in me the values of wisdom, morality and truthfulness. Their persistent inspiration, selfless sacrifice, continuous encouragement and moral support is a constant source of motivation for me in shaping up my career.*

*It is time to surface out my genuflect love and affectionate gratitude to my sister **Lavanya** and brother **Sairam** and all my family members whose everlasting love, encouragement and needy inspiration were my strongest assets during the course of my life with whose moral support I achieved this level of education.*

*I extend my heartfelt thanks to all the **faculty of Agricultural college, Bapatla and S. V. Agricultural college, Tirupati** for their active support and co-operation in providing me with required data.*

*I owe my sincere thanks to all those respondents of **Under Graduate and Post Graduate students of Agricultural College, Bapatla and S. V. Agricultural college, Tirupati** who indeed formed the base of this work, for their endurance and cooperation in filling the questionnaires.*

*I take pleasure in expressing my sincere thanks to my truly helping and supporting friends **Prathyusha, Anitha, Spandana, Satwika, Mounika, Sudhishna, Anusha, Karthik** and my seniors **Revathi, Raveena, Shanmukh Raju, Deepa, Lakshmi Prasanna, Rama Lakshmi, Anantha Vihari, Harisha, Venkat Reddy** and my juniors **Srikanya, Sravya, Samyuktha, Akhilesh, Saifuddin** and my special thanks to my batchmate **Shama** who supported me in all my efforts and helped me throughout my study.*

I fondly extend my thanks to all my friends of 2019 PG batch of Agricultural College Bapatla.

I am very much thankful to all the non-teaching staff of Department of Agricultural Extension for their help during my M.Sc. Programme in the department. I am thankful to our College Librarian and other staff for providing necessary facilities.

*I am thankful to **Acharya N. G. Ranga Agricultural University** for giving me opportunity to pursue my graduation successfully, for providing the facilities to conduct my Research work during the course of study.*

Date:
Place: **(CH. RAMYA)**

LIST OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

LIST OF SYMBOLS AND ABBREVIATIONS

%	:	Percentage
i.e.,	:	That is
$\overline{X}$	:	Arithmetic mean
σ	:	Standard deviation
σ^2	:	Variance
>	:	Greater than
<	:	Less than
≥	:	Greater than or equal to
≤	:	Less than or equal to
=	:	Equal to
&	:	And
B. Sc (Hons.)	:	Bachelor of Science Honours
CEC	:	Consortium for Educational Communication
CGPA	:	Cumulative Grade Points Average
COVID	:	Corona Virus Disease
df	:	Degrees of freedom
et al.	:	And Others
e-learning	:	Electronic learning
etc.	:	Et cetera
F	:	Frequency
Fig.	:	Figure
GOI	:	Government of India
GPA	:	Grade Points Average
H_0	:	Null hypothesis
H_1	:	Alternate hypothesis
ICAR	:	Indian Council of Agricultural Research
ICT	:	Information and Communication Technology
ID	:	Identification / Identifier

INFLIBNET	:	Information and Library Network
IUCs	:	Inter University Centres
KMO	:	Kaiser-Meyer-Olkin
LAN	:	Local Area Network
LMS	:	Learning Management System
MHRD	:	Ministry of Human Resource Development
M. Phil	:	Master of Philosophy
M. Sc. (Ag.)	:	Master of Science in Agriculture
MOOCs	:	Massive Open Online Courses
n	:	Sample size
NET	:	National Eligibility Test
NS	:	Non-Significant
p	:	Probability Value
PC	:	Personal Computer
PCA	:	Principal Component Analysis
PDF	:	Portable Document Format
PG	:	Post Graduate
Ph. D	:	Doctor of Philosophy
PPT	:	Power Point Presentation
S. D	:	Standard Deviation
S. No.	:	Serial Number
Sig.	:	Significance
SPSS	:	Statistical Packages for the Social Sciences
SWAYAM	:	Study Webs of Active Learning for Young Aspiring Minds
UG	:	Under Graduate
UGC	:	University Grants Commission
viz	:	Namely
Wi-Fi	:	Wireless Fidelity

ABSTRACT

Author	:	**CHUNCHU RAMYA**
Title of the Thesis	:	**"Analysis of Online Teaching and Learning by the Teachers and Students of Acharya N G Ranga Agricultural University – An Exploratory Study"**
Degree to which it is Submitted	:	**Master of Science**
Faculty	:	**Agriculture**
Department	:	**Agricultural Extension**
Major Advisor	:	**Dr. V. JYOTHI**
University	:	**Acharya N. G. Ranga Agricultural University**
Year of Submission	:	**2021**

The COVID-19 pandemic has resulted in closure of schools and colleges for months together across the world, situations are unpredictable to reopen the educational institutes and this paved the way for online teaching and learning. An exploratory study was planned and conducted to analyze the online education in Acharya N G Ranga Agricultural University. This research was taken up to study the profile of teachers and students, their attitude and competencies in online teaching and learning, constraints faced by them. The best practices in online teaching and learning were documented.

The study was conducted during 2020-21 using exploratory research design. Two Agricultural Colleges *viz.,* Agricultural College, Bapatla and S V Agricultural College, Tirupati were selected for the study. From each of the selected Agricultural College 30 teachers, 30 Post Graduate students and 90 Under Graduate students (30 each from 2^{nd}, 3^{rd}, 4^{th} year of B. Sc. (Hons.) Agriculture) involved in online teaching and learning were selected using simple random sampling procedure, thus making a total sample of 60 teachers, 60 Post Graduate students and180 Under Graduate students.

Less than two-third of the teachers were observed in middle (60.00%) age group, 58.33 per cent were male, 91.67 per cent possessed Ph. D qualification, 48.33 per cent were professors, 73.34 per cent had teaching experience of $\geq$12 years, 18.33 per cent of the teachers had previous experience in online teaching, only 16.67 had undergone training in online teaching for more than one week, 66.67 per cent used Zoom as video conferencing application in online teaching, cent per cent of the teachers possess smart phones, 53.33 per cent teachers often used personal laptops for online teaching. Three-fourth of the teachers had access to good internet connectivity (75.00%) and 63.33 per cent had sufficient internet data & speed. Less than half of the teachers spent 8-12 hours per week in preparation for online teaching (43.33%) while 46.67 per cent spent 13-16 hours per week in online teaching. More than one-third of the teachers reported that

attendance of students was 80-89% (38.33%), about 55.00 per cent shared learning material as PPT and word, half of the teachers shared reading material immediately after the class, 70.00 per cent used official meeting ID, 98.33 per cent used PPT regularly for online classes.

Less than two-third of the teachers had medium favourable attitude (65.00%). By applying factor analysis, six major factors were extracted having Eigen value greater than one which were explaining a total variance of 69.17 per cent towards the attitude of teachers towards online teaching. Less than two-third of the teachers were perceived as medium competent (61.67%) in online teaching.

Among the different constraints faced by the teachers in online teaching, problem with application was ranked I by garret ranking method, followed by lack of expertise and skills, internet connectivity issues, lack of infrastructure facilities in department (webcam, laptop, headphones, etc.,), lack of students' response, increased workload, heath issues (eyes strain, body pains, etc.,) and students' login all through the class. Less than two-third of the teachers were satisfied (60.00%) with online teaching.

More than half of the UG students (54.44%) and PG students (63.33%) belonged to 20-25 years age group. More than two-third of the UG students (68.89%) and PG students (58.33%) were female. More than half of the UG students (59.00%) and PG students (46.67%) belonged to rural background. More than three-fourth of the UG students (77.22%) and PG students (83.33%) completed their secondary school education in private school. Majority of the UG students (84.44%) and PG students (83.33%) were from nuclear families. Less than half of the UG students (43.89%) and PG students (43.33%) parental occupation was farming. More than half of the UG students (58.89%) and PG students (43.34%) per cent secured 8.1-9.0 GPA. Greater proportion of the UG (96.11%) students and PG students (98.33%) possess smart phone.

More than half of the PG students had access to good internet connectivity (56.67%) while 42.78 per cent of the UG students had access to good internet connectivity. Less than half of the PG students had sufficient internet data (46.67%) while 40.00 per cent of the UG students had sufficient internet data. Greater proportion of the UG students often (92.78%) used smart phone for online learning, followed by laptop (5.00%), tablet (3.33%) and personal computer (2.22%). Greater proportion of the PG students often (90.00%) used smart phone for online learning, followed by laptop (48.33%) and equal proportion of 5.00 per cent each used tablet and personal computer. Less than half of the PG students spent 9-18 hours per week (48.34%) in online classes. While 41.67 per cent of the UG students spent 19-28 hours per week in online classes.

More than three-fourth of the UG students had medium favourable attitude (79.44%) while 73.33 per cent of the PG students had medium favourable attitude. It was evident from the Z test that there exists a significant difference between the attitude of UG and PG students. By applying factor analysis, six major factors were extracted having eigen value greater than one which were explaining a total variance of 58.84 per cent towards the attitude of students towards online learning. More than two-third of the UG students were perceived as medium competent (68.89%) while 55.00 per cent of the PG students were perceived as medium competent in online learning. It was evident from the Z test that there exists no significant difference between the competency of UG and PG students in online learning.

Among the different constraints faced by the students in online learning, UG students ranked lack of knowledge on effective use of online apps as the major problem by garret ranking method, followed by internet connectivity issues, problem with application, lack of expertise and skills in using the apps, unfavourable learning environment, time consuming, lack of uninterrupted power supply, health issues like eye strain, body pains etc., and expensive. While PG students reported that unfavourable learning environment as the major problem, followed by lack of knowledge on effective use of online apps, lack of expertise and skills in using the apps, problem with application, time consuming, internet connectivity issues, lack of uninterrupted power supply, expensive and health issues like eye strain, body pains etc. More than one-third of the UG students were satisfied (34.44%) with online learning whereas 48.33 per cent of the PG students were satisfied with online learning.

The best practices documented in online learning were creating an organized study space, active participation, eliminating distractions, recording online lectures, maintaining notes, taking breaks in between the classes, managing the time for all works, intrinsic motivation and accountable in online classes. The best practices documented in online teaching were training on digital tools, improving student engagement by interacting and using different techniques, designing of course, easy access to students, developing online etiquettes, innovative teaching methods, active online presence, respond fast to queries with lively examples, assess student performance timely and providing feedback. Providing institutional infrastructure and internet facilities, training on ICTs, establishing smart class rooms, developing Learning Management System (LMS) with all the required features, incorporating ICT in curriculum are the institutional interventions in online teaching and learning.

Chapter – I

Introduction

Chapter - I

INTRODUCTION

"The illiterate of 21st century will not be those who cannot read and write, but those who cannot learn, unlearn and relearn" - Alvin Toffler

It was on 11 March 2020, when WHO declared COVID-19 as pandemic and informed all the countries to treat, detect and reduce the transmission by maintaining social distancing. But prior to it, University Grant Commission on 5th March 2020, circulated a letter to the all the universities and colleges advising measures to prevent the transmission of corona virus. The authorities had given instructions to avoid large gatherings, stop face to face workshops, seminars, conferences etc. As a measure to reduce the spread of COVID-19, all the educational institutes and universities across the country were closed from 16th March, 2020 for many months and so in Andhra Pradesh also. Online education started from mid-April 2020 to ensure the continuity of education process.

As the COVID-19 pandemic has resulted in closure of schools and colleges for months together across the world making face-to-face real classroom education impractical and examinations, admissions, entrance tests and competitive examinations are all detained. We cannot predict how long this pandemic situation would continue and when normalcy will be restored. In this regard to avoid the spread of the virus and to ensure the continuity of the educational process, universities transformed the centuries old, chalk and talk method of teaching to exclusively online teaching. Generally, web-based learning is considered an alternative option to traditional learning. But Coronavirus pandemic made it as the only option for maintaining the schools, colleges and universities.

The education sector in India has faced tremendous changes ever since the digital revolution took place. The most prevalent educational system underwent a paradigm shift from traditional to technology driven teaching.

e-learning platforms were launched and they became popular over time. e-learning connects the eminent academicians and learners from different parts of the world. Various institutes around the globe are utilising e-learning to educate and train their students and employees.

Ministry of Human Resource Development (MHRD), GOI; UGC and its Inter University Centres (IUCs), Information and Library Network (INFLIBNET) and Consortium for Educational Communication (CEC) started several ICT initiatives in the form of digital platforms like SWAYAM, Swayam Prabha, e-PG Pathshala which can be accessed by the teachers, students and researchers in all Universities and Colleges for broadening their horizon of learning. Therefore, it is maintaining a consistency in educational quality by providing them to a large group of students. It offers the ability to share material in all kinds of formats such as videos, slideshows, word documents, and PDFs. Conducting webinars, synchronous online classes and communicating with professors using chat and non-synchronous tools like social media groups allow learners to keep in touch and discuss course-related matters creating a sense of community.

e-learning require a few components such as an electronic device like computer, laptop, tablet or smart phone; equipment like web camera, ear phones, mike, speakers or a smart classroom; video-conferencing software and a stable internet connectivity. Earlier online technology and gadgets were used for only entertainment purposes, but now they are used even for productive purposes. Pedagogy of teaching has changed.

Online learning is of two types namely., synchronous and asynchronous. Synchronous learning allows the teachers and students to meet at a specific real time whereas asynchronous learning does not allow the teacher and students to meet at a same time and real time interaction is absent between teacher and student.

Our teaching and learning techniques have undergone a great change. We are meeting our friends virtually, watching live classes and lot of others things have changed. Everything is digitalized now, where teacher and students started meeting online on digital platforms for educational purpose. Previously, very few people used to learn from online lectures, but it became a compulsion now. The educational institutions charted out the time tables for synchronous online education where in the teacher and students come online at a predetermined time and date in a video conference application. In response to significant demand, many online learning platforms are offering free and paid access to their services. The educational institutions round the globe are utilizing these digital platforms to educate their students.

After switching the education to fully online, teachers and students focussed on knowing new technological advancements in education and learn skills and competencies needed and there is a surge in participation of teachers, students, researchers, scientists etc in online webinars, online certification courses. Changes in the education system happening at a faster pace like switching from traditional classroom to virtual, one digital platform to another, changing in the presentation of the lessons, learning from outside university resources, etc. All these made teachers and students competent with the technology usage and made teaching and learning effective. So, collaborating online with offline teaching even after pandemic may be beneficial.

e-learning is useful in many ways as it is available anywhere, anytime at cheaper rate, provides many learning resources in the form of videos, e-books, blogs, animations etc by which students get better clarity of subject and satisfy their learning needs. Faculty are available more time to contact than traditional. It is very convenient and students can learn at their own pace to achieve their goals. Evaluation of the students, feedback regarding their performance and feedback regarding teaching style of the teachers are very fast. Whereas lack of proper infrastructural facilities, network connectivity issues and no human touch etc are the major constraints faced during online teaching and learning.

Therefore, educational institutions should make every effort to analyse in 360 degrees angle and steps need to be taken to strengthen it to keep up the standards and as well make online education interesting and lively to the students. As a teacher it is very important to know what students are feeling about online education, what are their thoughts, mind-set towards online education. The negative feelings need to be taken care and efforts need to be made by the teacher to correct them by taking appropriate measures in online teaching. The positive feelings need to be maintained and promoted.

Acharya N G Ranga Agricultural University, Andhra Pradesh is reaching the students with synchronous online education. For the purpose of the study, online teaching and learning was operationalized as the situation in which the teacher and students separated by space come online using a video conference application, the lessons are carried out in real at a specific time and date.

NEED FOR THE PRESENT STUDY

As the consequence of COVID-19 pandemic, lockdown was imposed which resulted in closure of educational institutions and even agricultural universities. In order to complete the syllabus and continue the education, universities have adopted online teaching. But institutes did not had time to design and adopt the course contents for online mode as the course content in agriculture education is practical oriented. Curriculum was not prepared for online teaching before. In this context, experience of teachers and students can be incorporated to make online learning simple, interesting and effective. Online education is developing tremendously, we cannot predict that even after opening of educational institutes normalcy would be seen. Online learning is here to stay, may as a flipped approach *i.e.*, in combination with traditional offline classes. So, all the educational institutes need to be prepared to change their curriculum accordingly by shifting some of the course content to e-learning.

As online education is alternative to face-to-face education. The educational institutes have to make every effort to strengthen and make online teaching and learning productive. The research on online teaching and learning

in agricultural universities is scarce, as it is new to many universities. At this juncture an exploratory study was planned to analyse the online education in Acharya N G Ranga Agricultural University. This research was taken up to study the profile characteristics of teachers and students, their attitude towards online teaching and learning, online teaching and learning competencies, constraints faced by teachers and students in online teaching and learning and document the best practices in online teaching and learning.

The study **"**Analysis of online teaching and learning by the teachers and students of Acharya N G Ranga Agricultural University – An Exploratory Study" was planned and conducted with the following objectives.

OBJECTIVES OF INVESTIGATION

1. To study the profile of teachers and students involved in online teaching and learning
2. To study the attitude of teachers and students towards online teaching and learning
3. To map the online teaching and learning competencies of teachers and students
4. To document the best practices and enlist the constraints in online teaching and learning as perceived by the teachers and students

SCOPE OF THE STUDY

As the study is an exploratory research, the findings of this study provide insights for further research. The findings on the profile characteristics of the respondents would help the government, policy makers, educational institutes to acquaint with the existing situation of teachers and students related to age, education qualification, designation, background, family type, parent occupation, academic performance of students, previous experience in teaching and learning online, training received, possession and extent of use of electronic devices, internet access, time spent in online teaching and learning, usage of video conferencing applications. Based on these profile characteristics

appropriate trainings, internet connectivity and other infrastructural facilities may be provided for updating their skills, competencies in using digital tools. The study further analyses the attitude of teachers and students towards online teaching and learning and also finds if there exists any difference between the attitude of UG students and PG students. This would help in implementing new ways of online teaching.

The findings on competency of teachers and students in online teaching and learning help to know the skill and capabilities of teachers and students. It helps the educational institutes, policy makers, government to provide trainings, workshops in advancement of their skills.

The documentation of the constraints faced in online teaching and learning as perceived by the teachers and students would help the educational institutes in resolving the problems by suitable interventions for future online classes. Along with that, best practices in online teaching and learning were documented which would help the educational institutes, teachers and students to implement them and utilise the facilities effectively.

LIMITATIONS OF THE STUDY

i. The research was conducted online, so it was unable to reach the respondents who had no internet access.

ii. Due to physical absence of interviewer, it was difficult to establish a good rapport and level of trust between researcher and participant. Interviewer doesn't know whether the respondent has understood the question or not. Therefore, this made the participants less likely to be engaged in survey.

iii. Online survey was unable to capture the emotional response, non-verbal communication and spontaneity of the respondents.

iv. This study depends on the respondent's personality and mood at the time of survey; hence it may not be free from individual bias and prejudices.

v. This study was confined to Acharya N G Ranga Agricultural University, Andhra Pradesh. Hence generalizations are only possible where similar conditions exist.

vi. As there were no previous investigations in this area of research there is shortage of literature related to the study.

In spite of these limitations, efforts were made to objectively conduct the research and present it in a systematic manner to the possible extent.

PRESENTATION OF THE STUDY

This study was presented in six chapters namely

Chapter I - Dealt with 'INTRODUCTION' giving a concise explanation of the need, importance, objectives, scope and limitations of the study.

Chapter II - Dealt with 'REVIEW OF LITERATURE' giving an extensive review of the studies related to the study.

Chapter III - Dealt with 'MATERIAL AND METHODS' including statistical tools applied in the study.

Chapter IV - Dealt with 'RESULTS AND DISCUSSION' including tabulations of the study.

Chapter V - Dealt with 'SUMMARY AND CONCLUSIONS' consisting of implications of the findings and suggestions for future research.

Literature cited and appendices are enclosed at the end.

Chapter – II

Review of Literature

Chapter II

REVIEW OF LITERATURE

The main aim of the review of literature is to acquire knowledge on the earlier studies undertaken by the researchers in a given field of study. This would help to find out the available information, related to the objectives of the proposed research and assists in delineation of the problem area besides providing a basis for theoretical framework and interpretation of the findings. It facilitates to find out the gaps in selecting topics for research studies besides fetching the available techniques, which could be used to measure the factors under study and to compare the present results with the previous research. As there are a very few studies exclusively on online teaching and learning, an attempt was made to review the research studies which had a meaningful relation to the study and the same have been presented under the following headings.

2.1 Profile characteristics of teachers and students

2.2 Attitude towards online teaching and learning

2.3 Competencies in online teaching and learning

2.4 Constraints in online teaching and learning

2.5 Satisfaction with online teaching and learning

2.6 Best Practices for effective online teaching and learning

2.1 PROFILE CHARACTERISTICS OF TEACHERS AND STUDENTS

2.1.1 Age

Akaslan and Law (2011) in a study on “Measuring teachers’ readiness for e-learning” found that nearly two-fifth of the respondents were observed in the age group of 35 to 44 years (38.40%) followed by 25 to 34 years (36.30%), 45 to 55 years (16.60%), above 55 years (4.80%) and below 24 years (3.90%) age group.

Bhuasiri *et al*. (2012) in a study on "Critical success factors for e-learning" revealed that 38.00 per cent of the respondents were observed in the age group of 41-50 years followed by 21-30 years (28.00%), 31-40 years (26.00%) and 51-60 years (8.00%) age group.

Suri and Sharma (2013) in a study on "Impact of age on student's attitude towards e-learning" found that less than two-third of the respondents were observed in the age group of 20-26 years (62.70%) followed by less than 20 years (33.50%), 26-30 years (3.00%) and above 30 years (0.80%).

Martin and Parker (2014) in a study on "Use of synchronous virtual classrooms" reported that 46.67 per cent of the respondents were observed in 50 and above years age followed by 40-49 years (29.33%), 30-39 years (20.00%) and under 30 years (4.00%) age group.

Naresh and Reddy (2015) in a study on "An exploratory study on learner's perception towards e-learning courses" concluded that 56.70 per cent of the students were observed in the age group of 18 to 20 years followed by 24 to 26 years (21.60%), 21 to 23 years (18.60%) and above 27 years (3.10%) age group.

Gay (2016) in a study on "An assessment of online instructor e-learning readiness before, during and after course delivery" found that one-third of the respondents were observed in the age group of 30-39 years (33.70%) followed by 40-49 years (29.30%), 50-59 years (17.30%), below 29 years (14.40%) and above 60 years (5.30%) age group.

Soni (2016) in a study on "Utilisation pattern of social media by the students for education: a study at G. B. Pant University of Agriculture and Technology, Pant Nagar" reported that less than three-fourth of the students were observed in the age group of 20-25 years (73.33%) followed by less than 20 years (14.00%) and more than 25 years (12.67%) age group.

Aldowah *et al.* (2017) in a study on "The impacts of demographic variables on technological and contextual challenges of e-learning implementation" reported

that 39.30 per cent of the respondents were observed in the age group of 25-35 years followed by 36-46 years (37.40%), 47-57 years (21.50%) and more than 57 years (1.80%) age group.

Abdullah and Toycan (2018) in a study on "Analysis of the factors for the successful e-learning services adoption from education providers and students' perspectives" revealed that 38.30 per cent of the students were observed to be above 24 years age group followed by 22-23 years (23.40%), 20-21 years (21.10%) and 18-19 years (17.20%). While 31.00 per cent of the faculty were observed in the age group of 30-39 years followed by 40-49 years (26.70%), 20-29 years (26.00%) and above 50 years (16.30%) age group.

Anusha (2019) in a study on "A study on perception of university students regarding e-learning" found that more than half of the students were observed in the age group of 21-24 years (51.00%) followed by less than 20 years (38.50%) and more than 25 years (10.50%) age group.

Alhumaid *et al.* (2020) in a study on "Covid-19 & e-learning: Perceptions & attitudes of teachers towards e-learning acceptance in the developing countries" expressed that 80.00 per cent of respondents between 25 to 34 years followed by 35 to 43 years (16.70%) and 44 or above years (3.30%).

Khan *et al*. (2021) in a study on "Students' perception towards e-learning during covid-19 pandemic in India" found that 84.78 per cent of the respondents belong to the age group of 19–29 years followed by 30-39 years (8.70%) and below 18 years (4.89%). While only 1.09 per cent falls within the age group of 40–49 years and 50-59 years (0.54%).

2.1.2 Gender

Akaslan and Law (2011) in a study on "Measuring teachers' readiness for e-learning in higher education institutions" found that majority of the participants were male (85.10%) and the remaining 14.90 per cent were female.

Bhuvaneswari and Padmanaban (2012) in a study on “Attitude of senior secondary students towards e-learning” reported that 54.50 per cent of the respondents were male and the remaining 45.50 per cent were female.

Azimi (2013) in a study on “Readiness for implementation of e learning in colleges of education” indicated that that 61.80 per cent were female students and the remaining 38.20 per cent were males. While 57.20 per cent of the faculty were male and remaining 42.80 per cent were female.

Kar *et al*. (2014) in a study on “Attitude of university students towards e-learning” reported that more than half of the respondents were male (52.27%) and the remaining were female (47.73%).

Fedynich *et al.* (2015) in a study on “Graduate students’ perceptions of online learning” inferred that 61.50 per cent of the respondents were female and the remaining were male (38.50%).

Khan (2016) in a study on “Attitude of prospective teacher educators towards incorporation of electronic learning technology in teacher education institutions” revealed that more than half were male (52.50%) and the remaining were female (47.50%).

Dhas (2017) in a study on “Attitude of college students towards e-learning” reported that majority of the students were female (88.03%) and the remaining 11.97 per cent were male.

Abdullah and Toycan (2018) in a study on “Analysis of the factors for the successful e-learning services adoption from education providers and students’ perspectives” revealed that 61.70 per cent of the students were male and the remaining 38.30 per cent were female. Similarly, 61.60 per cent of the faculty were male and the remaining 38.40 per cent were female.

Benali *et al.* (2018) in a study on "Digital competence of Moroccan teachers of English" revealed that 62.00 per cent of the teachers were male and the remaining 38.00 per cent were female.

Akbarilakeh *et al.* (2019) in a study on "Attitudes of faculty members towards using e-learning" found that 57.75 per cent of the respondents were male and the remaining were female (42.25%).

Abbasi *et al.* (2020) in a study on "Perceptions of students regarding e-learning during covid-19" found that 64.10 per cent of the respondents were female and the remaining 35.90 per cent were male.

Khan and Thomas (2021) in a study on "Virtual learning during current normal at undergraduate level" reported that more than two-third of the students were female (67.84%) and the remaining 32.16 per cent were male.

2.1.3 Background

Kar *et al.* (2014) in a study on "Attitude of university students towards e-learning" reported that two-third of the students belonged to rural (66.56%) and the remaining 33.44 per cent of the students belonged to urban.

Sharanappa (2015) in a study on "Attitude and awareness of agriculture college teachers towards educational technology" reported that 62.20 per cent of the faculty belonged to urban background and the remaining 37.80 per cent belonged to rural background.

Madhumita (2016) in a study on "A study on e-learning among the post graduate students" found that 69.16 per cent of the students were from urban background and the remaining 30.84 per cent were from rural background.

Dhas (2017) in a study on "Attitude of college students towards e-learning" inferred that three-fourth belonged to rural (75.00%) and the remaining 25.00 per cent belonged to urban.

Konwar (2017) in a study on "A study on attitude of college students towards e-learning" indicated that more than half of the respondents belonged to rural (52.00%) and the remaining belonged to urban (48.00%).

Mythili (2017) in a study on "Satisfaction and performance of academic counsellors in an online training programme" revealed that less than two-third of the trainees belonged to the urban (64.13%) and the remaining 35.87 per cent were belonged to rural area.

Thakkar and Joshi (2017) in a study on "Student's attitude towards e-learning" reported that more than three-fourth of the students belonged to urban (76.80%) locality and the remaining 23.20 per cent belonged to rural locality.

Walter (2018) in a study on "Influence of parental occupation and parental income on students' academic performance" revealed that majority of the students were from rural (88.60%) background, whereas a small proportion of 7.60 per cent were from peri-urban and urban (3.80%) background.

Anusha (2019) in a study on "A study on perception of university students regarding e-learning" found that 62.50 per cent of the students belonged to urban background and the remaining belonged to rural (37.50%) background.

Hasan and Khan (2020) in a study on "Online teaching-learning during covid-19 pandemic" found that 58.80 per cent of the respondents belonged to rural area and the remaining belonged to urban (41.20%) area.

Bhowmik and Bhattacharya (2021) in a study on "Factors influencing online learning in higher education in the emergency shifts of covid 19" revealed that more than half of the students belonged to rural (57.00%) followed by urban (24.70%) and semi-urban (18.30%).

Muthuprasad *et al.* (2021) in a study on "Student' perception and preference for online education in India during covid -19 pandemic" reported that 45.60 per cent of the respondents belonged to rural background followed by urban (39.42%) and peri urban (14.98%) background.

2.1.4 Type of Family

Madhumita (2016) in a study on "A study on e-learning among the post graduate students" found that 57.50 per cent of the students belonged to nuclear family and the remaining belonged to joint (42.50%) family.

Soni (2016) in a study on "Utilisation pattern of social media by the students for education" reported that two-third of the students belonged to nuclear (66.67%) family and the remaining 33.33 per cent belonged to joint family.

Yadav and Kashyap (2017) in a study on "Entrepreneurial intention of undergraduate students" observed that 81.00 per cent of the respondents belonged to nuclear family and the remaining 19.00 per cent belonged to joint family.

Anusha (2019) in a study on "A study on perception of university students regarding e-learning" revealed that 81.00 per cent of the students belonged to nuclear family and the remaining 19.00 per cent belonged to joint family.

Koirala *et al.* (2020) in a study on "Perception towards online classes during covid-19" reported that 79.70 per cent of the respondents belonged to nuclear family and the remaining 20.30 per cent belonged to joint family.

2.1.5 Educational Qualification

Bhuasiri *et al.* (2012) in a study on "Critical success factors for e-learning" found that 54.00 per cent of the respondents completed master degree and the remaining 46.00 per cent completed doctorate degree.

Azimi (2013) in a study on "Readiness for implementation of e learning" concluded that more than three-fourth of faculty studied up to post graduation (76.00%) followed by Ph.D. qualification (.00%) and under graduation (4.00%).

Ghavifek and Rosdy (2015) in a study on "Teaching and learning with technology" reported that 62.38 per cent of the respondents were having degree qualification followed by post-degree teacher's training (18.81%), diploma qualification (9.90%) and master qualification (8.91%).

Mythili (2017) in a study on “Satisfaction and performance of academic counsellors in an online training programme” reported that 55.96 per cent of the trainees had post graduate degree followed by doctoral (22.02%), M. Phil (13.85%) and graduation (8.17%) degree.

Shah and Sharma (2018) in a study on “Opinion of teachers towards quality assurance in higher agricultural education” identified that cent per cent of the teachers had completed Ph. D studies.

Selvaraj (2019) in a study on “Success of e-learning systems in management education” inferred that 71.70 per cent of the faculty completed postgraduation and the remaining 28.30 per cent completed doctorate.

Uppal (2019) in a study on “Effectiveness of massive open online courses” found that more than half of the teachers studied upto post graduation (51.00%) and the remaining studied Ph. D (49.00%).

Kulal and Nayak (2020) in a study on "A study on perception of teachers and students toward online classes” observed that 45.70 per cent of the faculty had a post-graduation degree with NET qualification.

Gurung (2021) in a study on “Challenges faced by teachers in online teaching” reported that 39.10 per cent of the teachers completed master degree followed by Ph. D (22.70%), bachelor degree (13.70%), others (12.70%), diploma (10.20%) and under graduation (1.60%).

2.1.6 Designation

Al-Dosari (2011) in a study on “Faculty members and students’ perceptions of e-learning” reported that an equal proportion of 30.00 per cent each were assistant professors and lecturers. While the remaining 40.00 per cent were language instructors.

Lloyd *et al.* (2012) in a study on "Faculty-perceived barriers of online education" revealed that 38.60 per cent of the faculty were assistant professors followed by associate professors (22.70%), professors (18.70%), adjunct/part-time (10.70%) and instructors (9.30%).

Bamigboye *et al.* (2013) in a study on "Teachers' attitude and competence towards the use of ICT resources" reported that 40.30 per cent of the respondents were holding a position of lecture I followed by senior lecturer (30.30%), lecturer II (16.10%), readers (9.50%) and professors (3.80%).

Martin and Parker (2014) in a study on "Use of synchronous virtual classrooms" found that little less than one-fourth of the respondents were assistant professors (24.00%) followed by associate professor (22.67%), part-time lecturer (21.33%). While the remaining were full professor and full-time lecturer of 16.00 per cent each.

Gomez (2015) in a study on "Higher education faculty use of a learning management system" found that 41.00 per cent of the respondents were part time lecturers followed by professor (19.00%), associate professor (14.00%), assistant professor (16.00%), full time lecturer (10.00%).

Gade and Agarwal (2017) in a study on "e-Readiness of state open universities towards online learning" found that 55.00 per cent of the respondents were assistant professors followed by academic associates/academic consultants (32.00%) and professors (13.00%).

Abdullah and Toycan (2018) in a study on "Analysis of the factors for the successful e-learning services adoption" identified that 22.50 per cent of the faculty were lecturers followed by assistant professor (22.10%), assistant lecturer (15.10%), associate professor (25.70%) and professor (17.60%).

Selvaraj (2019) in a study on "Success of e-learning systems in management education" inferred that 70.00 per cent of the faculty were having designation as assistant professor followed by associate (16.70%) and professor (13.30%).

Sofat and Sharma (2021) in a study on "A study on perception of academicians towards online education courses" reported that majority of the respondents were assistant professors (85.00%) followed by professors (6.00%), head of the department (5.00%), associate professor (2.00%) and director (2.00%).

2.1.7 Parental Occupation

Shah and Anwar (2014) in a study on "Impact of parents occupation and family income on children performance" reported that 38.20 per cent of the respondents' parental occupation was self-employment, followed by public sector (31.30%), private sector (18.60%), informal employment (9.70%) and unemployed (2.20%).

Imam and Singh (2015) in a study on "Influence of gender, parental education and parental occupation on mathematics achievement of secondary school students" found that nearly one-fourth of the respondent's parental occupation was agriculture (24.95%), followed by business (24.22%), professional job (9.93%) and others (40.90%).

Madhumita (2016) in a study on "A study on e-learning among the post graduate students" found that 72.65 per cent had their father working in service sector followed by business (18.80%), farming (5.00%) and others (3.55%).

Yadav and Kashyap (2017) in a study on "Entrepreneurial intention of undergraduate students" observed that nearly two-third of the respondents' father was working in service sector (66.36%) followed by business (14.55%), cultivation/farming (11.82%) and remaining 7.27 per cent were involved in independent profession.

Walter (2018) in a study on "Influence of parental occupation and parental income on students' academic performance" found that 78.80 per cent of the students were from low parental occupation followed by middle (21.20%) level of parental occupation. There were no students from high parental occupation.

Moneva et al. (2019) in a study on “Parent’s occupation and students’ self-esteem” reported that 47.76 per cent of the students’ parental occupation was blue collared job, followed by pink collared (20.82%), white collared (15.10%), red (6.94%), grey (5.67%), gold (2.49%) and black (1.22%) collared job.

2.1.8 Academic Performance

Ren and Hagedorn (2012) in a study on “International graduate students' academic performance” reported that 42.40 per cent of the respondents had secured 3.7-3.9 GPA followed by 3.4-3.6 (30.30%), 3.0-3.3 (18.90%), 4.0 (5.30%) and less than 3.0 (3.10%) GPA.

Mbogo (2016) in a study on “Antecedent factors affecting academic performance” observed that more than half of the respondents had secured 3.0-3.4 GPA (52.18%) followed by 2.5-2.9 (30.43%), above 3.0 (13.04%) and 2.0-2.4 (4.35%) GPA in academics.

Soni (2016) in a study on “Utilisation pattern of social media by the students for education” reported that 70.00 per cent of the students had secured medium (7.0 to 8.3 CGPA) academic performance followed by low (<7.0) (23.00%) and high (>8.3) (7.00%) academic performance.

Yadav and Kashyap (2017) in a study on “Entrepreneurial intention of undergraduate students” observed that 63.64 per cent of the respondents secured average (7-7.87) academic performance followed by high (21.82%) and low (14.54%) academic performance.

Yigermal (2017) in a study on “Determinant of academic performance of under graduate students” revealed that more than half of the respondents secured more than 2.49 CGPA (52.00%) and the remaining 48.00 per cent secured less than 2.49 CGPA.

Walter (2018) in a study on “Influence of parental occupation and parental income on students’ academic performance” found that 18.00 per cent of the students performed average, followed by good (11.00%). While 70.50 per cent of the students performed below average and excellent (0.50%).

Soharwardi *et al.* (2020) in a study on "Impact of parental socioeconomic status on academic performance of students" revealed that 45.00 per cent of students scored average percentage of marks followed by best (31.30%) and poor (23.70%) percentage in marks.

Baticulon *et al.* (2021) in a study on "Barriers to online learning" revealed that 70.00 per cent of the respondents secured middle 50% in year level followed by highest 25% in year level (16.00%) and lowest 25% in year level (14.00%).

2.1.9 Possession and Extent of Use of Electronic Devices

Azimi (2013) in a study on "Readiness for implementation of e learning" indicated that half of faculty members (50.00%) and students (48.40%) owned laptops/home computers and only 1.60 per cent owned cell phones/pages.

Ncube (2015) in a study on "Students' perceptions of e-learning" concluded that equal proportion of the students and faculty of 43.00 per cent each accessed e-learning platform using desktop computers, laptops and smart phones and the remaining 14.00 per cent of them accessed e-learning platform using tablets or iPads.

Madhumita (2016) in a study on "A study on e-learning among the post graduate students" found that greater majority of the respondents possess laptop (95.00%) followed by the smartphone (94.17%), Computer (64.16%), tablet (33.33%), note-book (19.16%) and lastly kindle (9.16%).

Soni (2016) in a study on "Utilisation pattern of social media by the students for education" reported that majority of the students possess smart phone (85.33%), laptop (74.00%), personal computer (18.00%) and tablet (8.00%).

Benali *et al.* (2018) in a study on "Digital competence of moroccan teachers of english" revealed that greater majority of the teachers used laptop (93.00%) followed by smart phone (86.00%), tablet (35.00%) and desktop (32.00%) for online teaching.

Anusha (2019) in a study on "A study on perception of university students regarding e-learning" found that greater majority of the students possess smart phone (97.50%) followed by laptop (88.50%), personal computer (70.50%) and Tablet (29.00%).

Bhatt (2019) in a study on "A study on use of e-learning among rural youth" revealed that 63.57 per cent of the respondents used smart phone daily for e-learning followed by weekly (29.29%) and never (7.14%). More than one-fourth of the respondents used laptop (27.14%) for e-learning followed by weekly (15.00%) and never (57.85%). More than half of the students never (52.15%) used personal computer for e-learning followed by weekly (42.14%) and daily (5.71%).

Abbasi *et al.* (2020) in a study on "Perceptions of students regarding e-learning" found that three-fourth of the respondents used mobile (75.70%) to assess e-learning followed by laptop (21.20%), tablet (2.40%) and only 0.80 per cent used computer to assess e-learning.

Hasan and Khan (2020) in a study on "Online teaching-learning during covid-19 pandemic" found that greater majority of the students used mobile phone (98.00%) followed by laptop (14.70%), personal computer (1.00%) and only 0.50 per cent used tablet for online learning.

Baticulon *et al.* (2021) in a study on "Barriers to online learning" revealed that 93.00 per cent of the respondents possess a smartphone followed by laptop or desktop computer (83.00%) and tablet (63.00%).

Muthuprasad *et al*. (2021) in a study on "Students' perception and preference for online education in India" indicated that 57.98 per cent of the respondents used smart phone followed by laptop (35.83%), tablet (4.89%) and only 0.65 per cent used desktop for online education.

Rana (2021) in a study on "Online learning experiences during covid-19" indicated that greater majority of the students used mobile phone (96.00%) followed by laptop (8.00%), desktop (1.30%), iPad (1.00%) and other devices (0.70%) for online learning.

2.1.10 Possession of Internet Connectivity

Akaslan and Law (2011) in a study on "Measuring teachers' readiness for e-learning" reported that all the participants have access to the internet at university whereas only 88.20 per cent of them have access at home.

Madhumita (2016) in a study on "A study on e-learning among the post graduate students" found that cent percent of the respondents were connected to internet.

Soni (2016) in a study on "Utilisation pattern of social media by the students for education" reported that 64.67 per cent of the students accessed Wi-Fi for educational purpose.

Adnan and Anwar (2020) in a study on "Online learning amid the COVID-19 pandemic" observed that 73.00 per cent of the respondents had proper access to the internet.

Hasan and Khan (2020) in a study on "Online teaching-learning during covid-19 pandemic" inferred that 47.50 per cent of the students had good internet connectivity.

Koirala *et al*. (2020) in a study on "Perception towards online classes" reported that nearly two-third of the respondents used both cellular data and wi-fi (66.10%) followed by wi-fi (31.60%) and cellular data (2.30%) for online classes.

Baticulon *et al.* (2021) in a study on "Barriers to online learning" stated that 98.00 per cent of the respondents had access to internet.

Muthuprasad *et al*. (2021) in a study on "Students' perception and preference for online education in India" concluded that majority of the respondents used mobile data pack (85.67%) followed by wi-fi (11.40%) and LAN (2.93%) for online education.

2.1.11 Time Spent in Online Teaching and Learning

Kuo *et al*. (2013) in a study on "A predictive study of student satisfaction in online education programs" found that 38.00 per cent of the respondents spent 6-10 hours online per week followed by less than 5 hours (27.00%), 11-15 hours (21.00%), 16-20 hours (7.00%) and above 20 hours (7.00%).

Kenan (2015) in a study on "Improving the effectiveness of e-learning implementation" expressed that more than one-third of the respondents spent 5-10 hours per week (35.71%) in teaching followed by less than 5 hours (25.00%), 16-20 hours (21.43%), 11-15 hours (10.71%) and more than 20 hours (7.15%).

Ncube (2015) in a study on "Students' perceptions of e-learning" concluded that 54.00 per cent of the students spent 1 to 3 hours per week on e-learning platform followed by 4 to 6 hours (19.00%), 7 to 9 hours (11.00%), 10 to 12 hours (6.00%), 13 to 15 hours (8.00%) and 16 to 18 hours (2.00%) per week on e-learning platform.

Madhumita (2016) in a study on "A study on e-learning among the post graduate students" found that greater proportion of the students spent 0.2 hours to 5.85 hours on internet for e-learning (94.17%) followed by more than 5.85 hours (5.00%) and only 0.83 per cent spent less than 0.2 hours on internet fore-learning.

Naresh *et al*. (2016) in a study on "A Study on the relationship between demographic factor and e-learning readiness" revealed that 38.50 per cent of the respondents spent 11 - 15 hour on internet followed by more than 21 hours (24.60%), 6 - 10 hours (23.10%), 16 - 20 hours (9.20%) and less than 5 hours (4.60%).

Soni (2016) in a study on "Utilisation pattern of social media by the students for education" reported that half of the students spent 4-12 hours per week (50.67%) in social media for educational purpose followed by more than 4 hours per week (30.67%) and more than 12 hours per week (18.66%) in social media for educational purpose.

Faderogaya (2018) in a study on “Learning styles and attitude towards e-learning” found that more than half of the respondents spent 0-7 hours (54.70%) online for academic purposes followed by 8-14 hours (27.00%), 15-21 hours (10.70%), 22-29 hours (5.60%) and above 20 hours (2.00%) online for academic purposes.

Anusha (2019) in a study on “A study on perception of university students regarding e-learning” found that the average internet usage was more than three and half hours per day for e-learning.

Baticulon *et al.* (2021) in a study on “Barriers to online learning” indicated that half of the respondents spent 5 to 24 hours per week (50.00%) followed by 4 hours or less per week (42.00%) and 25 to 40 hours per week (8.00%) on online learning.

2.1.12 Teaching Experience

Al-Dosari (2011) in a study on “Faculty members and students’ perceptions of e-learning” reported that 42.90 per cent of the respondents had 1 - 2 years teaching experience followed by equal proportion of 21.40 per cent each had 3 - 5 years and 5 - 10 years of experience, while 14.30 per cent had 2 - 3 years.

Azimi (2013) in a study on “Readiness for implementation of e learning” revealed that 27.72 per cent of faculty had experience of 11-15 years followed by equal proportion of each 25.30 per cent had less than 5 years and more than 15 years and 6-10 years (21.68%) experience in teaching.

Martin and Parker (2014) in a study on “Use of synchronous virtual classrooms” reported that 38.67 per cent of the respondents had 11 or more years of teaching experience followed by 5-10 years (37.33%), 2-4 years (16.00%) and less than 1 year (8.00%) of teaching experience.

Ghavifek and Rosdy (2015) in a study on “Teaching and learning with technology” reported that 35.64 per cent of the respondents had 1-5 years of teaching experience followed by 6-10 years (33.66%), less than 1 year (19.80%) and more than 10 years (10.90%).

Aldowah *et al.* (2017) in a study on “Technological and contextual challenges of e-learning implementation” inferred that nearly one-third of the respondents had 6-10 years (32.70%) of teaching experience followed by 1-5 years (28.00%), 11-15 years (24.30%), 16-20 years (11.20%) and 21-25 and 26-30 years (3.80%) each.

Benali *et al.* (2018) in a study on “Digital competence of moroccan teachers of english” indicted that 42.00 per cent of teachers had less than 10 years of teaching experience followed by 10 and 15 (30.00%), more than 16 years (28.00%).

Uppal (2019) in a study on “Effectiveness of massive open online courses” expressed that 28.00 per cent of the teachers had 15 to 19 years of teaching experience followed by 5 to 9 years (23.00%), 0 to 4 years (19.00%), 10 to 14 years (18.00%) and above 20 years (12.00%) years of teaching experience.

Kulal and Nayak (2020) in a study on "A study on perception of teachers and students toward online classes” found that 64.70 per cent of the respondents had 0–5 years teaching experience followed by 6–10 years (26.50%), 11–15 years (2.90%) and 16–20 years (5.90%).

Gurung (2021) in a study on “Challenges faced by teachers in online teaching” observed that 37.50 per cent of the teachers had 1-5 years teaching experience followed by 5-10 years (25.00%), 15-20 years (17.20%), 10-15 years (15.60%) and above 20 years (4.70%) teaching experience.

2.1.13 Previous Experience in Online Teaching and Learning

Lloyd *et al.* (2012) in a study on “Faculty-perceived barriers of online education” reported that 54.70 per cent of the faculty had online education experience.

Becker *et al.* (2013) in a study on “A learner perspective on barriers to e-learning” revealed that little less than two-third of the respondents had e-learning experience (65.23%) while 34.77 per cent of the respondents had no e-learning experience.

Gay (2016) in a study on “An assessment of online instructor e-learning readiness” expressed that 28.30 per cent of the respondents had 4-6 years of experience in e-learning system followed by 1-3 years (26.00%), under 1 year (23.10%), more than 10 years (15.90%) and 7-10 years (6.70%).

Ghaderizefreh and Hoover (2018) in a study on “Student satisfaction with online learning” found that 62.07 per cent of the students had no previous experience in online learning followed by learning one online course (10.34%) and learning two or more online courses (27.59%).

Kulal and Nayak (2020) in a study on "A study on perception of teachers and students toward online classes” observed that 81.40 per cent of the respondents had 1 year of online teaching experience followed by 1-2 years (16.30%) and 3-5 years (2.30%) of online teaching experience.

Gurung (2021) in a study on “Challenges faced by teachers in online teaching” reported that 81.30 per cent of the respondents started teaching through online due to covid-19 pandemic followed by did not take online classes (14.80%) and already conducted online classes before covid–19 pandemic (3.90%).

Ahammad (2021) in a study on “Online learning initiatives and its effects on teaching-learning process” reported that 74.00 per cent of participants had previously done an online course.

2.1.14 Teaching and Learning Material

Sood and Singh (2014) in a study on “E-learning: usage among Indian students” found that 10.00 per cent of the students regularly used audio/video tapes followed by occasionally (31.00%) and never (59.00%) used audio/video tapes.

Gade and Agarwal (2017) in a study on “e-readiness of state open universities towards online learning” revealed that 43.00 per cent of the faculty prepared video lectures daily or frequently. While 40.00 per cent of the faculty frequently prepare audio lectures.

Amita (2020) in a study on “e-learning experience of students” indicated that 75.96 per cent of the students have been provided study material/learning resources in various forms such as notes pdf/word/ppt files.

Hasan and Khan (2020) in a study on “Online teaching-learning” expressed that 65.20 per cent of the students were provided with teacher made text materials as learning material.

Raju *et al.* (2020) in a study on ‘MOOCS’ reported that great majority of the online instructors preferred teaching formats as videos (96.49%) followed by power point presentation (96.30%), PDF (95.13%), images (89.28%), text (87.72%), animated objects (87.72%) and audio (74.27%).

Ahammad (2021) in a study on “Online learning initiatives” reported that 77.00 per cent of participants claimed that their school/college/university/ institution produce online learning materials.

Muthuprasad *et al*. (2021) in a study on “Students’ perception and preference for online education in India” expressed that 52.77 per cent of the respondents preferred the instructor to teach using PowerPoint presentations.

2.1.16 Video Conferencing Application(s)

Martin and Parker (2014) in a study on “Use of synchronous virtual classrooms” reported that horizon wimba, webex and adobe connect were the most commonly used synchronous tools for virtual classrooms among the respondents.

Hasan and Khan (2020) in a study on “Online teaching-learning” reported that nearly two-third of the institutes used whatsapp (65.70%) followed by zoom (53.40%), google classroom (25.00%), other platforms include facebook, you tube, google hangouts, telegram, edx, udemy (12.90%) for offering online teaching.

Kulal and Nayak (2020) in a study on "A study on perception of teachers and students toward online classes" inferred that google classroom is the most used and preferred tools for an online class by respondents.

Ahammad (2021) in a study on "Online learning initiatives" reported that less than one-third of participants claimed that zoom app (31.00%) followed by google meet (20.00%), go to webinar (10.00%), webex (5.00%), quiro (9.00%), microsoft teams (10.00%), skype (7.00%), conference call (8.00%) as most useful apps for the teaching and learning process.

Bhowmik and Bhattacharya (2021) in a study on "Factors influencing online learning" found that 72.30 per cent of the students used google meet followed by skype (10.60%), zoom (7.40%), others (7.0%) and cisco webex (2.10%) platforms for online learning.

Gurung (2021) in a study on "Challenges faced by teachers in online teaching" revealed that 86.60 per cent of the teachers were used Zoom, Google meet, WhatsApp, Google classroom software to deliver their lecture.

Rana (2021) in a study on "Online learning experiences" reported that 41.00 per cent of the students perceived zoom followed by google meet (32.30%), cisco webex (23.30%), go to webinar (2.70%) and microsoft teams (0.70%) as the best platform for online classes.

2.2 ATTITUDE TOWARDS ONLINE TEACHING AND LEARNING

Mehra and Omidian (2011) in a study on "Examining students' attitudes towards e-learning" reported that more than three-fourth of the respondents had positive (76.00%) attitude towards e-learning while the remaining had negative (24.00%) attitude.

Jyothi *et al.* (2011a) in a study on "A Scale to Measure the Attitude of Teachers towards ICTs" indicated that ICT makes lessons less diverse, makes the job of teaching more exciting, brings creativity in teaching, enrich teaching,

improves presentation of information, makes teaching convenient, cuts down the preparation time, a wonderful means of organising information for teaching.

Bamigboye *et al.* (2013) in a study on “Teachers’ attitude and competence towards the use of ICT Resources” reported that majority of the respondents had positive (84.90%) attitude towards the use of ICT in teaching and learning process.

Adewole-Odeshi (2014) in study on "Attitude of students towards e-learning" revealed that 80.40 per cent of the students had favourable attitude using e-learning tools.

Ghadei and Rudd (2015) in a study on “Perception and attitude of agricultural students towards e-learning” reported that more than two-third of the respondents had high (67.07%) attitude followed by medium (28.05%) and low (4.88%) attitudes towards e-learning.

Kisanga (2016) in a study on "Determinants of teachers attitudes towards e-learning" found that more than half of the teachers had positive (53.00%) attitude towards e-learning and the remaining teachers had negative (47.00%) attitude towards e-learning.

Mamattah (2016) in a study on “Students’ perceptions of e-learning” reported that more than three-fourth of the students had positive (76.00%) attitude towards e-learning.

Kumar (2017) in a study on “Attitude of teacher educators towards e-learning” reported that 70.00 per cent of the teachers had favourable attitude towards e-learning while 30.00 per cent of the teachers had unfavourable attitude.

Konwar (2017) in a study on “A study on attitude of college students towards e-learning” found that 39.00 per cent of the respondents had high attitude of e-learning, followed by above average (37.00%), average (16.50%), extremely high (5.00%) and low (2.50%) attitude.

Peytcheva-forsyth *et al.* (2018) in a study on "Factors affecting students' attitude towards online learning" revealed that 81.20 per cent of the female students and male students (18.80%) had positive attitude towards teachers support in online learning.

Akbarilakeh *et al.* (2019) in a study on "Attitudes of faculty members towards using e-learning" inferred that majority of the faculty had positive attitude towards e-learning.

Koirala *et al.* (2020) in a study on "Perception towards online classes during covid-19" reported that more than half of the respondents had negative (54.10%) attitude towards online classes whereas 45.90 per cent had positive attitude towards online classes.

Vinayagam and Akhila (2020) in a study on "Competency analysis among faculty of agriculture universities in using educational technology" found that 44.44 per cent of faculty had 'somewhat favourable' attitude towards use of educational technology in teaching process followed by favourable (36.70%) and unfavourable (18.90%) attitude towards educational technology in teaching process.

Khan *et al.* (2021) in a study on "Students' Perception towards e-learning during covid-19 pandemic in India" revealed that students showed positive attitude towards e-learning.

2.3 COMPETENCIES IN ONLINE TEACHING AND LEARNING

Bigatel *et al.* (2012) in a study on " The identification of competencies for online teaching success" identified competencies based on successful online teaching tasks into seven categories as active learning, administration and leadership, active teaching and responsiveness, multimedia technology, classroom decorum, technological competence and policy enforcement.

Jyothi *et al.* (2012) in a study on "An inventory to measure the ICT competencies of teachers" indicated competencies namely poster making, preparing voice files, using photoshop, updating software on computer, making PDF documents, etc.

Azimi (2013) in a study on "Readiness for implementation of e learning in colleges of education and assessment of e learning needs among its faculty members and students" found that 48.40 per cent of the heads indicated that their faculty had necessary skills for the implementation of e-learning. While 51.60 per cent did not have skills.

Ghavifek and Rosdy (2015) in a study on "Teaching and learning with technology" reported that two-third of the respondents had medium ability (66.34%) of handling ICTs in teaching followed by high ability (24.75%) and low ability (8.91%).

Koskinen (2015) in a study on "Digital competence development of teachers" concluded that 40.70 per cent of the respondents had good digital skills followed by fair (33.33%), excellent (18.50%) and below average (7.40%) digital skills.

Gade and Agarwal (2017) in a study on "e-Readiness of state open universities towards online learning" expressed that faculty have high expertise in developing and delivering audio and video lectures and use presentation tools for developing video lectures.

Gupta and Singh (2018) in a study on "Competency of teacher educators and student teachers towards e-learning tools" inferred that nearly two-third of the respondents had average (66.09%) basic computer competency. While 42.83 per cent of the respondents had average advanced computer competency.

Ally (2019) in a study on "Competency profile of the digital and online teacher in future education" concluded that the experts classified 105 competencies into nine major themes that indicate the major areas of responsibilities for the digital teacher of the future such as general, use digital

technology, develop digital learning resources, re-mix digital learning resources, communication, facilitate learning, pedagogical strategies, assess learning and personal characteristics.

Selvaraj (2019) in a study on "Success of e-learning systems in management education" inferred that less than three-fourth of the students had intermediate level (72.30%) of computer proficiency followed by basic (19.00%) and advanced (8.70%). While, more than half (51.70%) of the faculty had intermediate computer proficiency followed by advanced (28.30%) and basic (20.00%).

Albrahim (2020) in a study on "Online teaching skills and competencies" classified the skills and competencies required for online teaching into six categories as pedagogical skills, content skills, design skills, technological skills, management & institutional skills and social & communication skills.

Vinayagam and Akhila (2020) in a study on "Competency analysis among faculty of agriculture universities in using educational technology" found that 41.70 per cent of the respondents had medium level of expertise in the use of technology in teaching process followed by high (38.90%) and low (19.40%) level of expertise.

Baticulon *et al*. (2021) in a study on "Barriers to online learning in the time of covid- 19" concluded that 47.00 per cent of the teachers had the requisite skills and resources for online teaching.

Rana (2021) in a study on "Online learning experiences during covid-19 in higher education space" found that 35.30 per cent of the students had better ICT skills to access different online learning platforms.

2.4 CONSTRAINTS IN ONLINE TEACHING AND LEARNING

Al-Dosari (2011) in a study on "Faculty members and students' perceptions of e-learning" revealed that 80.00 per cent of the respondents perceived isolation

and lack of face-to-face interactions as drawbacks of online courses followed by lack of technological skills for student and/or faculty (50.00%) and time intensive (30.00%).

Tagoe (2012) in a study on "Students' perceptions on incorporating e-learning into teaching and learning" found that poor internet connectivity and glitches slow down the learning process.

Al-Shboul (2013) in a study on "The level of e-learning integration at the university of Jordan" found that more than half of the faculty agreed (52.10%) and strongly agreed (26.60%) that the teaching workload was an inhibiting factor to their use of e-Learning tools.

Abramenka (2015) in a study on "Students' motivations and barriers to online education" found that collaboration and interaction as the major barriers to online learning.

Ullah *et al*. (2017) in a study on "Students' attitude towards online learning" found that nearly three-fourth of the respondents agreed (74.70%) that slow computer and poor internet connections discouraged to use online learning.

Bhatt (2019) in a study on "A study on use of e-learning among rural youth" reported that health issues (66.43%), chances of distractions (65.71%), lack of motivation (65.71%), lack of access to technology (61.43%) and no face-to-face interaction (57.14%) as the limitations of the e-learning.

Amita (2020) in a study on "e-learning experience of students" concluded that poor internet connectivity problem was ranked I followed by problem in choosing best source due to flooding of information (Rank II), non-availability/affordability of e-learning resources like laptop/desktop at home (Rank III), lack of adequate technical skills (Rank IV) and electricity problem (Rank V) as barriers in online learning.

Kapasia *et al.* (2020) in a study on "Impact of lockdown on learning status of undergraduate and postgraduate students during covid-19 pandemic" reported that mental health, poor internet connection and non-conducive home environments as barriers in online learning.

Ahammad (2021) in a study on "Online learning initiatives" reported that less than one-fourth of participants claimed network problems (22.00%), followed by technical problems (14.00%), lack of knowledge about online-learning platform (13.00%), expensive (11.00%), understanding problems (9.00%), equal proportion of 8.00 per cent each claimed online learning content is not appropriate according to the needs of learners, lack of advance software, security problems and lack of time flexibility (7.00%) as barriers while using online learning platforms.

Means and Neisler (2021) in a study on "Teaching and learning in the time of covid" concluded that frequent internet connectivity issues and hardware and software problems interfered with online learning.

Muthuprasad *et al.* (2021) in a study on "Students' perception and preference for online education in India" concluded that lack of connectivity was ranked I followed by data limit (Rank II), data speed (Rank III), little/no face-to-face interaction (Rank IV), intense requirement for self-discipline (Rank V), lack of device (Rank VI), poor learning environment (Rank VII) and technophobia (Rank VIII) as constraints in online learning.

2.5 SATISFACTION WITH ONLINE TEACHING AND LEARNING

Jyothi *et al.* (2011b) in a study on "ICT utilisation pattern by the post-graduate students of ANGRAU" reported that a little less than half of the respondents were satisfied (47.50%) with the ICT facilities provided by the university, followed by dis-satisfied (39.17%), undecided (7.50%) and very much dis-satisfied (5.83%).

Cole *et al.* (2014) in a study on "Online instruction, e-learning and student satisfaction" found that 58.70 per cent of the students were fully satisfied with online course experience.

Madhumita (2016) in a study on "A study on e-learning among the post graduate students" concluded that cent per cent of students were satisfied with e-learning.

Mythili (2017) in a study on "Satisfaction and performance of academic counsellors in an online training programme" reported that a majority of the trainees of the ACT-Online training programme were satisfied with online training programme.

Shah and Sharma (2018) in a study on "Opinion of teachers towards quality assurance in higher agricultural education" observed that 56.00 per cent of the respondents were satisfied with the accessibility to computer and internet facility followed by not satisfied (40.00%) and highly satisfied (4.00%).

Selvaraj (2019) in a study on "Success of e-learning systems in management education" inferred that more than half of the students (51.70%) and faculty (53.30%) were highly satisfied with e-learning systems in management education in Chennai city.

Coman *et al.* (2020) in a study on "Online teaching and learning in higher education" reported that 39.10 per cent of the students were very much satisfied and satisfied with the online learning experience followed by undecided (31.90%) and dissatisfied (29.00%).

Fatima and Raj (2020) in a study on "Stress in students after lockdown due to covid-19 threat" revealed that 21.60 per cent of the students were satisfied with online classes, followed by not satisfied (43.60%). While 34.60 per cent of students were not sure about their satisfaction with online classes.

Koirala *et al*. (2020) in a study on "Perception towards online classes during covid-19" reported that 63.20 per cent of the students were satisfied with online classes followed by less satisfied (30.80%) and strongly satisfied (6.00%) with online classes.

Lall and Singh (2020) in a study on "Covid-19: unmasking the new face of education" reported that nearly three-fourth students were satisfied (74.00%) with online learning.

Surahman and Sulthoni (2020) in a study on "Student Satisfaction toward quality of online learning" found that 60.00 per cent of the respondents were satisfied with online learning.

Gurung (2021) in a study on "Challenges faced by teachers in online teaching during covid-19 pandemic" revealed that more than one-third of teachers were satisfied (35.20%) followed by neither satisfied nor dissatisfied (33.60%), dissatisfied (18.00%), highly satisfied (8.60%) and strongly dissatisfied (4.60%) with online teaching.

2.6 BEST PRACTICES FOR EFFECTIVE ONLINE TEACHING AND LEARNING

Crawford-Ferre and Wiest (2012) in a study on "Effective online instruction in higher education" expressed that online faculty need professional development and sufficient professional training related to the online design and instructions for effective online teaching and learning.

Tagoe (2012) in a study on "Students' perceptions on incorporating e-learning into teaching and learning" found that majority of the students agreed (88.10%) that mixed mode would improve teaching and learning and the remaining 11.90 per cent of the students disagreed.

Yuan and Kim (2014) in a study on "Guidelines for facilitating the development of learning communities in online courses" reported that both social and teaching presence as valuable influences in the development of a learning community.

Khan (2016) in a study on "Attitude of prospective teacher educators towards incorporation of electronic learning technology in teacher education institutions" revealed that teacher must be able to incorporate e-learning with the traditional learning, competent enough in web-based teaching, upgrade the teachers by offering re-training programmes on e-learning, need to revise curriculum in the light of technological advancement, accreditation of online learning courses and programmes to provide them social recognition, e-learning materials should be made available in various regional languages, reward system for teachers incorporating e-learning tools in their teaching-learning process for effective use of e-learning technology in teacher education institutions.

Salcido and Cole (2018) in a study on "Best practices for teaching online" reported that assignments that ask students to express what they have learned and what they still need to learn, breaking up class activities into shorter pieces than in an in-person course, frequent quizzes or other assessments, live sessions in which students can ask questions and participate in discussions, meeting in breakout groups during a live class, personal messages to individual students about how they are doing in the course or to make sure they can access course materials, using real-world examples to illustrate course content, work on group projects separately from the course meetings were best practices for more effective teaching and learning online.

Ishak *et al.* (2020) in a study on "Students needs satisfaction with asynchronous online video lectures in the flipped classroom environment" inferred that the students became more confident to interact with their peers and instructor in the classroom in flipped classroom approach

Jyothi and Vijayabhinandana (2020) in a study on "Perception of students about online education" revealed techniques to make online education interesting for students. The findings indicated that great majority of the students expressed that there should be pre and post evaluation of every class on google forms (98.33%) followed by classes on user friendly institutional app (97.50%), link for

recorded presentation to view later (95.83%), digital appreciation certificates to merit and sincere students for motivation (95.00%), include recap and posting of upcoming classes in every class (92.50%), regular feedback system (90.83%), sharing of lecture notes immediately after class (88.33%), oral lecture coupled with PPT/short video/photo/image (86.67%), classes should be interactive, every participant should be valued (85.83%), response to questions posted in chat groups (85.00%), chat groups a compulsion (83.33%), week end assignments (81.67%), use of multiple communication tools to reach students (80.83%), real time stories shared as examples (78.33%), regular practice exercises to improve skills (75.83%), there should be a class facilitator and screen sharing be given to teacher (71.67%), time management by teacher (70.83%) and avoid classes during peak internet use hours (65.00%).

Nagar (2020) in a study on "Assessing students' perception toward e-learning" revealed that more than two-third of the students favoured (69.00%) blended learning which is the combination of face to face and online learning

Ahammad (2021) in a study on "Online learning initiatives" reported that participants claimed that faster internet connectivity and solve network problems, developed high-quality software, implementation of appropriate security policies favouring online learning, provision of technical support for online learning at schools, colleges and university, provides appropriate content in appropriate languages, create awareness about the value and importance of online learning, provision of training for teachers in online learning at all levels make online teaching-learning more effective.

Jain and Soriya (2021) in a study on "Integrating the education with the technology - rise in demand for online education in India" found that half of the students think that effective learning is achieved when the teaching process is done with the combination of offline mode and online mode.

Muthuprasad *et al*. (2021) in a study on "Students' perception and preference for online education" reported that majority of the participants opined that online classes are effective provided that the classes are well structured and interactive with flexible curriculum supported with uninterrupted internet connectivity and competent instructor.

Chapter – III

Material and Methods

Chapter III

MATERIAL AND METHODS

This chapter deals with research design, sampling procedure, variables and their measurement, tools of data collection, statistical tests used and analytical procedures followed to interpret the data of the present study. The details of the methodology followed in the present investigation were presented under the following heads.

3.1 Research design

3.2 Sampling procedure

3.2.1 Locale of study

3.2.2 Selection of University

3.2.3 Selection of Agricultural College

3.2.4 Selection of respondents

3.3 Variables and their empirical measurement

3.4 Tools used for data collection

3.5 Statistical tools used for analysis of data

3.1 RESEARCH DESIGN

The design of research is the most important and critical aspect of research methodology. In a broad sense, research design is the process of planning and carrying out research. It is a systematic plan to study a scientific problem.

According to Kerlinger (1986), research design is the plan, structure and strategy of investigation so conceived as to obtain answers to research questions. It expresses both the structure of the research problem and the plan of investigation used to obtain empirical evidence on the relations of the problem.

The topic of the study "Online teaching and learning by the teachers and students of Acharya N. G. Ranga Agricultural University" is of the recent origin. To gain a deep insight into the topic exploratory research design was used in the present investigation. Exploratory Research design is used when there is no enough available information about the research subject (Sarantokos, 1993). Exploration helps in developing an accurate picture of the research object.

Exploratory research design is to discover significant variables in the field situation and to lay the ground work for, more systematic and rigorous testing of hypothesis. Exploratory research design was employed in the present research to achieve the objectives of the study.

It is often used to generate formal hypotheses and develop more precise research problems. The research design will be employed when there are few or no earlier studies to refer to. The researcher out of curiosity and desire to gain better understanding starts investigation with a general idea and uses this research as a medium to identify key issues that can be the focus for future research. An important aspect of this research design is that the researcher should be willing to change his/her direction subject to the revelation of new data or insight. Such a research is usually carried out when the problem is at a preliminary stage. It is often referred to address research questions of all types i.e., what, why and how.

Sabaratnam and Mulay (1983) indicated that the exploratory study is a pilot study conducted prior to main investigation. This study is planned to gain more knowledge and familiarity with the phenomena or the subject concerned. This is conducted to achieve new insights into the problem. Variables are not required, however there is sensitivity and awareness regarding the variances.

3.2 SAMPLING PROCEDURE

Sampling is the process of obtaining information about an entire population by examining only a part of it (Kothari, 2012). The procedure adopted for selection of the locale of the study and respondents is given below.

3.2.1 Locale of the Study

As Acharya N. G. Ranga Agricultural University is located in Andhra Pradesh state, hence this state was purposively selected for the study. Further, the researcher hails from the same state.

3.2.2 Selection of the University

Acharya N. G. Ranga Agricultural University was selected purposively as the researcher is studying in this university.

3.2.3 Selection of Agricultural Colleges

Two Agricultural Colleges one each from Andhra and Rayalaseema regions were selected based on highest number of teachers, Under Graduate and Post graduate students. Agricultural College, Bapatla and S V Agricultural College, Tirupati were selected for the study.

3.2.4 Selection of the Respondents

From each of the selected Agricultural College, 30 teachers, 90 Under Graduate students (30 each from 2^{nd}, 3^{rd}, 4^{th} year of B. Sc. (Hons.) Agriculture) and 30 Post Graduate students involved in online teaching and learning were selected using simple random sampling procedure, thus making a total sample of 60 teachers, 180 Under Graduate students and 60 Post Graduate students.

3.2.4.1 Selection of Teachers: The teacher for the study was operationalized as a teacher engaged at Under Graduate or Post Graduate online teaching or both. A sample of 30 teachers from Agricultural College, Bapatla and 30 teachers from S. V. Agricultural College, Tirupati, thus accounting to a total sample of 60 teachers were selected by following simple random sampling procedure (Table 3.1).

3.2.4.2 Selection of Students: For the purpose of this investigation the student is operationalized as a candidate who is currently studying 2^{nd}, 3^{rd}, 4^{th} year of Under Graduate programme i.e., B. Sc (Hons.) Agriculture and Post Graduate programme

i.e., M. Sc. (Ag.) and Ph. D in the selected colleges of the University. A total sample of 240 students comprising of 90 students from Under Graduate programme and 30 students from Post Graduate programme were selected from each college by following simple random sampling procedure (Table 3.1).

Table 3.1. Particulars of selected colleges and respondents

S. No	Name of the Agricultural College	No. of Under Graduate Students selected			No. of Post Graduate students Selected	No. of teachers selected
		2nd	3rd	4th		
1.	Agricultural College, Bapatla	30	30	30	30	30
2.	S V Agricultural College, Tirupati	30	30	30	30	30
	TOTAL	180			60	60

3.3 VARIABLES AND THEIR EMPIRICAL MEASUREMENT

The variables for the study were selected based on the pre survey, extensive review of literature on the subject, consultation with experts and previous studies undertaken in the related subject areas. Only those variables having most relevance to the present investigation were selected for the study. The instruments used to measure the variables together with the detailed procedure followed, has been described in the following pages. The list of variables selected and their empirical measurement are given in Table 3.2.

Table 3.2. Variables and their empirical measurement

S. No.	Variable	Instruments used for the study
Teachers		
1	Age	Chronological age of the respondent in completed years
2	Gender	Male/ Female
3	Educational qualification	M. Sc (Ag.)/ Ph. D / Post Doctorate
4	Designation	Schedule developed for the study
5	Experience in teaching	Schedule developed for the study
6	Previous experience in online teaching	Schedule developed for the study
7	Trainings undergone in online teaching	Schedule developed for the study
8	Video conferencing applications used for online teaching	Schedule developed for the study
9	Possession of electronic devices and internet connectivity for online teaching	Schedule developed for the study
10	Frequency of using electronic devices for online teaching	Schedule developed for the study
11	Number of hours spent per week in preparation for online teaching	Schedule developed for the study
12	Number of hours spent per week in online teaching	Schedule developed for the study
13	Attendance of students in online classes	Schedule developed for the study
14	Type of learning material shared with students	Schedule developed for the study
15	Time of sharing learning material in online classes	Schedule developed for the study
16	Meeting ID used for online classes	Personal ID/ Official ID/ Both
17	Frequency of using audio-visual aids in online teaching	Schedule developed for the study
18	Attitude towards online teaching	Scale developed by Jyothi and Vijayabhinandana (2021b) with slight modification
19	Competencies in online teaching	Schedule developed for the study

Table 3.2. (Cont.)

20	Perceived constraints in online teaching	Schedule developed for the study
21	Satisfaction with online teaching	Schedule developed for the study
Students		
1	Age	Chronological age of the respondent in completed years
2	Gender	Male/Female
3	Background	Schedule developed for the study
4	Secondary school education	Schedule developed for the study
5	Type of family	Schedule developed for the study
6	Parental occupation	Schedule developed for the study
7	Academic performance	Schedule developed for the study
8	Possession of electronic devices and internet connectivity for online learning	Schedule developed for the study
9	Frequency of using electronic devices for online learning	Schedule developed for the study
10	Number of hours spent per week in online learning	Schedule developed for the study
11	Attitude towards online learning	Scale developed by Jyothi and Vijayabhinandana (2021a) with slight modification
12	Competencies in online learning	Schedule developed for the study
13	Perceived constraints in online learning	Schedule developed for the study
14	Satisfaction with online learning	Schedule developed for the study

3.3.1 Variables of teachers' sample

3.3.1.1 Age : Age was operationalized as the chronological age of the respondent in completed years at the time of investigation. Based on the responses the respondents were grouped into three categories namely., young (up to 40 years), middle (41-50 years) and old (above 50 years). Frequency and percentage were calculated.

3.3.1.2 Gender : Gender of the respondent was operationalized as the one's own identification as male or female. Frequency and percentage were calculated.

3.3.1.3 Educational Qualification : Educational qualification in this study was operationalized as the formal education attained by the teacher in terms of the highest degree acquired. Based on the responses the respondents were grouped into three categories namely., M. Sc. (Ag.), Ph. D and Post Doctorate. Frequency and percentage were calculated.

3.3.1.4 Designation : For the purpose of the study, designation was operationalized as the position of the respondent in the hierarchy of organization structure where he/she is working. Based on the responses the respondents were grouped into three categories namely., Assistant Professor, Associate Professor and Professor. Frequency and percentage were calculated.

3.3.1.5 Experience in Teaching : Experience in teaching was operationalized as the total number of years of service put up by the respondent in teaching in the university. Based on the responses the respondents were grouped into three categories using class interval method as 0-12 years, 13-24 years and 25-36 years of experience. Frequency and percentage were calculated.

3.3.1.6 Previous Experience in Online Teaching : Previous experience in online teaching was operationalized as the experience possessed by the respondent if any in online teaching before it was started in the college. This was studied in terms of yes or no. Frequency and percentage were calculated.

3.3.1.7 Training Undergone in Online Teaching : Training undergone in online teaching was operationalized as the duration of training the respondent has undergone in online teaching. Based on the responses, it was categorised into two groups as I week and more than 1 week duration. Frequency and percentage were calculated.

3.3.1.8 Video Conferencing Application(s) Used in Online Teaching : Video conferencing application was operationalized as the software application used for online teaching. Based on the responses the applications included Zoom, Cisco WebEx and Google meet. Frequency and percentage were calculated.

3.3.1.9 Possession of Electronic Devices & Internet Connectivity for Online Teaching : Possession of electronic devices & internet connectivity refer to the electronic devices owned by the respondent and accessible to network connection with sufficient internet data to teach online. Based on the responses the electronic devices included smart phone, tablet, personal computer and laptop. Possession of internet connectivity included availability of good internet connectivity and availability of sufficient internet data. Frequency and percentage were calculated.

3.3.1.10 Frequency of using Electronic Devices for Online Teaching : Frequency of using electronic devices for online teaching was operationally defined as the degree to which the respondent used the electronic device namely., smart phone, tablet, personal computer and laptop for online teaching. Frequency of use was studied in terms of often, rarely and never. Frequency and percentage were calculated

3.3.1.11 Number of Hours Spent per Week in Preparation for Online Teaching : Number of hours spent per week in preparation for online teaching was operationalized as the time spent in preparation of teaching & learning material and scheduling of classes by the teacher. Based on the responses the respondents were grouped into three categories using class interval method as 8-12 hours, 13-16 hours and 17-20 hours. Frequency and percentage were calculated.

3.3.1.12 Number of Hours Spent per Week in Online Teaching : Number of hours spent per week in online teaching was operationalized as the time spent in delivering lecture, discussion with students and conducting tests by the teacher. Based on the responses the respondents were grouped into three categories using class interval method as 8-12 hours, 13-16 hours and 17-20 hours. Frequency and percentage were calculated.

3.3.1.13 Attendance of Students in Online Classes (%) : Attendance of students in online class was operationalized as the percentage of students attending online classes. Based on the responses the respondents were grouped into five categories using class interval method as 50-59 %, 60-69%,70-79%, 80-89% and 90-100%. Frequency and percentage were calculated.

3.3.1.14 Type of Learning Material Shared with Students : Type of learning material was operationalized as the study material provided by the teacher to the student for reading and better understanding of the online class. Based on the responses the learning material was categorises as PPT, word, PPT + word and none. Frequency and percentage were calculated.

3.3.1.15 Time of Sharing the Learning Material in Online Classes : The time of sharing the learning material was operationalized as the time during which the study material was shared with the students. Based on the responses the time of sharing learning material was categorises as before the class, immediately after the class, after sometime of the class and not shared. Frequency and percentage were calculated.

3.3.1.16 Meeting ID used for Online Classes : In this study, meeting ID refers to the identity name used while scheduling online classes in various video conferencing applications such as Official ID, Personal ID and both. Frequency and percentage were calculated.

3.3.1.17 Frequency of using Audio-Visual Aids in Online Classes : Frequency of using audio-visual aids namely., PPT, video clips, live links from google, youtube and audio clips in online classes was studied in terms of regularly, sometimes and never. Frequency and percentage were calculated

3.3.1.18 Attitude towards Online Teaching : Attitude was operationally defined as the opinion of the respondent regarding online teaching. The scale developed by Jyothi and Vijayabhinandana (2021b) with slight modification was used for the study. The scale consisted of twenty statements measured on a 5-point continuum of strongly agree, agree, undecided, disagree, strongly disagree. The scale consisted of both positive and negative statements. The scoring pattern adopted for positive statements was 5 weights to strongly agree, followed by 4 weights to agree, 3 weights to undecided, 2 weights to disagree and 1 weight to strongly disagree. Whereas the scoring pattern was reversed in case of negative statements i.e.,1 weight to strongly agree, followed by 2 weights to agree, 3 weights to undecided, 4 weights to disagree and 5 weights to strongly disagree. By adding the

scores of all statements, the individual total score was worked out. The maximum and minimum scores one could get for attitude were 100 and 20 respectively. The scores so obtained for each respondent was summed up and the respondents were grouped into three categories based on mean and S.D. as shown below.

S. No.	Category	Scores
1	Low	Mean –S. D and below
2	Medium	Mean ± S. D
3	High	Mean + S. D and above

Frequency, percentage and Factor analysis were worked out.

3.3.1.19 Competencies in Online Teaching : Competency was operationalized as the ability of the teacher to make use of different features of a videoconferencing application and handle online class. The schedule consisted of 29 features scored as below.

Category	Range
Yes	2
No	1

The maximum and minimum obtainable score for a respondent was 58 and 29 respectively. Further by using mean and standard deviation as a measure of check, the respondents were classified into three categories as below.

S. No.	Category	Scores
1	Low	Mean –S. D and below
2	Medium	Mean ± S. D
3	High	Mean + S. D and above

Frequency and percentage were worked out.

3.3.1.20 Perceived Constraints in Online Teaching : Constraint was operationalized as the difficulties faced by the respondent in online teaching. The schedule consisted of eight listed constraints. The respondents were asked to rank each of the constraint on 1 to 8 scale based on the intensity of the constraint, 8

indicating least constraint and 1 indicating as major constraint. The constraints were ranked based on Garrett ranking method.

3.3.1.21 Satisfaction : Satisfaction was operationalized as the extent to which the respondent was satisfied with the online teaching. It was studied on a five-point continuum namely., very much satisfied, satisfied, undecided, dis-satisfied and very much dis-satisfied. Frequency and percentage were calculated.

3.3.2 Variables of Students' sample

3.3.2.1 Age : Age was operationalized as the chronological age of the respondent in completed years at the time of investigation. Based on the responses the respondents were grouped into four categories namely., < 20 years, 20-25 years, 25-30 years and >30 years. Frequency and percentage were calculated.

3.3.2.2 Gender : Gender of the respondent was operationalized as the one's own identification as male or female. Frequency and percentage were calculated.

3.3.2.3 Background : Background is operationally defined as the place from where the respondent hails. It was categorised into three categories as rural, semi-urban and urban. Frequency and percentage were calculated.

3.3.2.4 Secondary School Education : Secondary school education was operationally defined as the type of school in which the respondent completed his/her secondary school education *i.e.,* private or government institution. Frequency and percentage were calculated.

3.3.2.5 Type of Family : The family type was operationally defined as number of pairs of couples and their children living together. The respondents were grouped into two categories based on blood relations living together viz., nuclear and joint. For the purpose of the study, nuclear family was operationally defined as a family with a single pair of couple with unmarried children living together. Joint family is a family with more than a pair of couple with married children living together. Frequency and percentage were calculated.

3.3.2.6 Parental Occupation : It was operationalized as an activity in which a respondent's parents were engaged to achieve a standard of living. Based on the responses the parental occupation was categorised into five namely., farming, government employee, business, agricultural labour and others. Frequency and percentage were calculated.

3.3.2.7 Academic Performance : Academic performance is operationally defined as the Grade Point Average (GPA) awarded by the college at the end of previous semester of study for a respondent. Based on the responses GPA was categorised into four groups as 9.1-10.0, 8.1-9.0, 7.1-8.0 and 6.1-7.0. Frequency and percentage were calculated.

3.3.2.8 Possession of Electronic Devices and Internet Connectivity for Online Learning : Possession of electronic devices and internet connectivity refers to the electronic devices owned by the respondent and accessible to internet connection with availability of sufficient data to participate in online learning. Based on the responses the electronic devices included smart phone, tablet, personal computer and laptop. Possession of internet connectivity included availability of good internet connectivity and availability of sufficient internet data. Frequency and percentage were calculated.

3.3.2.9 Frequency of using of Electronic Devices for Online Learning : Extent of use of electronic devices for online learning is operationally defined as the degree to which the respondent uses the electronic device namely., smart phone, tablet, personal computer and laptop for online learning. Frequency of use was studied in terms of often, rarely and never. Frequency and percentage were calculated

3.3.2.10 Number of Hours Spent per Week in Online Learning : Number of hours spent per week in online classes is operationally defined as the average time spent by the respondent in working days of a week for online learning. Based on the responses the respondents were grouped into four categories as 9-18 hours, 19-28 hours, 29-38 hours and 39-48 hours. Frequency and percentage were calculated.

3.3.2.11 Attitude towards Online Learning : Attitude was operationally defined as the opinion of the respondent regarding online learning. The scale developed by Jyothi and Vijayabhinandana (2021a) with slight modifications was used for the study. The attitude scale consisted of twenty statements measured on a 5-point continuum of strongly agree, agree, undecided, disagree, strongly disagree. The scale consisted of both positive and negative statements. The scoring pattern adopted for positive statements was 5 weights to strongly agree, followed by 4 weights to agree, 3 weights to undecided, 2 weights to disagree and 1 weight to strongly disagree. Whereas the scoring pattern was reversed in case of negative statements i.e.,1 weight to strongly agree, followed by 2 weights to agree, 3 weights to undecided, 4 weights to disagree and 5 weights to strongly disagree. By adding the scores of all statements, the individual total score was worked out. The maximum and minimum scores one could get for attitude were 100 and 20 respectively. The scores so obtained for each respondent was summed up and the respondents were grouped into three categories based on mean and S.D. as shown below.

S. No.	**Category**	**Scores**
1	Low	Mean –S. D and below
2	Medium	Mean ± S. D
3	High	Mean + S. D and above

Frequency, percentage, Z test and factor analysis were worked out.

3.3.2.12 Competencies in Online Learning : Competency is operationalized as the ability of the student to make use of different features of a videoconferencing application for effective online learning. The schedule consisted of 15 features scored as below.

Category	**Range**
Yes	2
No	1

The maximum and minimum obtainable score for a respondent was 30 and 15 respectively. Further by using mean and standard deviation as a measure of check, the respondents were classified into three categories as below.

Category	Range
Low	Below mean-SD
Medium	Between mean ± SD
High	Above mean + SD

Frequency, percentage, Z test were worked out.

3.3.2.13 Perceived Constraints in Online Learning: Constraint was operationalized as the difficulties faced by the respondent in online learning. The schedule consisted of nine listed constraints. The respondents were asked to rank each of the constraint on 1 to 9 scale based on the intensity of the constraint, 9 indicating least constraint and 1 indicating as major constraint. The constraints were ranked based on Garrett ranking method.

3.3.2.14 Satisfaction with Online Learning: Satisfaction was operationalized as the extent to which the respondent was satisfied with the online learning. It was studied on a five-point continuum namely., very much satisfied, satisfied, undecided, dis-satisfied and very much dis-satisfied. Frequency and percentage were calculated.

3.4 TOOLS USED FOR DATA COLLECTION

3.4.1 Instruments Used for Data Collection

The study required data on several variables from the respondents. So, an online questionnaire using google form was considered to be most appropriate tool for data collection. Separate questionnaires for both students and teacher respondents were prepared keeping in view the objectives of the study.

3.4.2 Pre-Testing of Interview Schedule

Before giving a final shape to the questionnaire, pre-testing of the questionnaire is necessary on the part of the researcher. It helps to identify the mistakes, ambiguities, unfamiliar words and complex questions included in the questionnaire. The questionnaire was pretested with 40 respondents each in non-sample area. Based on experience gained in pretesting, the questionnaires were suitably modified**.**

3.4.3 Method of Data Collection

The well-structured online questionnaires were prepared according to the objectives of the study. Link to self-administered online questionnaire (Google form) along with covering letter requesting the respondent to participate voluntarily in the survey has been sent to both the teachers and students through Email and WhatsApp. Students were further asked to forward the google form link and covering letter to other contacts also.

3.4.4 Preparation of Report

The data thus collected from the students and teachers through questionnaire were coded, tabulated, classified and analysed using different statistical tests in order to make the findings meaningful. The findings were suitably interpreted and necessary conclusions and inferences were drawn accordingly.

3.5 STATISTICAL TOOLS USED FOR ANALYSIS OF DATA

The collected data were processed and analyzed with the help of appropriate statistical tools according to the relevance of information required and the nature of the scale of data. The data in this study were analyzed using Excel and Statistical Package for Social Sciences (SPSS) Version 20.0. The statistical tools and tests used in this study are described as follows:

1. Arithmetic Mean ($\bar{X}$)

2. Standard Deviation (σ)

3. Frequency (F) and percentage (%)

4. Class Interval Method

5. Factor Analysis

6. Z test

8. Garret Ranking

Arithmetic Mean ($\bar{X}$):

It is defined as the sum of all values of the observations divided by the total number of observations. Symbolically it is represented as $\bar{X}$.

$$\text{Arithmetic Mean } (\bar{X}) = \frac{\Sigma xi}{n} = \frac{x_1 + x_2 + ...x_n}{n}$$

Where, $\bar{X}$ = Arithmetic Mean

xi = Value of ith item of x

i = 1, 2……n

n= Total number of observations.

Standard Deviation (σ)

It is positive square root of the mean of the squared deviations taken from arithmetic mean. It is represented by symbol (σ).

$$\text{SD } (\sigma) = \sqrt{\frac{1}{n}\left[\Sigma x^2 - \frac{(\Sigma x)^2}{n}\right]}$$

Σx^2 = Sum of squares of observations

$(\Sigma x)^2$ = Square of sum of 'x' values

n = number of observations

Frequency and Percentage

Frequency was used to know the distribution pattern of the respondents according to the objectives under study. The frequency of a particular cell was divided by the total number of respondents in that particular category and multiplied by 100 for calculating the percentage. Frequency was represented by 'F' and percentage was represented by '%' in the results of the study.

Category Interval Method

Range method calculated to classify the age of students, family size, parent's education, family income, land holding and perception towards e-leaning into different categories. The formula used was:

$$\text{Category Interval} = \frac{\text{Maximum Score-Minimum Score}}{\text{No. of categories to be formed}}$$

Factor Analysis

It is one of the multivariate analysis which can used to describe variability among observed, correlated variables in terms of a potentially lower number of unobserved variables called factors.

Principal component analysis (PCA) is a widely used method for factor extraction. As it is easy to apply and interpret, especially when study is exploratory in nature and main objective is to summarize most of the original information in minimum number of factors (Hair et al 2007). Most of the variables get associated

more with one particular variable when factor analysis takes place, in order to associate variables to more than one factor, rotation of factors is required which can be orthogonal or oblique rotation method. Orthogonal rotation was used in this study. Out of the many methods available to carry out orthogonal rotation, the study used varimax rotation procedure which maximizes dispersion of loadings within factors and tries to load a smaller number of variables highly onto factor.

The study employed the latent root criterion or Eigen value criterion for determining the number of factors to be extracted, which states that only factors having Eigen value greater than 0 are considered significant. Eigen value represents amount of variation explained by the factor. Hair *et al.* (2007) recommended interpreting only those factor loadings with an absolute value or greater than 0.4.

This study used the criterion or factor loading greater than absolute value of 0.4 for determining the feasibility factor loadings (inclusion of variables with the particular factors) within a particular factor. Factor loadings less than 0.5 were not considered and the same variables were not considered for the study. Various factors extracted were named on the basis of common tone of the variables they include and on the mathematical considerations of magnitude of factor loading. Reliability was also checked and reported as Cronbach's alpha. Nunnally (1967) suggests that a Cronbach alpha value of 0.7 is acceptable, with a slightly lower value might sometimes be acceptable. Bartlett's test of sphericity (which is reported as Chi- square value) and the values have been reported in table of factor analysis diagnostics. For the purpose or the study, the level of significance for Bartlett's test of sphericity has been taken as 0.05 (5%).

Z-test

Z-test is a statistical test used to determine whether two population means are different when the variances are known and the sample size is large. Here, Z test was used to find out significance of difference between attitude of UG students and PG students towards online learning.

$$z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

$\overline{X}_1$ = mean of first sample

$\overline{X}_2$ = mean of second sample

σ_1^2 = Variance of first sample

σ_2^2 = Variance of second sample

n_1 = number of respondents in first sample

n_2 = number of respondents in second sample

Null Hypothesis (H_0): There was no significant difference between the attitude of UG and PG students towards online learning.

Empirical hypothesis (H_1): There was a significant difference between the attitude of UG and PG students towards online learning.

If Z calculated value is significant at 0.01 or 0.05 level of significance. Then null hypothesis is rejected and empirical hypothesis is accepted.

Garret Ranking

This analysis will be used to identify the problems of the respondents. The orders of merit given by the respondents were converted in to rank by using the formula. To find out the most significant factor which influences the respondent, Garrett's ranking technique was used. As per this method, respondents will be asked to assign the rank for all factors and the outcomes of such ranking have been converted into score value with the help of the following formula:

Percent position = 100 (Rij – 0.5)/ Nj

Where,

Rij = Rank given for the i^{th} variable by j^{th} respondents

Nj = Number of variables ranked by j^{th} respondents

Table 3.3. Percent Positions and their corresponding Garret table values

Percent Position	Calculated Value	Garret Value
Teachers		**(Nj=8)**
100(1-0.5)/8	6.25	80
100(2-0.5)/8	18.75	68
100(3-0.5)/8	31.25	60
100(4-0.5)/8	43.75	53
100(5-0.5)/8	56.25	47
100(6-0.5)/8	68.75	41
100(7-0.5)/8	81.25	33
100(8-0.5)/8	93.75	20
Students		**(Nj=9)**
100(1-0.5)/9	5.55	81
100(2-0.5)/9	16.66	69
100(3-0.5)/9	27.77	62
100(4-0.5)/9	38.88	56
100(5-0.5)/9	50	50
100(6-0.5)/9	61.11	44
100(7-0.5)/9	72.22	38
100(8-0.5)/9	83.33	31
100(9-0.5)/9	94.44	19

After calculating percent positions their corresponding Garrett values are taken from the Garrett's ranking table (Appendix- C) for each rank. Then, for each item the total score and mean score have been calculated based on frequency of rank given to each factor and total number of members. Total score is calculated by multiplying the number of members ranking each constraint by their respective table values. Mean score is calculated by dividing the total score by the number of members. Based on highest mean score, the ranks were given for each item.

Chapter – IV

Results and Discussion

Chapter IV

RESULTS AND DISCUSSION

This chapter consists of the results obtained from the data collected from students and teachers and was subjected to statistical analysis as per the objectives of the study. The results and its interpretation have been discussed under the following sub heads.

4.1 Profile of teachers involved in online teaching.

4.2 Attitude of teachers towards online teaching.

4.3 Online teaching competencies of teachers.

4.4 Constraints in online teaching as perceived by the teachers.

4.5 Teacher satisfaction with online teaching.

4.6 Profile of students involved in online teaching.

4.7 Attitude of students towards online teaching.

4.8 Online learning competencies of students.

4.9 Constraints in online learning as perceived by the students.

4.10 Student satisfaction with online teaching.

4.11 Best practices in online teaching and learning

4.1 PROFILE OF TEACHERS INVOLVED IN ONLINE TEACHING

4.1.1 Age

It is evident from Table 4.1. and Figure 4.1. that majority of the teachers were observed in middle (60.00%) age group followed by old (25.00%) and young (15.00%). The results are in conformity with that reported by Bhuasiri *et al*. (2012), Martin and Parker (2014), Gay (2016), Abdullah and Toycan (2018) and Alhumaid *et al.* (2020).

Table 4.1. Distribution of teachers according to their age

(n=60)

S. No.	Age	Total	
		Frequency	Percentage
1.	Young (<40 Years)	9	15.00
2.	Middle (41-50 Years)	36	60.00
3.	Old (>50Years)	15	25.00

Age diversity is always maintained in any organisation hence the sample covered all the age groups. The sample for the study covered more from middle age category as these people are more in the organisation.

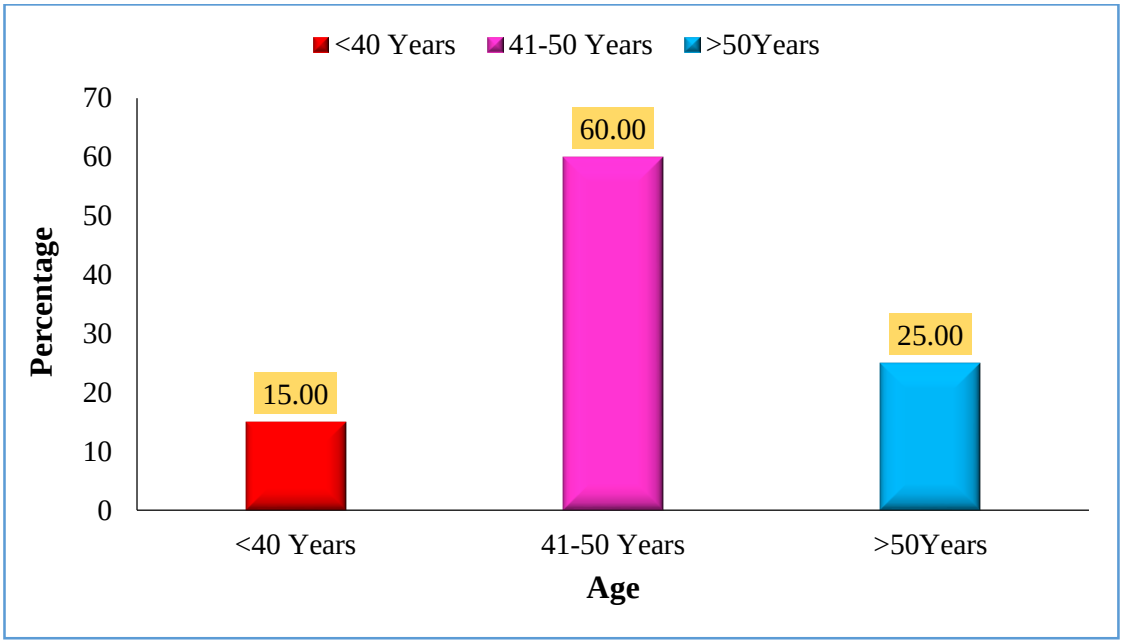

Fig. 4.1. Distribution of teachers according to their age

4.1.2 Gender

It is evident from Table 4.2. and Figure 4.2. that 58.33 per cent of the teachers were male and the remaining were female (41.67%). The results are in conformity with that reported by Akaslan and Law (2011), Azimi (2013), Khan (2016) and Akbarilakeh *et al.* (2019).

Table 4.2. Distribution of teachers according to their gender

(n=60)

S. No.	Gender	Total	
		Frequency	Percentage
1.	Male	35	58.33
2.	Female	25	41.67

Both the genders were sampled for the study. The male respondents were more in the sample as they are more in the organization as well.

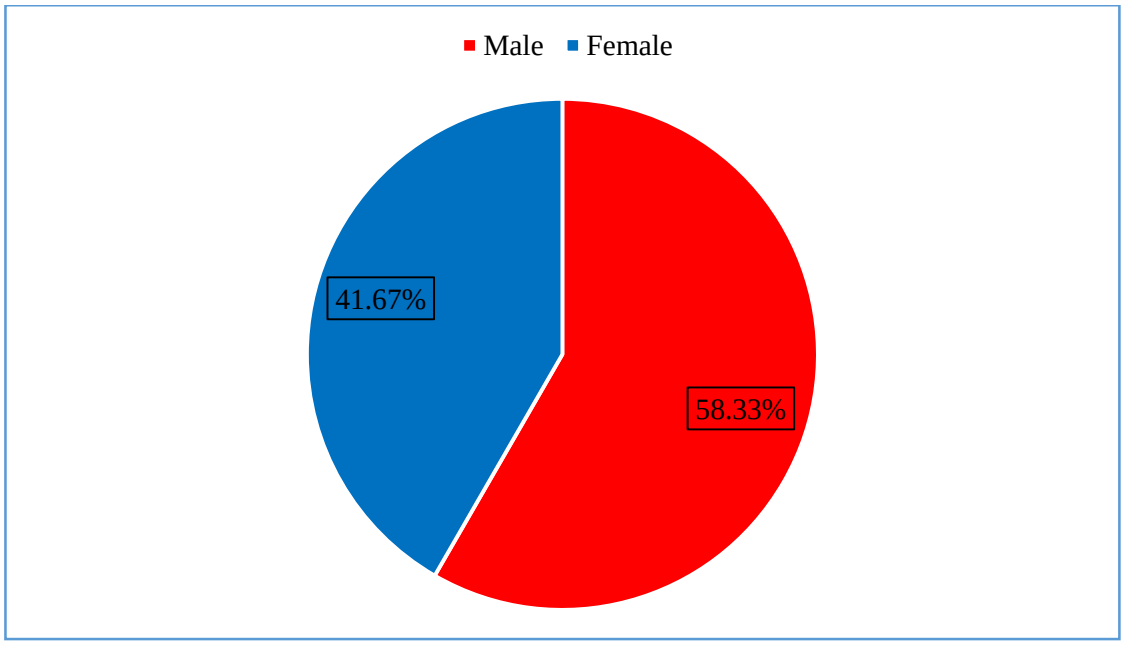

Fig. 4.2. Distribution of teachers according to their gender

4.1.3 Educational Qualification

It is evident from Table 4.3. and Figure 4.3. that greater majority of the teachers completed Ph. D (91.67%) followed by M. Sc (Ag.) (6.67%) and a meagre proportion of them completed Post Doctorate (1.67%). The results are in conformity with that reported by Shah and Sharma (2018), Uppal (2019), Kulal and Nayak (2020) and Gurung (2021).

Table 4.3. Distribution of teachers according to their educational qualification (n=60)

S. No.	Degree	Total	
		Frequency	Percentage
1.	M. Sc. (Ag.)	4	6.66
2.	Ph. D	55	91.67
3.	Post Doctorate	1	1.67

Great majority of the teachers possessed higher educational qualification as it is a prerequisite for the selection in the University and as well for higher promotions and perquisites.

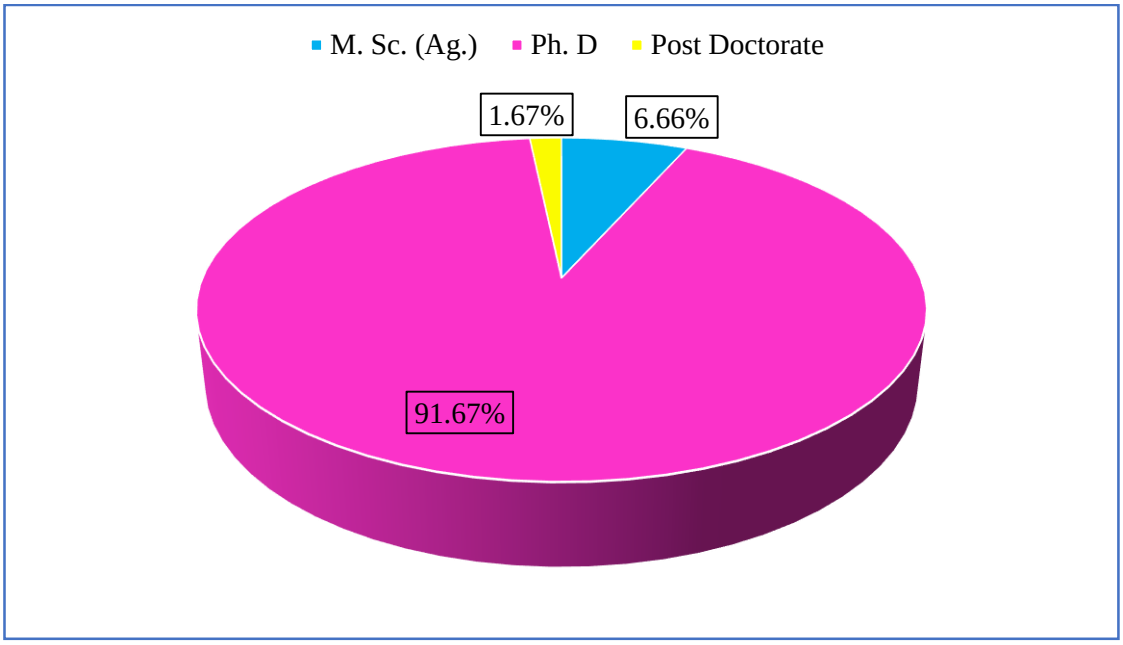

Fig. 4.3. Distribution of teachers according to their educational qualification

4.1.4 Designation

It is evident from Table 4.4. and Figure 4.4. that less than half of the teachers were professors (48.33%) followed by assistant professors (46.67%) and associate professors (5.00%). The results are in conformity with that reported by Lloyd *et al.* (2012), Gomez (2015), Gade and Agarwal (2017), Abdullah and Toycan (2018) and Sofat and Sharma (2021).

Table 4.4. Distribution of teachers according to their designation

(n=60)

S. No	Degree	Total	
		Frequency	Percentage
1.	Assistant Professor	28	46.67
2.	Associate Professor	3	5.00
3.	Professor	29	48.33

The sample covered respondents from different cadres with more being from Professors followed by Assistant Professors and Associate Professors. The results also correspond to the strength of different cadre teachers in the organization.

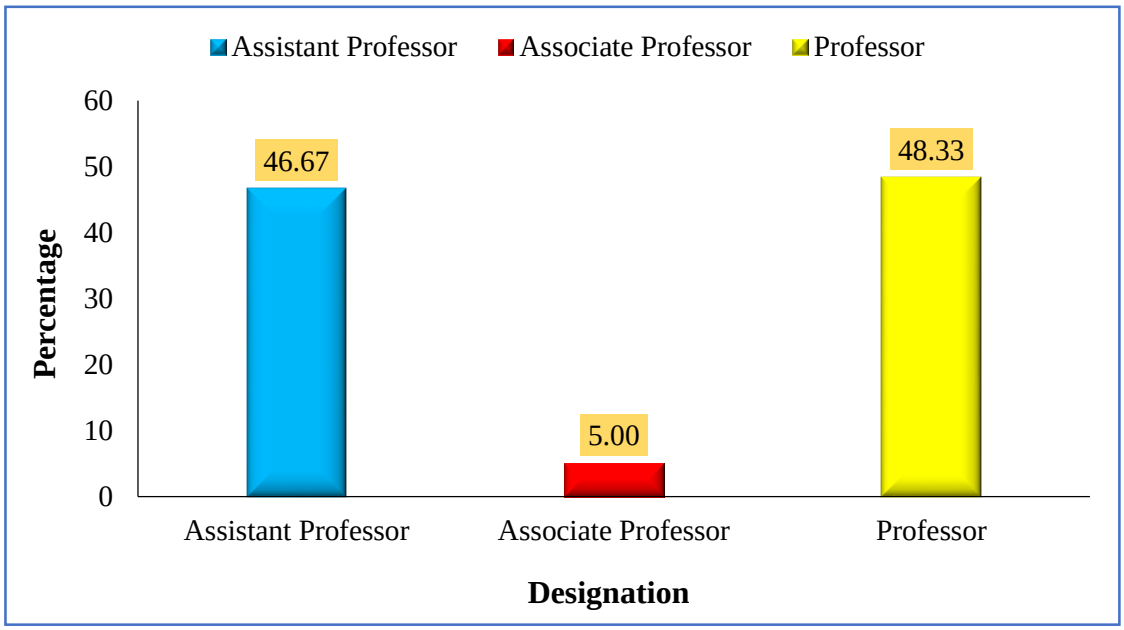

Fig. 4.4. Distribution of teachers according to their designation

4.1.5 Department

It is evident from Table 4.5. and Figure 4.5. that 16.67 per cent of the teachers were observed in agricultural extension, entomology (15.00%), soil science and agricultural chemistry (11.67%), about 10.00 per cent each from agronomy and plant pathology, about 8.33 per cent each from genetics and plant breeding, agricultural economics and crop physiology, statistics and computer applications (6.67%) and horticulture (5.00%).

Table 4.5. Distribution of teachers according to their department

(n=60)

S. No.	Department	Total	
		Frequency	Percentage
1.	Agronomy	6	10.00
2.	Soil Science and Agricultural Chemistry	7	11.67
3.	Entomology	9	15.00
4.	Genetics and Plant breeding	5	8.33
5.	Horticulture	3	5.00
6.	Agricultural Economics	5	8.33
7.	Agricultural Extension	10	16.67
8.	Statistics and Computer Applications	4	6.67
9.	Crop Physiology	5	8.33
10.	Plant Pathology	6	10.00
	Total	60	100

Efforts were made to sample the teachers from all the departments in the organization to get accurate and clear understanding about online teaching.

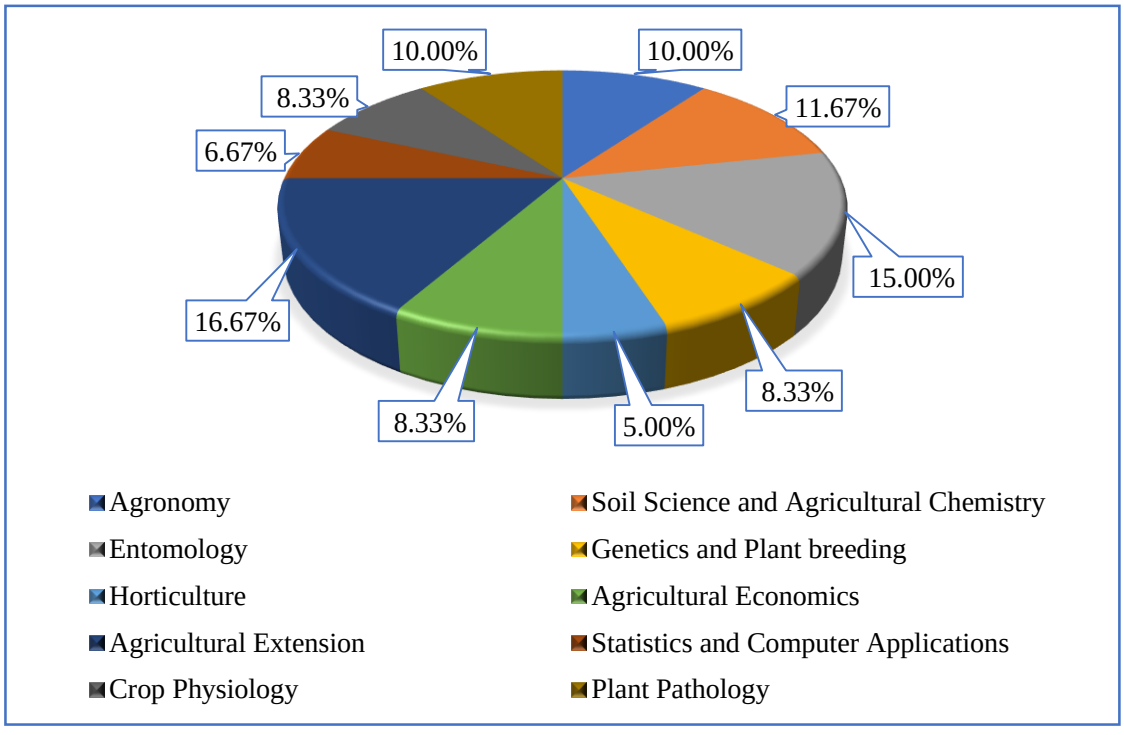

Fig. 4.5. Distribution of teachers according to their department

4.1.6 Experience in Teaching

It is evident from Table 4.6. and Figure 4.6. that less than three-fourth of the teachers experience in teaching was ≥12 years (73.34%), followed by 13-24 years (18.33%) and 25-36 years (8.33%). The results are in conformity with that reported by Ghavifek and Rosdy (2015), Aldowah *et al.* (2017), Benali *et al.* (2018), Uppal (2019) and Kulal and Nayak (2020).

Table 4.6. Distribution of teachers according to their experience in teaching

(n=60)

S. No.	Experience (in completed years)	Total	
		Frequency	Percentage
1.	≥12	44	73.34
2.	13-24	11	18.33
3.	25-36	5	8.33

The teaching experience of the respondents ranged from minimum to maximum possible extent. The study included respondents having difference in the duration of teaching experience.

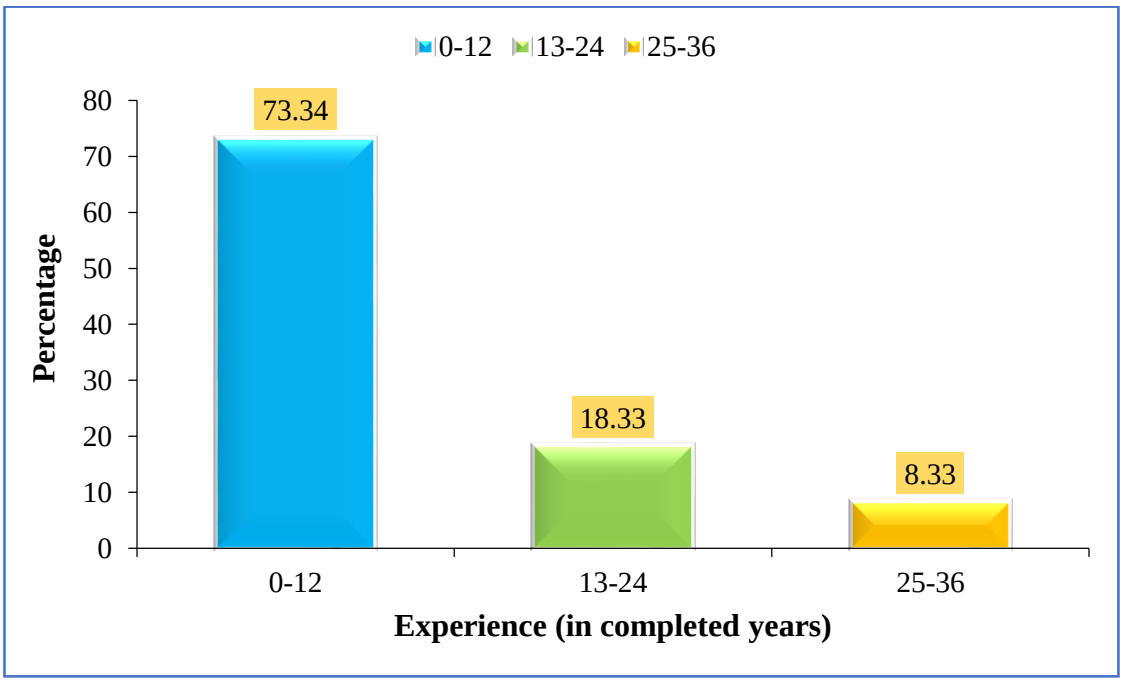

Fig. 4.6. Distribution of teachers according to their experience in teaching

4.1.7 Previous Experience in Online Teaching

It is evident from Table 4.7. and Figure 4.7. that less than one-fourth of the teachers had previous experience in online teaching (18.33%) while the remaining have no previous experience in online teaching (81.67%). The results are in conformity with that reported by Lloyd *et al.* (2012), Becker *et al.* (2013), Gay (2016), Ghaderizefreh and Hoover (2018) and Gurung (2021).

Table 4.7. Distribution of teachers according to their previous experience in online teaching

(n=60)

S. No.	Category	Total	
		Frequency	Percentage
1.	Have previous experience in online teaching	11	18.33
2.	Have no previous experience in online teaching	49	81.67

The major way of teaching is in-presence class room teaching and it was very rare for the teachers to teach in online classes. Prior to covid-19 it was felt safe to travel from place to place to give in-presence direct lectures, hence there was no promotion to online education so a meagre proportion of the respondents had experience in online teaching. Very less proportion of the respondents had experience in teaching through google hangouts, skype, etc.

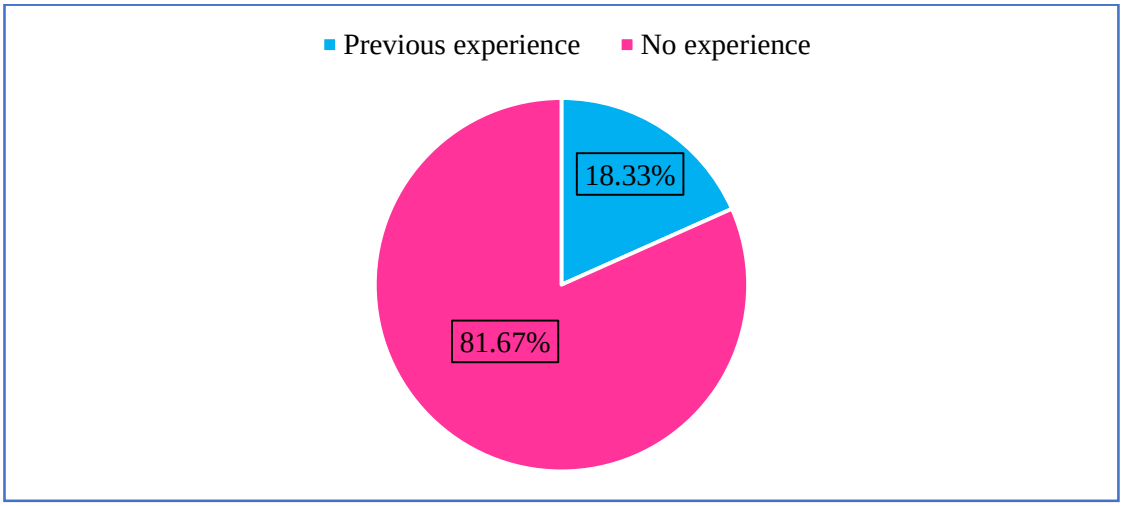

Fig. 4.7. Distribution of teachers according to their previous experience in online teaching

4.1.8 Training Undergone in Online Teaching

It is evident from Table 4.8. and Figure 4.8. that more than three-fourth of the teachers had not undergone training (76.67%). While 16.67 per cent of the teachers had undergone training in online teaching for more than one week and one week (6.67%).

Table 4.8. Distribution of teachers according to training undergone in online teaching

(n=60)

S. No.	Training	Total	
		Frequency	Percentage
1.	1 Week	4	6.66
2.	More than 1 week	10	16.67
3.	No training	46	76.67

Majority of the teachers were not trained in online teaching because it was not necessary earlier and the situation of online education came into force without prior intimation. However, a few teachers under went online training courses in the recent past.

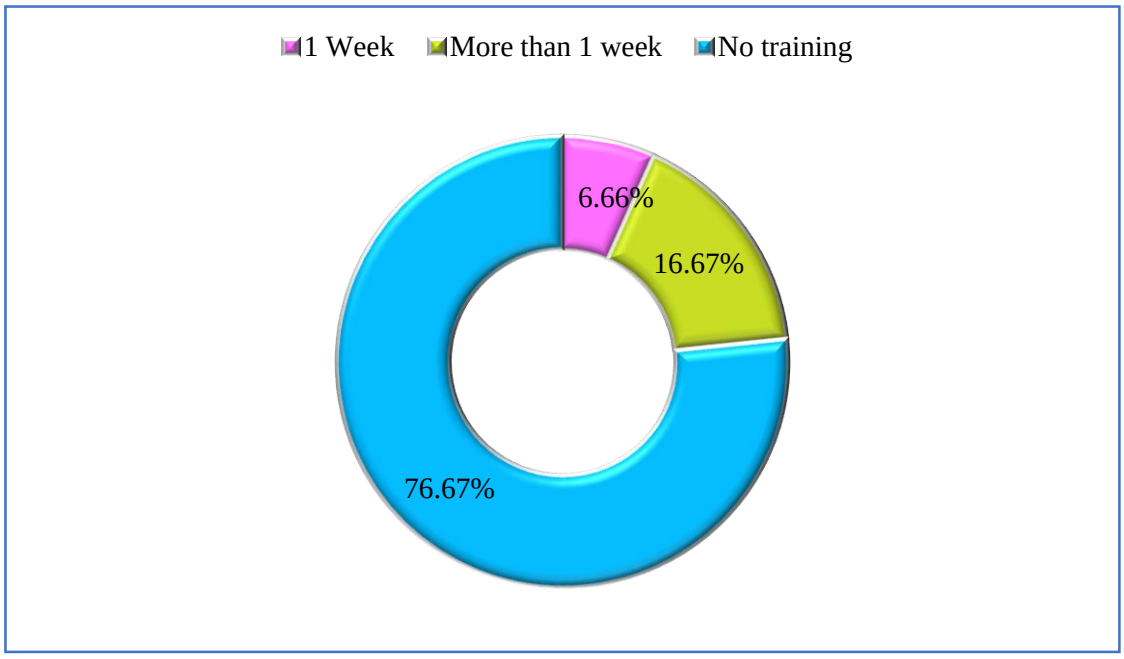

Fig. 4.8. Distribution of teachers according to training undergone in online teaching

4.1.9 Video Conferencing Application(s) Used for Online Teaching

It is evident from Table 4.9. and Figure 4.9. two-third of the teachers used Zoom (66.67%) as video conferencing application in online teaching, followed by both Zoom and cisco WebEx (16.67%), cisco WebEx (10.00%) and google meet (6.67%). The results are in conformity with that reported by Martin and Parker (2014), Hasan and Khan (2020), Gurung (2021) and Rana (2021).

Table 4.9. Distribution of teachers according to video conferencing application(s) used in online teaching

(n=60)

S. No.	Video Conferencing Application(s)	Total	
		Frequency	Percentage
1.	Zoom	40	66.67
2.	Cisco WebEx	6	10.00
3.	Google meet	4	6.66
4.	Zoom + Cisco WebEx	10	16.67

Zoom video conferencing application is used by majority of the teachers as it is user friendly, simple in using, professional looking, easy compatibility with any operating system, it is built for conferencing and seminar applications which is like a classroom.

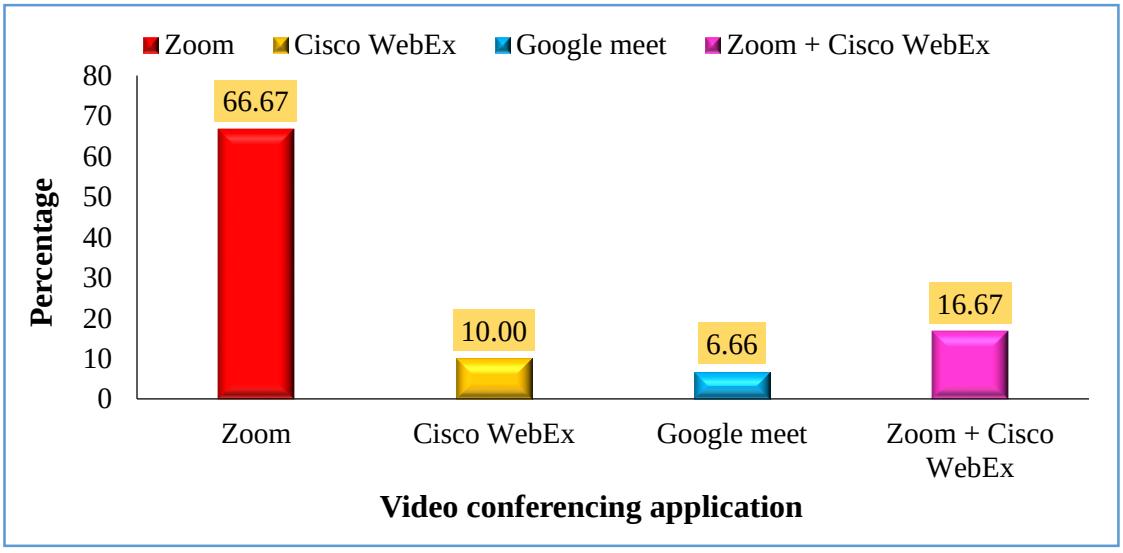

Fig. 4.9. Distribution of teachers according to video conferencing app(s) used in online teaching

4.1.10 Possession of Electronic Devices and Internet Connectivity for Online Teaching

It is evident from Table 4.10. that cent per cent of the teachers possesses smart phone followed by office computer (70.00%), office laptop (65.00%), personal computer (50.00%), personal laptop (33.33%) and none of them possess tablet. Three-fourth of the teachers had access to good internet connectivity (75.00%) and sufficient internet data & speed (63.33%). The results are in conformity with that reported by Akaslan and Law (2011), Azimi (2013) and Benali *et al.* (2018).

Table 4.10. Distribution of teachers according to possession of electronic devices and internet connectivity for online teaching

(n=60)

S. No.	Device	Total	
		Frequency	Percentage
1	PC (Personal)	30	50.00
2	PC (Office)	42	70.00
3	Laptop (Personal)	20	33.33
4	Laptop (Office)	39	65.00
5	Tablet	--	--
6	Smart phone	60	100.00
7.	Good internet connectivity	45	75.00
8.	Sufficient Internet data & Speed	38	63.33
Note: Responses are inclusive			

The respondents possessed a variety of electronic gadgets like computers, laptops, smart phones with internet connectivity and data balance to use them for online teaching. The organisation in which they are working is also providing personal computers, laptops with internet connectivity.

4.1.11 Frequency of Using Electronic Devices for Online Teaching

It is evident from Table 4.11. and Figure 4.10. that more than one fourth of the teachers often (28.33%) used personal computer for online teaching, followed by rarely (25.00%) and never (46.67%). More than one third of the

teachers often (36.67%) used office computer for online teaching, followed by rarely (13.33%) and never (50.00%) for online teaching. More than half of the teachers often used personal laptop (53.33%), followed rarely (20.00%) and never (26.67%) for online teaching. While 35.00 per cent often used office laptop, followed by rarely (15.00%) and never (50.00%) for online teaching. Less than half of the teachers often used smart phone (43.33%), followed by rarely (31.67%) and never (25.00%) for online teaching. None of the teachers used tablet for online teaching. The results are in conformity with that reported by Akaslan and Law (2011), Azimi (2013) and Benali *et al.* (2018).

Table 4.11. Distribution of teachers according to frequency of use of electronic devices for online teaching

(n=60)

S. No	Device	Often		Rarely		Never	
		F	%	F	%	F	%
1	PC (Personal)	17	28.33	15	25.00	28	46.67
2	PC (Office)	22	36.67	8	13.33	30	50.00
3	Laptop (Personal)	32	53.33	12	20.00	16	26.67
4	Laptop (Office)	21	35.00	9	15.00	30	50.00
5	Tablet	--	--	--	--	60	100.00
6	Smart phone	26	43.33	19	31.67	15	25.00

*F=Frequency %= Percentage

The findings revealed that the teachers used computers, laptops, smart phone for teaching online. Often, they have used personal laptops followed by smart phones, office computer and personal computer. The use depends on availability of the electronic devices and comfortability in using it. It also depends on the time at which the class is scheduled and the place from where the class is taken i.e., from office or home.

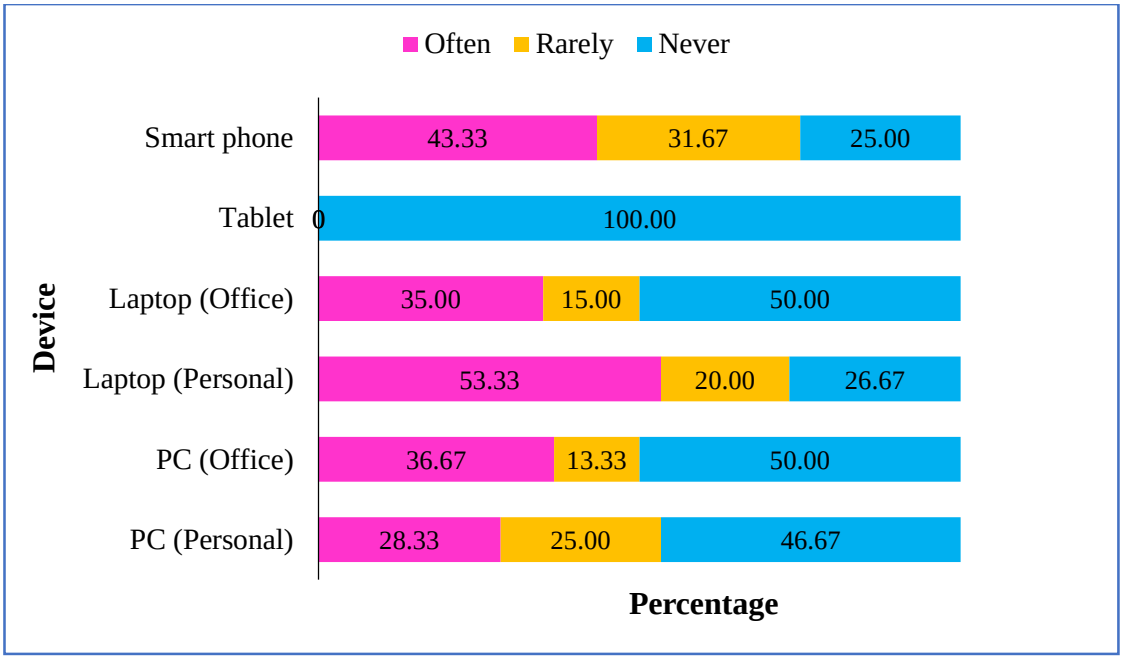

Fig. 4.10. Distribution of teachers according to frequency of use of electronic devices for online teaching

4.1.12 Number of Hours Spent Per Week in Preparation for Online Teaching (Preparation of AV Aids, Creation and Posting of Meeting ID etc)

It is evident from Table 4.12. and Figure 4.11. that less than half of the teachers spent 8-12 hours per week in preparation for online teaching (43.34%), followed by 13-16 hours (38.33%) and 17-20 hours (18.33%) per week. The results are in conformity with that reported by Kenan (2015), Naresh *et al*. (2016) and Baticulon *et al.* (2021).

Table 4.12. Distribution of teachers according to number of hours spent per week in preparation for online teaching

(n=60)

S. No.	Hours	Total	
		Frequency	Percentage
1	8-12	26	43.34
2	13-16	23	38.33
3	17-20	11	18.33

The teachers have spent about 8 to 20 hours per week in preparing for online teaching. Time spent depends on the workload of the teachers in terms of UG and PG classes. During the initial days lot of time was spent for preparing power point presentations and gathering other audio-visual aids for effective online teaching.

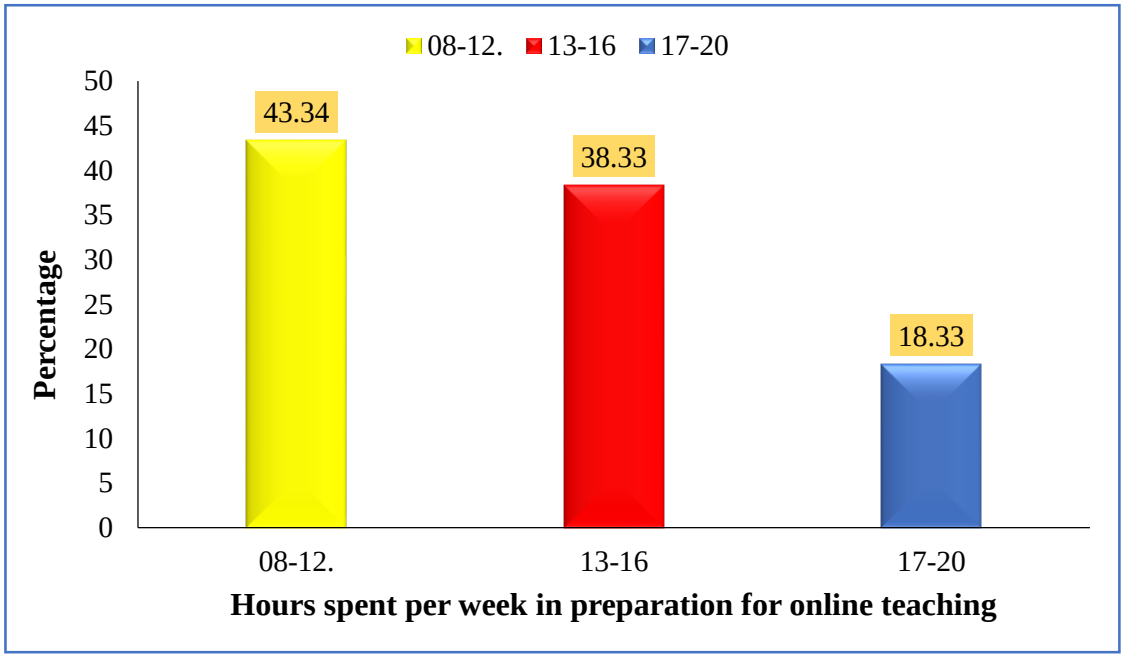

Fig. 4.11. Distribution of teachers according to number of hours spent per week in preparation for online teaching

4.1.13 Number of Hours Spent Per Week in Online Teaching

It is evident from Table 4.13. and Figure 4.12. that less than half of the teachers spent 13-16 hours per week in online teaching (46.67%), followed by 8-12 hours (45.00%) and 17-20 hours (8.33%). The results are in conformity with that reported by Kenan (2015), Naresh *et al*. (2016) and Baticulon *et al.* (2021).

Table 4.13. Distribution of teachers according to number of hours spent per week in online teaching

(n=60)

S. No.	Hours	Total	
		Frequency	Percentage
1	8-12	27	45.00
2	13-16	28	46.67
3	17-20	5	8.33

The teachers have spent about 8 to 20 hours per week in online teaching. Time spent depends on the workload of the teachers in terms of UG and PG classes. Online classes were taken instead of in-presence classes. Moreover, the work load of the teachers as per UGC guidelines range from 8 to 16 hours per week and the findings are in accordance to it.

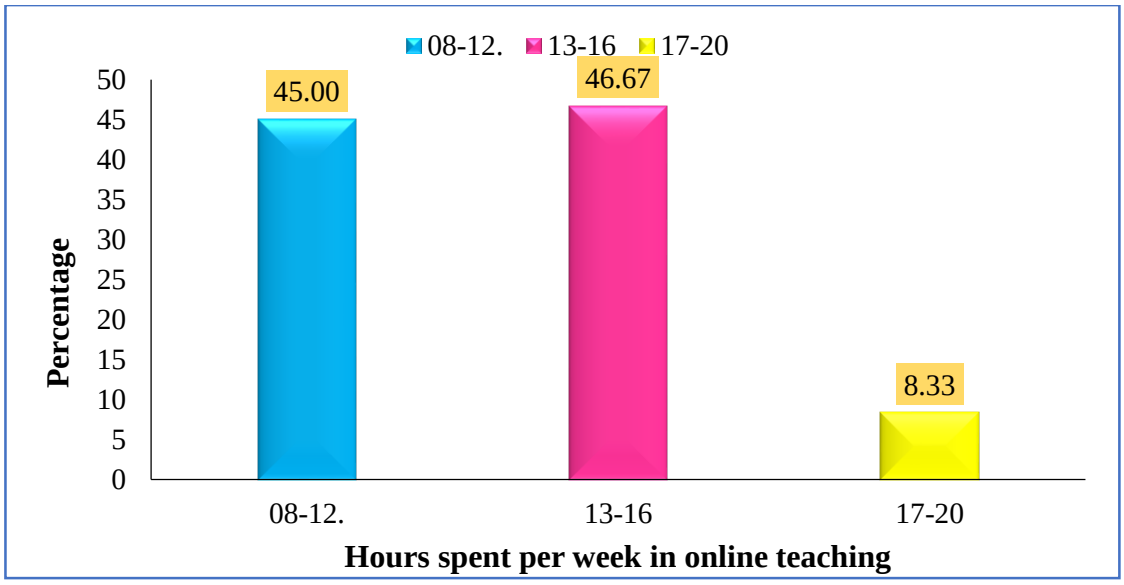

Fig. 4.12. Distribution of teachers according to number of hours spent per week in online teaching

4.1.14 Attendance of Students in Online Classes

It is evident from Table 4.14. and Figure 4.13. that more than one-third of the teachers reported that attendance of students was 80-89% (38.33%), followed by 90-100% (26.67%), 70-79% (16.67%), 60-69% (10.00%) and 50-59% (8.33%).

Table 4.14. Attendance of students in online classes

(n=60)

S. No.	Attendance of students (%)	Total	
		Frequency	Percentage
1	50-59	5	8.33
2	60-69	6	10.00
3	70-79	10	16.67
4	80-89	23	38.33
5	90-100	16	26.67

The attendance of the students in online classes varied. It was mostly dependent on the internet connectivity. As many of the students resided in rural and semi-urban areas connectivity was a problem. However, in majority of the online classes the attendance of the students was more than 70 per cent.

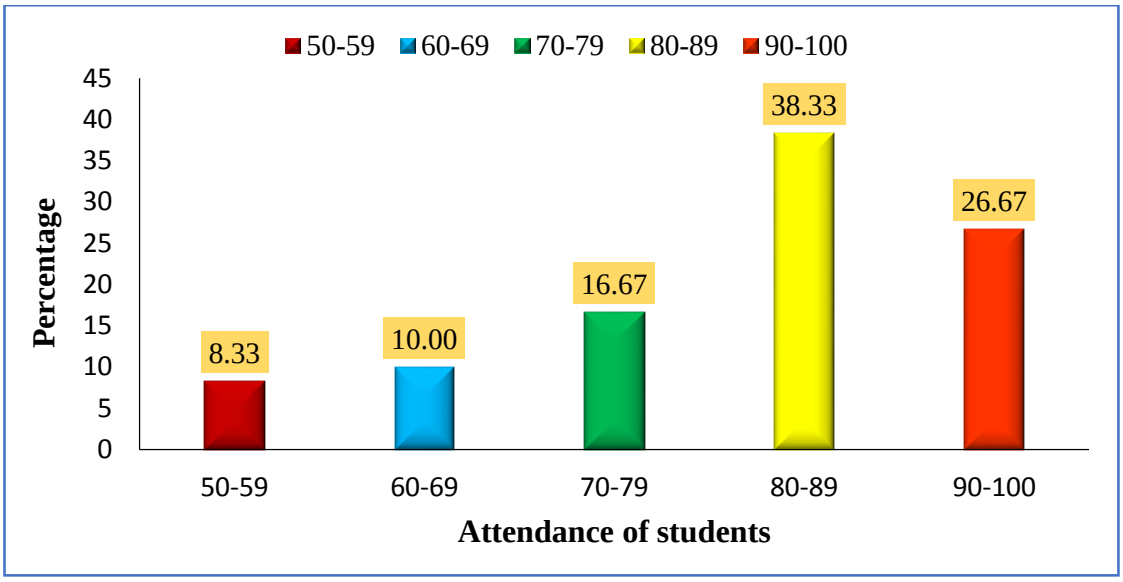

Fig. 4.13. Attendance of students in online classes

4.1.15 Type of Learning Material Shared with Students

It is evident from Table 4.15. and Figure 4.14. that more than half of the teachers shared learning material as PPT and word (55.00%) and remaining shared PPT (45.00%) with students. The results are in conformity with that reported by Sood and Singh (2014), Gade and Agarwal (2017), Amita (2020) and Ahammad (2021).

Table 4.15. Distribution of teachers based on the type of learning material shared

(n=60)

S. No.	Type of Learning Material	Total	
		Frequency	Percentage
1	PPT	27	45.00
2	Word	--	--
3	PPT + Word	33	55.00
4	None	--	--

As most of the teachers spent lot of time in preparing power point presentations and class notes the same was shared to the students in online classes for prior class preparation and further reference.

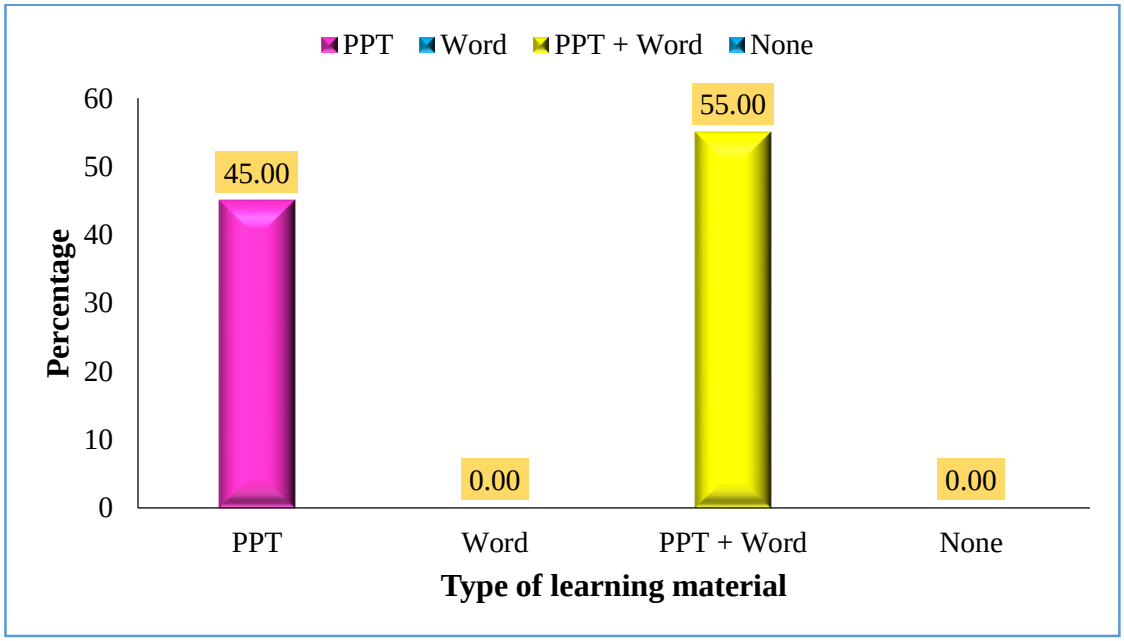

Fig. 4.14. Distribution of teachers based on the type of learning material shared

4.1.16 Time of Sharing the Learning Material in Online Classes

It is evident from Table 4.16. and Figure 4.15. that half of the teachers shared reading material immediately after the class (50.00%) followed by before the class (28.33%), after sometime of the class (18.33%) and a meagre proportion of them shared no teaching material (3.33%).

Table 4.16. Distribution of teachers based on time of sharing the learning material

(n=60)

S. No.	Sharing teaching material	Total	
		Frequency	Percentage
1	Before the class	17	28.34
2	Immediately after the class	30	50.00
3	After sometime of the class	11	18.33
4	None	2	3.33

The findings revealed that great majority of the teachers shared reading material with the students and mostly it was shared immediately after the class for further reference.

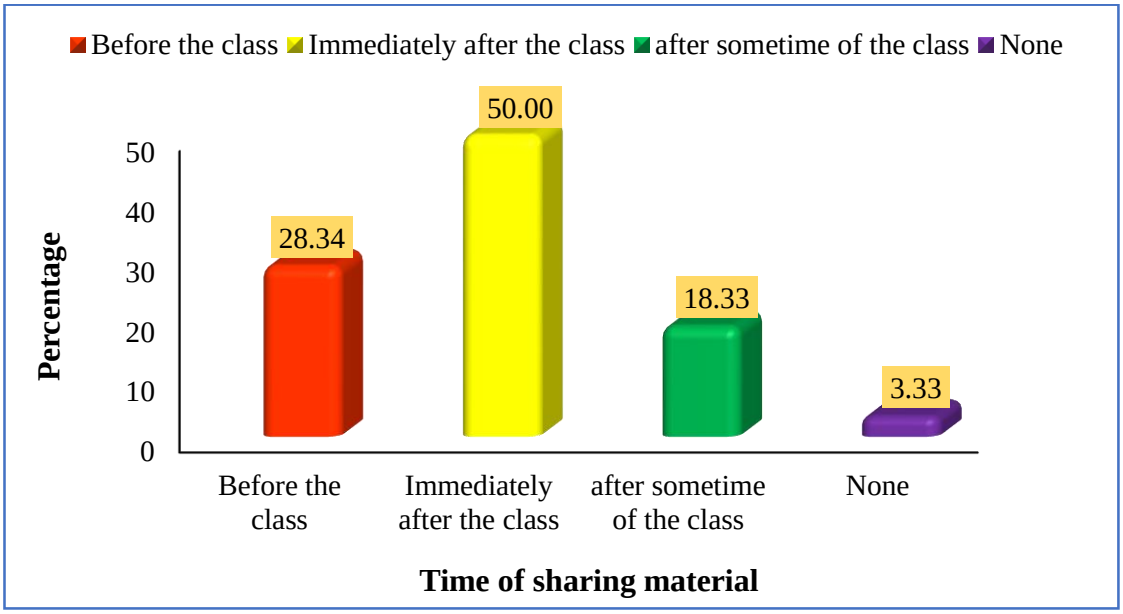

Fig. 4.15. Distribution of teachers based on time of sharing the reading material

4.1.17 Meeting ID Used for Online Classes

It is evident from Table 4.17. and Figure 4.16. that 70.00 per cent of the teachers used official ID for online classes followed by personal ID (15.00%) and both official and personal ID (20.00%).

Table 4.17. Distribution of teachers based on ID used for online classes

(n=60)

S. No.	ID for classes	Total	
		Frequency	Percentage
1	Official ID	42	70.00
2	Personal ID	9	15.00
3.	Both	9	15.00

Official IDs were used for online teaching as it is an official work. Moreover, the official IDs were paid versions with privileges and privacy options.

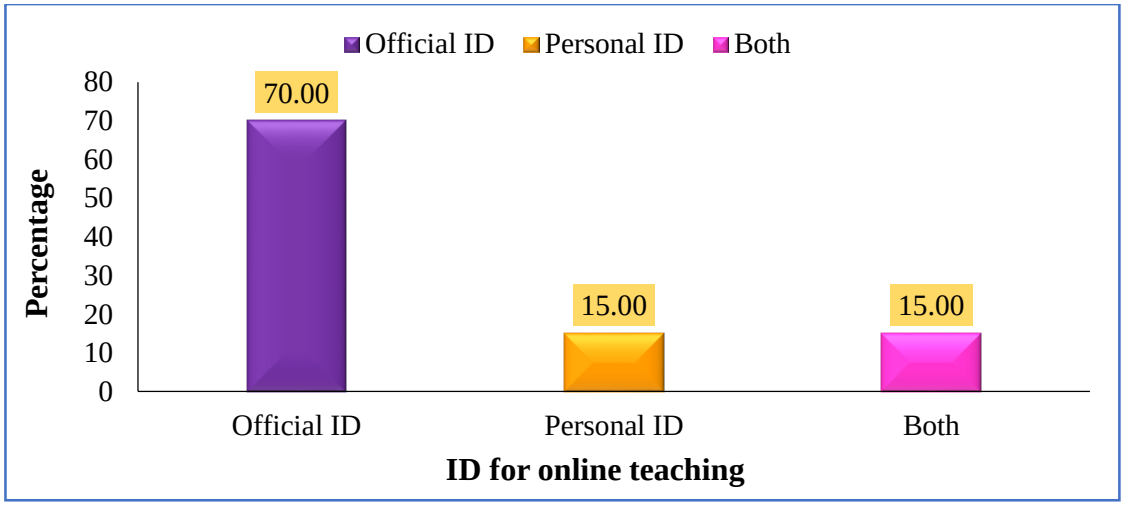

Fig. 4.16. Distribution of teachers based on ID used for online classes

4.1.18 Frequency of Using Audio-Visual Aids in Online Classes by the Teachers

It is evident from Table 4.18. and Figure 4.17. that greater majority of the teachers used PPT regularly for online classes (98.33%) and a meagre proportion of them used sometimes (1.67%). Less than three-fourth of the teachers used video sometimes for online classes (73.33%) followed by regularly (15.00%) and never (11.67%). Only 5.00 per cent of the teachers regularly used audio clips, while 23.33 per cent used sometimes and never (71.67%). Less than one-third of the teachers used you tube sometimes (31.67%), followed by regularly (8.33%) and never (60.00%). Less than one-third of the teachers used live links on browser sometimes for online classes (30.00%) followed by regularly (3.33%) and while 66.67 per cent never used for online classes. The results are in conformity with that reported by Sood and Singh (2014), Gade and Agarwal (2017), Raju *et al.* (2020) and Ahammad (2021).

Table 4.18. Distribution of teachers according to the frequency of using audio-visual aids in online classes (n=60)

S. No.	Audio-visual aid	Regularly		Sometimes		Never	
		F	%	F	%	F	%
1	PPT	59	98.33	1	1.67	--	--
2	Video	9	15.00	44	73.33	7	11.67
3	Audio Clips	3	5.00	14	23.33	43	71.67
4	Youtube	5	8.33	19	31.67	36	60.00
5	Live links on browser	2	3.33	18	30.00	40	66.67

*F=Frequency %= Percentage

The findings revealed that great majority of the teachers used PPTs to make lessons effective and interesting to the students. However, some of the teachers also used videos, audio clips, youtube videos, live links based on necessity.

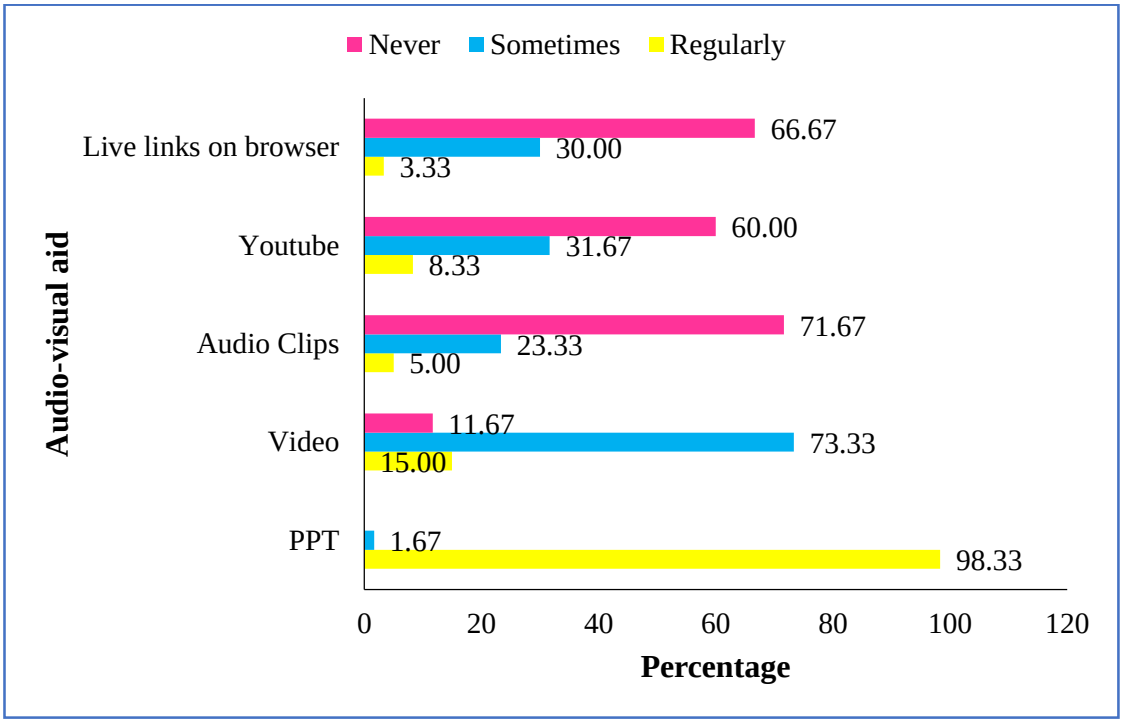

Fig. 4.17. Distribution of teachers according to the frequency of using audio-visual aids in online classes

4.2 ATTITUDE OF TEACHERS TOWARDS ONLINE TEACHING

To study the Attitude of the teachers towards online teaching, 20 statements were tested on five-point Likert scale i.e., Strongly Agree, Agree, Undecided, Disagree and Strongly Disagree. The results were analyzed and presented under the following subheads.

4.2.1 Item analysis of attitude of the teachers towards online teaching

4.2.2 Factor analysis of attitude of the teachers towards online teaching

4.2.1 Item Analysis of Attitude of the Teachers towards Online Teaching

The item wise responses on attitude of the students towards online learning were given in Table 4.19. and discussed below

Table 4.19. Item analysis of attitude of teachers towards online teaching (n=60)

S. No	Statement	Strongly agree		Agree		Undecided		Disagree		Strongly disagree	
		F	%	F	%	F	%	F	%	F	%
1	Teachers can turn anywhere with internet access and electricity into a classroom	17	28.33	27	45.00	4	6.67	7	11.67	5	8.33
2	Online teaching should be supplementary to the traditional teaching	25	41.67	25	41.67	2	3.33	6	10.00	2	3.33
3	I feel I am disconnected with students in online teaching	21	35.00	20	33.33	9	15.00	9	15.00	1	1.67
4	Online teaching includes increased workloads	12	20.00	22	36.67	7	11.67	17	28.33	2	3.33
5	It is difficult to manage time in online classes	6	10.00	19	31.67	3	5.00	28	46.67	4	6.66
6	I am stressed taking classes online	6	10.00	15	25.00	9	15.00	23	38.33	7	11.67
7	Online teaching made me tech savvy	17	28.33	31	51.67	7	11.67	5	8.33	--	--
8	I lack enthusiasm while teaching online	7	11.67	14	23.33	8	13.33	26	43.34	5	8.33
9	Online classes assure schedule flexibility	20	33.34	33	55.00	2	3.33	3	5.00	2	3.33
10	Online teaching needs advanced technical knowledge	22	36.67	24	40.00	3	5.00	11	18.33	--	--
11	Teaching practical component is difficult	42	70.00	16	26.67	--	--	1	1.67	1	1.66
12	Difficult to evaluate the students after class	33	55.00	20	33.33	1	1.67	6	10.00	--	--
13	Attendance is less in class	12	20.00	31	51.67	2	3.33	14	23.33	1	1.67
14	Online teaching requires more preparation time	16	26.67	25	41.67	5	8.33	13	21.67	1	1.66
15	Online teaching is convenient	3	5.00	23	38.33	17	28.33	16	26.67	1	1.67
16	Too many distractions while teaching	11	18.33	33	55.00	4	6.67	10	16.67	2	3.33
17	Student interaction with teacher is reduced	--	--	8	13.33	4	6.67	24	40.00	24	40.00
18	It is difficult to understand whether the students understood the class or not	29	48.33	25	41.67	--	--	6	10.00	--	--
19	It is not possible to maintain eye contact in online teaching	39	65.00	18	30.00	--	--	1	1.67	2	3.33
20	Students do not concentrate in online teaching	25	41.67	22	36.67	6	10.00	5	8.33	2	3.33

*F=Frequency %= Percentage

4.2.1.1 Teachers can Turn Anywhere with Internet Access and Electricity into a Classroom : An overview of Table 4.19. revealed that less than half of the teachers agreed (45.00%) with the statement "Teachers can turn anywhere with internet access and electricity into a classroom" followed by strongly agreed (28.33%), disagreed (11.67%), strongly disagreed (8.33%) and undecided (6.67%).

4.2.1.2 Online Teaching should be Supplementary to the Traditional Teaching: Less than half of the students equally agreed and strongly agreed (41.67%) with the statement "Online teaching should be supplementary to the traditional teaching" followed by disagree (10.00%) and each of undecided and strongly disagreed (3.33%).

4.2.1.3 I feel I am Disconnected with Students in Online Teaching : More than one-third of the students strongly agreed (35.00%) with the statement "I feel I am disconnected with students in online teaching" followed by agreed (33.33%), equal proportion of each undecided and disagreed (15.00%) and strongly disagreed (1.67%).

4.2.1.4 Online Teaching Includes Increased Workloads : More than one-third of the students agreed (36.67%) with the statement "Online teaching includes increased workloads" followed by disagree (28.33%), strongly agreed (20.00%), undecided (11.67%) and strongly disagreed (3.33%).

4.2.1.5 It is Difficult to Manage Time in Online Classes : Less than one-third of the students agreed with the statement "It is difficult to manage time in online classes" followed by strongly agreed (10.00%), strongly disagreed (6.66%) and undecided (5.00%). While 46.67 per cent of the teachers disagreed.

4.2.1.6 I am Stressed Taking Classes Online : One-fourth of the students agreed (25.00%) with the statement "I am stressed taking classes online" followed by undecided (15.00%), strongly disagreed (11.67%) and strongly agreed (10.00%) whereas 38.33 per cent of the teachers disagreed.

4.2.1.7 Online Teaching made me Tech Savvy : More than half of the teachers agreed (51.67%) with the statement "Online teaching made me tech savvy" followed by strongly agreed (28.33%), undecided (11.67%), disagreed (8.33%) and none of them strongly disagreed (0.00%).

4.2.1.8 I Lack Enthusiasm while Teaching Online : Less than one-fourth of the teachers agreed (23.33%) with the statement "I lack enthusiasm while teaching online" followed by undecided (13.33%), strongly agreed (11.67%) and strongly disagreed (8.33%). While 43.34 per cent of the teachers disagreed.

4.2.1.9 Online Classes Assure Schedule Flexibility : More than half of the teachers agreed (55.00%) with the statement "Online classes assure schedule flexibility" followed by strongly agreed (33.34%), disagreed (5.00%) and equal proportion of them undecided and strongly disagreed (3.33%).

4.2.1.10 Online Teaching Needs Advanced Technical Knowledge : More than one-third per cent of the students agreed (40.00%) with the statement "Online teaching needs advanced technical knowledge" followed by strongly agreed (36.67%), disagreed (18.33%), undecided (5.00%) while none of them strongly disagreed (0.00%).

4.2.1.11 Teaching Practical Component is Difficult : Less than three-fourth of the students strongly agreed (70.00%) with the statement "Teaching practical component is difficult" followed by agreed (26.67%), disagree (1.67%), strongly agreed (1.66%) and none of them undecided (0.00%).

4.2.1.12 Difficult to Evaluate the Students After Class : More than half of the teachers were strongly agreed (55.00%) with the statement "Difficult to evaluate the students after class" followed by agreed (33.33%), disagreed (10.00%), undecided (1.67%) and none of them strongly disagreed (0.00%).

4.2.1.13 Attendance is Less in Class : More than half of the teachers agreed (51.67%) with the statement "Attendance is less in class" followed by disagreed (23.33%), strongly agreed (20.00%), undecided (3.33%) and strongly disagreed (1.67%).

4.2.1.14 Online Teaching Requires More Preparation Time : Less than half of the teachers agreed (41.67%) with the statement "Online teaching requires more preparation time" followed by strongly agreed (26.67%), disagreed (21.67%), undecided (8.33%) and strongly disagreed (1.66%).

4.2.1.15 Online Teaching is Convenient : More than one-third of the teachers agreed (38.33%) with the statement "Online teaching is convenient" followed by undecided (28.33%), disagreed (26.67%), strongly agreed (5.00%) and meagre proportion of them strongly disagreed (1.67%).

4.2.1.16 Too Many Distractions while Teaching : More than half of the teachers agreed (55.00%) with the statement "Too many distractions while teaching" followed by strongly agreed (18.33%), disagreed (16.67%), undecided (6.67%) and strongly disagreed (3.33%).

4.2.1.17 Student Interaction with Teachers is Reduced : Less per cent of the teachers agreed (13.33%) with the statement "Student interaction with teachers is reduced" while equal proportion of 40.00 per cent each strongly disagreed and disagreed, undecided (6.67%) and none of them strongly agreed

4.2.1.18 It is Difficult to Understand Whether the Students Understood the Class or Not : Less than half of the teachers strongly agreed (48.33%) with the statement "It is difficult to understand whether the students understood the class or not" followed by agreed (41.67%), disagreed (10.00%) and none of them undecided and strongly disagreed (0.00%).

4.2.1.19 It is Not Possible to Maintain Eye Contact in Online Teaching : Less than two-third of the teachers strongly agreed (65.00%) with the statement "It is not possible to maintain eye contact in online teaching" followed by agreed (30.00%), strongly disagreed (3.33%), disagreed (1.67%) and none of them undecided (0.00%).

4.2.1.20 Students Do Not Concentrate in Online Teaching : Less than half of the teachers strongly agreed (41.67%) with the statement "Students do not concentrate in online teaching" followed by agreed (36.67%), undecided (10.00%), disagreed (8.33%) and strongly disagreed (3.33%).

Based on mean and SD, attitude of the teachers was categorised into three categories namely low, medium and high. The results are presented in Table 4.20. and Figure 4.18.

Table 4.20. Distribution of teachers according to their attitude towards online teaching

(n=60)

S. No	Category	Total	
		Frequency	Percentage
1.	Low	8	13.33
2.	Medium	39	65.00
3.	High	13	21.67
	Total	60	100.00
		Mean=54.15 SD=7.83	

An overview of Table 4.20. and Figure 4.18. indicated that less than two-third of the teachers had medium favourable attitude (65.00%), followed by high (21.67%) and low (13.33%) favourable attitude in online teaching. The results are in conformity with that reported by Bamigboye *et al.* (2013), Kisanga (2016), Kumar (2017), Akbarilakeh *et al.* (2019) and Vinayagam and Akhila (2020).

The findings revealed that majority of the teachers had medium to high favourable attitude towards online teaching which is a positive sign. Positive attitude is a pre-requisite to promote any new technology. Online teaching could be promoted by correcting the negative attitudes by making necessary efforts by the university to make online teaching more interesting and effective for students.

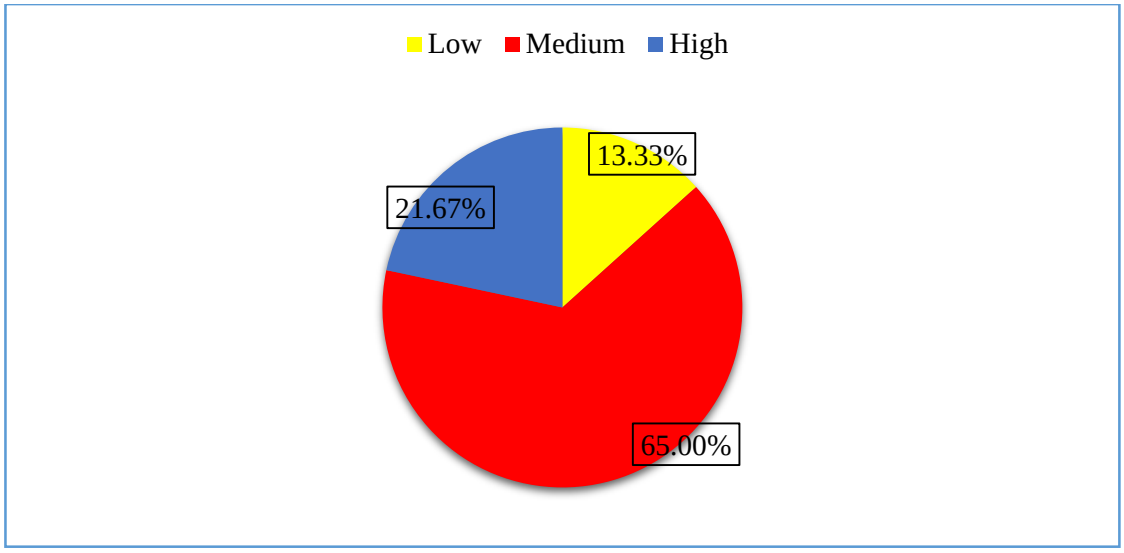

Fig. 4.18. Distribution of teachers according to their attitude towards online teaching

4.2.2 Factor Analysis of Attitude of the Teachers towards Online Teaching

Factor Analysis is a commonly used data/ variable reduction technique. To identify the key factors that affect the attitude of the students towards online learning, factor analysis needs to be performed. Measure of reliability (Cronbach's alpha) often used as a preliminary step before factor analysis.

A reliability test was conducted, which resulted in a Cronbach's Alpha of 0.671 as shown in Table 4.21. which is acceptable, a value of alpha greater than 0.7 or nearly 0.7 is acceptable. Therefore, factor analysis is appropriate.

Table 4.21. Reliability Statistics

Cronbach's Alpha	Number of Items
.671	20

Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity were used to determine the appropriateness of data for factor analysis. As per Table 4.22. the result of KMO measure of sampling adequacy is 0.568, higher than 0.5 which shows that data collected is appropriate to conduct factor analysis. Moreover, chi-square value of Bartlett's test of sphericity is also 541.945, very high and is significant at 5 % level of significance. Therefore, null hypothesis of factor test that variables are not correlated in the population gets rejected.

Table 4.22. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.568
Bartlett's Test of Sphericity	Approx. Chi-Square	541.945
	df	190
	Sig.	.000

Table 4.23 depicts that Principal component analysis method with varimax rotation was applied to extract the factors regarding attitude of teachers towards online teaching. The attitude of teachers can be represented by six factors (eigenvalues $\geq$1.0) and the cumulative variance explained by the extracted factors was 69.17% variance which is near 70 % expected value. Each factor is constituted of all those variables that had factor loadings greater than 0.4. These factors had been named appropriately on the basis or constituent variables. The extracted factors names along with the constituent variables, their factor loadings, the variance and the eigen values had been summarized in Table 4.23.

Table 4.23. Factors summary for attitude towards online teaching

Items for attitude towards online teaching	Component				
	Label	Factor Loadings	Factor name	Variance explained (%)	Eigen value
20. Students does not concentrate in online teaching	X_{20}	.837	Behaviour of the students	21.29	4.26
17. Student interaction with teacher is increased	X_{17}	.787			
18. It is difficult to understand whether the students understood the class or not	X_{18}	.758			
19. It is not possible to maintain eye contact in online teaching	X_{19}	.703			
16. Too many distractions while teaching online	X_{16}	.566			
13. Attendance is less in class	X_{13}	.519			
6. I am stressed taking classes online	X_6	.772	work management	16.67	3.33
8. I lack enthusiasm while teaching online	X_8	.697			
3. I feel I am disconnected with students in online teaching	X_3	.637			
4. Online teaching includes increased workloads	X_4	.584			
5. It is difficult to manage time in online classes	X_5	.558			
11. Teaching practical component is difficult	X_{11}	.844	Practical aspect	10.38	2.07
12. Difficult to evaluate the students after class	X_{12}	.720			
10. Online teaching needs advanced technical knowledge	X_{10}	-.769	Technical knowledge	9.41	1.88
14. Online teaching requires more preparation time	X_{14}	.765			
15. Online teaching is convenient	X_{15}	.810	perceived ease and usefulness	6.28	1.26
2. Online teaching should be supplementary to the traditional teaching	X_2	.613			
7. Online teaching made me tech savvy	X_7	.536			
1. Teachers can turn anywhere with internet access and electricity into a classroom	X_1	.711	flexibility	5.14	1.02
9. Online classes assures schedule flexibility	X_9	.588			

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 11 iterations.

From Table 4.23. revealed that the first and the foremost factor consisted of 6 variables (X_{13}, X_{16} X_{17} X_{18}, X_{19} and X_{20}). This particular factor explained 21.29% variance with eigen value 4.26 and thus forms an important factor in studying the attitude construct, and the factor had been named as 'behaviour of the students'. The factor loading ranges from 0.519 to 0.837. This factor mainly represents the concentration, distraction, attendance of the students.

In importance, second factor consisted of 5 variables (X_3, X_4, X_5, X_6 and X_8). This particular factor explained variance of 16.67% with eigen value 3.33 and thus forms an important factor in studying the attitude construct, and the factor had been named as 'work management'. The factor loading ranges from 0.558 to 0.772. This factor mainly represents the stress management, workload, time management.

The third factor consisted of 2 variables (X_{11} and X_{12}). This particular factor explained variance of 10.38% with eigen value 2.07 and thus forms an important factor in studying the attitude construct, and the factor had been named as 'practical aspect'. The factor loading of the variables were 0.720 and 0.844. This factor mainly represents the practical subject, evaluation of students.

The fourth factor consisted of 2 variables (X_{10} and X_{14}). This particular factor explained variance of 9.41% with eigen value 1.88 and thus forms an important factor in studying the attitude construct, and the factor had been named as 'technical knowledge'. The factor loading of the variables were 0.765 and 0.769. This factor mainly represents the skills and knowledge for online teaching.

The fifth factor consisted of 3 variables (X_2, X_7 and X_{15}). This particular factor explained variance of 6.28% with eigen value 1.26 and thus forms an important factor in studying the attitude construct, and the factor had been named as 'perceived ease and usefulness'. The factor loading ranges from 0.536 to 0.810. This factor mainly represents the convenient, tech savvy and supplementary to traditional teaching.

The sixth factor consisted of 2 variables (X_1 and X_9). This particular factor explained variance of 5.14% with eigen value 1.02 and thus forms an important factor in studying the attitude construct, and the factor had been named as 'flexibility'. The factor loading of the variables were 0.588 and 0.711. This factor mainly represents the schedule flexibility and internet usage in online classes.

4.3 ONLINE TEACHING COMPETENCIES OF TEACHERS

The item wise responses on competency of the teachers in online teaching were given in Table 4.24 and discussed below.

Table 4.24. Item analysis of competency of the teachers in online teaching

(n=60)

S. No.	Competency	TOTAL	
		F	%
1.	I use fresh meeting ID and Passcode for each class	42	70.00
2.	I take the help of students for scheduling the class	21	35.00
3.	I use mute all option	39	65.00
4.	In online classes I prefer to mute my video	23	38.33
5.	Did you organize any class presentations/term paper presentations online	49	81.67
6.	Do you record your online classes	25	41.67
7.	I post the link of recorded presentation in WhatsApp group	18	30.00
8.	I post my recorded class in You tube	2	3.33
9.	I use google forms for attendance	17	28.33
10.	I conducted class tests online using google forms	24	40.00
11.	I have a separate WhatsApp / Instagram student's group for my subject	46	76.67
12.	I conducted discussions in WhatsApp/ Instagram student's group after every class	37	61.67
13.	I often check the number of participants in class	56	93.33
14.	I can add co-hosts	37	61.67
15.	I lock the meeting	10	16.67
16.	I can share on screen		
	Power point presentation	60	100.00
	Video	30	50.00
	Word document	27	45.00
	Live links from google	17	28.33
17.	I use following features in online teaching		
	White board	29	48.33
	Chat box	42	70.00
	Breakout Room	3	5.00
	Polling	7	11.67
18.	In my class I encourage students to use non-verbal communications like		
	Thumbs Up/Thumbs Down	23	38.33
	Raise hand	51	85.00
	Claps	7	11.67
	Laughing	2	3.33
	Shocking	1	1.67
	Celebrations	3	5.00

*F=Frequency %= Percentage

It is evident from Table 4.24. revealed that 70.00 per cent of the teachers use fresh meeting ID and password for each class. More than one-third of the teachers take the help of students for scheduling the class (35.00%). Less than two-third of the teachers can use mute all option (65.00%). While 38.00 per cent of the teachers prefer to mute video. Majority of the teachers organized class presentations/term paper presentations online (81.67%). Less than half of the teachers can record their online classes (41.67%). While less than one-third of the teachers post the recorded presentation in WhatsApp group (30.00%) and only 3.33 per cent of the teachers post recorded class in you tube. More than one-fourth of the teachers used google forms for attendance (28.33%). While 40.00 per cent of the teachers conducted class tests online using google forms.

More than three-fourth of the teachers created separate WhatsApp students' group for their subject (76.67%). While 61.67 per cent of the teachers conducted discussion in WhatsApp students' group after every class. Greater proportion (93.33%) of the teachers often check the number of participants in class. Less than two-third per cent of the teachers can add co-hosts (61.67%) and only 16.67 per cent of the teachers can lock the meeting. Cent per cent of the teachers share power point presentation on screen, followed by video (50.00%), word document (45.00%) and live links from google (28.33%) on screen. Less than three-fourth of the teachers used chat box (70.00%) in online teaching with students in online classes, followed by whiteboard (48.33%), polling (11.67%) and breakout room (5.00%) used in online teaching. Majority of the teachers encourage the students to use raise hand (85.00%) symbol as a non-verbal communication followed by thumps up (38.33%), claps (11.67%), celebration (5.00%), laughing (3.33%) and shocking (1.67%) symbol used as a non-verbal communication.

Based on mean and SD, the competency of the teachers was classified into three categories namely low, medium and high. The results are presented in Table 4.25. and Figure 4.19.

An overview of Table 4.25. and Figure 4.19. revealed that less than two-third of the teachers perceived as medium (61.67%) competent, followed by low (20.00%) and high (18.33%) competent in online teaching. The results are in conformity with that reported by Ghavifek and Rosdy (2015), Gade and Agarwal (2017), Gupta and Singh (2018), Albrahim (2020) and Baticulon *et al*. (2021).

Table 4.25. Distribution of teachers according to their competencies in online teaching

(n=60)

S. No.	Category	Total	
		Frequency	Percentage
1.	Low	12	20.00
2.	Medium	37	61.67
3.	High	11	18.33
	Total	60	100.00
		Mean=54.15 SD=7.83	

A measure of competencies indicate need for training and development, facilitation of organisational change and building desired culture. As many of the teachers fall in the categories of low and medium competency levels they need to be trained in online teaching. As per the requirement for online teaching equipment need to be strengthened in the university.

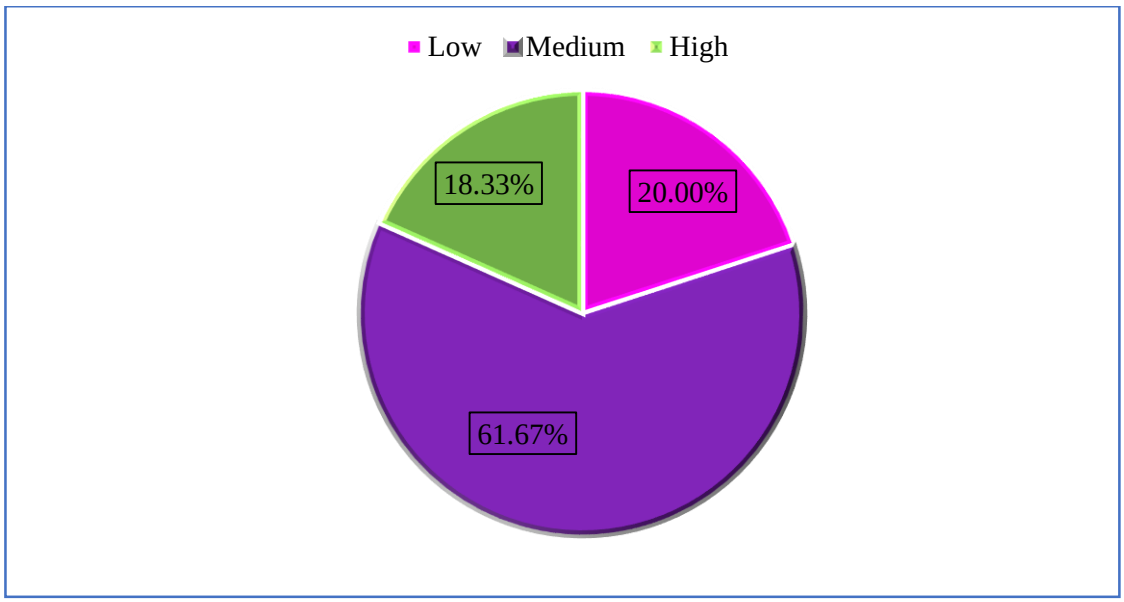

Fig. 4.19. Distribution of teachers according to their competencies in online teaching

4.4 CONSTRAINTS IN ONLINE TEACHING AS PERCEIVED BY THE TEACHERS

The constraints reported by teachers as presented in Table 4.26. and Figure 4.20. that problem with application (Rank I), followed by lack of expertise and skills (Rank II), internet connectivity issues (Rank III), lack of infrastructure facilities in department (webcam, laptop, headphones, etc) (Rank IV), lack of student's response (Rank V), increased workload (Rank VI), heath issues (eyes strain, body pains, etc) (Rank VII) and students' login all through the class (Rank VIII). The results are in conformity with that reported by Al-Dosari (2011), Amita (2020) and Muthuprasad *et al.* (2021).

The constraints indicate the strong need for hands on training for teachers to update and strengthen the competencies of teachers in handling video conferencing applications. Teachers should be supported with necessary infrastructure facilities along with uninterrupted internet connectivity. Students' login all through the class may be corrected if the class is locked after 5-10 minutes of beginning of the class or waiting room option may be removed.

Table 4.26. Distribution of teachers based on ranking of constraints using garret mean score (n=60)

S. No.	Constraint	I	II	III	IV	V	VI	VII	VIII	TGV	GMS	Rank
1.	Students' login all through the class	320	272	480	265	329	246	231	380	2523	42.05	VIII
2.	Lack of infrastructure facilities in department (Webcam, laptop, headphones, etc)	720	408	480	424	329	451	99	160	3071	51.18	IV
3.	Lack of expertise and skills	720	816	600	530	235	246	132	80	3359	55.98	II
4.	Internet connectivity issues	1200	476	360	424	376	164	231	100	3331	55.52	III
5.	Increased workload	560	544	360	318	282	205	429	180	2878	47.97	VI
6.	Lack of student's response	240	340	660	477	423	533	231	60	2964	49.40	V
7.	Problem with application	720	816	540	583	423	205	132	20	3439	57.32	I
8.	Heath issues (eyes strain, body pains, etc)	320	408	120	159	423	410	495	220	2555	42.58	VII

*TGV=Total Garret Score GMS=Garret Mean Score

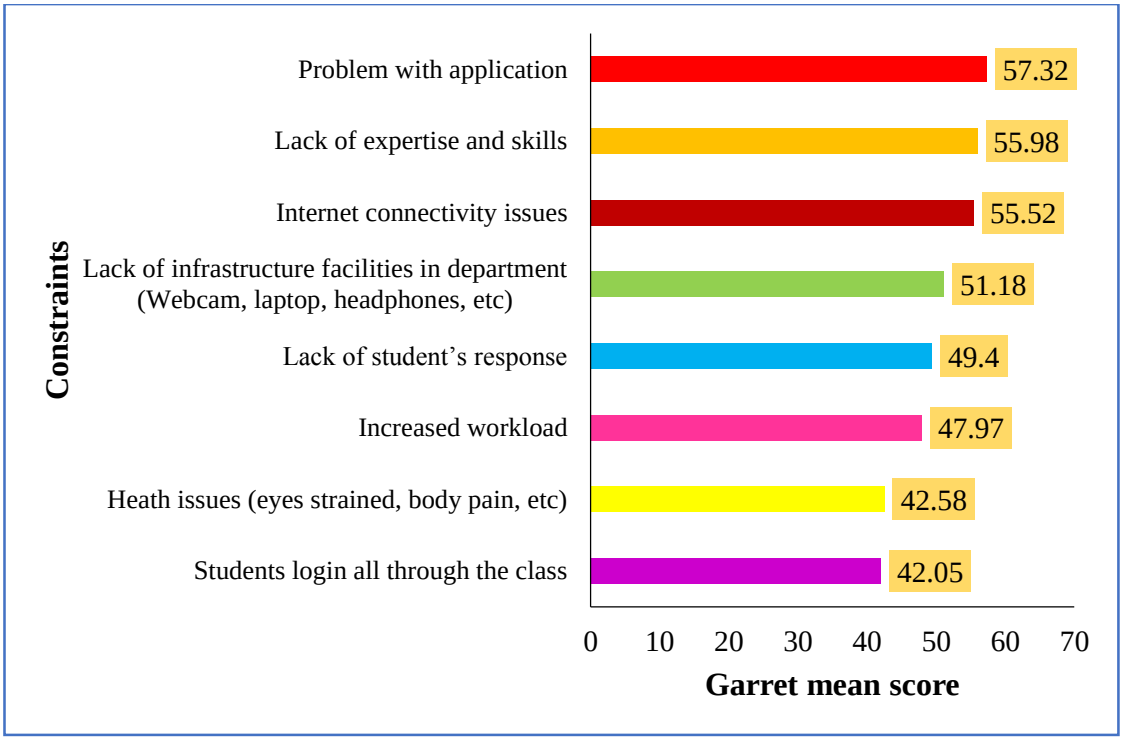

Fig. 4.20. Distribution of teachers based on ranking of constraints using garret mean score

4.5 TEACHERS SATISFACTION WITH ONLINE TEACHING

It is evident from Table 4.27. and Figure 4.21. that less than two-third of the teachers were satisfied (60.00%), followed by dis satisfied (28.33%), very much dis satisfied (6.67%), undecided (5.00%) and none of them were very much satisfied with online teaching. The results are in conformity with that reported by Mythili (2017), Shah and Sharma (2018), Selvaraj (2019) and Gurung (2021).

Table 4.27. Distribution of teachers according to satisfaction with online teaching

(n=60)

S. No.	Category	Total	
		Frequency	Percentage
1.	Very much Satisfied	--	--
2.	Satisfied	36	60.00
3.	Undecided	3	5.00
4.	Dis satisfied	17	28.33
5.	Very much dis satisfied	4	6.67

Satisfaction indicates pleasure in working in online teaching environment. Dis-satisfaction and undecidedness indicate some gaps that need to be filled in online teaching to make it more pleasureful. This may be in the form of hands-on training, support from the university in terms of infra structure, etc. Dis-satisfaction may be accounted for lack of personal contact with students, etc.

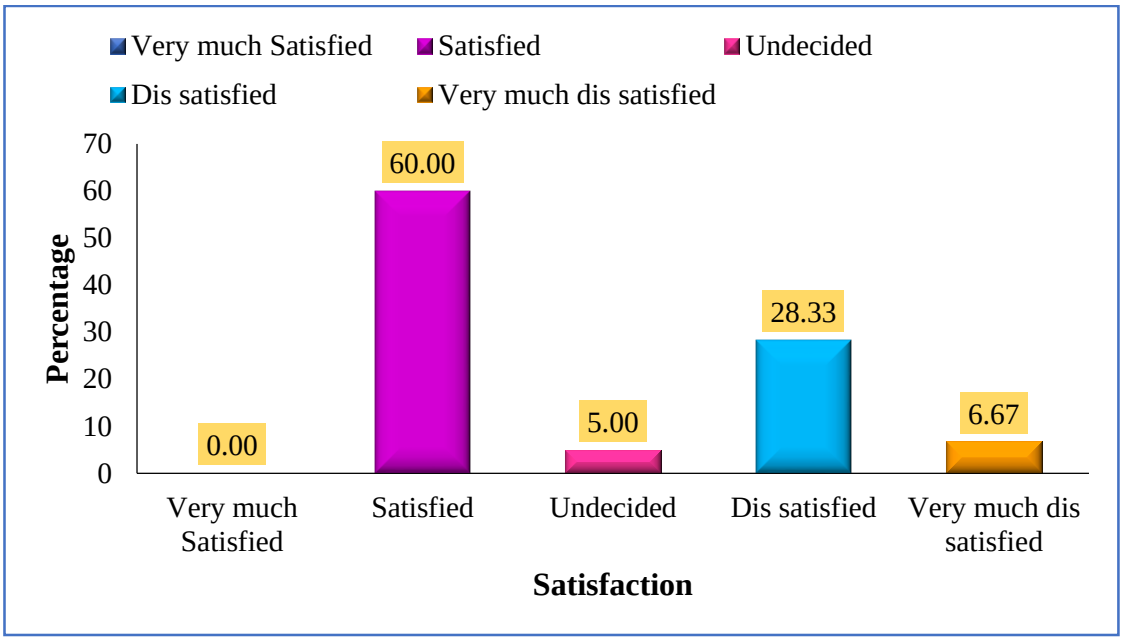

Fig. 4.21. Distribution of teachers according to satisfaction with online teaching

4.6 PROFILE OF STUDENTS INVOLVED IN ONLINE LEARNING

4.6.1 Age

It is evident from Table 4.28. and Figure 4.22. that more than half of the UG students were observed in the category of 20-25 years (54.44%) age group, followed by ≤20 years (45.00%) and ≥ 30 years (0.56%). While less than two-third of the PG students belonged to 20-25 years (63.33%) age group, followed by 25-30 years (31.67%) and ≥ 30 years (5.00%). The results are in conformity with that reported by Naresh and Reddy (2015), Soni (2016), Abdullah and Toycan (2018) Anusha (2019) and Khan *et al*. (2021).

Table 4.28. Distribution of students according to their age

S. No.	Category	UG (n=180)		PG (n=60)	
		Frequency	Percentage	Frequency	Percentage
1.	≤20 Years	81	45.00	--	--
2.	20-25Years	98	54.44	38	63.33
3.	25-30 Years	--	--	19	31.67
4.	≥ 30 Years	1	0.56	3	5.00

It could be inferred that age corresponded to their degree of study. UG students were younger than PG students. A meagre proportion of the UG students were above 30 years corresponded to students pursuing UG programme under in-service quota.

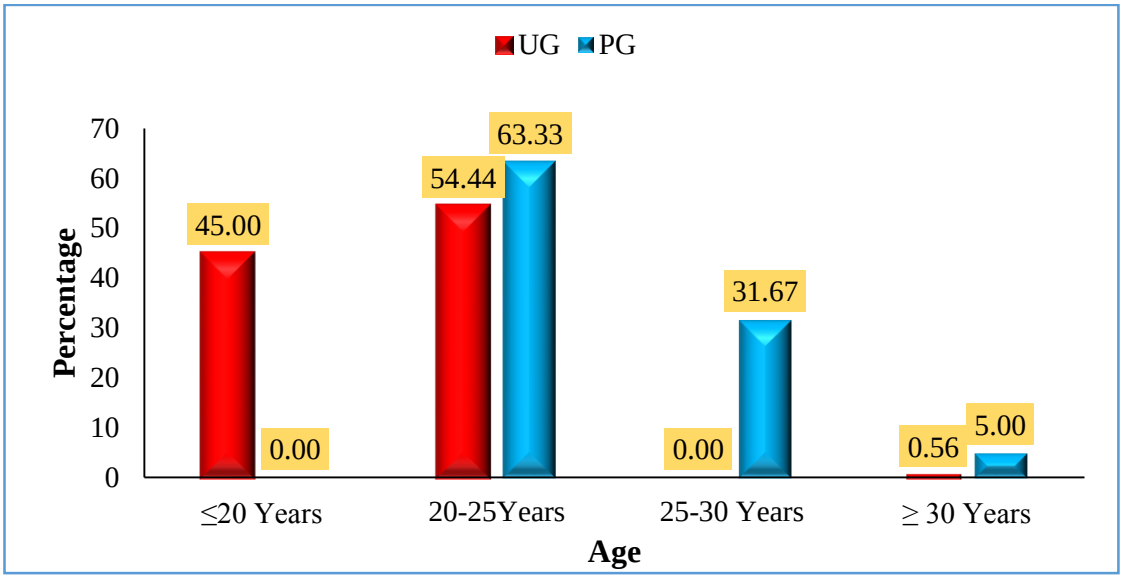

Fig. 4.22. Distribution of students according to their age

4.6.2 Gender

It is evident from Table 4.29. and Figure 4.23. that a little more than two-third of the UG students were female (68.89%) and the remaining 31.11 per cent were male. Among the PG students 58. 33 per cent were female and the remaining were male (41.67%). The results are in conformity with that reported by Kar *et al.* (2014), Fedynich *et al.* (2015), Abbasi *et al.* (2020) and Khan and Thomas (2021).

Table 4.29. Distribution of students according to their gender

S. No.	Category	UG (n=180)		PG (n=60)	
		Frequency	Percentage	Frequency	Percentage
1.	Male	56	31.11	25	41.67
2.	Female	124	68.89	35	58.33

The findings indicated that in both UG and PG the female students were more as compared to male students. The admission of female students in the university is double that of male students which could be the probable reason for the above findings.

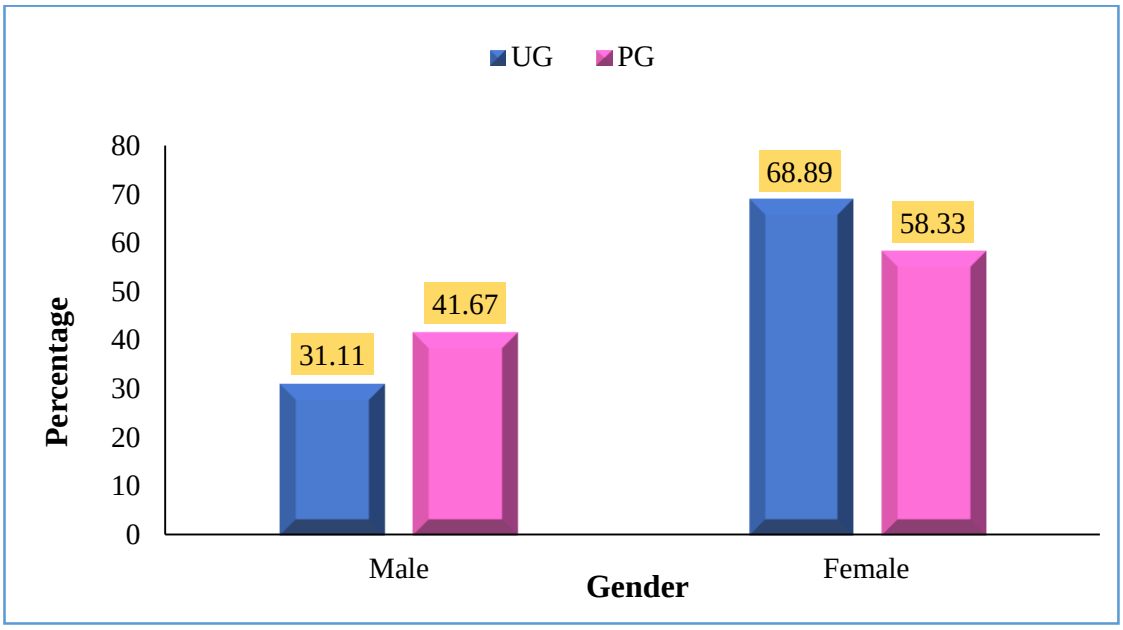

Fig. 4.23. Distribution of students according to their gender

4.6.3 Background

It is evident from Table 4.30. and Figure 4.24. that 59.44 per cent of the UG students belonged to be rural background followed by urban (27.78%) and semi-urban (12.78%) background. Less than half of the PG students belonged to rural (46.67%) background followed by semi-urban (31.67%) and urban (21.66%) background. The results are in conformity with that reported by Dhas (2017), Walter (2018), Hasan and Khan (2020) and Bhowmik and Bhattacharya (2021).

Table 4.30. Distribution of students according to their background

S. No.	Category	UG (n=180)		PG (n=60)	
		Frequency	Percentage	Frequency	Percentage
1.	Rural	107	59.44	28	46.67
2.	Semi-Urban	23	12.78	19	31.67
3.	Urban	50	27.78	13	21.66

The above findings could be due to the reason that, in the admission process there is preference for the children of farmers under farmers quota. The results clearly indicated that greater proportion of the rural families preferred agricultural education for their children. Moreover, the major profession of the people dwelling in rural areas is agriculture and allied activities. Hence due to the inclination towards agriculture-based profession, parents might have opted agriculture education for their children. Further it could be added that student's personal interest towards their parent's profession might be the reasons for more students preferring agricultural courses from rural backgrounds.

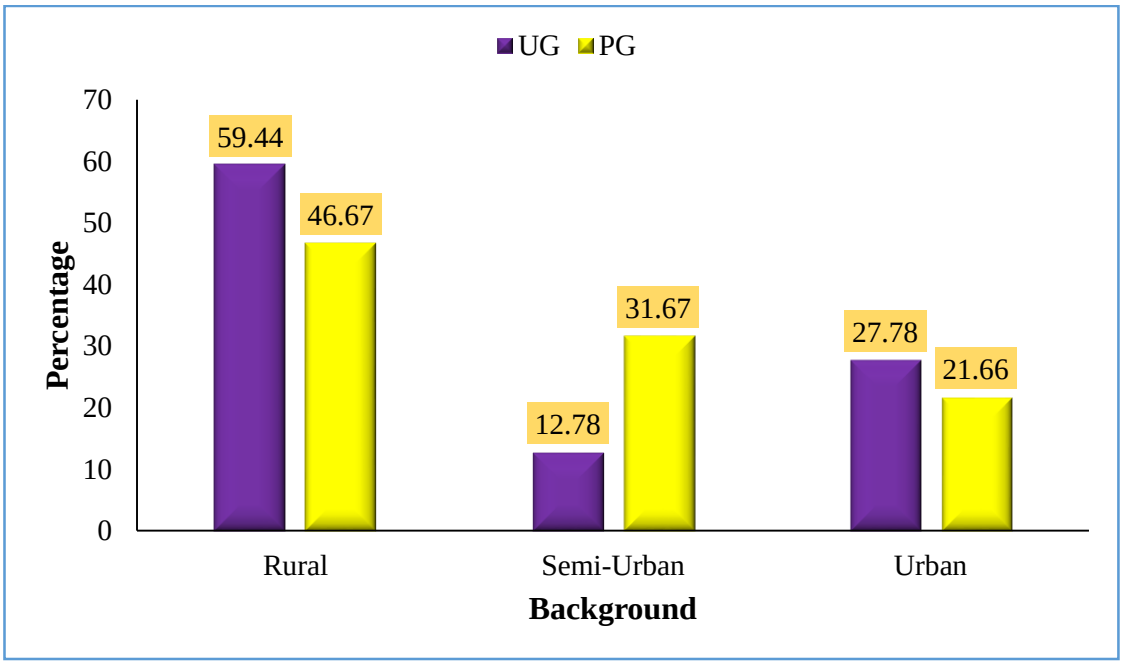

Fig. 4.24. Distribution of students according to their background

4.6.4 Secondary School Education

It is evident from Table 4.31. and Figure 4.25. that more than three-fourth of the UG students completed their secondary school education in private schools (77.22%) and the remaining 22.78 per cent completed their schooling in government schools. Majority of the PG students also completed their secondary school education in private school (83.33%) and the remaining 16.67 per cent completed their schooling in government schools.

Table 4.31. Distribution of students according to their secondary school education

S. No.	Category	UG (n=180)		PG (n=60)	
		F	%	F	%
1.	Government school	41	22.78	10	16.67
2.	Private school	139	77.22	50	83.33

*F=Frequency %=Percentage

Parents preferred private schools for educating their children for better career opportunities. Parents and their children feel that private schools provide better infrastructure required for the physical and mental development of the child and can help with the required facilities for the students to learn their lessons in a better way. Hence majority of the respondents underwent secondary school education in private institutions. A little proportion of the respondents underwent secondary school education in government schools which could be accounted for their low parental annual income leading to non-affordability of their parents to educate their children in private schools.

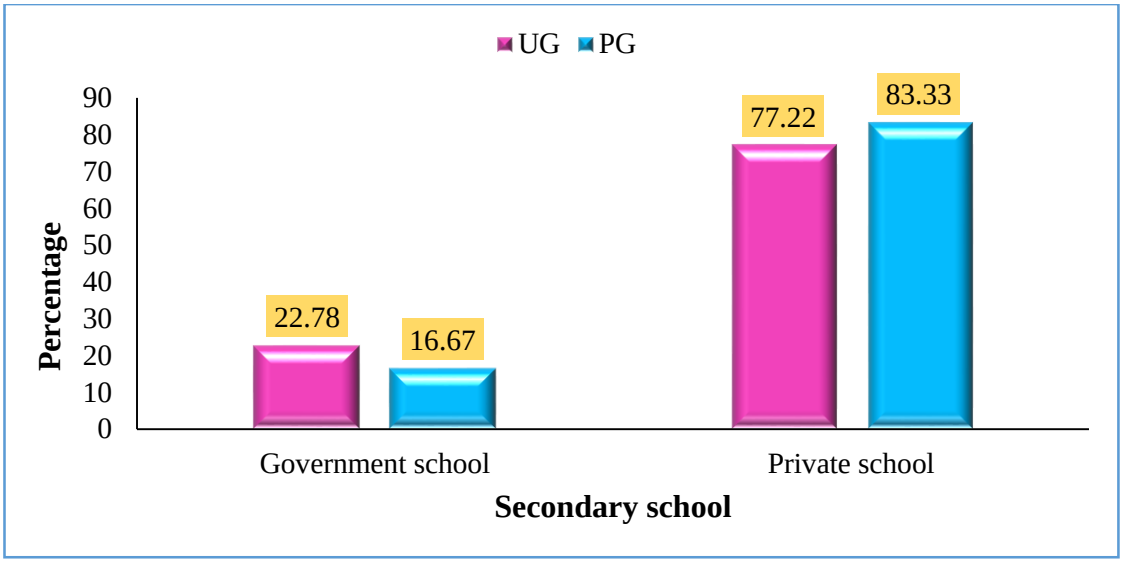

Fig. 4.25. Distribution of students according to their secondary school education

4.6.5 Type of Family

It is evident from Table 4.32. and Figure 4.26. that majority of the UG students were from nuclear (84.44%) family, while the remaining were from joint (15.56%) family. Majority of the PG students were from nuclear (83.33%) family, while the remaining were from joint (16.67%) family. The results are in conformity with that reported by Madhumita (2016), Yadav and Kashyap (2017), Anusha (2019) and Koirala *et al.* (2020).

Table 4.32. Distribution of students according to their type of family

S. No.	Category	UG (n=180)		PG (n=60)	
		Frequency	Percentage	Frequency	Percentage
1.	Nuclear	152	84.44	50	83.33
2.	Joint	28	15.56	10	16.67

Living in nuclear families is the trend of current era. The probable reasons for disintegration of joint families into nuclear families might be due to over population, problem of accommodation, family quarrels, impact of western culture, enlightenment of women, social legislations, education, urbanisation, industrialisation etc.

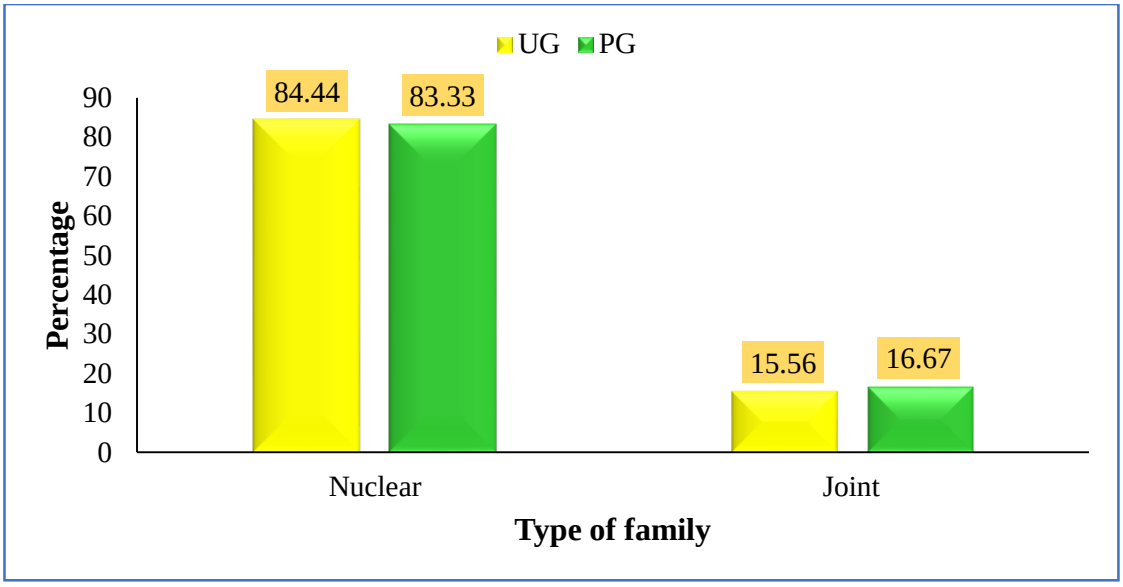

Fig. 4.26. Distribution of students according to their type of family

4.6.6 Parental Occupation

It is evident from Table 4.33. and Figure 4.27. that less than half of the UG student's parental occupation was farming (43.89%), followed by others (25.00%), government employee (15.56%), business (11.67%) and agricultural labour (3.88%). Less than half of the PG student parental occupation was farming (43.33%), followed by others (21.67%), government employee (18.33%) and business (16.67%). The results are in conformity with that reported by Madhumita (2016) and Yadav and Kashyap (2017).

Table 4.33. Distribution of students according to their parental occupation

S. No.	Category	UG (n=180)		PG (n=60)	
		Frequency	Percentage	Frequency	Percentage
1.	Farming	79	43.89	26	43.33
2.	Government employee	28	15.56	11	18.33
3.	Business	21	11.67	10	16.67
4.	Agricultural Labour	7	3.88	--	--
5.	Others	45	25.00	13	21.67

A variety of parental occupations were observed with greater proportion practicing agriculture which could be accounted for the background of the respondents where they hail from. Other occupations included private jobs, artisans, etc.

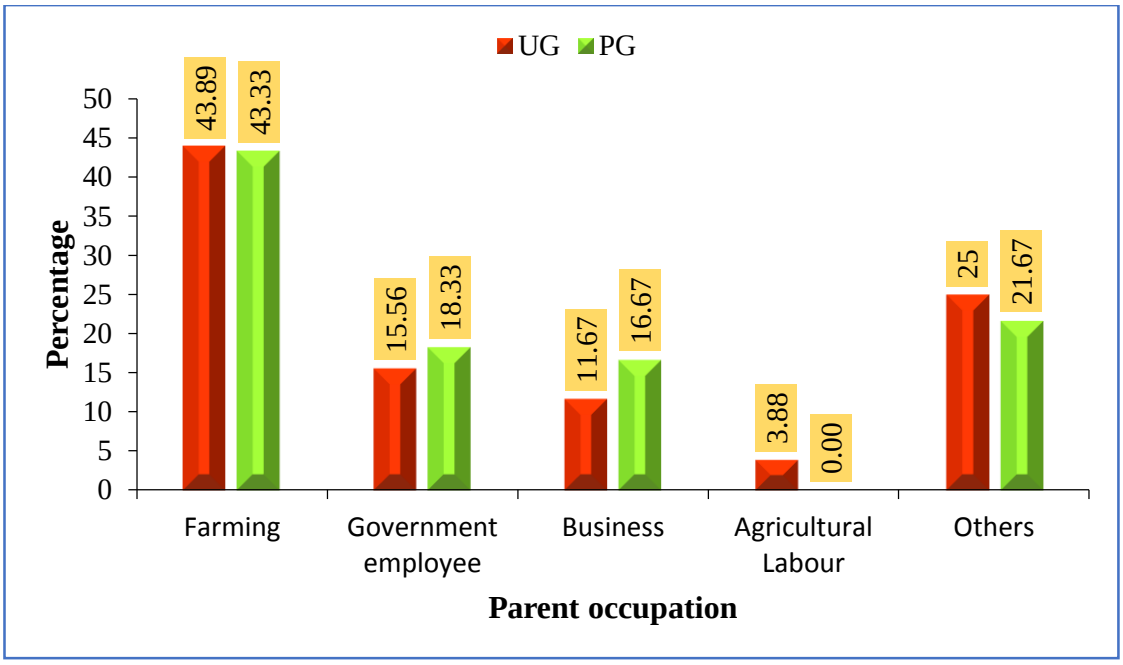

Fig. 4.27. Distribution of students according to their parental occupation

4.6.7 Academic Performance

It is evident from Table 4.34. and Figure 4.28. that more than half of the UG students secured 8.1-9.0 (58.89%), followed by 7.1-8.0 (18.89%), 9.1-10.0 (16.11%) and 6.1-7.0 (6.11%) GPA. Among PG students 43.34 per cent secured 8.1-9.0, followed by 7.1-8.0 (33.33%), 9.1-10.0 (15.00%) and 6.1-7.0 (8.33%) GPA. The results are in conformity with that reported by Ren and Hagedorn (2012), Soni (2016), Yadav and Kashyap (2017), Soharwardi *et al.* (2020) and Baticulon *et al.* (2021).

Table 4.34. Distribution of students according to their academic performance

S. No.	GPA	Total			
		UG (n=180)		PG (n=60)	
		Frequency	Percentage	Frequency	Percentage
1.	9.1-10.0	29	16.11	9	15.00
2.	8.1-9.0	106	58.89	26	43.34
3.	7.1-8.0	34	18.89	20	33.33
4.	6.1-7.0	11	6.11	5	8.33

Among both UG and PG students the GPA of majority of the students was 8.1 and above. The findings could be accounted for the reason that they were more career oriented for which GPA plays a crucial role. Only merit students with higher GPA are likely to get good placements.

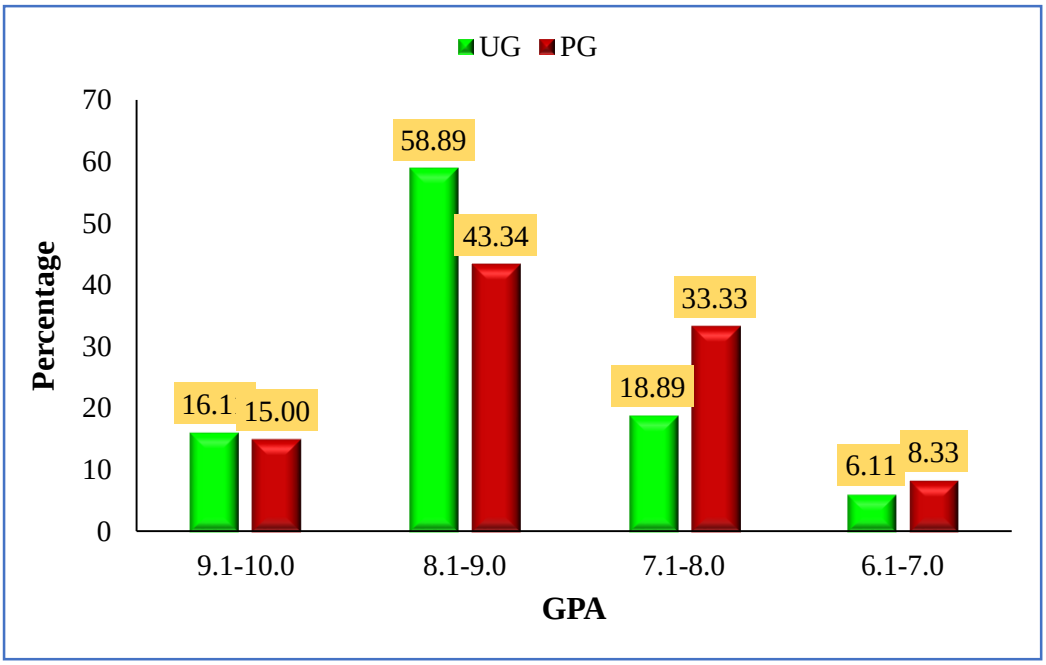

Fig. 4.28. Distribution of students according to their academic performance

4.6.8 Possession of Electronic Devices and Internet Connectivity for Online Learning

It is evident from Table 4.35. that greater proportion of the UG students possess smart phone (96.11%), followed by laptop (11.67%) and an equal proportion of 1.67 per cent each possess tablet and personal computer. Only 42.78 per cent had access to good internet connectivity and sufficient internet data (40.00%). While greater proportion of the PG students possess smart phone (98.33%), followed by laptop (71.67%), personal computer (16.67%), and tablet (3.33%). Only 56.67 per cent had access to good internet connectivity and sufficient internet data (46.67%). The results are in conformity with that reported by Azimi (2013), Madhumita (2016), Anusha (2019) and Adnan and Anwar (2020).

Table 4.35. Distribution of students according to possession of electronic device and internet connectivity for online learning

S. No.	Category	Total			
		UG (n=180)		PG (n=60)	
		F	%	F	%
1.	Smart Phone	173	96.11	59	98.33
2.	Laptop	21	11.67	43	71.67
3.	Tablet	3	1.67	2	3.33
4.	Personal Computer	3	1.67	10	16.67
5.	Good internet connectivity	77	42.78	34	56.67
6.	Sufficient internet data	72	40.00	28	46.67
Note: Responses are inclusive					

*F=Frequency %= Percentage

These days smart phone with internet connectivity has become an important element in everybody's life due to the connectivity they provide through social networking, internet surfing, navigation, calculation and many more hence greater proportions of the UG and PG student possess smart phone. When compared to UG students, PG students have additional computer-based works namely thesis preparation, term paper presentations, seminars, assignments for which they usually purchase a laptop. Internet connectivity

depends on signals and the location where we are situated. As many are from rural and semi urban areas connectivity is a problem. The internet data balance depends on the package we subscribe. Both UG and PG students reported insufficient internet data due to continuous online classes coupled with social networking, internet surfing etc.

4.6.9 Frequency of Using of Electronic Devices for Online Learning

It is evident from Table 4.36. that greater proportion of the UG students often (92.78%) used smart phone and the remaining used rarely (7.22%). A meagre proportion of them often (5.00%) used laptop, followed by rarely (23.33%) and never (71.67%). A meagre proportion of them often (3.33%) used tablet, followed by rarely (5.56%) and never (91.11%). A meagre proportion of them often (2.22%) used personal computer, followed by rarely (4.44%) and never (93.33%).

Greater proportion of the PG students often (90.00%) used smart phone and the remaining used rarely (10.00%). Less than half of the PG students often (48.33%) used laptop, followed by rarely (45.00%) and never (6.67%). An equal proportion of 5.00 per cent each used tablet rarely and often while the remaining never (90.00%) used. A meagre proportion of them often (5.00%) used personal computer, followed by rarely (25.00%) and never (70.00%). The results are in conformity with that reported by Ncube (2015), Bhatt (2019), Hasan and Khan (2020) and Rana (2021).

Table 4.36. Distribution of students according to their extent of use of electronic device for online learning

(n of UG=180 & n of PG=60)

S. No.	Category	Students	Extent of use					
			Often		Rarely		Never	
			F	%	F	%	F	%
1.	Smart Phone	UG	167	92.78	13	7.22	--	--
		PG	54	90.00	6	10.00	--	--
2.	Laptop	UG	9	5.00	42	23.33	129	71.67
		PG	29	48.33	27	45.00	4	6.67
3.	Tablet	UG	6	3.33	10	5.56	164	91.11
		PG	3	5.00	3	5.00	54	90.00
4.	Personal Computer	UG	4	2.22	8	4.44	168	93.33
		PG	3	5.00	15	25.00	42	70.00

*F=Frequency %= Percentage

Use of electronic devices corresponds to their possession and requirement. As smart phones are handy, they were often used by both UG and PG students for social networking, internet surfing, etc. As per the requirement PG students used laptops also for preparation of thesis work, term paper presentations, seminar presentations, assignments, etc.

4.6.10 Number of Hours Spent Per Week in Online Learning

It is evident from Table 4.37. and Figure 4.29. that 41.67 per cent of the UG students spent 19-28 hours per week in online classes, followed by 29-38 hours (28.33%), 9-18 hours (17.22%) and 39-48 hours (12.78%) per week. Less than half of the PG students spent 9-18 hours per week (48.34%) in online classes, followed by 19-28 hours (35.00%), 29-38 hours (13.33%) and 39-48 hours (3.33%) per week. The results are in conformity with that reported by Kuo *et al*. (2013), Ncube (2015) Naresh *et al*. (2016) and Baticulon *et al.* (2021).

Table 4.37. Distribution of students according to number of hours spent per week in online classes

S. No.	Category (Hours)	UG (n=180)		PG (n=60)	
		F	%	F	%
1.	9-18	31	17.22	29	48.34
2.	19-28	75	41.67	21	35.00
3.	29-38	51	28.33	8	13.33
4.	39-48	23	12.78	2	3.33

*F=Frequency %= Percentage

The time spent by the respondents in online learning firstly depends on the class timetable, internet connectivity and data balance. Classes are scheduled for a period of six hours in traditional class room teaching and the same time tables are followed for online classes also. The respondents are spending more time in online classes denotes sincerity in attending classes, interest, good internet connectivity and data balance. While the respondents spending less time for online classes denotes poor internet connectivity, less data balance and sometimes no interest in online classes.

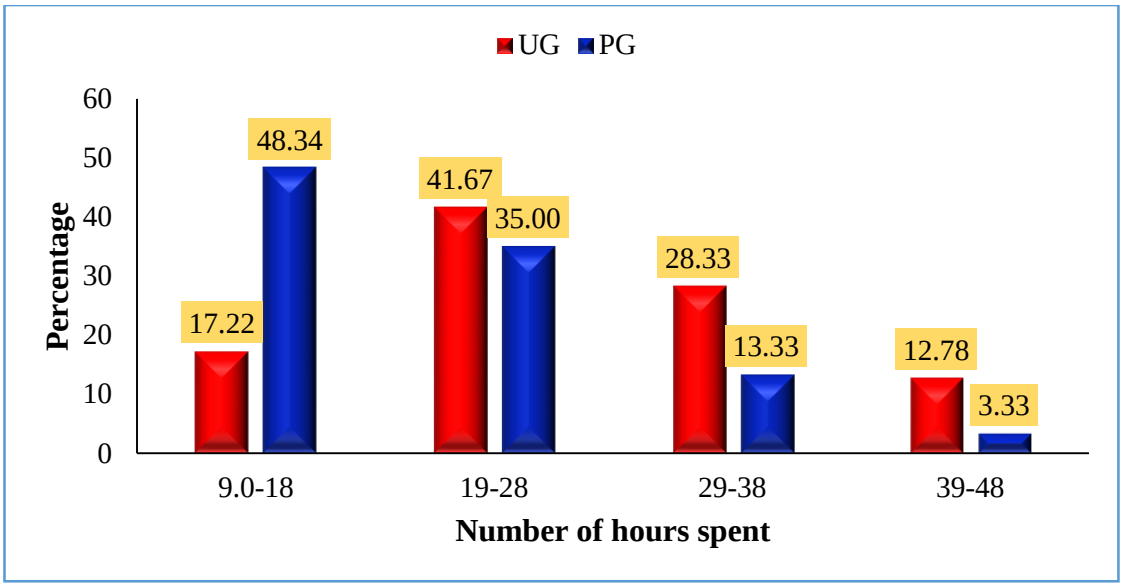

Fig. 4.29. Distribution of students according to number of hours spent per week in online classes

4.7 ATTITUDE OF STUDENTS TOWARDS ONLINE LEARNING

The attitude of the students towards online learning was measured using a scale consisting of 20 statements measured on a five point continuum *i.e.*, strongly agree, agree, undecided, disagree and strongly disagree. The results were analysed and presented under the following subheads.

4.7.1 Item analysis of attitude of the students towards online learning

4.7.2 Z test to find out the significant difference between attitude of UG and PG students

4.7.3 Factor analysis of attitude of the students towards online learning

4.7.1 Item Analysis of Attitude of the Students towards Online Learning

The item wise responses on attitude of the students towards online learning were given in Table 4.38. and discussed below

Table 4.38. Item analysis of attitude of the students towards online learning

(n of UG=180 & n of PG=60)

S. No.	Statement	Students	Strongly agree		Agree		Undecided		Disagree		Strongly disagree	
			F	%	F	%	F	%	F	%	F	%
1.	Students can turn anywhere with Internet access and electricity into a classroom	UG	23	12.78	80	44.45	44	24.44	22	12.22	11	6.11
		PG	19	31.67	26	43.33	10	16.67	3	5.00	2	3.33
2.	I listen to online classes comfortably and relaxed	UG	11	6.11	65	36.11	18	10.00	66	36.67	20	11.11
		PG	12	20.00	25	41.67	6	10.00	13	21.67	4	6.66
3.	Online learning lacks practical learning	UG	137	76.11	36	20.00	3	1.66	1	0.56	3	1.67
		PG	34	56.67	18	30.00	4	6.67	2	3.33	2	3.33
4.	Saves time as I need not travel to class room	UG	18	10.00	60	33.33	28	15.56	54	30.00	20	11.11
		PG	16	26.67	24	40.00	6	10.00	10	16.67	4	6.66
5.	Online classes distract my attention	UG	72	40.00	66	36.67	21	11.66	20	11.11	1	0.56
		PG	13	21.67	27	45.00	5	8.33	11	18.33	4	6.67
6.	Online learning is boredom	UG	50	27.78	71	39.44	34	18.89	23	12.78	2	1.11
		PG	13	21.67	20	33.33	18	30.00	8	13.33	1	1.67
7.	It is easy to question without shyness	UG	32	17.78	85	47.22	29	16.11	27	15.00	7	3.89
		PG	17	28.33	31	51.67	7	11.67	4	6.67	1	1.66
8.	Online learning helps in exploring more about the subject	UG	4	2.22	31	17.22	37	20.56	79	43.89	29	16.11
		PG	7	11.67	18	30.00	13	21.67	18	30.00	4	6.66
9.	Flipped classroom approach would be better	UG	45	25.00	85	47.22	27	15.00	17	9.45	6	3.33
		PG	28	46.67	26	43.33	5	8.33	1	1.67	--	--
10.	I feel I am disconnected with my class mates in online learning	UG	51	28.33	90	50.00	19	10.56	15	8.33	5	2.78
		PG	13	21.67	28	46.67	7	11.67	11	18.33	1	1.66
11.	Online learning includes increased workloads	UG	50	27.78	61	33.89	35	19.44	30	16.67	4	2.22
		PG	5	8.33	25	41.67	12	20.00	15	25.00	3	5.00
12.	Online learning enhanced the quality of teaching	UG	7	3.89	21	11.67	30	16.67	89	49.44	33	18.33
		PG	3	5.00	13	21.67	12	20.00	22	36.67	10	16.66
13.	Lower retention rate for online learning	UG	32	17.78	86	47.78	46	25.56	14	7.77	2	1.11
		PG	10	16.67	29	48.33	18	30.00	1	1.67	2	3.33
14.	I am not getting enough time for brainstorming in online classes	UG	36	20.00	90	50.00	33	18.33	18	10.00	3	1.67
		PG	7	11.67	33	55.00	12	20.00	5	8.33	3	5.00
15.	Online learning made learning easy	UG	1	0.56	29	16.11	28	15.56	96	53.33	26	14.44
		PG	9	15.00	23	38.33	14	23.33	10	16.67	4	6.67
16.	Less responsible in class, less accountable	UG	30	16.67	89	49.44	33	18.33	25	13.89	3	1.67
		PG	13	21.67	31	51.67	10	16.67	2	3.33	4	6.66
17.	Note taking is avoided here	UG	25	13.89	74	41.11	34	18.89	40	22.22	7	3.89
		PG	10	16.67	24	40.00	7	11.67	14	23.33	5	8.33
18.	Difficult to manage study time at home	UG	71	39.44	81	45.00	10	5.56	14	7.78	4	2.22
		PG	21	35.00	22	36.67	6	10.00	8	13.33	3	5.00
19.	Online learning is stressful	UG	60	33.34	74	41.11	22	12.22	20	11.11	4	2.22
		PG	13	21.67	15	25.00	17	28.33	12	20.00	3	5.00
20.	Online learning made me tech savvy	UG	14	7.78	69	38.33	69	38.33	25	13.89	3	1.67
		PG	9	15.00	32	53.33	16	26.67	2	3.33	1	1.67

*F=Frequency %= Percentage UG=Under Graduate PG=Post Graduate

4.7.1.1 Students Can Turn Anywhere with Internet Access and Electricity into a Classroom : An overview of Table 4.38. revealed that less than half of the UG students agreed (44.45%) with the statement "Students can turn anywhere with internet access and electricity into a classroom" followed by undecided (24.44%), strongly agreed (12.78%), disagreed (12.22%) and strongly disagreed (6.11%). Among the PG students 43.33 per cent agreed followed by strongly agreed (31.67%), undecided (16.67%), disagreed (5.00%) and strongly disagreed (3.33%).

4.7.1.2 I Listen to Online Classes Comfortably and Relaxed : More than one-third of the UG students agreed (36.11%) with the statement "I listen to online classes comfortably and relaxed" followed by strongly disagreed (11.11%), undecided (10.00%) and strongly agreed (6.11%) whereas 36.67 per cent disagreed. While 41.67 per cent of the PG students agreed followed by disagreed (21.67%), strongly agreed (20.00%), undecided (10.00%) and strongly disagreed (6.66%).

4.7.1.3 Online Learning Lacks Practical Learning : More than three-fourth of the UG students strongly agreed (76.11%) with the statement "Online learning lacks practical learning" followed by agreed (20.00%), strongly disagreed (1.67%), undecided (1.66%) and a meagre proportion of them disagreed (0.56%). While 56.67 per cent of the PG students strongly agreed followed by agreed (30.00%), undecided (6.67%) and equal proportion of 3.33 per cent each disagreed and strongly disagreed.

4.7.1.4 Saves Time as I Need Not Travel to Class Room : One-third of the UG students agreed (33.33%) with the statement "Saves time as I need not travel to class room" followed by disagreed (30.00%), undecided (15.56%), strongly disagreed (11.11%) and strongly agreed (10.00%). Among PG students 40.00 per cent of the PG students agreed followed by strongly agreed (26.67%), disagreed (16.67%), undecided (10.00%) and strongly disagreed (6.66%).

4.7.1.5 Online Classes Distract My Attention : More than one-third of the UG students strongly agreed (40.00%) with the statement "Online classes distract my attention" followed by agreed (36.67%), undecided (11.66%), disagreed (11.11%) and a meagre proportion of them strongly disagreed (0.56%). While less than half of the PG students agreed (45.00%) followed by strongly agreed (21.67%), disagreed (18.33%), undecided (8.33%) and strongly disagreed (6.67%).

4.7.1.6 Online Learning is Boredom : More than one-third of the UG students agreed (39.44%) with the statement "Online learning is boredom" followed by strongly agreed (27.78%), undecided (18.89%), disagreed (12.78%) and a meagre proportion of them strongly disagreed (1.11%). While one-third of the PG students agreed (33.33%) followed by undecided (30.00%), strongly agreed (21.67%), disagreed (13.33%) and a meagre proportion of them strongly disagreed (1.67%).

4.7.1.7 It is Easy to Question Without Shyness : Less than half of the UG students agreed (47.22%) with the statement "It is easy to question without shyness" followed by strongly agreed (17.78%), undecided (16.11%), disagreed (15.00%) and strongly disagreed (3.89%). While, little more than half of the PG students agreed (51.67%) followed by strongly agreed (28.33%), undecided (11.67%), disagreed (6.67%) and a meagre proportion of them strongly disagreed (1.66%).

4.7.1.8 Online Learning Helps in Exploring More About the Subject : Less than one-fourth of the UG students agreed (17.22%) with the statement "Online learning helps in exploring more about the subject" followed by strongly disagreed (16.11%) and strongly agreed (2.22%) whereas 43.89 per cent disagreed and undecided (20.56%). While, less than one-third of the PG students agreed (30.00%) followed by undecided (21.67%), strongly agreed (11.67%) and strongly disagreed (6.66%) whereas 30.00 per cent of them disagreed.

4.7.1.9 Flipped Classroom Approach Would be Better : Less than half of the UG students agreed (47.22%) with the statement "Flipped classroom approach would be better" followed by strongly agreed (25.00%), undecided (15.00%), disagreed (9.45%) and strongly disagreed (3.33%). While, less than half of the PG students strongly agreed (46.67%) followed by agreed (43.33%), undecided (8.33%), disagreed (1.67%) and none of them strongly disagreed (0.00%).

4.7.1.10 I Feel I am Disconnected with My Class mates in Online Learning: Half of the UG students agreed (50.00%) with the statement "I feel I am disconnected with my class mates in online learning" followed by strongly agreed (28.33%), undecided (10.56%), disagreed (8.33%) and strongly disagreed (2.78%). While, less than half of the PG students agreed (46.67%) followed by strongly agreed (21.67%), disagreed (18.33%), undecided (11.67%) and a meagre proportion of them strongly disagreed (1.66%).

4.7.1.11 Online Learning Includes Increased Workloads : More than one-third of the UG students agreed (33.89%) with the statement "Online learning includes increased workloads" followed by strongly agreed (27.78%), undecided (19.44%), disagreed (16.67%) and strongly disagreed (2.22%). While, less than half of the PG students agreed (41.67%) followed by disagreed (25.00%), undecided (20.00%), strongly agreed (8.33%) and strongly disagreed (5.00%).

4.7.1.12 Online Learning Enhanced the Quality of Teaching : Less than one-fourth of the UG students agreed (11.67%) with the statement "Online learning enhanced the quality of teaching" followed by strongly agreed (3.89%) while less than half of them disagreed (49.44%), strongly disagreed (18.33%) and undecided (16.67%). Among the PG students 21.67 per cent agreed followed by undecided (20.00%), strongly disagreed (16.66%) and strongly agreed (5.00%) while 36.67 per cent of them disagreed.

4.7.1.13 Lower Retention Rate for Online Learning : Less than half of the UG students agreed (47.78%) with the statement "Lower retention rate for online learning" followed by undecided (25.56%), strongly agreed (17.78%), disagreed (7.77%) and a meagre proportion of them strongly disagreed (1.11%). Similarly, less than half of the PG students agreed (48.33%) followed by undecided (30.00%), strongly agreed (16.67%), strongly disagreed (3.33%) and a meagre proportion of them disagreed (1.67%).

4.7.1.14 I am Not Getting Enough Time for Brainstorming in Online Classes : Half of the UG students agreed (50.00%) with the statement "I am not getting enough time for brainstorming in online classes" followed by strongly agreed (20.00%), undecided (18.33%), disagreed (10.00%) and a meagre proportion of them strongly disagreed (1.67%). While, more than half of the PG students agreed (55.00%) followed by undecided (20.00%), strongly agreed (11.67%), disagreed (8.33%) and strongly disagreed (5.00%).

4.7.1.15 Online Learning Made Learning Easy : Less than one-fourth of the UG students agreed (16.11%) with the statement "Online learning made learning easy" followed by undecided (15.56%), strongly disagreed (14.44%), strongly agreed (0.56%) while 53.33 per cent of them disagreed. More than one-third of the PG students agreed (38.33%) followed by undecided (23.33%), disagreed (16.67%), strongly agreed (15.00%) and strongly disagreed (6.67%).

4.7.1.16 Less Responsible in Class, Less Accountable : Less than half of the UG students agreed (49.44%) with the statement "Less responsible in class, less accountable" followed by undecided (18.33%), strongly agreed (16.67%), disagreed (13.89%) and a meagre proportion of them strongly disagreed (1.67%). While, more than half of the PG students agreed (51.67%) followed by strongly agreed (21.67%), undecided (16.66%), strongly disagree (6.67%) and disagreed (3.33%).

4.7.1.17 Note Taking is Avoided Here : Less than half of the UG students agreed (41.11%) with the statement "Note taking is avoided here" followed by disagreed (22.22%), undecided (18.89%), strongly agreed (13.89%) and strongly disagreed (3.89%). While 40.00 per cent of the PG students agreed followed by disagreed (23.33%), strongly agreed (16.67%), undecided (11.67%) and strongly disagreed (8.33%).

4.7.1.18 Difficult to Manage Study Time at Home : Less than half of the UG students agreed (45.00%) with the statement "Difficult to manage study time at home" followed by strongly agreed (39.44%), disagreed (7.78%), undecided (5.56%) and strongly disagreed (2.22%). While 36.67 per cent of the PG students agreed followed by strongly agreed (35.00%), disagreed (13.33%), undecided (10.00%) and strongly disagreed (5.00%).

4.7.1.19 Online Learning is Stressful : Less than half of the UG students agreed (41.11%) with the statement "Online learning is stressful" followed by strongly agreed (33.34%), undecided (12.22%), disagreed (11.11%) and strongly disagreed (2.22%). While, one-fourth of the PG students agreed (25.00%) followed by strongly agreed (21.67%), disagreed (20.00%), strongly disagreed (5.00%) whereas 28.33 per cent of them were undecided.

4.7.1.20 Online Learning Made Me Tech Savvy : More than one-third of the UG students each agreed and undecided (38.33%) with the statement "Online learning made me tech savvy" followed by disagreed (13.89%), strongly agreed (7.78%) and a meagre proportion of them strongly disagreed (1.67%). While, more than half of the PG students agreed (53.33%) followed by undecided (26.67%), strongly agreed (15.00%), disagreed (3.33%) and strongly disagreed (1.67%).

Based on mean and SD, the attitude of the students was classified into three categories namely low, medium and high. The results are presented in Table 4.39. and Figure 4.30.

An overview of Table 4.39. and Figure 4.30. revealed that more than three-fourth of the UG students had medium (79.44%) favourable attitude, followed by low (16.11%) and high (4.44%) favourable attitude. While, less than three-fourth of the PG students had medium (73.33%) favourable attitude and the remaining 13.33 per cent each had high and low favourable attitudes. The results are in conformity with that reported by Ghadei and Rudd (2015), Mamattah (2016), Peytcheva-forsyth *et al.* (2018), Koirala *et al.* (2020) and Khan *et al.* (2021).

Table 4.39. Distribution of students according to their attitude towards online learning

(n of UG=180 & n of PG=60)

S. No.	Category	UG		PG	
		Frequency	**Percentage**	**Frequency**	**Percentage**
1.	Low	8	4.44	8	13.33
2.	Medium	143	79.45	44	73.34
3.	High	29	16.11	8	13.33
	Total	180	100.00	60	100.00
	Mean SD	48.93 9.01		55.47 11.03	

The attitude towards an object depends on the individual's experience and interpretation. Attitude denotes readiness towards online learning. Greater portion of the respondents had medium favourable attitude towards online learning indicating that they are comfortable and ok with online learning. Low favourable attitude might be due to the problems associated with internet connectivity and data balance. High favourable attitude is a good sign for online learning and it indicates that connectivity and data balance was not a problem at all for them.

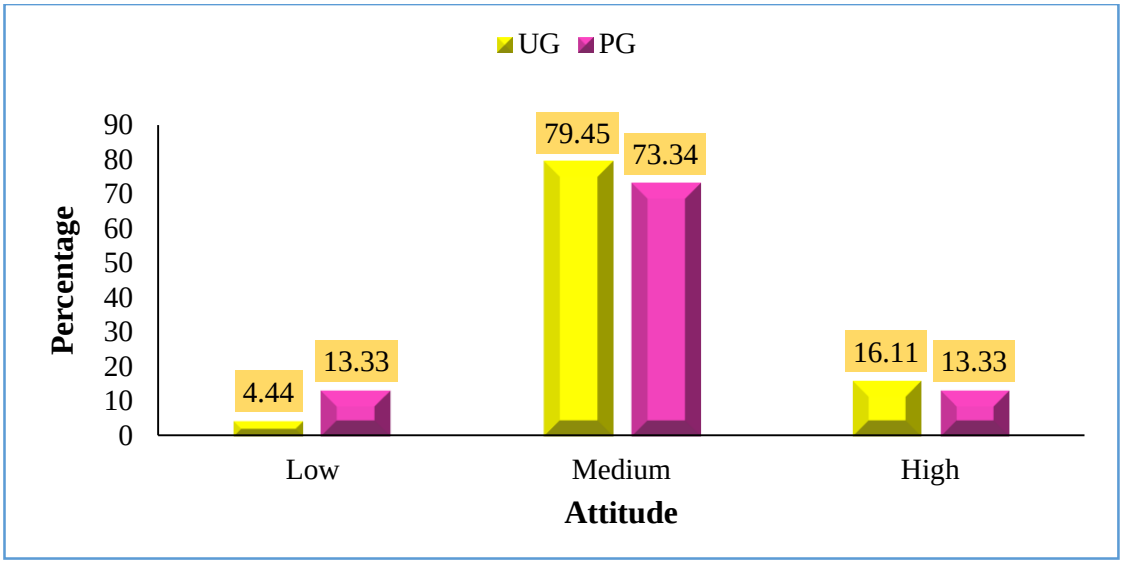

Fig. 4.30. Distribution of students according to their attitude towards online learning

4.7.2 Z Test to Find out the Significant Difference between Attitude of UG and PG Students

In order to find out the significant difference between the attitude of UG students and PG students, Z-test was calculated for two sample means and the values were presented in Table 4.40.

Testing of hypothesis

Null Hypothesis (H_0):

H_0: There is no significant difference between the attitude of UG and PG students

Empirical Hypothesis (H_1):

H_1: There is a significant difference between the attitude of UG and PG students

It is evident from Table 4.40. that Z test value (-4.15) is not in the range of Z critical value (-2.57 to 2.57) at 0.01 level of significance (p=0.00). Therefore, the null hypothesis (H0) is rejected and accepts empirical hypothesis. It indicates that there is a significant difference between attitude of UG and PG students. Considering the mean, it can be interpreted that PG students (55.47 mean) had high attitude towards online learning than UG students (48.93 mean).

Table 4.40. Z-test to find out the significant difference between attitude of UG and PG students towards online learning

(n of UG=180 & n of PG=60)

S. No.	Categories	Mean	SD	'Z' value	p
1.	Attitude of UG students	48.93	9.01	-4.15**	0.00
2.	Attitude of PG students	55.47	11.03		

** significant at 0.01 level of significance, UG=Under Graduate, PG= Post Graduate

4.7.3 Factor Analysis of Attitude of the Students towards Online Learning

Factor analysis is a commonly used data/ variable reduction technique to identify the key factors that affect the attitude of the students towards online learning. Measure of reliability (Cronbach's alpha) often used as a preliminary step before factor analysis.

A reliability test was conducted, which resulted in a Cronbach's Alpha of 0.830 as shown in Table 4.41., which is excellent, a value of alpha greater than 0.7 is acceptable. Therefore, factor analysis is appropriate.

Table 4.41. Reliability Statistics

Cronbach's Alpha	Number of Items
0.830	20

Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity were used to determine the appropriateness of data for factor analysis. As per the Table 4.42. the result of KMO measure of sampling adequacy is 0.847, higher than 0.5 which shows that data collected is appropriate to conduct factor analysis. Moreover, chi-square value of Bartlett's test of sphericity is also 1222.422, very high and is significant at 5 % level of significance indicating that variables are correlated in the population.

Table 4.42 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.847
Bartlett's Test of Sphericity	Approx. Chi-Square	1222.422
	df	190
	Sig.	.000

Table 4.43 depicts that Principal component analysis method with varimax rotation was applied to extract the factors regarding attitude of students towards online learning. The attitude of students can be represented by six factors (eigenvalues >1.0) and the variance explained by the extracted factors was 58.84% variance which is near 60 % expected value. Each factor is constituted of all those variables that had factor loadings greater than 0.4. These factors had been named appropriately on the basis or constituent variables. The extracted factors names along with the constituent variables, their factor loadings, the variance and the eigen values had been summarized in Table 4.43.

Table 4.43. Factors summary for attitude towards online learning

Items for attitude towards online learning	Component				
	Label	**Factor Loadings**	**Factor name**	**Variance explained (%)**	**Eigen value**
10. I feel I am disconnected with my class mates in online learning	X_{10}	.697	Personal factor	25.52	5.11
5. Online classes distracts my attention	X_5	.682			
3. Online learning lacks practical learning	X_3	.604			
6. Online learning is boredom	X_6	.603			
16. Less responsible in class, less accountable	X_{16}	.472			
8. Online learning helps in exploring more about the subject	X_8	.764			
12. Online learning enhanced the quality of teaching	X_{12}	.683	Self-development	11.22	2.24
15. Online learning made learning easy	X_{15}	.658			
20. Online learning made me tech savvy	X_{20}	.491			
14. I am not getting enough time for brainstorming in online classes	X_{14}	.746			
17. Note taking is avoided here	X_{17}	.627			
18. Difficult to manage study time at home	X_{18}	.614	Time management	5.86	1.17
19. Online learning is stressful	X_{19}	.568			
7. It is easy to question without shyness	X_7	.734	usefulness	5.76	1.15
11. Online learning includes increased workloads	X_{11}	.688			
4. Saves time as I need not travel to class room	X_4	.538	Comfort and ease	5.46	1.09
1. Students can turn anywhere with Internet access and electricity into a classroom	X_1	.798			
2. I listen to online classes comfortably and relaxed	X_2	.559			
9. Combination of Online and traditional approach would be better	X_9	.744	impact	5.02	1.00
13. Lower retention rate for online learning	X_{13}	.710			

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 11 iterations.

The first and the foremost factor consisted of 6 variables (X_3, X_5 X_6 X_8, X_{10} and X_{16}). This particular factor explained 25.52% variance with eigen value 5.11 and thus forms an important factor in studying the attitude construct, and the factor had been named as ‘personal factor’. The factor loading ranges from 0.472 to 0.764. This factor mainly represents the distraction, boredom, responsible and accountability of the students.

In importance, second factor consisted of 5 variables (X_{12}, X_{14}, $X1_5$, X_{17} and X_{20}). This particular factor explained variance of 11.22% with eigen value 2.24 and thus forms an important factor in studying the attitude construct, and the factor had been named as ‘self-development’. The factor loading ranges from 0.491 to 0.746. This factor mainly represents the tech savvy, brainstorming and note taking of the students.

The third factor consisted of 2 variables (X_{18} and X_{19}). This particular factor explained variance of 5.86% with eigen value 1.17 and thus forms an important factor in studying the attitude construct, and the factor had been named as 'time management'. The factor loading of the variables were 0.568 and 0.614. This factor mainly represents the time management and stress management.

The fourth factor consisted of 2 variables (X_7 and X_{11}). This particular factor explained variance of 5.76% with eigen value 1.15 and thus forms an important factor in studying the attitude construct, and the factor had been named as 'usefulness'. The factor loading of the variables were 0.688 and 0.734. This factor mainly represents the easy to question and workload.

The fifth factor consisted of 3 variables (X_1, X_2 and X_4). This particular factor explained variance of 5.46% with eigen value 1.09 and thus forms an important factor in studying the attitude construct, and the factor had been named as 'comfort and ease'. The factor loading ranges from 0.538 to 0.798. This factor mainly represents the comfort and saves time and internet access for online learning.

The sixth factor consisted of 2 variables (X_9 and X_{13}). This particular factor explained variance of 5.02% with eigen value 1.00 and thus forms an important factor in studying the attitude construct, and the factor had been named as 'impact'. The factor loading of the variables were 0.710 and 0.744. This factor mainly represents the flipped approach and lower retention of subject in online classes.

4.8 ONLINE LEARNING COMPETENCIES OF STUDENTS

The competency of the students in online learning were analysed and the results presented under the following subheads.

4.8.1 Item analysis of competency of the students in online learning

4.8.2 Z test to find out the significant difference between competencies of UG students and PG students

4.8.1 Item Analysis of Competency of the Students in Online Learning

The item wise responses on competency of the students in online learning were given in Table 4.44. and discussed below

Table 4.44. Item analysis of competency of the students in online learning

(n of UG=180 & n of PG=60)

S. No.	Category	UG (n=180)		PG (n=60)	
		F	%	F	%
1.	Basic knowledge on system operating	147	81.67	60	100.00
2.	Awareness on video conferencing applications	121	67.22	48	80.00
3.	Knowledge on how to join an online meeting	179	99.44	60	100.00
4.	Skill to download an online meeting application	161	89.44	59	98.33
5.	Creating an account in video conferencing application	103	57.22	49	81.67
6.	Share invite link to friends while meeting is going on	136	75.56	54	90.00
7.	Mute my video	168	93.33	52	28.89
8.	Mute my audio	154	85.56	54	30.00
9.	Share the screen in any video conferencing application	143	79.44	58	96.67
10.	Chat and reply in chat box	166	92.22	58	96.67
11.	Reply with symbols in application i.e., claps, thumps up, laughing, shocking, celebration	148	82.22	57	95.00
12.	Share video, animations etc on screen	114	63.33	51	85.00
13.	Fill and submit a google form	162	90.00	59	98.33
14.	Effectively use the whole application in online classes	115	63.89	48	80.00
15.	Aware of every tool in settings of application	80	44.44	39	65.00

*F=Frequency, %= Percentage, UG=Under Graduate, PG=Post Graduate

4.8.1.1 Basic Knowledge on System Operating : Majority of the UG students (81.67%) and cent per cent of the PG students had basic knowledge on system operating.

4.8.1.2 Awareness on Video Conferencing Applications : More than two-third of the UG students (67.22%) and 80.00 per cent of the PG students were aware of video conferencing applications.

4.8.1.3 Knowledge on How to Join an Online Meeting : Greater proportion of the UG students (99.44%) and cent per cent of the PG students know how to join in a meeting.

4.8.1.4 Skill to Download an Online Meeting Application : Majority of the UG students (89.44%) and PG students (98.33%) can download the online meeting application.

4.8.1.5 Creating an Account in Video Conferencing Application : More than half of the UG students (57.22%) and 81.67 per cent of the PG students can create account in video conferencing application.

4.8.1.6 Share Invite Link to Friends While Meeting Going On : More than three-fourth of the UG students (75.56%) and greater proportion of the PG students (90.00%) can share invite link to friends while meeting going on.

4.8.1.7 Mute My Video : Greater proportion of the UG students (93.33%) and PG students (88.89%) can mute my video.

4.8.1.8 Mute My Audio : Majority of the UG students (85.56%) and PG students (90.00%) can mute my audio.

4.8.1.9 Share the Screen in any Video Conferencing Application : More than three-fourth of the UG students (79.44%) and greater proportion of the PG students (96.67%) can share the screen in any video conferencing application.

4.8.1.10 Chat and Reply in Chat Box : Great majority of the UG students (92.22%) and PG students (96.67%) can Chat and reply in chat box

4.8.1.11 I Know How to Reply with Symbols in Application i.e., Claps, Thumps up, Laughing, Shocking, Celebration : Majority of the UG students (82.22%) and PG students (95.00%) know how to reply with symbols in application i.e., claps, thumps up, laughing, shocking, celebration.

4.8.1.12 Share Video, Animations etc on Screen : Less than two third of the UG students (63.33%) and majority of the PG students (85.00%) can share video, animations etc on screen.

4.8.1.13 Fill and Submit the Google Form : Great majority of the UG students (90.00%) and PG students (98.33%) can fill and submit the google form.

4.8.1.14 Effective Use the Whole Application on Online Classes : Less than two third of the UG students (63.89%) and 80.00 per cent of the PG students can effectively use the whole application on online classes.

4.8.1.15 Aware of Every Tool in Settings of Application : Less than half of the UG students (44.44%) and less than two-third of the PG students (65.00%) were aware of every tool in settings of application.

Based on mean and SD, the students were classified into three competency categories namely low, medium and high. The results are presented in Table 4.45. and Figure 4.31.

Table 4.45. Distribution of students according to competency towards online learning

(n of UG=180 & n of PG=60)

S. No.	Category	UG		PG	
		Frequency	Percentage	Frequency	Percentage
1.	Low	29	16.11	12	20.00
2.	Medium	124	68.89	33	55.00
3.	High	27	15.00	15	25.00
	Total	180	100.00	60	100.00
	Mean SD	10.54 2.87		11.82 1.86	

*UG=Under Graduate, PG=Post Graduate

An overview of Table 4.45. and Figure 4.31. revealed that more than two-third of the UG students had medium (68.89%) competency followed by low (16.11%) and high (15.00%) competency in online learning. While more than half of the PG students had medium competency (55.00%), followed by high (25.00%) and low (20.00%) competency in online learning. The results are in conformity with that reported by Azimi (2013), Selvaraj (2019) and Rana (2021).

The findings revealed that majority of the respondents were observed to have medium competencies. But the proportion of the respondents having high competencies were more in case of PG students than compared to UG students as PG students have additional works with computers and laptops. Age and degree of study are not barriers for gaining competencies. Interest, inclination in operating the electronic devices and software could be accounted for their competencies.

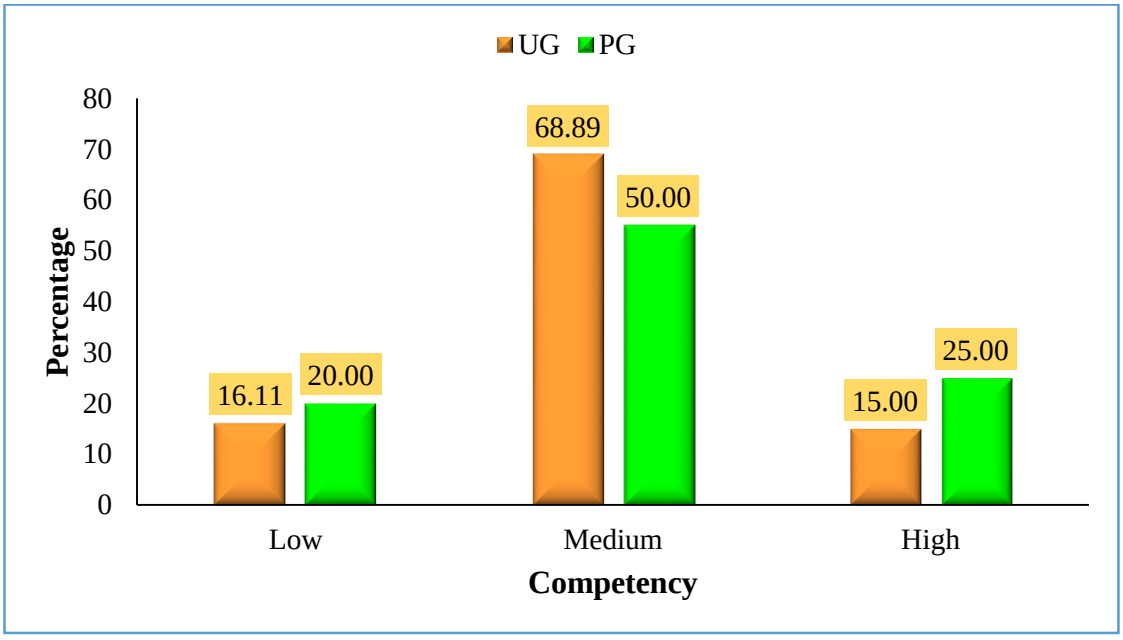

Fig. 4.31. Distribution of students according to competency in online learning

4.8.2 Z Test to Find out the Significant Difference between Competency of UG Students and PG Students

In order to find out the significant difference between competency of UG students and PG students, Z-test was calculated for two sample means and the values were presented in Table 4.46.

Testing of hypothesis

Null Hypothesis (H_0):

H_0: There is no significant difference between the competency of UG and PG students

Empirical Hypothesis (H_1):

H_1: There is significant difference between the competency of UG and PG students

It is evident from Table 4.46. that Z test value (-0.06) is in the range of Z critical value (-1.96 to 1.96) at 5% level of significance (p=0.95). Therefore, null hypothesis (H_0) is accepted. It indicates that there is no significant difference between competency of UG and PG students.

Table 4.46. Z-test to find out the significant difference between competency of UG and PG students in online learning

(n of UG=180 & n of PG=60)

S. No.	Categories	Mean	SD	'Z' value	p
1.	Competency of UG students	10.88	2.78	-0.06 ^{NS}	0.95
2.	Competency of PG students	10.90	2.51		

NS=Non significant at 0.05 level of significance, UG=Under Graduate, PG=Post Graduate

4.9 CONSTRAINTS IN ONLINE LEARNING AS PERCEIVED BY THE STUDENTS

The constraints reported by UG students as presented in Table 4.47. and Figure 4.32. that lack of knowledge on effective use of online apps (Rank I), followed by internet connectivity issues (Rank II), problem with application compatibility with ICT tools (Rank III), lack of expertise and skills in using the apps (Rank IV), unfavourable learning environment (Rank V), online learning is time consuming (Rank VI), lack of uninterrupted power supply (Rank VII), health issues like eyes strain, body pains etc., (Rank VIII) and expensive (Rank IX). The constraints reported by PG students were unfavourable learning environment (Rank I), followed by lack of knowledge on effective use of online apps (Rank II), lack of expertise and skills in using the apps (Rank III), problem with application compatibility with ICT tools (Rank IV), online learning is time consuming (Rank V), internet connectivity issues (Rank VI), lack of uninterrupted power supply (Rank VII), expensive (Rank VIII) and health issues like eyes strain, body pains etc., (Rank IX). The results are in conformity with that reported by Tagoe (2012), Abramenka (2015), Ullah et al. (2017), Amita (2020) and Muthuprasad *et al*. (2021).

The problems perceived by UG and PG students differed in terms of ranking. UG students perceived that the prime problem in online education was the lack of training in use of video conference applications along with internet problems. While the PG students perceived the prime problem was unfavourable learning environment which they usually get in the college environment. A good learning environment is available to PG students in library and department which they felt was missing in online learning. The administration should consider these problems and their priority to make online learning more interesting to the students.

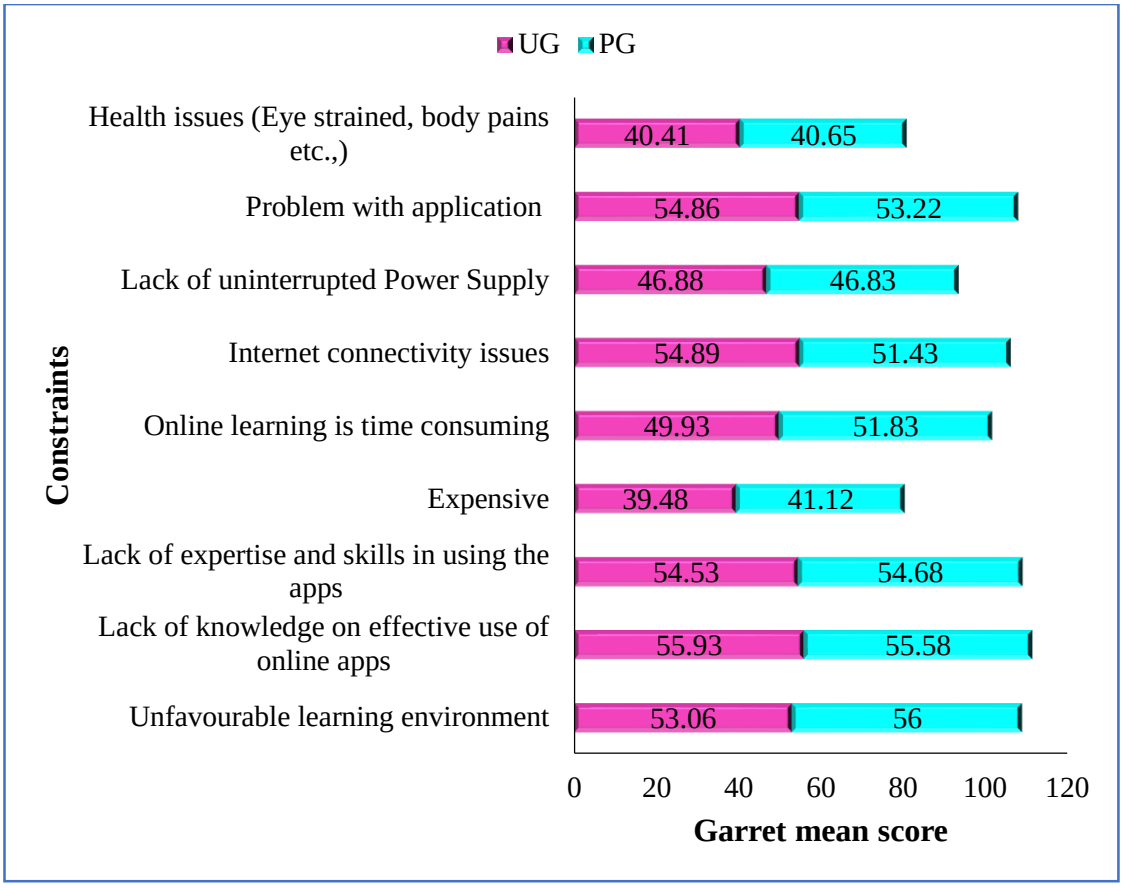

Fig. 4.32. Distribution of UG and PG students based on ranking of constraints using garret mean score

Table 4.47. Distribution of UG and PG students based on ranking of constraints using garret mean score

(n of UG=180; n of PG=60)

S. No.	Constraint	Students	I	II	III	IV	V	VI	VII	VIII	IX	TGS	GMS	Rank
1	Unfavourable learning environment	UG	2187	1173	992	1736	1500	660	646	372	285	9551	53.06	V
		PG	648	552	496	560	650	176	190	31	57	3360	56.00	I
2	Lack of knowledge on effective use of online apps	UG	1863	2415	2108	896	900	792	532	372	190	10068	55.93	I
		PG	810	414	682	392	250	528	152	31	76	3335	55.58	II
3	Lack of expertise and skills in using the apps	UG	1458	2001	2046	1232	1000	792	646	527	114	9816	54.53	IV
		PG	243	1035	620	280	500	220	190	155	38	3281	54.68	III
4	It is expensive	UG	405	414	930	1120	1000	616	722	930	969	7106	39.48	IX
		PG	324	414	310	168	100	264	266	279	342	2467	41.12	VIII
5	Online learning is time consuming	UG	1539	1518	682	1400	1300	792	646	806	304	8987	49.93	VI
		PG	648	345	434	504	450	220	228	186	95	3110	51.83	V
6	Internet connectivity issues	UG	2349	1587	1302	1288	800	1364	760	279	152	9881	54.89	II
		PG	567	414	434	504	250	396	228	217	76	3086	51.43	VI
7	Lack of uninterrupted Power Supply	UG	1458	897	1054	616	900	1188	1140	806	380	8439	46.88	VII
		PG	243	345	310	392	350	352	494	248	76	2810	46.83	VII
8	Problem with application compatibility with ICT tools	UG	2673	1587	1550	896	1100	792	608	403	266	9875	54.86	III
		PG	1053	276	310	392	250	220	418	217	57	3193	53.22	IV
9	Health issues (Eye strained, body pains etc.,)	UG	567	828	496	896	700	968	1140	899	779	7273	40.41	VIII
		PG	324	345	248	168	200	264	152	434	304	2439	40.65	IX

*TGS=Total Garret Score, GMS=Garret Mean Score, UG=Under Graduate, PG=Post Graduate

4.10 STUDENT SATISFACTION WITH ONLINE LEARNING

It is evident from Table 4.48. and Figure 4.33. that more than one-third of the UG students were satisfied (34.45%) followed by very much dis-satisfied (8.33%), undecided (7.78%) while 49.44 per cent of them dis-satisfied with online learning. Less than half of the PG students were satisfied (48.33%), followed by dis-satisfied (26.67%), very much dis-satisfied (13.33%), undecided (11.67%) and none of UG students and PG students were very much satisfied (0.00%) with online learning. The results are in conformity with that reported by Jyothi *et al.* (2011b), Cole *et al.* (2014), Madhumita (2016), Selvaraj (2019) and Coman *et al.* (2020).

Table 4.48. Distribution of the students based on their satisfaction with online learning

S. No.	Category	UG (n=180)		PG (n=60)	
		F	%	F	%
1	Very much Satisfied	--	--	--	--
2	Satisfied	62	34.45	29	48.33
3	Undecided	14	7.78	7	11.67
4	Dis-satisfied	89	49.44	16	26.67
5	Very much dis-satisfied	15	8.33	8	13.33

*F=Frequency %= Percentage UG=Under Graduate PG=Post Graduate

Many of the respondents were satisfied with online classes understanding that online classes are an alternate to in-presence classes during covid-19 pandemic situation. However, some of the students expressed dis-satisfaction as there is no sense of friendship or relationship between the students that would usually be built in traditional in-person classes. Without in-person interactions with professors and classmates, students at times struggle to focus in class and refrain from asking questions. Reading in library environment is lost. Staying after classes to meet professors allows students to ask more questions to seek more answers. Students like to be on campus for studies.

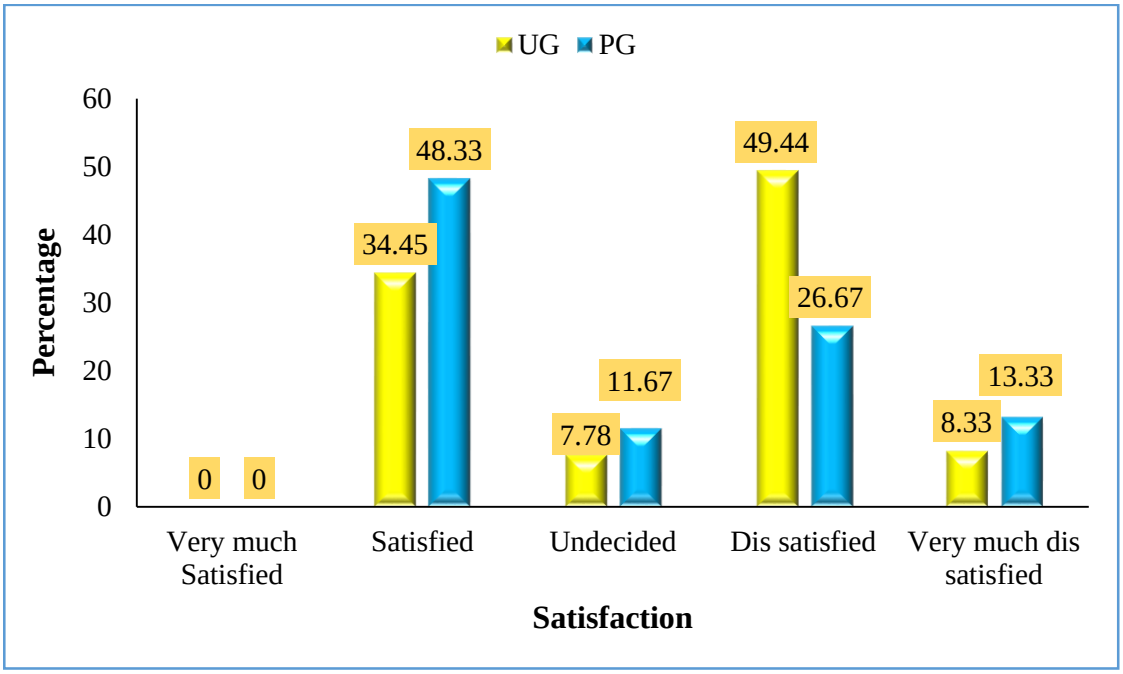

Fig. 4.33 Distribution of the students based on their satisfaction with online learning

4.11 BEST PRACTICES IN ONLINE TEACHING AND LEARNING

The best practices in online teaching and learning were documented separately and listed below.

4.11.1 Best Practices in Online Teaching

1. Training

Pandemic has made the sudden transition of education system from traditional to virtual learning. As it is new to everyone, teachers should get acquainted with the technology. Take your time to familiarize yourself with the technology. Now a days many institutes are offering training programmes. Attend the training programmes and utilise it in teaching.

2. Improving Student Engagement

Use technology to enhance and activate the learning experience. During synchronous class meetings, use polls to determine the students understanding of the subject before moving to another topic so that teachers can modify their teaching approach accordingly. Integration of synchronous and asynchronous

instructional opportunities can improve the student engagement in online education. Frequent interactions with the students and teachers with short time gaps, asking their views individually. It is difficult to ask every individual if class strength is more. So, try asking randomly to few persons daily by calling their names or ID number or keep the gallery view in Videoconferencing application and check the students who are not showing interest and name them. In order to grab the attention of the students, teachers should make the lesson interesting by using different media like video, animation, showing live experiments whichever possible. It also increases the teaching and learning efficiency. Group discussions can be arranged online by creating small groups and providing them with separate Id, use of breakout rooms available in videoconferencing application to engage the students in online classes.

3. Course Design

Setting up the clear course outline and objectives of the course. Clarity, consistency, and simplicity of course design effect the students perceived learning in online courses. To deliver the lecture in an effective way, teachers should use different media like video, animation etc and each lecture should be divided into sub topics for simple for clear and easy understanding. Learning material could be a video or text document or an animation or any other things which should make the student engage with the course. Use real life examples, create familiar situations which helps to maintain the focus of the student in class and also improve their knowledge retention. Arrange weekly virtual meetings so that students have the opportunity to ask questions as needed. Record the class while in live or later and provide the recorded classes to the students. So, it helps to revise the lesson whenever needed and few students who are unable to attend due to network issues can view the video. Teachers should provide scaffolding and reminders for major assignments. Assess the quality of the course using a rubric.

4. Accessible

Teacher should clearly mention the available timing to contact him for any queries, advices etc and also the media through which the teacher will be available. for example, email, WhatsApp, call, text message etc., Then the students know when to contact and how best to contact the teacher. Additionally, educational researchers have found that a teacher's immediacy of response can lessen the psychological distance between teachers and their students, leading to greater learning.

5. Online Etiquettes

Establish norms for student behaviour and interaction to ensure that communication will maintain a positive and professional tone. Make sure that students maintain online etiquettes while in class or meeting like turn on video while speaking, presenting and mute audio while listening, raise hand symbol before talking etc., Teacher should find one effective online platform and stick to it.

6. Innovative

As online education does not support more interaction between faculty and student and between the students. At the start of the class, incorporate ice breaking sessions, so that students get to know one another, interaction is increased. Use of breakout rooms for discussions may increase their comfort, communication skills, knowledge. Using Captioning and live transcription during online teaching for better understanding to the students. Assigning creative assignments and projects individually or group like growing any plants, preparing models of agricultural implements with the available resources. For group projects, teacher can guide the students to schedule their online meeting and discuss about it. Teachers encourage the students to use non-verbal communication such as emojis. Many claimed that practicality is missing in online teaching and learning. So, teachers can try to show the possible live experiments, demonstrations at their place or videos already available on internet.

7. Active Online Presence

Building community is especially important in an online course where it can be easy for students to feel disconnected. So, before starting the first class, turn on the video and welcome the students with a brief account on yourself, your bio and provide the course information so that students have the opportunity to get to know you and your expertise. Establish the positive tone and build excitement for the start of the term. Ask questions that empower participants to question each other, and elicit rich discussion. Every student is given an opportunity to talk to improve their communication skills. To improve their technical skills, teachers assigned few presentations, video making tasks etc.

8. Query Box

Teachers should encourage the students to use the live chat in video conferencing application. At the end of the session i.e., atleast before 10-15 minutes, teacher should clear the doubts of the students posted in the chat box. Along with synchronous (Video conferencing), non-synchronous tools like WhatsApp and other social media can be used to communicate and clear the queries. By posting the questions in the WhatsApp group and the teacher can answer it there, that chat can be long lasting and can review whenever needed. Additionally, use specific examples familiar to students to clarify doubts, it helps them to remind for long.

9. Assess Student Performance

Teacher should actively monitor the students for the progress. To ascertain the subject understanding by students, teachers made the students to explain the key points at the end of the lecture. Google forms used to evaluate the student performance. Google form with simple questions of daily lectures created and shared to students to submit in few minutes after the class or write down atleast 5 to 10 key points of a lecture on a paper or google form and submit.

10. Feedback

One of the most important tasks of the instructor is providing prompt and effective feedback that guides the learner to a greater understanding of course content and improves student engagement. Feedback allows students to assess their existing knowledge and what they still need to learn and improve for future work. Teacher should give positive feedback first later constructive feedback, which encourage the students to learn more.

4.11.2 Best Practices in Online Learning

1. Create an Organised Study Space

A better study space is very important as it is helps to maintain concentration and maximise the learning efficiency. Make sure to keep all the essentials such as your laptop or mobile, headphones, notes, pen and pencil, water bottle and snacks at the study space. It can be anywhere that helps the learner to focus whether at a dining table, balcony, room etc., Never try to do anything productive while lying or sitting on bed or anything associated with relaxing or sleeping, obviously it will decrease your productivity and limit your focus so do your work at a proper study desk every single time. Select a space with good ventilation, quiet, clean to comfortably sit and keep the gadget straight to the face.

2. Time Management

Be prepared to join your online class a few minutes before it starts so that you can make sure your audio and video are working or any network issues so that u can switch to other place. Maintain punctuality in joining the class, submission of assignments etc., Manage the time to participate in online class and writing notes, complete assignments in time.

3. Eliminate Distractions

While attending the online classes in your gadgets like mobile, laptop, personal computer, the notifications from social media apps and other websites and calls may distract your attention. So, it would be better if you mute those app

notifications, block the websites and keep the mobile in do not disturb mode during online classes. By this you can focus your online classes very well now.

4. Maintaining Notes

Create a proper system for taking notes like it should cover the main concept of the lecture, provide space at one side and write down the queries and points to be discussed. At the end you can write the summary and key points for quick revision to next day lecture or exams. If you are interested you can also write anticipated questions for exams. Notes should be brief and clear without wasting much time on unimportant points. Making notes with different colours, figurative shortcut notes help to memorise easily.

5. Recording the Online Lectures

For few students, it may be difficult to take notes very fast and might miss few important points, then it is better to record the class and later check the points missed in your notes and it also improves retention of the subject.

6. Active Participation

Participate in the group discussions, speak up interact with the teachers and students actively. If you have a question, ask for clarification. Be proactive and don't hesitate to ask the teacher to repeat the topic which was not clearly understood. Don't keep the questions with you by assuming answers. Don't be shy to ask verbally to a teacher, if a person feeling shy to ask, then live chat box can be used.

7. Take Breaks

Studying for long hours in online can exhaust the students and easily lead to frustration and health issues like strain on eyes, neck pain etc., It is important to take breaks to feel refresh and recharge yourself. So, take a break from gadgets, do relaxation exercise, meditate, talk to friends and family, go for walk, play few games, do something fun like watch tv for a few minutes check out social medias etc.

8. Self-motivation and Accountable

In a traditional classroom setting, naturally a learning environment was created, which motivates the students to focus and study. But in online education, feels isolated. So, students should motivate intrinsically to concentrate, study hard by creating a good learning environment around them without any distractions, listening to music, doing their creative things. Staying positive and motivated is necessary to enjoy studying. Be accountable for your own work and writing and submission of assignments. Schedule the time table for everyday routine and follow it to achieve the desired goals.

4.11.3. Institutional Interventions

Institutional infrastructure and internet facilities should be provided to all teachers. Establishing the smart class room with an available expert to operate. So, every teacher can utilise the different media and technology to make the students meet their learning objectives.

University should develop Learning Management System (LMS) with all the required features. LMS with face recognition attendance system should be developed as manual method of attendance by teacher is a time-consuming process. Maintaining the recorded lectures and learning material in the application. Include short quizzes to assess learner comprehension of material. Curriculum should be developed by incorporating ICT based lectures. Institute should provide trainings on ICT to students and teachers to enhance their technical skills.

Learning Management System (LMS)

A learning management system is a software application or a website where course material can be uploaded, stored, organised, provide place to interact between teacher and student, take live classes and assessment can be given by self-marking quizzes and assignments. It should consist of following features:

1. LMS can be accessible only those people with a log-in will be able to access. Log-in access can be provided to teachers to assign work, check the progress of students' performance, answer the queries, interact with the students and provided to the students to access the courses, learning material, videos, quizzes and assignments, interact with the teachers, post the queries and to the administration to maintain the LMS with update tools, videos, course content, user information.

2. Through LMS it can be able to conduct synchronous online classes.

3. LMS should be an easy process to access and use everything without any complicated procedures.

4. LMS should be compatible with computer, laptop, tablet and smartphone.

5. It should also have a tracking facility of how frequent the user has logged in, who completed their works.

6. Course designed according to learning objectives with a well-supported video for each course.

7. Learning material, recorded classes, quiz and discussion boards should be made available to all teachers and students.

8. Face recognition attendance system that automatically records the student attendance only when the student turns on the video.

9. Additionally, LMS should include advanced encryption features to make sure the data and content remain secure.

Flipped Approach

Due to pandemic, traditional classroom is transformed into fully online. Even after the normalcy is restored. Online education is here to stay. Online education can be mixed with traditional learning as a blended or flipped approach method. In this method teachers deliver the lectures online, reading material is also provided and its application activities is to be done offline in classes by interacting and discussion. It helps to reduce the wastage of time on theoretical part and spend more time on practical part which in turn increases the communication skills and course skills. By this method, students understand the

topic in depth before they attend offline classes at college. It helps in engaging students with learning material and pre-recorded videos provided. It improves the student academic performance.

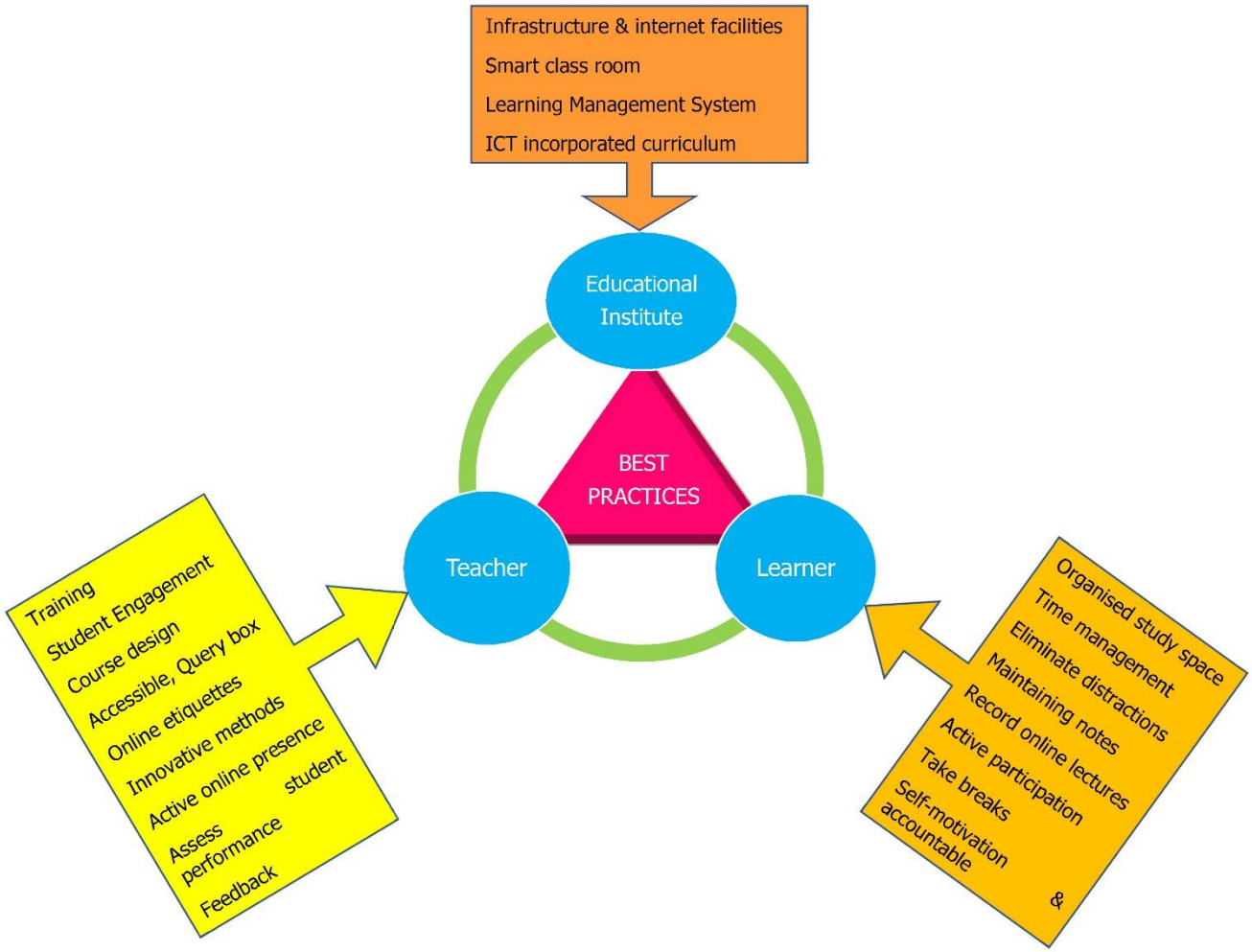

Fig. 4.34. Schematic representation of best practices for effective online teaching and learning

Chapter – V

Summary and Conclusions

Chapter V

SUMMARY AND CONCLUSIONS

This chapter presents the summary of the findings, implications of the study and suggestions for future research.

The COVID-19 pandemic has resulted in closure of schools and colleges for months together across the world. As a result, education has changed spectacularly, with the distinctive rise of online education, whereby teaching is undertaken remotely and on digital platforms. In response to significant demand, many online learning platforms are offering free access to their services. The educational institutions round the globe are utilizing these digital platforms to educate their students. Even Acharya N G Ranga Agricultural University, Andhra Pradesh is reaching the students with synchronous online education where teacher and students meet online at a predetermined time at virtual interface for educational purpose. We cannot estimate how long this pandemic situation would continue and how long the educational institutions will remain locked. Online education is an alternate to face to face education which has come to the rescue. So, it has to be strengthened to make education interesting to the students.

At this juncture, a study entitled **"**Analysis of Online Teaching and Learning by the Teachers and Students of Acharya N G Ranga Agricultural University – An Exploratory Study" was planned and conducted with the following objectives.

5.1 OBJECTIVES OF INVESTIGATION

1. To study the profile of teachers and students involved in online teaching and learning

2. To study the attitude of teachers and students towards online teaching and learning

3. To map the online teaching and learning competencies of teachers and students

4. To document the best practices and enlist the constraints in online teaching and learning as perceived by the teachers and students

After the thorough review of literature, discussion with the expert team the variables for teachers included age, gender, educational qualification, designation, department, teaching experience, previous experience in online teaching, training undergone in online teaching, video conferencing app used, possession of electronic device and internet connectivity for online teaching, frequency of using electronic devices, number of hours spent per week in preparation for online teaching and for teaching, attendance of students in class, type of learning material, time of sharing learning material, meeting ID used for online classes, frequency of using audio-visual aids, attitude towards online teaching, competencies for online teaching, satisfaction with online teaching were studied.

The variables for students included age, gender, background, secondary school education, type of family, parent occupation, academic performance, possession of electronic device and internet connectivity for online learning, frequency of using electronic devices, number of hours spent per week in online learning, attitude towards online learning, competencies for online learning, satisfaction with online learning.

5.2 REVIEW OF LITERATURE

Keeping in view the above objectives, the relevant literature on various aspects was collected and reviewed with the results of the present investigation.

5.3 RESEARCH DESIGN

Exploratory research design was used for carrying out the study.

5.4 SAMPLING PROCEDURE

The study was conducted in Andhra Pradesh state during the year 2020-2021. Acharya N. G. Ranga Agricultural University was selected purposively as the researcher is studying in this university. Two Agricultural Colleges *viz.*, Agricultural College, Bapatla and S V Agricultural College, Tirupati were selected for the study. From each of the selected Agricultural College, 30 teachers, 30 Post Graduate students and 90 Under Graduate students (30 each from 2^{nd}, 3^{rd} and 4^{th} year B. Sc. (Hons.) Agriculture) involved in online teaching and learning were selected using simple random sampling procedure, thus making a total sample of 60 teachers, 60 Post Graduate students and180 Under Graduate students.

5.5 COLLECTION OF DATA

The data was collected by administering a well-structured online questionnaire separately for both teachers and students. Questions were framed in simple language. Google form link along with covering letter has been sent to respondents through email and whatsapp and further personally contacted on mobile to build rapport and convince them about the purpose and importance of the study. To convert the data into meaningful findings the statistical tools namely mean, standard deviation, frequency, percentage, category interval method, Z-test, factor analysis and garret ranking were used.

5.6 THE SUMMARY OF THE FINDINGS ARE PRESENTED AS FOLLOWS

5.6.1 Profile of Teachers

- Less than two-third of the teachers were observed in middle (60.00%) age group, were male (58.33%), completed Ph. D (91.67%), were professors (48.33%), had teaching experience of ≥12 years (73.33%).

- Less than one-fourth of the teachers had previous experience in online teaching (18.33%), only 16.67 per cent had undergone training in online teaching for more than one week.

- Two-third of the teachers used Zoom (66.67%) as video conferencing application in online teaching, cent per cent of the teachers possess smart phones followed by office computer (70.00%).

- Three-fourth of the teachers had access to good internet connectivity (75.00%) and 63.33 per cent had sufficient internet data & speed.

- More than half of the teachers often used personal laptop (53.33%) for online teaching.

- Less than half of the teachers spent 8-12 hours per week in preparation for online teaching (43.33%). Less than half of the teachers spent 13-16 hours per week in online teaching (46.67%).

- More than one-third of the teachers reported that attendance of students was 80-89% (38.33%). More than half of the teachers shared learning material as PPT and word (55.00%) and half of the teachers shared reading material immediately after the class.

- Less than three-fourth of the teachers used official meeting ID (70.00%) for online classes. Greater majority of the teachers used PPT (98.33%) regularly for online classes.

5.6.2 Attitude of Teachers towards Online Teaching

- Less than two-third of the teachers had medium favourable attitude (65.00%), followed by high (21.67%) and low (13.33%) attitude.

- By applying factor analysis for attitude of teachers towards online teaching, six major factors were extracted having Eigen value greater than one which were explaining a total variance of 69.17 per cent towards the attitude of teachers.

5.6.3 Competency of Teachers in Online Teaching

- Less than two-third of the teachers perceived as medium (61.67%) competent, followed by low (20.00%) and high (18.33%) competent in online teaching.

5.6.4 Constraints in Online Teaching as Perceived by the Teachers

- The constraints reported by teachers were problem with application (Rank I), followed by lack of expertise and skills (Rank II), internet connectivity issues (Rank III), lack of infrastructure facilities in department (webcam, laptop, headphones, etc) (Rank IV), lack of student's response (Rank V), increased workload (Rank VI), heath issues (eyes strained, body pain, etc) (Rank VII) and students' login all through the class (Rank VIII).

5.6.5 Teachers Satisfaction with Online Teaching

- Less than two-third of the teachers were satisfied (60.00%), followed by dis satisfied (28.33%), very much dis satisfied (6.67%), undecided (5.00%) and none of them were very much satisfied with online teaching.

5.6.6 Profile of Students

- More than half of the UG students (54.44%) and PG students (63.33%) of the belonged to 20-25 years age group. More than two-third of the UG students (68.89%) and PG students (58.33%) were female.

- More than half of the UG students (59.00%) and PG students (46.67%) belonged to rural background. More than three-fourth of the UG students (77.22%) and PG students (83.33%) completed their secondary school education in private school.

- Majority of the UG students (84.44%) and PG students (83.33%) were from nuclear families. More than one-third of the UG students (38.33%) and PG students (40.00%) parental occupation was farming.

- More than half of the UG students (58.89%) and PG students (43.33%) per cent secured 8.1-9.0 grade point. Greater proportion of the UG (96.11%) students and PG students (98.33%) possess smart phone.

- More than half of the PG students had access to good internet connectivity (56.67%) while 42.78 per cent of the UG students had access to good internet connectivity. Less than half of the PG students had sufficient internet data (46.67%) while 40.00 per cent of the UG students had sufficient internet data.

- Greater proportion of the UG students often (92.78%) used smart phone for online learning, followed by laptop (5.00%), tablet (3.33%) and personal computer (2.22%). Greater proportion of the PG students often (90.00%) used smart phone for online learning, followed by laptop (48.33%) and equal proportion of 5.00 per cent each used tablet and personal computer.

- Less than half of the PG students spent 9-18 hours per week (48.33%) in online classes. While 41.67 per cent of the UG students spent 19-28 hours per week in online classes.

5.6.7 Attitude of Students towards Online Learning

- More than three-fourth of the UG students had medium favourable attitude (79.44%). While 73.33 per cent of the PG students had medium favourable attitude.

- It was evident from the Z test that there exists a significant difference between the attitude of UG and PG students. Considering the mean, it can be interpreted that PG students (Mean=55.47) had high attitude towards online learning than UG students (Mean=48.93).

- By applying factor analysis for attitude of students towards online learning six major factors were extracted having Eigen value greater than one which were explaining a total variance of 58.84 per cent towards the attitude of students.

5.6.8 Competency of Students in Online Learning

- More than two-third of the UG students perceived as medium (68.89%) competent while 55.00 per cent of the PG students perceived as medium competent in online learning.

- It was evident from the Z test that there exists no significant difference between the competency of UG and PG students.

5.6.9 Constraints in Online Learning as Perceived by the Students

- The constraints reported by UG students were lack of knowledge on effective use of online apps (Rank I), followed by internet connectivity issues (Rank II), problem with application compatibility with ICT tools (Rank III), lack of expertise and skills in using the apps (Rank IV), unfavourable learning environment (Rank V), online learning is time consuming (Rank VI), lack of uninterrupted power supply (Rank VII), health issues like eyes strain, body pains etc., (Rank VIII) and expensive (Rank IX). The constraints reported by PG students were unfavourable learning environment (Rank I), followed by lack of knowledge on effective use of online apps (Rank II), lack of expertise and skills in using the apps (Rank III), problem with application compatibility with ICT tools (Rank IV), online learning is time consuming (Rank V), internet connectivity issues (Rank VI), lack of uninterrupted Power Supply (Rank VII), expensive (Rank VIII) and health issues like eyes strain, body pains etc., (Rank IX).

5.6.10 Student Satisfaction with Online Learning

- Less than half of the PG students were satisfied (48.33%) with online learning. While 34.44 per cent of the UG students were satisfied with online learning.

5.6.11 Best Practices in Online Teaching and Learning

- Create an organised study space, active participation, eliminating distractions, recording the online lectures, maintaining notes, taking breaks in between the classes, managing the time for all works, intrinsic motivation and accountable in online classes were documented as best practices in online learning.

- Training on digital tools, improving student engagement by interacting and using different techniques, designing of course, easy access to students, developing online etiquettes, innovative teaching methods, active online presence, clear the queries fast with lively examples, assess student performance timely and providing feedback were documented as the best practices in online teaching.

- Providing institutional infrastructure and internet facilities, trainings on ICT, establishing the smart class room, utilization of the different media and technology to meet their learning objectives. University should develop Learning Management System (LMS) with all the required features like face recognition attendance system, quizzes, maintaining the recorded lectures and learning material. Curriculum should be developed by incorporating ICT based lectures were the institutional interventions in online teaching and learning.

5.7 IMPLICATIONS OF THE STUDY

1. The findings provide an insight into current situation in online teaching and learning which would aid the administration to take necessary measures to enhance the quality of online education.

2. Many teachers and students reported problem in using video conferencing application. Hence measures need to be taken by the university to design and develop user friendly institutional video conferencing application. This application could be used to upload learning materials and other circulars for students. User friendly institutional apps creates safety and privacy.

3. Pre and post evaluation of every class on google forms need to be conducted by the teachers. By way of pre and post evaluations the gap filled by the online classes could be assessed, it further also says the topics to be revised.

4. Majority of the students were from rural background and may not have good network connection. Hence, teachers can provide recorded video lectures to them. Link for recorded presentation may also be given to view later. This also allows students to access the learning material at a time of their comfort. At times when it is not possible for students to attend the online class may be due to connectivity problem or other reasons the links for recorded presentations can be viewed by the students to cover the missed classes further it also helps the average and below average students to access the presentations again and again to gain perfection.

5. Teachers should take steps to include recap and posting of upcoming classes in every class to improve knowledge retention of students and to keep up their interest.

6. Majority of the teachers have not received trainings in ICT and had no prior experience in online teaching, hence efforts should be made to plan and conduct need based and related training programmes to expand their own knowledge and proficiency in computer usage, ICTs and e-learning technologies.

7. Only half of the teachers share learning material after the class. But it would be better if all the teachers share the learning material after the students submit their daily quiz after the class. So that the students check their mistakes immediately and helps to remember for long.

8. Teachers can assign different types of assignments to involve them in the course like preparation of models etc. It helps to explore more about the subject, improve the creative skills of the students. Send them follow-up emails and reminders of the assignments.

9. Majority of the teachers and students felt that online teaching and learning lacks practical component. Hence, teachers can make videos with technical support provided by the institution. Institute should hire technical experts for making videos. Teachers can also show live demonstrations online whatever possible with available resources.

10. Many of the teachers felt that they are disconnected with students and majority of the UG and PG students also felt that they are disconnected with their classmates. Hence, teachers can start the class with few ice breaking, puzzles, funny jokes. It creates a sense of community and make the students feel free, interact, active and stay connected in the class.

11. Greater proportion of the teachers are using social media like whatsapp for discussions along with chat box. Use of asynchronous tools like Whatsapp, email can help to interact with each other regarding subject. Email reminders can be used for assignments and quiz activities. Chat groups should be made a compulsion in every subject to promote interaction among the participants. Multiple communication tools may be used to reach students.

12. This study also helps to identify the factors which influence the attitude of a teacher and student towards online teaching and learning by performing factor analysis. Both teachers and students showed medium favourable attitude. Therefore, teachers and students need to be exposed to more effective online teaching and learning technologies to improve their attitudes.

13. It is evident from the study that majority of the teachers and students had medium competencies in using digital platforms, so educational institutes should come up with trainings and workshops in enhancing the competencies of a teacher and students.

14. University should utilise the e-learning technologies and arrange guest lectures from experts around the globe. It helps to explore the opportunities and enhance the learning process.

15. Every course should have well supported videos to supplement practical experience of students for which teachers need to be provided with necessary infrastructure and training. Technical expert support is needed to maintain the LMS and to prepare the video lessons with an appropriate faculty with a catchy voice and interesting ways of teaching to grab the attention of the students.

16. Feedback should be mutual. Teachers should assess student performance and give feedback to them in the same way, teachers can take feedback from the students about their views on the teaching methods. It will help the teacher to improve their teaching techniques.

17. Majority of the students use smart phone to access online classes as it is affordable and handy. But it is difficult to study from mobile for hours daily which lead to health issues and lose interest. So, University should plan to provide laptops to the students at lower rate.

18. Majority of the teachers, UG and PG students agreed online teaching and learning is supplementary to traditional learning. So, the educational institution can plan for flipped approach method/ blended method of education even after normalcy restored. Flipped approach method is the combination of traditional and online method. It includes the delivery of the lecture online and application activities are done in classroom.

19. Classes should be interactive. Teacher should take care to value every student in the class may be by calling them with their names, etc.

20. Establishment of smart classroom with a technical expert to arrange classes for all departments. All the faculty can utilise this advanced smart class at one place to deliver the lectures efficiently.

21. The use of chat box in online classes should be promoted by the teacher. Posing questions in chat box by the students should be encouraged. At the end of each class the questions posted should be readout by the teacher and answers may be given.

22. Sharing of real time stories as examples, regular week end assignments, and regular practice exercises to improve skills also can retain the interest of the students in online classes.

23. There should be a class facilitator and screen sharing be given to teacher this allows the teacher to manage time and concentrate on teaching rather than admitting the participants and keeps away from other distractions from internet.

24. Although two-third of the teachers used zoom video conferencing application for online teaching. Majority of the teachers perceived problems with application as the major constraint in online teaching. Majority of the teachers did not provide recorded lectures to the students, as it is difficult to share without any platform and majority of the students use mobile phone to assess online classes. To resolve these problems, administration can develop a Learning Management System.

A learning management system is a software application or a website where course material can be uploaded, stored, organised, provide video conferencing, a place to interact between teacher and student, tracked and assessment can be given by self-marking quizzes and assignments.

LMS can be accessible only those people with a log-in will be able to access. Log-in access can be provided to teachers to assign work, check the progress of students' performance, answer the queries, interact with the students and students to access the courses, learning material, videos, quizzes and assignments, interact with the teachers, post the queries, administration to maintain the LMS with update tools, videos, course content, user information.

25. Majority of the students and teachers used mobile phone for online teaching and learning. LMS should be compatible with computer, laptop, tablet and smartphone.

26. Greater majority of the student mute their video in online classes. Teacher can't understand whether student listening to the class and able to understand. So, face recognition attendance system should be developed in LMS which automatically records the student attendance only when student turn on their video for minimum 20 minutes and teachers should make the students interact at the end of the class by turn on their video. Teachers should inform the students that it will be considered for internal evaluation.

27. Majority of the teachers expressed difficulty in evaluating the performance of the students and only a few teachers used google forms to give tests. Teachers have to continuously evaluate the students to make them stay connected to the class. Teachers can evaluate the student by conducting quiz at the end of the class, oral or written test or to write key points and submit in last 5 minutes of the class. Teachers should inform the students that these tests will add to their internal marks. An assessment tool like rubric can be created for online assignments and quizzes. Rubric is an assessment tool to evaluate the works of the students. It is created based on certain criteria and scoring is given. It helps the students to know the scoring criteria in turn helps to improve the performance.

28. Some proportion of teachers and students were observed in the categories representing dis-satisfaction towards online teaching and learning. Efforts should be made by the university to rectify the problems and increase the satisfaction levels of the teachers and students.

29. Students perceived lack of knowledge on effective use of online apps and internet connectivity issues as the major constraints in online learning. Hence steps need to be taken to solve their constraints.

30. For merit and sincere students in online classes digital appreciation certificates should be given by the teachers to motivate and retain their interest in online classes for longer period of time.

5.8 CONCLUSION

Due to the covid-19 pandemic, the educational institutions suddenly changed the educational system from traditional to completely online. We cannot predict when the normalcy would be seen. Online learning is here to stay even in future. Although online education benefits in many ways, there are some concerns that need to be identified and rectified. As online education is alternative to face-to-face education. So, the educational institutes have to make every effort to resolve the issues by suitable interventions and enhance the quality of online teaching and learning.

Therefore, online education may be provided as a flipped approach i.e., in combination with traditional offline classes. Integrating curriculum with online activities, lectures. So, all the educational institutes need to be prepared to change their curriculum accordingly by shifting some of the course content to e-learning. Online course content should be prepared by the teachers. In order to enhance the learning experience, teachers should use different media to make the subject easy and more understandable. Teachers should think innovatively in delivering the lectures and in giving assignment and students should utilize the modern technologies to improve their academic performance.

5.9 SUGGESTIONS FOR FUTURE RESEARCH

1. As there was scarce literature on online teaching and learning exploratory study was conducted. In future ex-post facto research design may be adopted and relationship between independent and dependent variables may be worked out.

2. Exclusive case study approach may be followed to get in depth information.

3. Advanced statistical tools can be used to find out factors affecting the implementation of e-learning technologies and relationship between variables for obtaining meaningful research.

4. Research studies may be taken on flipped approach method of education.

5. Studies on e-learning technologies may be conducted.

6. Impact of online education on student's academic performance may be taken up.

7. Critical studies on the effectiveness of online education could be organised

8. Similar studies may be undertaken in other state agricultural universities or in other disciplines. So that the results obtained can be generalized to a greater extent.

9. The study was conducted considering only limited sample size based on time limit. Similar studies may be conducted with larger samples covering more areas.

Literature Cited

LITERATURE CITED

Abbasi, S., Ayoob, T., Malik, A and Memon, SI. 2020. Perceptions of students regarding E-learning during Covid-19 at a private medical college. *Pakistan Journal of Medical Sciences*. 36(COVID19-S4): COVID19-S57-S61.

Abdullah, M. S and Toycan, M. 2018. Analysis of the factors for the successful e-learning services adoption from education providers' and students' perspectives: A case study of Private Universities in Northern Iraq. *Eurasia Journal of Mathematics, Science and Technology Education*. 14 (3): 1097-1109.

Abramenka, V. 2015. Students' Motivations and Barriers to Online Education. *M. Sc (Ag.) Thesis. 776*. Grand Valley State University.

Adewole-Odeshi, E. 2014. Attitude of Students Towards E-learning in South-West Nigerian Universities: An Application of Technology Acceptance Model. *Library Philosophy and Practice (e-journal)*. 1035.

Adnan, M and Anwar, K. 2020. Online learning amid the COVID-19 pandemic: Students' perspective. *Journal of Pedagogical Sociology and Psychology*. 2 (1): 45-51. http://www.doi.org/10.33902/JPSP.2020261309

Ahammad, F. 2021. Online learning initiatives and its effects on teaching-learning process during the covid-19 pandemic. *The Online Journal of Distance Education and e-Learning*. 9 (1): 144-155.

Akaslan, D and Law, E. L. C. 2011. Measuring teachers' readiness for e-learning in higher education institutions associated with the subject of electricity in Turkey. *Paper presented at the IEEE EDUCON Education Engineering 2011, Amman, Jordan*.

Akbarilakeh, M., Razzaghi, A and Delavar Pour Moghaddam H. 2019. Attitudes of faculty members towards using e-learning. *Research and Development in Medical Education*. 8 (1): 12-19.

Albrahim, F.A. 2020. Online teaching skills and competencies. *The Turkish Online Journal of Educational Technology.* 19(1): 9-20.

Al-Dosari, H. 2011. Faculty Members and Students Perceptions of E-Learning in the English Department: A Project Evaluation. *Journal of Social Sciences*.7 (3): 391-407.

Aldowah, H., Ghazal, S., Umar, I. N and Muniandy, B. 2017. The Impacts of Demographic Variables on Technological and Contextual Challenges of E-learning Implementation. *Journal of Physics: Conference Series 892 (2017) 012013*. http://doi.org/10.1088/1742-6596/892/1/012013

Alhumaid, K., Ali, S., Waheed, A., Zahid, E and Habes, M. 2020. COVID-19 & E-learning: Perceptions &Attitudes of Teachers Towards E-Learning Acceptance in The Developing Countries. *Multicultural Education*. 6 (2): 100-115.

Ally, M. 2019. Competency Profile of the Digital and Online Teacher in Future Education. *International Review of Research in Open and Distributed Learning*. 20 (2): 303-318.

Al-Shboul, M. 2013. The Level of E-Learning Integration at the University of Jordan: Challenges and Opportunities. *International Education Studies*. 6 (4): 93-113.

Amita. 2020. e-learning experience of students in higher education institutions during the covid 19 pandemic: a primary survey. *COVID-19 Pandemic: A Global Challenge*. Aryan Publications, New Delhi. 115–131.

Anusha. 2019. A study on perception of university students regarding e-learning. *M. Sc (Ag.) Thesis*. Punjab Agricultural University, Ludhiana.

Azimi, H. M. 2013. Readiness for implementation of e learning in colleges of education and assessment of e learning needs among its faculty members and students. *Ph. D Thesis*. University of Mysore, Mysore.

Bamigboye, O.B., Bankole, O.M., Ajiboye, B.A. and George, A.E. 2013. Teachers' Attitude and Competence Towards the use Of ICT Resources: A Case Study of University of Agriculture Lecturers, Abeokuta Ogun State, Nigeria. *The Information Manager*. 13 (1& 2): 10-15.

Baticulon, R. E., Sy, J. J., Alberto, N. R. I., Baron, M. B. C., Mabulay, R. E. C., Rizada, L. G. T., Tiu, C. J. S., Clarion, C. A and Reyes, J. C. B. 2021. Barriers to Online Learning in the Time of COVID- 19: A National Survey of Medical Students in the Philippines. *Medical Science Educator*. 31: 615–626.

Becker, K., Newton, C and Sawang, S. 2013. A learner perspective on barriers to e-learning. *Australian Journal of Adult Learning*. 53 (2): 211-233.

Benali, M., Kaddouri, M and Azzimani, T. 2018. Digital competence of Moroccan teachers of English. *International Journal of Education and Development using Information and Communication Technology*. 14 (2): 99-120.

Bhatt, K. 2019. A study on use of e-learning among rural youth. *M. Sc (Ag.) Thesis*. Maharana Pratap university of agriculture and technology, Udaipur. Rajasthan.

Bhowmik, S and Bhattacharya, D. 2021. Factors influencing online learning in higher education in the emergency shifts of covid 19. *The Online Journal of Distance Education and e-Learning*. 9 (1): 74-83.

Bhuasiri, W., Xaymoungkhou, O., Zo, H., Rho, J. J and Ciganek, A. P. 2012. Critical success factors for e-learning in developing countries: A comparative analysis between ICT experts and faculty. *Computers & Education*. 58 (2): 843–855.

Bhuvaneswari, A.S and Padmanaban, T. 2012. Attitude of senior secondary students towards e-learning. *Elixir Educational Technology*. 51: 10886-10888.

Bigatel, P.M., Ragan, L.C., Kennan, S., May, J. and Redmond, B.F. 2012. The Identification of Competencies for Online Teaching Success. *Journal of Asynchronous Learning Networks*. 16 (1): 59-77.

Cole, M. T., Shelley, D. J and Swartz, L. B. 2014. Online instruction, E-learning and student satisfaction: A three year study. *The International Review of Research in Open and Distance Learning*. 15 (6): 111- 131.

Coman, C., Tiru, L. G., Mesesan-Schmitz, L. Stanciu, C and Bularca, M. C. 2020. Online Teaching and Learning in Higher Education during the Coronavirus Pandemic: Students' Perspective. *Sustainability 2020, 12, 10367*. http://doi.org/10.3390/su122410367

Crawford-Ferre, H. G and Wiest, L. R. 2012. Effective online instruction in higher education. *The Quarterly Review of Distance Education*. 13 (1): 11-14.

Dhas, L. J. S. 2017. Attitude of College Students towards E-Learning. *International journal for research in emerging science and technology*. 4 (9): 13-23.

Faderogaya, S. L. 2018. Learning styles and attitude towards e-learning among university undergraduate students in international programs in Bangkok Thailand. *M. Sc (Ag.) Thesis.* Assumption University of Thailand, Thailand.

Fatima, A and Raj, U. 2020. Stress in students after lockdown due to COVID-19 threat and the effects of attending online classes. *SSRN Electronic Journal.* http://dx.doi.org/10.2139/ssrn.3584220

Fedynich, L. Bradley, K. S and Bradley, J. 2015. Graduate students' perceptions of online learning. *Research in Higher Education Journal*. 27: 1-13.

Gade, L and Agarwal, M. 2017. e-Readiness of State Open Universities towards Online Learning: A Study of BRAOU and UOU. *Indian Journal of Open Learning*. 26 (3): 177-202.

Gay, G. H. E. 2016. An assessment of online instructor e-learning readiness before, during and after course delivery. *Journal of Computing in Higher Education. 28 (2): 199-220.* http://doi.org/10.1007/s12528-016-9115-z

Ghadei, K and Rudd, R. D. 2015. Perception and Attitude of Agricultural Students towards E-learning. *Southern Agricultural Economics Association's 2015 Annual Meeting, Atlanta, Georgia, January 31-February 3, 2015*: 65-70. http://dx.doi.org/10.22004/ag.econ.196776

Ghaderizefreh, S and Hoover, M. L. 2018. Student Satisfaction with Online Learning in a Blended Course. *International Journal of Digital Society*. 9 (3): 1393-1398.

Ghavifekr, S and Rosdy, W.A.W. 2015. Teaching and learning with technology: Effectiveness of ICT integration in schools. *International Journal of Research in Education and Science*. 1 (2): 175-191.

Gomez, J.F. 2015. Higher education faculty use of a learning management system in face-to-face classes. *Ph. D thesis*. California State University, Stanislaus.

Gupta, D and Singh, G. 2018. Competency of Teacher Educators and Student Teachers towards E-learning Tools. *Journal of Indian Education*. 126-140.

Gurung, S. 2021. Challenges faced by teachers in online teaching during COVID-19 pandemic. *The Online Journal of Distance Education and e-Learning*. 9 (1): 8-18.

Hair, J.F., Black, W.C., Babin, J.B., Andersen, R.E. and Taham, R.I. 2007. *Multivariate data analysis*. 6th edition. Upper Saddle River, New Jersey: Pearson/Prentice Hall.

Hasan, N and Khan, N. H. 2020. Online teaching-learning during covid-19 pandemic: students' perspective. *The Online Journal of Distance Education and e-Learning*. 8 (4): 202-213.

Imam, A and Singh, G. P. 2015. Influence of Gender, Parental Education and Parental Occupation on Mathematics Achievement of Secondary School Students. *Paripex - Indian Journal of Research*. 4 (11): 187-190.

Ishak, T., Kurniawan, R., Zanzibar, Z., Andirfa, M and Keumala, C. M. 2020. Students' needs satisfaction with asynchronous online video lectures in the flipped classroom environment. *The Online Journal of Distance Education and e-Learning*. 8 (2): 103-111.

Jain, R and Soriya, S. 2021. Integrating the education with the technology - rise in demand for online education in India. *The Online Journal of Distance Education and e-Learning*. 9 (1):112-124.

Jyothi, V and Vijayabhinandana, B. 2021a. A Scale to Measure the Attitude of Students towards Online Learning. *Indian Res. J. Ext. Edu*. 21 (2&3): 37-42.

Jyothi, V and Vijayabhinandana, B. 2021b. A Scale to Measure the Attitude of Teachers towards Online Teaching. Unpublished.

Jyothi, V and Vijayabhinandana, B. 2020. Perception of Students about Online Education. *The Andhra Agricultural Journal*. 67 (Spl. II): 142-143.

Jyothi, V., Rao, A.V and Vijayabhinandana, B. 2011a. A Scale to Measure the Attitude of Teachers towards Information Communication Technologies (ICTs). *The Andhra Agricultural Journal*. 58 (3): 378-380.

Jyothi, V., Vijayabhinandana, B. and Rao, A.V. 2011b. Information and Communication Technology (ICT) Utilisation Pattern by the Post-Graduate Students of Acharya N. G. Ranga Agricultural University. *The Andhra Agricultural Journal*. 58 (4): 550-554.

Jyothi, V., Vijayabhinandana, B. and Rao, A.V. 2012. An Inventory to Measure the Information and Communication Technology (ICT) Competencies of Teachers. *The Andhra Agricultural Journal*. 59 (1): 141-144.

Kapasia, N., Paul, P., Roy, A., Saha, J., Zaveri, A., Mallick, R., Barman, B., Das, P., and Chouhan, P. 2020. Impact of lockdown on learning status of undergraduate and postgraduate students during COVID-19 pandemic in West Bengal, India. *Children and Youth Services Review.* 116: 105194. https://doi.org/10.1016/j.childyouth.2020.105194

Kar, D., Saha, B and Mondal, B. C. 2014. Attitude of University Students towards E-learning in West Bengal. *American Journal of Educational Research*. 2 (8): 669-673.

Kenan, T. A. A. 2015. Improving the effectiveness of e-learning implementation in the school of engineering at Tripoli university. *Ph. D Thesis*. The University of Huddersfield.

Kerlinger, F.N. 1986. *Foundations of Behavioral Research*. 3rd Edition, Holt, Rinehart and Winston, New York.

Khan, M.A., Vivek., Nabi, M.K., Khojah, M and Tahir, M. 2021. Students' Perception towards E-Learning during COVID-19 Pandemic in India: An Empirical Study. *Sustainability* 2021. 13 (1): 57. https://dx.doi.org/10.3390/su13010057

Khan, S. H. 2016. Attitude of prospective teacher educators towards incorporation of electronic learning technology in teacher education institutions: an empirical approach. *Scholarly Research Journal for Humanity Science and English Language*. 3 (18): 4121-4131.

Khan, T and Thomas, S. 2021. Virtual learning during Current Normal at Undergraduate Level. *Education India Journal: A Quarterly Refereed Journal of Dialogues on Education*. 10 (1): 259-271.

Kisanga, D.H. 2016.Determinants of Teachers' Attitudes Towards E-Learning in Tanzanian Higher Learning Institutions. *International Review of Research in Open and Distributed Learning*. 17 (5): 109-125.

Koirala, D. Silwal, M. Gurung, S. Bhattarai, M. Vikash Kumar, KC. 2020. Perception towards Online Classes during COVID-19 among Nursing Students of a Medical College of Kaski District, Nepal. *Journal of Biomedical Research & Environmental Sciences*. 1 (6): 249-255. http://doi.org/10.37871/jbres1151

Konwar, I.H. 2017. A Study on Attitude of College Students towards E-learning with Special Reference to North Lakhimpur of Lakhimpur District, Assam. *International Journal of Information Science and Education*. 4 (1): 1-9.

Koskinen, J. 2015. Digital competence development of teachers in finnish higher education Case: Lathi UAS. *M. Sc (Ag.) Thesis*. Lahti University of Applied Sciences.

Kothari, C. R. 2012. *Research Methodology Methods &Techniques* (5thed.). New Age International Publishers.

Kulal, A. and Nayak, A. 2020. "A study on perception of teachers and students toward online classes in Dakshina Kannada and Udupi District". *Asian Association of Open Universities Journal.* 15 (3): 285-296. https://doi.org/10.1108/AAOUJ-07-2020-0047

Kumar, P. 2017. Attitude of teacher educators towards e-learning. *Bhartiyam international journal of education & research*. 6 (4): 18-35.

Kuo, Y.C., Walker, A. E., Belland, B. R and Schroder, K. E. E. 2013. A predictive study of student satisfaction in online education programs. *The International Review of Research in Open and Distributed Learning*. *14* (1): 16-39. https://doi.org/10.19173/irrodl.v14i1.1338

Lall, S. and Singh, N. 2020. Covid-19: Unmasking the new face of education. *International Journal of Research in Pharmaceutical Sciences*. 11: 48-53. https://doi.org/10.26452/ijrps.v11iSPL1.2122.

Lloyd, S. A., Byrne, M. M and McCoy, T. S. 2012. Faculty-perceived barriers of online education. *MERLOT Journal of Online Learning and Teaching*. 8 (1): 1–12.

Madhumita. 2016. A study on e-learning among the Post Graduate students of Banaras Hindu University. *M. Sc (Ag.) Thesis*. Banaras Hindu University, Varanasi, India.

Mamattah, R. S. 2016. Students' Perceptions of E-Learning. *M. Sc (Ag.) Thesis*. Linköping University.

Martin, F and Parker, M. A. 2014. Use of synchronous virtual classrooms: Why, who and how? *Journal of Online Learning and Teaching*. 10 (2): 192-210.

Mbogo, R. W. 2016. Antecedent Factors Affecting Academic Performance of Graduate Students at the Nairobi Evangelical Graduate School of Theology. *Journal of Education and Practice*. 7 (18): 128-141.

Means, B and Neisler, J. 2021. Teaching and learning in the time of COVID: The student perspective. *Online Learning*. 25 (1): 8-27.

Mehra, V and Omidian, F. 2011. Examining Students' Attitudes Towards E-learning: A Case from India. *Malaysian Journal of Educational Technology*. 11 (2): 13-18.

Moneva, J. C., Rozada, G. G and Sollano, A.M. 2019. Parents occupation and students self-esteem. *International Journal of Research-Granthaalayah*. 7 (12): 315-324. https://doi.org/10.5281/zenodo.3604567

Muthuprasad, T. Aiswarya, S. Aditya, K. S and Jha, G. K. 2021 Students' Perception and Preference for Online Education in India during COVID -19 Pandemic. *Social Sciences & Humanities Open*. 3 (1): 00101. https://doi.org/10.1016/j.ssaho.2020.100101

Mythili, G. 2017. Satisfaction and Performance of Academic Counsellors in an Online Training Programme - A Study. *Indian Journal of Open Learning*. 26 (1): 3-19.

Nagar, S. 2020. Assessing Students' perception toward e-learning and effectiveness of online sessions amid COVID-19 Lockdown Phase in India: An analysis. *Tathapi*. 19 (13).

Naresh, B and Reddy, D. B. S. 2015. An Exploratory Study on Learner's Perception Towards E-Learning Courses. *Mediterranean Journal of Social Sciences*. 6 (5): 562-568.

Naresh, B., Reddy, D. B. S and Pricilda, U. 2016. A Study on the Relationship Between Demographic Factor and e-Learning Readiness among Students in Higher Education. *Sona Global Management Review*. 10 (4): 1-11.

Ncube, L. S. 2015. Students' perceptions of e-learning in the department of information science at the university of South Africa. *M. Sc (Ag.) Thesis*. University of South Africa.

Nunnally, J. 1967. *Psychometric Theory*. New York: McGraw.

Peytcheva-forsyth, R., Yovkova, B. and Aleksieva, L. 2018. Factors affecting students' attitude towards online learning- The case of Sofia University. *AIP Conference Proceedings 2048.*

Raju, D.T., Murthy, G.R.K., Vinayagam, S.S., Krishnan, M and Rao, C.S. 2020. Impact of Massive Open Online Courses (MOOCs) on capacity building. *ICAR-National Academy of Agricultural Research Management,* Hyderabad.

Rana, N. 2021. Online learning experiences during covid-19 in higher education space: the new normal. *The Online Journal of Distance Education and e-Learning*. 9 (1): 137-143.

Ren, J and Hagedorn. L. S. 2012. International graduate students' academic performance: What are the influencing factors? *Journal of International Students*. 2 (2): 135-143.

Sabaratnam, V.E and Mulay, S. 1983. *Research methods in extension education*. Manasyan, New Delhi. 96-99.

Salcido, A and Cole, J. 2018. Best practices for teaching online. Teach Online. *Arizona State University.*

Sarantakos, S. 1993. *Social research*. Basingstoke: Macmillan.

Selvaraj, C. 2019. Success of e-learning systems in management education in Chennai city – using user's satisfaction approach. *The Online Journal of Distance Education and e-Learning*. 7 (2): 124-132.

Shah, M.A.A. and Anwar, M. 2014. Impact of parent's occupation and family income on children performance. *International Journal of Research*. 1 (9):606-612. https://pdfs.semanticscholar.org/4b89/522d6096e58ca4bbbc7d8c36df5ec9ccf66e.pdf

Shah, R and Sharma, G. 2018. Opinion of Teachers towards Quality Assurance in Higher Agricultural Education. *Indian Journal of Economics and Development*. 14 (1a): 491-496. http://doi.org/10.5958/2322-0430.2018.00102.6

Sharanappa, P. 2015. Attitude and awareness of agriculture college teachers towards educational technology. *M. Sc (Ag.) Thesis*. College of agriculture, Latur Vasantharao Naik Marathwada Krishi Vidyapeeth, Parbhani (M.S.) India: 51

Sofat, R and Sharma, R. 2021. A study on perception of academicians towards online education courses. *The Online Journal of Distance Education and e-Learning*. 8 (1): 1-9.

Soharwardi, M. A., Fatima, A., Nazir, R and Firdous, A. 2020. Impact of parental socioeconomic status on academic performance of students: a case study of Bahawalpur, Pakistan. *Journal of Economics and Economic Education Research*. 21 (2): 1-8.

Soni, J. 2016. Utilisation pattern of social media by the students for education: a study at G. B. Pant University of Agriculture and Technology, Pant Nagar. *M. Sc (Ag.) Thesis*. Govind Ballabh Pant university of Agriculture and Technology, Pant Nagar.

Sood, M and Singh V. 2014. E – Learning: Usage among Indian Students. *International Journal of Scientific & Engineering Research*. 5 (4): 1353-1360.

Surahman, E and Sulthoni. 2020. Student Satisfaction toward Quality of Online Learning in Indonesian Higher Education During the Covid-19 Pandemic. *6th International Conference on Education and Technology (ICET)*: 120-125.

Suri, G and Sharma, S. 2013. Impact of Age on student's attitude towards e-learning: A study on Panjab University, India. *Gian Jyoti E-Journal*. 3 (2): 73-80.

Tagoe, M. 2012. Students' perceptions on incorporating e-learning into teaching and learning at the University of Ghana. *International Journal of Education and Development using Information and Communication Technology*. 8 (1): 91-103.

Thakkar, S and Joshi, H. 2017. Students' Attitude towards E-learning. *International Journal of Advance Engineering and Research Development*. 4 (11): 209-213.

Ullah, O., Khan, W. and Khan, A. 2017. Students' Attitude towards Online Learning at Tertiary Level. *Peshawar University Teachers Association Science Journal*. 25 (1-2): 63-82.

Uppal, R. 2019. Effectiveness of massive open online courses for training teachers in higher education. *Ph. D Thesis*. Department of Educational Technology. SNDT women's university, Mumbai.

Vinayagam, S. S and Akhila, K. 2020. Competency analysis among faculty of agriculture universities in using educational technology. *International Journal of Education & Management Studies*. 10 (1): 66-70.

Walter, K. 2018. Influence of Parental Occupation and Parental Income on Students' Academic Performance in Public Day Secondary Schools. *World Journal of Innovative Research*. 5 (6): 1-10.

Yadav, A and Kashyap, S. K. 2017. Entrepreneurial intention of undergraduate students of G. B. Pant University of Agriculture and Technology, Pantnagar. *Journal of Applied and Natural Science*. 9 (3): 1501-1504.

Yigermal, M. E. 2017. Determinant of Academic Performance of Under Graduate Students: In the Cause of Arba Minch University Chamo Campus. *Journal of Education and Practice*. 8 (10): 155-166.

Yuan, J and Kim, C. 2014. Guidelines for facilitating the development of learning communities in online courses. *Journal of Computer Assisted Learning*. 30: 220-232.

Note: The pattern of Literature Cited presented above is in accordance with the guidelines for thesis presentation, Acharya N. G. Ranga Agricultural University, Lam, Guntur.

Appendices

APPENDIX-A

ANALYSIS OF ONLINE TEACHING AND LEARNING BY THE TEACHERS AND STUDENTS OF ACHARYA N G RANGA AGRICULTURAL UNIVERSITY – AN EXPLORATORY STUDY

QUESTIONNAIRE FOR TEACHERS

Respondent name:

1. Age: Mobile number:
2. Gender: Email ID:
3. Educational qualification: **M. Sc / Ph. D / Post Doctorate**
4. Designation: Department:
5. College:
6. Experience in teaching (in completed years):
7. Previous experience in online teaching: **Yes/No**
8. Training undergone in online teaching: **Yes/No**

   If yes please mention course_____
9. Mention the video conferencing application(s) you are using for online teaching (Zoom/ Cisco Webex/Google meet/Others please mention_____
10. **Indicate the possession of electronic device and their frequency for online teaching**

S. No	Device	Possession		Frequency		
		Yes	No	Never	Rarely	Often
1	PC (Personal)					
2	PC (Office)					
3	Laptop (Personal)					
4	Laptop (Office)					
5	Tablet					
6	Smart phone					

11. Do you have good internet connectivity for online classes: Yes/ No
12. Is your internet data speed sufficient for all online classes Yes/ No
13. Number of hours spent per day in preparation for online teaching (preparation of av aids, creation and posting of meeting ID:
14. Number of hours spent per day in online teaching:

15. Attendance of students in class (average %):

16. Type of learning material shared: **PPT/Word/Both/None**

17. When do you share the teaching material: **Before the class/ Immediately after the class/ after sometime of the class/ None**

18. I take online classes in: **Personal ID/ Official ID**

19. Attitude of teachers towards Online teaching

S. No	Attitude statements	Strongly agree	Moderate agree	Neutral	Moderately disagree	Strongly disagree
1.	Teachers can turn anywhere with internet access and electricity into a classroom					
2.	Online teaching should be supplementary to the traditional teaching					
3.	I feel I am disconnected with students in online teaching					
4.	Online teaching includes increased workloads					
5.	It is difficult to manage time in online classes					
6.	I am stressed taking classes online					
7.	Online teaching made me tech savvy					
8.	I lack enthusiasm while teaching online					
9.	Online classes assure schedule flexibility					
10.	Online teaching needs advanced					

(Table 19 contd.)

	technical knowledge					
11.	Teaching practical component is difficult					
12.	Difficult to evaluate the students after class					
13.	Attendance is less in class					
14.	Online teaching requires more preparation time					
15.	Online teaching is convenient					
16.	Too many distractions while teaching					
17.	Students interaction with teacher is reduced					
18.	It is difficult to understand whether the students understood the class or not					
19.	It is not possible to maintain eye contact in online teaching					
20.	Students do not concentrate in online teaching					

20. How often you use the following in online classes

S. No	Audio visual aids	Regularly	Sometimes	Never
1	PPT			
2	Video			
3	Audio clips			
4	You tube			
5	Live links on browser			

III. Online teaching competencies of teachers

21. Which of the following you use in online teaching		
Features	Yes	No
White board		
Chat box		
Breakout Room		
Polling		
22. In my class I encourage students to use non-verbal communications like		
Thumbs Up		
Raise hand		
Claps		
Laughing		
Shocking		
Celebrations		
23. Which of the below you follow for online classes	**Yes**	**No**
I use Fresh meeting ID and Passcode for each class		
I take the help of students for scheduling the class		
I use mute all option		
In online classes I prefer to mute my video		
Do you use live chat to communicate with students in online classes		
Did you organize any class presentations/term paper presentations online		
Do you record your online classes		
I post the link of your recorded presentation in whatsapp group		
I post my recorded class in youtube		
I use google forms for attendance		
I conduced class tests online using google forms		
I have a separate whatsapp/ instagram student's group for my subject		
I conducted discussions in whatsapp/ instagram student's group after every class		
I often check the no of participants in class		
I add co-hosts		
I lock the meeting		

24. Satisfaction with online teaching

Very much satisfied	Satisfied	Undecided	Dis-satisfied	Very much dis-satisfied

25. Mechanisms followed by you to know the attention of the students towards online teaching?

1.
2.

26. Please mention any two (atleast) best practices for effective online teaching _____

1.
2.

27. Constraints faced during online teaching

S. No.	**Constraints**	**Rank**
1	Students' login all through the class	
2	Lack of infrastructure facilities in department (Webcam, laptop, headphones, etc.,)	
3	Lack of expertise and skills	
4	Internet connectivity issues	
5	Increased workload	
6	Lack of student's response	
7	Problem with application	
8	Heath issues (eyes strained, body pain, etc.,)	

If any other constraints, Please Specify

APPENDIX-B

QUESTIONNAIRE FOR STUDENTS

1. **Name of the college:_____**
2. **Name of the student**: _____
3. **Gender**: Male / Female
4. **Degree of study: _____ Department**: _____
5. **Age (in completed years): _____**
6. **Background**: Rural / Semi urban / Urban
7. **Type of Family: Nuclear / Joint**
8. **Parental occupation: _____**
9. **Academic performance in grade point:**

   B.Sc. _____, M. Sc _____

10. **Possession and extent of use of electronic devices for online learning:**

S. No.	Device	Possession		Extent of use		
1	PC	Yes	No	Often	Rarely	Never
2	Laptop	Yes	No	Often	Rarely	Never
3	Tablet	Yes	No	Often	Rarely	Never
4	Smart phone	Yes	No	Often	Rarely	Never

11. Number of hours spent per week in online classes:
12. Do you have good internet connectivity for online classes: Yes/No
13. Is your internet data sufficient for all online classes: Yes/No
14. **Attitude of students towards online learning**

S. No	Attitude statements	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
1.	Students can turn anywhere with Internet access and electricity into a classroom					
2.	I listen to online classes comfortably and relaxed					
3.	Online learning lacks practical learning					
4.	Saves time as I need not travel to class room					

(Table 14 contd.)

5.	Online classes distract my attention					
6.	Online learning is boredom					
7.	It is easy to question without shyness					
8.	Online learning helps in exploring more about the subject					
9.	Flipped classroom approach would be better					
10.	I feel I am disconnected with my class mates in online learning					
11.	Online learning includes increased workloads					
12.	Online learning enhanced the quality of teaching					
13.	Lower retention rate for online learning					
14.	I am not getting enough time for brainstorming in online classes					
15.	Online learning made learning easy					
16.	Less responsible in class, less accountable					
17.	Note taking is avoided here					
18.	Difficult to manage study time at home					
19.	Online learning is stressful					
20.	Online learning made me tech savvy					

15. Online learning competencies of students

S. No	Competencies	Yes	No
1	I have basic knowledge on system operating		
2	I am aware of video conferencing applications		
3	I know how to join in a meeting		
4	I know how to download the application		

(Table 15 contd.)

5	I can create account in video Conferencing application		
6	I can share invite link to friends while meeting going on		
7	I am able to mute and unmute the audio		
8	I am able to mute and unmute my video		
9	I can share the screen in any video conferencing application		
10	I know how to chat and reply in chat box		
11	I know how to reply with symbols in application i.e., claps, thumps up, laughing, shocking, celebration		
12	I can share video, animations etc on screen		
13	I know how to fill and submit the google form		
14	I can effectively use the whole application on online classes		
15	I am aware of every tool in settings of application		

16. Constraints faced during online learning

S. No	Constraints	Rank
1.	Unfavourable learning environment	
2	Lack of knowledge on online apps	
3	Lack of expertise and skills in ICTs	
4	Expensive	
5	Time consuming	
6	Internet connectivity issues	
7	Lack of uninterrupted Power Supply	
8	Problem with application	
9	Health issues (Eye strain, body pains etc.,)	
10	Others Specify	

17. Satisfaction with online learning

Very much satisfied	Satisfied	Undecided	Dis-satisfied	Very much dis-satisfied

APPENDIX- C
GARRETT'S RANKING TABLE

Percentage	Score	Percentage	Score	Percentage	Score
0.09	99	20.93	66	80.61	33
0.2	98	22.32	65	81.99	32
0.32	97	23.88	64	83.31	31
0.45	96	25.48	63	84.56	30
0.61	95	27.15	62	85.75	29
0.78	94	28.86	61	86.89	28
0.97	93	30.61	60	87.96	27
1.18	92	32.42	59	88.97	26
1.42	91	34.25	58	89.94	25
1.68	90	36.15	57	90.83	24
1.96	89	38.06	56	91.67	23
2.28	88	40.01	55	92.45	22
2.63	87	41.97	54	93.19	21
3.01	86	43.97	53	93.86	20
3.43	85	45.97	52	94.49	19
3.89	84	47.98	51	95.08	18
4.38	83	50	50	95.62	17
4.92	82	52.02	49	96.11	16
5.51	81	54.03	48	96.57	15
6.14	80	56.03	47	96.99	14
6.81	79	58.03	46	97.37	13
7.55	78	59.99	45	98.72	12
8.33	77	61.94	44	98.04	11
9.17	76	63.85	43	98.32	10
10.16	75	65.75	42	98.58	9
11.03	74	67.48	41	99.82	8
12.04	73	69.39	40	99.30	7
13.11	72	71.14	39	99.22	6
14.25	71	72.85	38	99.39	5
15.44	70	74.52	37	99.55	4
18.69	69	76.12	36	99.68	3
18.01	68	77.68	35	99.80	2
19.39	67	79.12	34	99.91	1
				100	0