LEARNERS' INTENTION TOWARDS TECHNOLOGY ADOPTION WITH RESPECT TO ONLINE TEACHING IN PUNJAB

Thesis Submitted for the Award of the Degree of

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Management

By

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2024

DECLARATION

I, hereby declared that the presented work in the thesis entitled "**Learners' Intention Towards Technology Adoption with respect to Online Teaching in Punjab**" in fulfilment of degree of Doctor of Philosophy (Ph. D) is outcome of research work carried out by me under the supervision of Dr. Krishan Gopal, working as Associate Professor, in the Mittal School of Business, Lovely Professional University, Punjab, India. In keeping with general practice of reporting scientific observations, due acknowledgements have been made whenever work described here has been based on findings of other investigators. This work has not been submitted in part or full to any other University or Institute for the award of any degree.

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CERTIFICATE

This is to certify that the work reported in the Ph. D. thesis entitled **"Learners' Intention Towards Technology Adoption with respect to Online Teaching in Punjab"** submitted in fulfillment of the requirement for the award of degree of Doctor of Philosophy (Ph. D) in the Mittal School of Business, is a research work carried out by **Navpreet Kaur, Registration Number: 42000471**, is bonafide record of her original work carried out under my supervision and that no part of thesis has been submitted for any other degree, diploma or equivalent course.

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ABSTRACT

Online education has undergone a transformative journey, shaped by historical evolution and propelled into prominence by the COVID-19 pandemic. The concept of distance learning dates back to the mid-19th century, with correspondence courses enabling students to study remotely. However, it wasn't until the advent of the internet that online education truly took off. The COVID-19 pandemic accelerated the transition to online learning, forcing educational institutions worldwide to adapt rapidly to remote teaching. Severe disruptions caused by lockdowns and social distancing measures compelled educators to leverage digital platforms to ensure continuity in education. Overnight, classrooms shifted from physical spaces to virtual environments, challenging both teachers and students to navigate this new frontier. Despite initial hurdles, the pandemic catalyzed innovation in online education. Institutions invested in technology infrastructure and training for educators to enhance online teaching methodologies. Interactive platforms, multimedia resources, and collaborative tools emerged, enriching the learning experience and fostering engagement in virtual classrooms. The transition from face-to-face to online learning necessitated a paradigm shift in pedagogical approaches. Educators embraced blended learning models, combining synchronous and asynchronous teaching methods to accommodate diverse learning styles. Flexibility became paramount, empowering students to access educational content at their convenience while fostering self-directed learning skills.

The review of literature began with exploring general literature available on online learning/e-learning, Technology Acceptance Model (TAM), technology platforms available for online classes, gadgets employed by the students, online classroom environment, students' engagement, and challenges faced by the teachers during online classes. Over 200 research papers, published in the national and international journals of repute, and other related articles from websites and books and significant news articles published related to the area under study were reviewed. The studies were categorized into four sections, namely; a) studies related to learners' willingness towards technology adoption for online classes, b) studies related to

evaluating the effect of technology differentiation and gadget category on learning effectiveness, c) studies related to measuring the influence of online classroom environment on students’ engagement, and d) studies related to the challenges in online teaching. Based on the review of literature, some gaps were identified. A substantial amount of research has been conducted to evaluate students' perceptions of online teaching, including the benefits and drawbacks of the same, in countries such as the United States, United Kingdom, Australia, China, Malaysia, South Africa, and the Middle East, shedding light on the topic from various perspectives. While studying the students’ perception towards technology adoption in online classes, most studies have ignored importance and role of technology differentiation and even the gadgets employed. The acceptability of online education and technology is widespread in advanced economies, as indicated by the review of the literature but research to analyse this in the Indian context has not yet happened. Hence, in the current study, an attempt is made to address this gap. The technology platform under the scope of the study includes Blackboard, My Class, Zoom, Google Meet, Microsoft Teams and the gadgets under the purview of the study include desktop, laptop, tablet/iPad and smart phone. Further, the research and studies conducted at the international level (primarily at United States, followed by the United Kingdom, Taiwan, and China) to determine students' perceptions and attitudes toward e-learning, and those related to learners’ intentions of technology adoption with regard to online learning may not be reflective of the challenges and conditions of a developing country like India. The present study covering Indian population and conditions will shed light on knowing the influence of online classroom environment on students’ engagement.

Additionally, all the studies carried out in past were done in seclusion and did not cover all the aspects of the present study. So, it has the potential to influence the other and if they are not analysed together, the outcome could be erroneous. Holistic approach, carried out in the present study, is bound to provide analysis which would assist all the stakeholders namely students, teachers, educational institutions, and society at large. The permanence of online education is evident, and a correct analysis, considering the conditions unique to India, can play a pivotal role in conserving significant human, intellectual, and financial resources. These resources hold particular value for a developing nation like India. Hence, the present study addressed the gaps through its objectives.

Online education has become a cornerstone of modern learning, emphasizing its importance and permanence in today's digital age. The shift towards virtual classrooms not only provides flexibility but also ensures continuity in education, regardless of physical constraints. For instance, the University Grants Commission (UGC) guiding Higher Education Institutions (HEIs) to offer online degrees and programmes underscores this shift's significance. Notable institutions like Lovely Professional University (LPU) and Chitkara University (both in Punjab) and many other across the country have embraced this trend, offering a wide array of online degrees. This accessibility not only makes education more affordable but also opens doors for students and professionals worldwide, democratizing learning opportunities.

The current study is useful for examining the ways in which the technology enhances or hinders learning and teaching. This can further be used as a strategic tool for understanding the segment of young population and target them as a market. The study also focuses on knowing the learners' engagement during online classes as not much is known in this area especially with respect to the Punjab context, conditions and environment. The surge in internet usage, especially in the State of Punjab, emphasized the importance of understanding the habits and perceptions of the learners with respect to the online teaching.

The first objective of the study deals with examining the learners' willingness towards technology adoption for online classes. The second objective shed light on evaluating the effect of technology differentiation and gadget category on learning effectiveness. The third objective aim to measure the influence of online class environment on students' engagement. The last and final objective addresses the bottlenecks of online teaching and exploring ways to mitigate them.

To achieve the objectives, the present study has employed both descriptive and exploratory research designs. Descriptive research design involves studying of characteristics, attitude and behaviour of population under study without any willful manipulation of variables. Exploratory qualitative research, using in-depth interviews, was conducted to understand the teachers' views about the online teaching, developing themes based on those views regarding bottlenecks encountered by them and finally ways of mitigating the same. Multistage sampling technique was used to select the appropriate sample for the study. In the first stage, all universities of Punjab as per University Grants Commission (UGC) website was referred to. In the second stage, universities that are ranked under National Institute Ranking Framework (NIRF) were selected for drawing the sample. In the third stage, within the selected universities, the respondents were chosen from different academic fields like Management, Commerce, Humanities, Science and Engineering. The sample consisted of 600 students and 32 teachers from the selected universities. A scientifically structured questionnaire based on comprehensive literature review and secondary data was used to take response from the respondents. For achieving the first three objectives, a scientifically structured questionnaire based on comprehensive literature review and secondary data was used to take response from the respondents. For achieving fourth objective, semi structured in-depth interviews were taken to obtain the data. The research instrument used for data collection included five scales namely; a) a delf-developed 46-item scale that explore the students' willingness towards technology adoption with respect to online teaching, b) a self-developed 18-item scale to evaluated the effect of technology differentiation and gadget category on learning effectiveness, c) a self-developed 41-item scale to assess the effect of online classroom environment of students engagement and d) a self-developed 16-item scale for understanding the bottlenecks faced by the teachers during online classes. In the present study the collected data was recorded in Statistical Package for Social Sciences (SPSS 21.0) and NVivo for analysis. To achieve the first and third objectives, Structural Equation Modeling (SEM) was used which is one of the most popular and powerful statistical technique to analyze the association between different latent variables in the conceptual model (Akter *et al.*, 2017). To analyze the second objective, one-way ANOVA was employed. And lastly, to assess the bottlenecks of online teaching and exploring ways to mitigate them, qualitative technique of content analysis using NVivo was applied. Furthermore, the descriptive statistics of data was calculated using SPSS 21.0.

Findings of the study revealed that institutional support plays a pivotal role in shaping students' satisfaction with online classes, encompassing factors like access to resources, teacher interactions, and timely feedback. Studies consistently highlight the positive impact of institutional support on student satisfaction and intentions to engage in online learning. Extrinsic factors like ICT infrastructure support and resources also contribute significantly to students' perceived enjoyment and satisfaction with online classes, emphasizing the importance of proper training and access to technology. Additionally, students' attitudes towards online learning are strongly influenced by perceived usefulness and perceived enjoyment, as indicated by various studies. Positive attitudes towards technology in education correlate with higher intentions to engage in online learning, underscoring the importance of perceived usefulness and enjoyment in driving students' adoption of online education. In summary, while intrinsic factors like self-efficacy and perceived usefulness pose challenges, institutional support, and extrinsic factors play crucial roles in shaping students' satisfaction, attitudes, and intentions towards online learning, highlighting the complex interplay between individual beliefs, institutional support, and technological infrastructure in fostering successful online education experience.

The study delved into the impact of technology platforms and gadgets on students' learning effectiveness across various dimensions comprising knowledge construction, interaction among students in the class and presence of the instructor in the online class. Regarding knowledge construction, significant differences were observed among technology platforms, with My Class and Microsoft Teams emerging as the most effective platforms due to their interactive features facilitating file exchange, screen sharing, and breakout rooms for collaborative work. In contrast, Google Classroom was deemed less effective as it lacked practical exercises, limiting students to theoretical content. In terms of student’s interaction, My Class and Microsoft Teams stood out for fostering an interactive environment, empowering students to articulate ideas confidently, whereas Google Classroom fell short in providing effective interaction opportunities. Similarly, instructor presence varied significantly among platforms, with My Class and Microsoft Teams being the most effective, offering features for direct interaction between students and instructors, whereas, Zoom lagged due to limitations in content presentation and engagement features. Regarding gadgets, laptop were found to be the most effective for knowledge construction and interaction, followed closely by desktop, while tablet/iPads and mobile phone were less effective, primarily due to limitations in screen size and usability. Additionally, the choice of device influenced instructor presence, with laptop and desktop enabling a more immersive learning experience, whereas tablet/iPads exhibited limitations in screen size and multitasking capabilities, potentially hindering engagement with instructional content. Learning or attending classes through gadgets like mobile phone or tablet brings convenience but also introduces potential distractions. One common distraction is excessive movement, as these devices are portable and easily carried around, leading to a lack of focus on the lesson. Notifications from various apps, emails, or messages can divert attention away from the learning material. Additionally, the temptation to multitask by browsing social media or engaging in unrelated activities can hinder concentration. Moreover, technical issues such as poor internet connection or device malfunctions can disrupt the learning process, highlighting the need for disciplined usage to mitigate these distractions. Overall, the findings underscore the critical role of technology platforms and gadgets in shaping students' learning experiences, with implications for designing effective online learning environments that promote interaction, engagement, and instructor presence.

The study further investigated the influence of the online classroom environment on students' engagement using Structural Equation Modeling (PLS-SEM). Results indicated a significant direct impact of the online classroom environment on students' social engagement, which in turn affected their cognitive and emotional engagement. Amicable relationships between students and teachers, as well as fellow students, were found to enhance social engagement, aligning with prior research. Moreover, collaborative activities and effective communication tools facilitated social interaction, thereby promoting cognitive engagement and ultimately impacting learning outcomes. Similarly, the current study highlighted the positive mediating role of social engagement between the online classroom environment and student’s emotional and cognitive engagement, emphasizing the importance of fostering a sense of community through activities like discussions and societal issue work. Students who are more socially engaged tend to exhibit higher level of cognitive engagement.

Furthermore, the study revealed a significant direct impact of the online classroom environment on students' cognitive engagement, which subsequently influenced their behavioural engagement. Factors such as timely feedback, support from teachers, and effective team learning tasks were identified as critical in developing cognitive engagement among students. This finding corroborated earlier studies emphasizing the importance of focused thinking and cognitive thinking in learning tasks. Additionally, emotional engagement, characterized by emotional commitment and reactions supporting students' attention and positive attitudes, was found to be influenced by the online classroom environment, particularly effective student-teacher interaction and a user-friendly learning platform. Results revealed that emotional engagement has a significant positive impact on behavioural engagement of the students underscoring its significance in students' active participation by way of expressing opinions in academic discussions to supporting and encouraging peers and making efforts to meet instructor's expectations.

Despite the merits associated with it, online education is not free from challenges both for the teachers and the students. While India has made great strides in terms of digital infrastructure in recent years, many students and teachers from remote areas of the state still lack access to reliable internet and technology, which can limit their ability to participate fully in online learning. During the transition to online teaching, the teachers had faced several problems while taking online classes. They had to adapt to using new technology and online platforms for delivering their lessons. They had to manage their workload and ensure they had time for lesson planning, grading, and interacting with students while also attending to their personal responsibilities and family needs. This often resulted in longer working hours and added stress. Maintaining students' attention and engagement during online classes also presented a significant challenge. Teachers had to find innovative ways to keep students motivated, address distractions, and ensure effective communication and participation while keeping them engaged right from the beginning of the class towards the end so that the learning curve does not drop. Some teachers lacked sufficient training from their institutes on online teaching methodologies and techniques, which made it more challenging for them to deliver effective lessons in a virtual setting. The undeniable significance of classroom learning is highlighted during this pandemic, indicating that not all higher education institutions and teachers were adequately prepared to handle online teaching (Mahesh, 2020; Azevedo *et al*., 2021).

After analysis of all the four objectives, it can be concluded that online learning is no longer peripheral or supplementary; it has become an integral part of every stage of our life. Due to COVID-19 pandemic induced lockdown, online learning has become formalized. It is growing at a fast pace and is here to stay. The ever-evolving nature of technology will continue to push not only the students but also the teachers and educational institutions to use new tools to create effective learning environments.

Looking ahead, online education is poised to continue its trajectory of growth and evolution. The lessons learned from the pandemic underscore the importance of resilience and adaptability in education, driving continuous innovation in the digital realm. As technology continues to advance, online education promises to democratize access to quality learning opportunities, transcending geographical boundaries and empowering learners worldwide.

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Navpreet Kaur

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LIST OF ABBREVIATIONS

Abbreviation	Full Form
ICSE	Indian Certificate of Secondary Education
CBSE	Central Board of Secondary Education
UGC	University Grant Commission
BCI	Bar Council of India
AICTE	All India Council for Technical Education
B2C	Business to Consumers
B2B	Business to Business
C2C	Consumer to Consumer
NEP	National Education Policy
ICT	Information and Communication Technology
ICI	Information and Communication Infrastructure
IT	Information Technology
AI	Artificial Intelligence
VR	Virtual Reality
LMS	Learning Management System
MOODLE	Modular Object-Oriented Dynamic Learning Environment
IGNOU	Indira Gandhi National Open University
NCERT	National Council of Educational Research and Training
AIR	All India Radio
MOOC	Massively Open Online Course
MHRD	Ministry of Human Resource Development
P2PU	Peer 2 Peer University
MOOC	Massive Open Online Courses
ALN	Asynchronous Learning Networks
TAM	Technology Acceptance Model

Abbreviation	Full Form
TRA	Theory of Reasoned Action
PU	Perceived Usefulness
PEU	Perceived Ease of Use
BI	Behavioural Intention
ATU	Attitudes towards use
FTF	Face-to-face
TPB	Theory of Planned Behaviour
PDA	Personal Digital Assistants
BSLE	Blended Synchronous Learning Environment
OLE	Online Learning Environment
HEI	Higher Education Institute
ANOVA	Analysis of Variance
PLS-SEM	Partial Least Square Structural Equation Modeling
NIRF	National Institute Ranking Framework
CFA	Confirmatory Factor Analysis
AVW	Average Variance Extracted
HTMT	Heterotrait- Monotrait Ratio
VIF	Variation Inflation Factor
IS	Institutional Support
PE	Perceived Enjoyment
IF	Intrinsic Factors
OLS	Ordinary Least Squares
TRAI	Telecom Regulatory Authority of India
PDP	Professional Development Programmes
AISHE	All India Higher Education Survey

Chapter 1

INTRODUCTION

1.1 INDIAN EDUCATION SYSTEM

The ancient system of education in India was highly structured and focused on transmitting religious and cultural traditions from one generation to the next. The earliest form of education in India was oral, with sacred texts such as the Vedas and Upanishads being passed down through generations by word of mouth. This oral tradition was later recorded in writing, with the creation of written texts such as the Ramayana and Mahabharata (Yadav, 2018). The education system in primeval India highly focused on religious and spiritual pursuits, with little emphasis on secular education (Selvamani, 2019). However, it laid the foundation for the development of modern educational institutions and philosophies in India.

India has a diverse and complex education system that reflects the country's cultural, economic, and social diversity. In India, state governments are primarily responsible for education, with the central government providing support. The system includes a significant private education sector, which is attended by students from affluent families who can afford to pay for their education (National Education Policy, 2020).

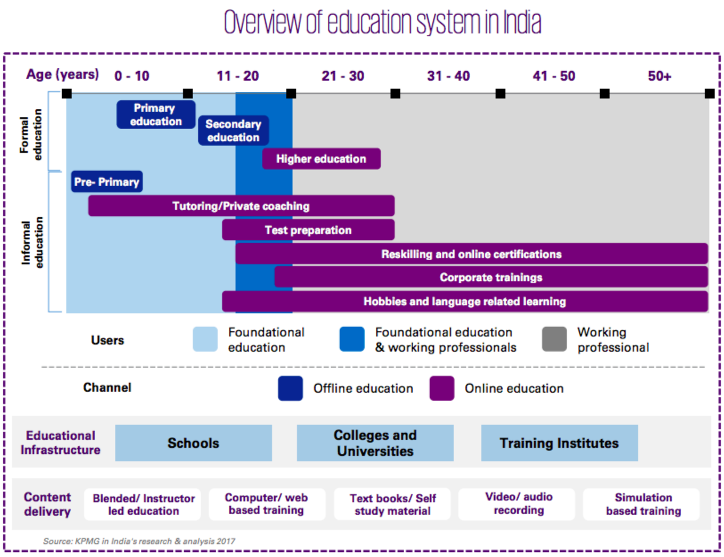

Fig.1.1: Overview of Education System in India

India possesses a multi-tiered formal education system, as illustrated in Figure 1.1. Diploma programmes, post-secondary education, primary and secondary institutions, and graduation and post-graduate programmes are all classified as formal education. Administration of schools is the responsibility of federal organizations such as the Central Board of Secondary Education (CBSE) and Indian Certificate of Secondary Education (ICSE), in addition to state and international boards. India is home to one of the most exceptional higher education systems globally, with a preponderance of private sector institutions. In spite of being regulated by the University Grant Commission (UGC), India's higher education system consists of three tiers: the university, the college, and the course. Diverse professional domains are governed by regulatory bodies such as the Bar Council of India (BCI) and the All India Council for Technical Education (AICTE), among others. Complementary to formal education are informal programmes and initiatives such as preschool, coaching classes, vocational training, and those utilizing multimedia and technology. The pre-primary sector has witnessed a great deal of competition. With respect to the vocational training, substantial workforce and the increasing demand for skilled labor are pivotal elements contributing to its swift growth in India. A substantial proportion of informal education in India consists of examination preparation. In response to consumer needs, online education providers have created Business to Business (B2B), Business to Consumer (B2C), and Consumer to Consumer (C2C) solutions.

India is one of the largest markets for formal education. According to All India Survey of Higher Education (AISHE) Report, Ministry of Education, Government of India (2021-2022), the operational presence of 1,168 universities, along with 45,473 colleges and 12,202 stand-alone institutions across the country collectively accommodate over 4.33 crore students and employ 15.98 lakhs faculty members. This vast network of universities, colleges, and stand-alone institutions underscores the nation's commitment to providing diverse educational opportunities and catering to the educational needs of its populace. It reflects a significant investment in human capital development, with a focus on fostering knowledge dissemination and academic growth at various levels of the educational spectrum. In 2020-21, higher education enrolment reached 4.14 crore, up from 3.85 crore in 2019-20, marking a

21% increase since 2014-15. Distance education saw a rise to 45.71 lakh students, a 7% increase from 2019-20 and a 20% increase from 2014-15. Undergraduate enrolment dominates at 79.06%, with arts leading at 33.5%, followed by science, commerce, and engineering. Government universities (59% of total) and colleges (21.4% of total) contribute significantly to enrolment. Enrolment in Institutes of National Importance (INIs) surged by 61% during 2014-15 to 2020-21, showcasing substantial growth across various sectors of higher education (AISHE Report, 2021).

However, there are still significant challenges to ensuring universal access to education in India. Many children, particularly those from marginalized communities, continue to face barriers to education, including poverty, discrimination, and lack of infrastructure (Bhatia & Dè Silva, 2018). At the secondary and higher secondary levels, students have the option of pursuing either academic or vocational education. At the tertiary level, Indian universities provides a diverse selection of undergraduate and graduate programmes, including professional degrees in fields such as business administration, medicine, engineering, and law. In FY20, the education market in India was valued at approximately US$ 117 billion. It is projected to grow to US$ 225 billion by FY25 (Fig. 1.2).

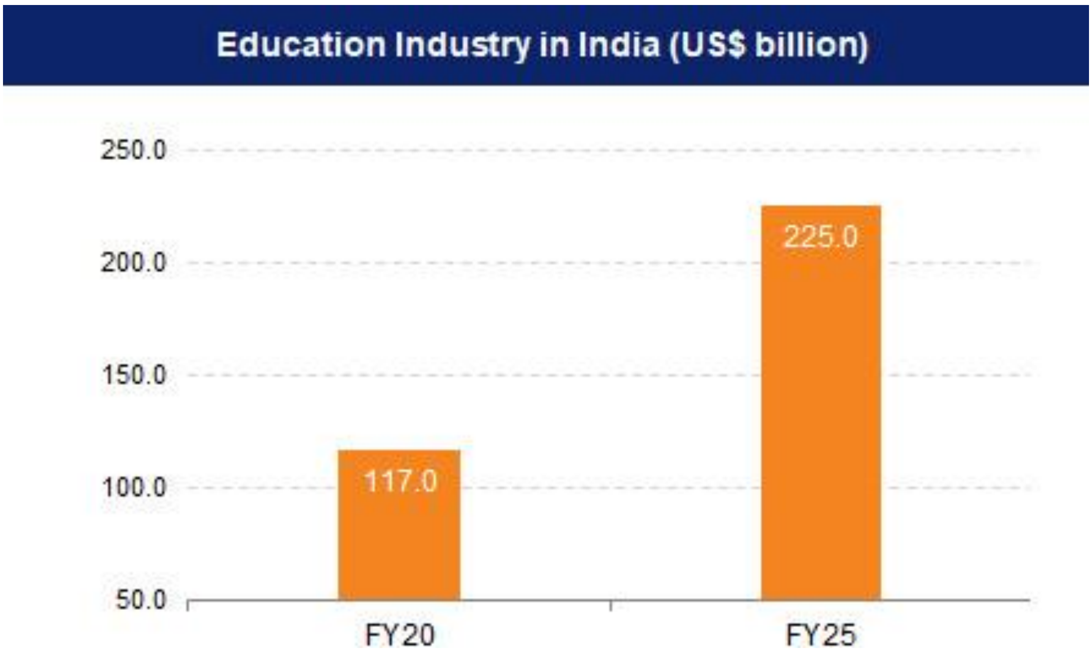

Fig. 1.2: Education Industry in India

***(Source:** ibef.org)*

1.2 TECHNOLOGY AND EDUCATION

Technology encompasses the assemblage of tools, techniques, and methodologies employed in the creation, advancement, and improvement of procedures, products, and services. It covers a broad spectrum of disciplines, such as information technology, engineering, manufacturing, medical, and communications. Technology can be physical, such as a smartphone or computer, or it can be intangible, such as software or algorithms. It is constantly evolving and changing, driven by innovation and advancements in science, engineering, and other related fields. The advent of technology has had a profound influence on humanity, changing how people, work, live and interact with one another. From the invention of the wheel to the emergence of the internet, technology has enabled us to achieve incredible feats and has the potential to solve many of the world's most pressing problems. To stay up with the most recent advancements in the information society of today, people must have access to knowledge through ICT. Information and communication technology, according to a study by Talebien, Mohammadi, and Rezvanfar (2014), comprises networks, hardware, software, and media that are used for gathering, storing, processing, transmitting, and displaying information in different forms like speech, data, text, and images. Information and communication infrastructure (ICI) and information technology (IT) are the two parts of ICTs that can be separated. Unlike the latter, which pertains to the equipment and software utilized for gathering, storing, processing, and displaying information, the former specifically refers to the tangible telecommunications system and network, encompassing cellular, phone, mail, radio, and television (Sarkar, 2012). It would be feasible to offer students a learning environment devoid of time and place constraints by utilizing ICT. The influence of information technology on human existence is immense, and its importance for education is of utmost significance (Khan *et al.*, 2020). ICT modifies thought processes, enhances current educational models, and offers new training techniques. These techniques emphasise interactive, self-directed, independent, adaptable, and technology-based learning while also sharing characteristics of technology-based training (Allahi & Sanayei, 2009: Talebien *et al.*, 2014). In this situation, the internet and computers have combined to create a type of teaching known as e-learning. In this approach, curriculum are competency-based rather than content-centered, and delivery techniques are student-centered rather than teacher-centered (Alestalo & Peltola, 2006; Attaran, 2007).

Technology has provided a solution for every contemporary social need, and it has had a significant impact on the educational field. Since the introduction of the Gurukul system of instruction until the advent of artificial intelligence (AI) and virtual reality (VR), technology has been at the forefront of education. The present educational system has been radically transformed by technology, nevertheless, thanks to classrooms that are equipped with computers. The education sector managed to overcome certain challenges despite the COVID-19 pandemic. It displayed grit by converting traditional classroom settings to online ones that could be accessed by anybody, anywhere. Eventually, the pandemic has significantly increased the adoption of technology in education. As a result of schools and colleges being closed to prevent the spread of the virus, many educational institutions had to switch to remote or online learning to ensure that education could still take place (Khan *et al.,* 2020). Consequently, the adoption of technology in education has become increasingly prevalent and has had a substantial influence on the delivery of education.

Higher education has been significantly impacted by technology, which has changed how students' study and teachers teach. As per the report by the National Center for Education Statistics (2019), 93% of undergraduate students in the United States use the internet for their coursework, while 75% use a learning management system (LMS) such as Blackboard or Canvas. An important development in higher education brought about by technology is the proliferation of online learning possibilities. Online courses and degree programmes have become increasingly popular, allowing students to learn from anywhere in the world at any time that suits them (Allen & Seaman, 2017). This has increased access to higher education for people who might not have been able to attend traditional brick-and-mortar institutions.

An analysis of previous research (Capper & Fletcher, 1996; Carter, 1996; Clark, 1985 and Thompson, 2007) that compared the efficacy of distance education with face-to-face instruction reveals that distance education is often equally effective as traditional education or the effectiveness of different technologies and there are no distinctions in learning outcomes; one sort of technology does not have a general learning advantage over another. Multiple authors (Clements and Sarama, 2003; Glaubke, 2007; and Dynarski *et al.*, 2007) contend that attention should be directed towards specific aspects of software programmes that have the potential to greatly impact students' learning experiences. These aspects include the educational value of the programme, its ability to engage students in learning, its user-friendliness, the interaction between the learner and the programme, and the programmes capability to track the learner's progress. In an attempt to assess the benefits and repercussions of ICT-based methods compared to traditional learning methods, several researchers (Tornabene, 1998; Sarkar, 2012 and Bhuasiri *et al.*, 2012) conducted a study. They spent many years to offer resolutions regarding the merits and demerits of traditional and contemporary pedagogy, particularly in an era where educational technology predominated. The years 1967 to 1972 are widely recognized as a critical juncture in the development of educational technology, a term that has since become synonymous with the field of pedagogy and the educational process (Danilović, 2004). Online education may use asynchronous, synchronous, or a combination of the two modes of instruction. Asynchronous learning is characterized by instruction and learning not occurring simultaneously (Moore *et al.*, 2011). In contrast, synchronous learning utilizes technological platforms, such as the Internet, to facilitate instruction and learning that occur simultaneously. During the latter part of the 20th century, most online courses and programmes used synchronous methods, such as chat rooms, instant messaging, and texting.

In addition to online learning opportunities, technology has also facilitated new teaching methods such as flipped classrooms, which involve students completing coursework online before coming to class for discussions and activities (Bergmann & Sams, 2012). This approach has been shown to increase student engagement and improve learning outcomes. Technology has also provided new tools for instructors to engage with students, such as video conferencing software and online collaboration platforms. These tools allow instructors to create interactive and engaging learning experiences that are not limited by physical location (Mullen, 2018). Finally, technology has also facilitated new research opportunities in higher education, with big data and machine learning algorithms allowing for the analysis of large datasets and the identification of new patterns and trends (Shah, 2018).

1.3 WHAT IS ONLINE EDUCATION?

The explosion of new technology, particularly information technology, has altered the shape of the entire world and influenced all aspects of human life. The same is true for the educational sector as well, where traditional student-teacher interaction and learning techniques have been aided by cutting-edge technologies. Online education refers to the process of learning that occurs exclusively through online platforms, allowing students to acquire knowledge and skills without being physically present in a traditional classroom setting (Oblinger *et al.*, 2005). At times, e-learning is often mixed with online learning but there is a difference between the two. According to Maheshwari and Thomas (2017) and Nichols (2003), e-learning is the process of obtaining access to web-based technological resources that can be utilized both within and outside of the classroom. Online learning offers students relevant and handy methods to achieve their learning goals. Multiple elements, such as technological components, the usability of the online platform, instructional activities, and assessment techniques, can impact the effectiveness of online learning (Wijekumar *et al.*, 2006; Shuey, 2002). Most terms associated with learning methodologies, such as online learning, open learning, web-based learning, computer-mediated learning, blended learning, and m-learning, rely on the utilization of a computer connected to a network. This enables the acquisition of knowledge to occur remotely, at any moment, at any speed, and by utilizing any available materials (Cojocariu *et al.*, 2014). Due to the COVID-19 pandemic, numerous institutions have been forced to transition from in-person teaching to online teaching. Institutions should comprehend the several aspects that can impact student happiness and their inclination to pursue online courses in the future.

Online education is a versatile teaching system that includes any sort of learning that takes place over the internet. It enables teachers to teach students who would otherwise be unable to enrol in a traditional education system and also to students who want to learn on their own. It is believed that online education is user-friendly and may even reach remote and rural parts of the country. It is seen as a less expensive form of education due to large cost savings on issues such as transportation, accommodation, and other expenses, as well as a significant reduction in overall costs when compared to institution-based learning. Another appealing feature of online learning is its adaptability; students can arrange their time and work according to their abilities to complete tasks. Online education aims to fundamentally revolutionise the academic process from beginning to end, according to Asabere and Enguah (2012). Online learning is referred to by many names, including computer-assisted education, online learning, and learning via the internet, to mention a few. The word "online education" can be used in a variety of various ways depending on the context. Online learning, according to some experts like Bertea (2009), is an attempt to use a variety of technical tools in teaching, while others claim that it is a replacement for distant learning, which is made feasible by the use of the internet.

The desire to "provide quality education to all students, regardless of location or time" (Chaney, 2001) drives the demand for online courses. Blended learning and flipped classrooms are educational models that integrate technology with in-person lectures, with the aim of enhancing students' learning capabilities. It has also been described as a learning environment that uses ICT to flexible and student-centric approach to teaching and learning.

An integral part of the online learning ecosystem are the providers of online platforms. The platform first served as an enabler, connecting potential students with content providers. In recent years, platform providers have increasingly taken on the role of content creators and curators. When it comes to online education, India has a mix of offline businesses with an online presence and online-only experts. Additionally, C2C business models that use a platform to connect instructors and potential students have been established (Fig. 1.3). B2C services are widely used in higher education. Higher education institutes use their own platforms or outside aggregators to offer degree or certificate programmes to students. Corporate partnerships facilitate the co-creation of industry-certified content, increasing online education's acceptance among its intended user base. Improved internet access and the usage of digital payment options have greatly aided in the growth of online education in India.

Many changes have happened in various aspects of life over a period of time and education system is no exception. Classrooms are no longer the same as they once were. The augmented leap of technological innovations over the years have changed the whole meaning of education and has created a pressing need for education research on how the learning has been mediated by emerging technologies.

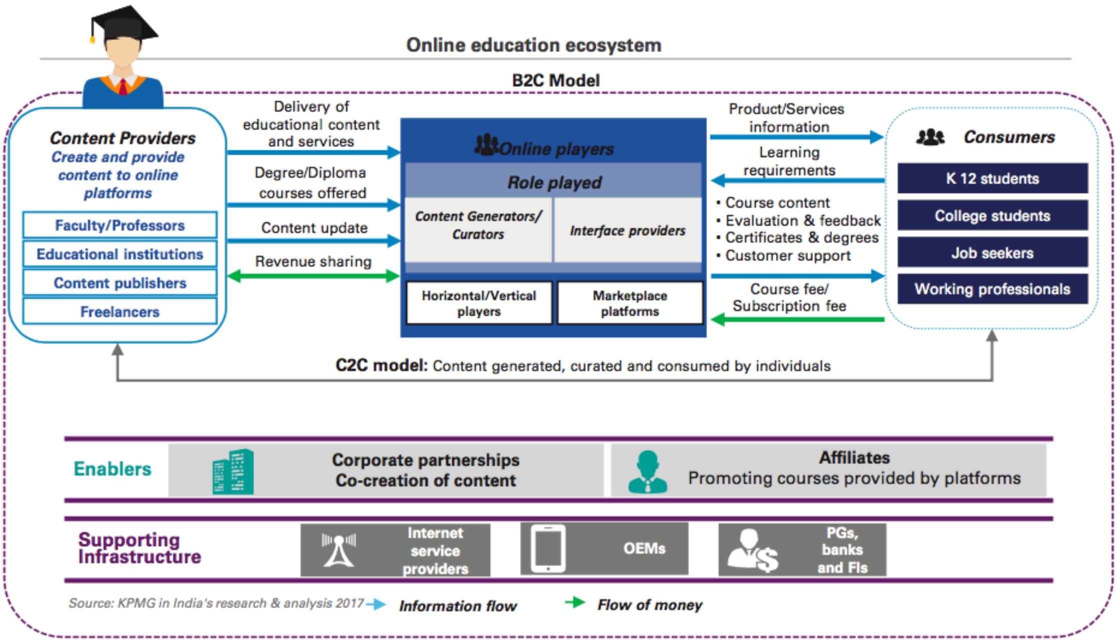

Fig1.3: Online Education Ecosystem

Students have access to a variety of learning environments, including in-person instruction, distance education, and online education, for learning across the globe. Online education encompasses a wide range of technologies, such as computer-aided instructions, audio and video recordings, web-based and multimedia resources, synchronous and asynchronous group communication, gaming and simulation applications, online collaborative learning, asynchronous learning networks (ALN), wireless and handheld devices (Hiltz and Turoff, 2005). Globally, online learning is becoming an increasingly significant component of the educational system. Everyone now has greater accessibility and convenience to education. The education industry in India is experiencing continuous growth. For higher education, India is among the largest markets in the globe.

1.4 EVOLUTION OF ONLINE EDUCATION

Online education in India has a long history, with All India Radio (AIR) and Doordarshan providing broadcasting space for telecasting pre-recorded educational programmes for both higher education and school-age students. Although several educational institutions, such as the UGC, Indira Gandhi National Open University (IGNOU), and National Council of Educational Research and Training (NCERT), utilized the services of All India Radio (AIR) and Doordarshan, there remained a requirement for active participation from the learners as all the broadcasts were pre-recorded. During the 1980s and 1990s, there was a significant surge in innovation and expansion of online education and networking across all educational levels. The technology surge of the mid-1980s is chiefly recognized for the development of the personal computer but it also marked the emergence of another important advancement, that is, online learning. At that time, the usage of this technology was primarily limited to business executives and a small number of well-equipped high schools. India envisions the utilization of ICT in the field of education. The pilot project known as Computer Literacy and Studies in Schools (CLASS) was implemented in 1984-1985. The proliferation of ICT has significantly increased due to the installation of thousands of computers in upper elementary and intermediate/higher secondary schools as part of various national and state government initiatives (AISHE Report, 2021). The exponential expansion of the Internet and the World Wide Web (WWW) has led to innumerable educational advantages. It was established in 1991, facilitating greater accessibility to online education and enabling the advancement of innovative pedagogical methods. Due to its user-friendly interface and ability to support multimedia content, the internet has expanded the scope of subjects that can be taught online. The Internet has had a notable influence (Wallace *et al.*, 2004) by aiding instructors in addressing the commonly mentioned constraints of online education more efficiently and by facilitating the delivery of instruction to individuals at distant locations, including students and employees (Oblinger, 2005).

The MOOC (Massive Online Open Courses) format, which combines university-based and corporate-based online programmes, was created in 2008 to increase the availability of higher education to a wider audience. Ivy League colleges were the first to introduce university-based platforms like edX, which was established by Harvard University and the Massachusetts Institute of Technology (MIT) in 2012, MOOC, founded by the University of Illinois Springfield in 2011, Coursera, founded by five universities (Princeton, Stanford, California/Berkeley, Michigan-Ann Arbor, and Pennsylvania) in 2012, Khan Academy by Salman Khan (Hedge Fund manager) in 2007, MITx, a joint effort by MIT and edX, Udemy by Eren Balin in 2010 and so on. The majority of these are free and available to the public, demonstrating the institute/university's commitment to education. Most corporate-based web offerings—whether free or for profit—were made by individuals, groups, and companies. Sebastian Thrun founded Udacity, a for-profit online programme, after resigning from Stanford University in 2011. Udacity offers multiple certification options that are acknowledged by leading technology companies that frequently recruit from the Udacity student community. P2PU, also known as Peer 2 Peer University, is an internet-based educational initiative facilitated by volunteers who instruct all of the courses. Many individuals now perceive online learning to be a new phenomenon.

Online education is known as "distance education," "e-learning," "online learning," "blended learning," "computer-based learning," "web-based learning," "virtual learning," "tele-education," "cyber learning," "Internet-based learning," "distributed learning," in the academic literature. All of these phrases were regarded sufficiently synonymous in this investigation, and they were used interchangeably throughout. The definition of online education has evolved as technology has progressed. Distance education gave rise to online programmes. Distance education was designed as a way for instructors to reach students who could not physically attend a college campus, allowing them to manage the learning process while putting the responsibility for learning on the students. At most universities, online education has evolved from a minor alternative role of "learning by correspondence" to the centre of life (Feenberg, 1999; Larreamendy-Joerns & Leinhardt, 2006). Despite the clear necessity to conceptualize distance education within the framework of rapidly evolving technology and the exponential growth of online education, its complex nature makes it challenging to reach a consensus on a single term or definition and the practical components that characterise distance education.

The advent of telecommunications and the knowledge revolution facilitated enhanced and expedited human connectivity and collaboration, leading to the emergence of novel forms of economic activity known as the knowledge economy. This, in turn, necessitated significant reforms in education, research and development, and professional practices. A significant number of individuals hold the belief that online education is a relatively recent occurrence. Online education emerged as an early result of e-mail and has since developed alongside the progression of computer networking. The advent of e-mail communication and computer conferencing occurred within the past three decades, a fact that may appear astonishing considering the rapid pace of technological advancement. Thanks to technology advancements, individuals from diverse backgrounds worldwide now have access to online education. Online classes are especially popular in the United States, with almost one-third of the 20.6 million college students opting for this format.

Understanding the history of online learning in higher education, like the history of the internet, can be challenging. However, a concise chronology is provided here to facilitate a better understanding of the beginnings of today's online institutes and courses:

- In 1982, the Western Behavioural Sciences Institute introduced a distant education programme for corporate executives, which utilized computer conferencing.

- In 1983, Ron Gordon, the former president of Atari, establishes the Electronic University Network with the aim of providing online courses to those who have access to personal computers.

- In 1985, Nova Southeastern University in Fort Lauderdale-Davie, Florida, pioneers the establishment of the first electronic classroom through an approved online graduate programme.

- In 1986, The National Science Foundation Network (NSFNET) pioneered the development of the initial computer network that laid the groundwork for the internet. This network facilitated the creation and dissemination of digital information among organizations.
- In 1993, Jones International University became the first fully web-based and accredited university in Centennial, Colorado.
- In 1994, CALCampus introduced synchronous learning, which was the first curriculum to be exclusively online and included real-time instruction and involvement.
- In 1995, Western Governors University was established by a group of nineteen U.S. governors with the aim of optimizing educational resources in Western states through online learning.
- In 1998, California Virtual University was established as a partnership between various universities in California. It provides access to more than 700 online courses.
- In 2002, the Massachusetts Institute of Technology (MIT) initiates the Open Courseware Project with the objective of providing open access to MIT courses to anyone worldwide.
- In 2012, Udacity introduced MOOCs, which are free online course resources. These courses provide students with the opportunity to learn at their own speed and without the need for real-time interaction.
- In 2020, the COVID-19 epidemic forces a transition from in-person instruction to online learning for all colleges and universities.

Over the decades, the face of education has changed dramatically. The conventional classroom model of education has given way to online and self-directed learning. Indian education has now embraced online learning, which is evolving on a daily basis. India has more than 500 million people aged 5 to 24 which presents a significant opportunity for the education sector. As mentioned about the size of the

India’s education market earlier too, it is estimated to grow to US$ 225 billion by FY25. Higher education's Gross Enrolment Ratio (GER), which includes vocational programmes, is intended to rise from 26.3% in 2018 to 50% by 2035 (Fig. 1.4) as part of NEP 2020 (India Brand Equity Foundation report, February 2024).

India has emerged as the second largest market for e-learning, following the United States. The online education sector in India is expected to increase by US$ 2.28 billion from 2021 to 2025, with a compound annual growth rate (CAGR) of approximately 20% (IBEF report, February 2024).

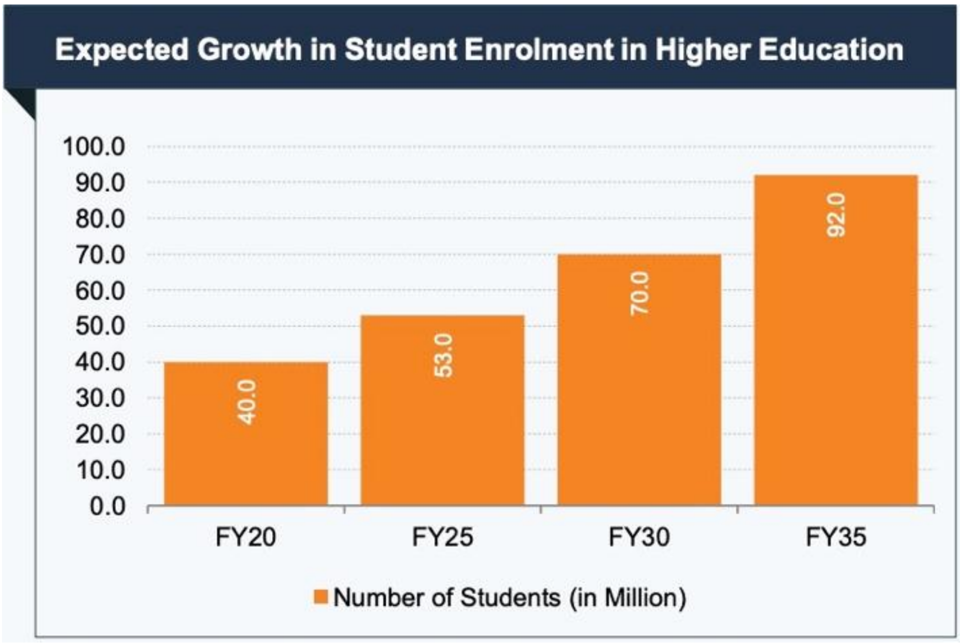

Fig.1.4: Students enrolment in Higher Institutes

Gone are the days when only textbooks were used to impart education; now that everyone has access to the internet, all limitations and impediments to learning have been erased. Initially, platforms acted as a bridge between students and content which over a period of time transformed itself as a knowledge supplier.

1.5 SUDDEN SURGE IN ONLINE EDUCATION

The COVID-19 epidemic has significantly impacted global educational system to an unprecedented extent, affecting over 1.6 billion students worldwide across 190 countries and all continents (UN Report, August 2020). With the substantial expansion of online learning as a result, education has undergone significant change. Over the past ten years, online learning has increased rapidly as the internet and education have come together to provide people with the opportunity to learn new skills. Even before the epidemic, Research and Markets projected that the $350 billion online education market would exist by 2025 (Forbes, 2020).

This is catastrophic considering that over 1.6 billion students worldwide have been denied access to schools. As a result, there have been significant changes in education, most notably the emergence of online learning, which allows for remote and digital platform teaching. Learning and teaching provision has become increasingly disaggregated as online education has grown, and universities are collaborating with several organisations to reach new learners. A plethora of online learning platforms, such as Udemy, Coursera, Lynda, Skillshare, and Udacity, are available to millions of individuals. Additionally, various user verticals are influencing the platforms. Skillshare focuses on serving individuals in creative fields by giving courses in animation, photography, and lifestyle. In contrast, Coursera caters to individuals in academia by granting them access to university-level courses.

In the past ten years, there has been a substantial increase in the popularity of online learning, as the internet and education have merged to offer individuals the chance to acquire new skills. Prior to the pandemic, researchers forecasted that the online education industry will have a value of $350 billion by 2025. However, due to the impact of COVID-19 on the online learning market, these projections would need to be revised (Koksal, 2020). Within days after the COVID-19 directives, many universities and other institutes began exploring all available video-conferencing tools and platforms. The institutes closure affected 87% of the world's student population. The UNESCO formed a global education coalition to assist nations in scaling up their best remote learning methods and addressing children and teenagers who are most at danger (UNESCO, 2020a). Shortly after the COVID-19 guidelines were issued, numerous university instructors and colleagues promptly started exploring various videoconferencing software and platforms that were available. Aside from their Learning Management System (LMS) or Modular Object-Oriented Dynamic Learning Environment (Moodle), which facilitates the delivery and exchange of documents, graded assignments, quizzes, and other learning materials between teachers and students in a user-friendly format, as well as the creation of top-notch online courses, a few other technologies such as GoToMeeting, Skype, ezTalk, emails, BlueJeans, Google Meet, and Zoom were utilized. Distance learning solutions encompass platforms, educational software, and resources specifically developed to aid students, teachers and parents.

Educational institutions were scrambling to find ideal solutions. Institutes at all levels were transitioning from face-to-face teaching. Local, regional and national institutions using objectivist, teacher-centered pedagogy have been forced to move to hybrid and online courses utilizing digital technology to make possible student-centered, constructivist, collaborative learning, which was earlier provided by only a few global “mega-universities”. These circumstances emphasize the necessity of employing scenario planning in academic institutions (Rieley, 2020). The COVID-19 epidemic has presented a situation that necessitates the collective effort and collaboration of all individuals. It was imperative to prioritize the safeguarding of human lives, including those of students, instructors and academic staff. It was crucial for everyone to understand the gravity of the situation.

While some think that the sudden and abrupt transition to online learning—which comes with no training, inadequate bandwidth, and minimal preparation—will lead to a poor user experience that is unfit for long-term expansion, others think the emergence of a brand-new hybrid educational model with enormous advantages. In between all of this, online learning and teaching can be considered as a solution for continuity of education.

1.6 BENEFITS OF ONLINE EDUCATION

By utilizing educational technology, online learning offers several advantages. Students have the ability to independently advance in their learning by accessing teaching materials, setting their own pace of work, reviewing unclear material, and receiving immediate assessment results and progress tracking. During the COVID-19 pandemic, the utilization of internet resources experienced significant growth. This allowed lecturers and students to easily access knowledge and materials through various online platforms such as blogs, papers, websites, and other associated resources. In addition, the increasing abundance of online resources accessible through the Internet, such as online journals and relevant websites, offers a valuable source of information for individuals who are learning online (Thurmond, 2003). Despite the physical distance between students, technology enables remote groups to connect through the Internet, collaborate on common problems, and foster a sense of community (An & Kim, 2006). There are clear financial benefits for students who live at home and wish to further their education. An additional benefit of transitioning to online teaching is the capability to create real-time cloud recordings of courses, meetings, lectures, and other forms of interaction (Oyedotun, 2020). By harnessing technology and various online resources, students and instructors were able to discover numerous educational opportunities for instruction and learning. One additional benefit of utilizing the online delivery method is that the inherent anonymity can result in heightened engagement from all students, including those who are more reserved or introverted. Due to the absence of visual cues, the instructor is capable of treating all students impartially. In the realm of online learning, the concept of learner identification has emerged as a significant factor in the learning process. Learner identity can be deliberately utilized as a learning strategy, similar to how it is used in online role-plays or discussion forums where users post under pseudonyms. Furthermore, students might utilize online studying to redefine their learner identities on various occasions (Appana, 2008). In a study by Kim *et al.* (2005), some students reported that working together with their peers in an online learning setting enabled them to develop virtual teaming skills. These skills are considered essential for those working in the current global corporate world. A student highlighted the potential professional advantages of his virtual collaboration experience in the online MBA courses. Educators and university officials explored the potential for implementing blended learning. The use of interactive, multimedia information in contemporary education offers a notable advantage compared to conventional learning methods (Oyedotun, 2020).

The popularity of online education has grown significantly over time, providing a range of advantages for individuals of diverse ages and backgrounds. Online learning offers flexibility, allowing students to learn at their own pace and according to their own schedule. This makes it more convenient for them to manage their education with other responsibilities such as employment, family, or personal obligations. Another important factor is accessibility. Online education overcomes the limitations of geographical location, allowing learners to access courses and resources from any part of the world, as long as they have an internet connection. Additionally, it is economically efficient. Online education is frequently more cost-effective than traditional classroom-based instruction. Online courses generally provide reduced tuition prices, allowing students to reduce expenses related to attending classes on campus, such as travel costs and other associated expenses. It provides a variety of learning possibilities by offering a wide selection of courses and activities, including those that may not be accessible locally. Individuals have the option to select from a diverse range of subjects and levels of education, including undergraduate and graduate degrees as well as professional certificates. Moreover, it offers personalized guidance by allowing learners to customize their learning experience based on their unique needs and interests. Individuals have the freedom to select the speed, manner, and structure of their education, and can receive tailored assistance and input from teachers and fellow students.

Overall, online education offers a convenient, affordable, and flexible way for learners to pursue their education and career goals, regardless of their location or schedule.

1.7 CURRENT STATE OF EDUCATION TECHNOLOGY

The worldwide digital explosion has changed how we communicate and do daily business, particularly in India. Businesses, the government, non-profit organisations, the healthcare industry, and the education sector have all been touched in one way or another as a result of the replacement of traditional processes with digital solutions.

Education Technology's popularity and demand were already rising quickly before the pandemic had started. E-learning programmes, however, gained a lot of support with the advent of newer COVID-19 viral strains, highlighting its comfort, cost-efficiency, and help in restricting the disease's spread. As our Prime Minister, Shri

Narendra Modi, clearly articulates, "Technology for us is a medium to empower the people of the country. For us, technology is the mainstay of making the country Atmanirbhar".

India is rapidly emerging as a major market for education technology solutions, driven by a growing demand for online learning and the need to provide greater access to quality education across the country. Here are some key trends and developments in the current state of education technology in India:

- Increasing adoption of online learning: The pandemic has expedited the transition to virtual learning in India, with schools and colleges across the country turning to virtual classrooms and online learning platforms to continue teaching during lockdowns. This has led to a surge in demand for EdTech solutions, such as learning management systems (LMS), video conferencing tools, and e-learning platforms.

- Government support for digital education: The Indian government has implemented various measures to encourage digital education in the country. These include the Digital India programme and the NEP 2020, which highlight the significance of utilizing technology to enhance the quality and availability of education.

- Emergence of EdTech startups: India is home to a thriving EdTech startup ecosystem, with a growing number of companies offering innovative solutions for online learning, test preparation, and skill development. Some of the most prominent EdTech startups in India include BYJU's, Unacademy, and Vedantu.

- Investment in EdTech: India has seen a significant increase in investment in the EdTech sector in recent years, with several large funding rounds for EdTech startups. In 2020, Indian EdTech companies raised over $2 billion in funding, according to industry reports.

- Challenges to adoption: While there is growing enthusiasm for EdTech solutions in India, there are also significant challenges to adoption, including limited internet access in some parts of the country, lack of digital literacy among learners and educators, and concerns around the quality and effectiveness of online learning.

Overall, the state of education technology in India is rapidly evolving, with significant potential for growth and innovation in the coming years.

In conclusion, the education system in India is complex and multifaceted, reflecting the country's diverse cultural and economic landscape. While there have been efforts to address challenges in the system, more work is needed to ensure that all children and young people in India have access to high-quality education. In the modern world, going to a physical school is no longer required to get an education or to increase one's knowledge. The people can more easily obtain information because there are many options for learning and education. Online learning is the most widely used and recognised method of advancing academics in reputable educational institutions all over the world, regardless of where they are located, despite the diversity and ease with which it may be accessible.

1.8 CHAPTER SUMMARY

This chapter explores the multifarious Indian education system, which has a rich and diverse history. It chronicles the development of educational practices in India, starting with the traditional gurukul system, in which sages impart knowledge in ashrams, and progressing to modern institutions that incorporate global pedagogical trends. The discussion encompasses the dynamic and adaptive character of Indian education, as evidenced by the diverse methodologies that have been employed over the centuries.

The chapter offers an exhaustive comprehension of the Indian education system's development and ongoing evolution by analysing both historical and contemporary perspectives. Additionally, it also sheds light on how the education system of India has transformed over the years, incorporating technological advancements to improve the quality of the learning experience. Technology is essential in the field of education, as it provides interactive software, digital classrooms, and educational applications that enable personalized learning, hence its role has also been examined.

In this light, the development of e-learning platforms, the proliferation of digital devices, and the advent of the internet have been brought out as these have played a significant role in the gradual evolution of online education.

This chapter further discusses the sudden surge in the online education after COVID-19 broke out. Towards its culmination, this chapter brings out the rationale behind the study. The pandemic precipitated an abrupt increase in the popularity of online education, as lockdowns necessitated the implementation of remote learning solutions. This chapter also highlights the advantages associated with online education such as the ability to access a diverse array of resources, the ability to create a flexible learning schedule, and the possibility of self-paced learning. On the flip side, it also brings out numerous obstacles which include digital divide issues that result in students from economically disadvantaged backgrounds experiencing difficulty accessing essential technology and internet connectivity, and the absence of face-to-face interaction, which can impact the quality of education and student engagement.

At the end, this chapter also states the growth that Indian education technology (EdTech) sector is experiencing as a plethora of entrepreneurs and established companies are developing innovative solutions to improve the quality of online learning.

Chapter – 2

REVIEW OF LITERATURE

The rapid advancement of technology has transformed the education landscape, particularly with the widespread adoption of online teaching. This chapter focuses on the literature that is pertinent to the current study. The review highlights key factors influencing students' intentions to adopt technology, explores theoretical models used to understand technology adoption behaviour, evaluate the effect of the technology platform used and the gadget employed on the learning effectiveness, assess the online classroom environment and its impact on students' engagement and lastly the issues encountered by the instructors while teaching online. The gap in the prior studies was highlighted to establish the need for this study. The literature review is organized thematically and has been divided under themes related to the topic:

1. Studies on learners' intentions towards technology adoption for online teaching
2. Studies pertaining to the effect of technology differentiation and gadget category on learning effectiveness
3. Studies related to the online classroom environment and its effect on students' engagement
4. Studies related to challenges in online teaching

2.1 STUDIES ON LEARNERS' INTENTIONS TOWARDS TECHNOLOGY ADOPTION FOR ONLINE TEACHING

Understanding students' inclination to embrace technology is becoming increasingly essential as their interaction with technology plays a significant role in the realm of online education. Students' impressions of online learning have been reported in studies, both positively and negatively. Multiple studies have looked into the variables that impact the outcomes of online education (Bolliger & Halupa, 2018; Yang *et al.,* 2017 and Shelton *et al.,* 2017). These studies have also investigated the primary elements that impact learner satisfaction in an online learning setting

(Weidlich & Bastiaens, 2018; Dziuban *et al.*, 2015 and Liaw & Huang, 2013). There has been a notable surge in research dedicated to examining students' perspectives and expectations around e-learning (Armstrong, 2011; Biswas, 2020). According to Moore's (1989) study, learner-content interaction, learner-learner interaction, and learner-instruction interaction are the three fundamental forms of communication in online education. In order to ensure successful and effective learning, it is crucial to take into account the preferences and views of learners while designing online courses or programmes. The design and implementation of online courses have a significant impact on student satisfaction, learning outcomes, and student retention (Irani, 2005).

2.1.1 Technology Acceptance Model

Acquiring a thorough comprehension of the foundational principles of the Technology Acceptance Model (TAM) is imperative in order to develop a resilient extended iteration of the TAM. Fishbein and Ajzen's (1975) work served as a foundation for their 1980 development of the Theory of Reasoned Action (TRA), which is the main antecedent of the TAM. The TRA (shown in Figure 2.1) is intended to predict human behaviour in general.

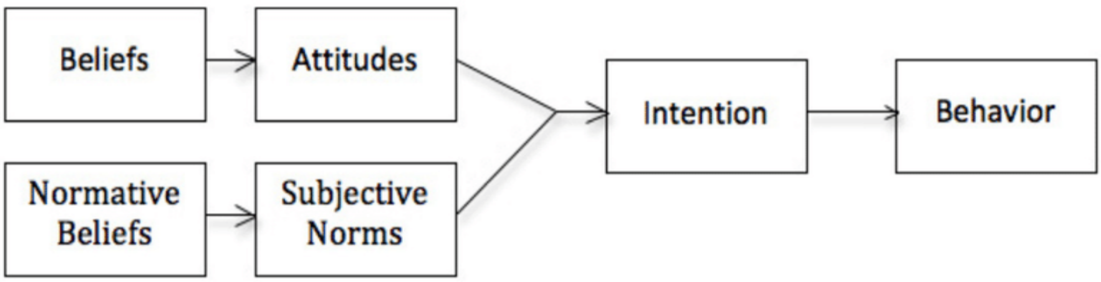

Fig. 2.1: Theory of Reasoned Action (TRA)

It pinpoints two essential elements as major behaviour determinants: subjective norm and attitude towards an action (Fishbein & Ajzen, 1975). According to Fishbein and Ajzen (1975), an individual's attitude towards a behaviour is their subjective assessment, which may include both positive and negative feelings, about how that behaviour was carried out. Conversely, a subjective norm is a person's judgement of whether important people in their life think they should or shouldn't participate in the particular behaviour in question (Fishbein & Ajzen, 1975). Beliefs about a behaviour shape an individual's attitude towards that behaviour, and normative beliefs about that behaviour form an individual's subjective norm regarding that behaviour (Fishbein & Ajzen, 1975).

Davis (1989) used the theoretical framework developed by the TRA to examine the behaviour of technology adoption. In accordance with Fishbein and Ajzen's (1975) advice, Davis created a belief system for technological adoption. The Technology Acceptance Model (TAM) was introduced by Davis (1989). TAM was the pioneering model that incorporated psychological factors into the study of technology adoption, as described by Davis *et al.* (1989), Hu *et al.* (1999), Adams (1992), Mathieson (1991), and Davis (1989). As per the studies by Huang *et al.* (2021 b), Granić and Marangunić (2019), and Al-Emran *et al.* (2018)), TAM is one of the most accurate hypotheses for forecasting users' adoption of technology. As shown in Figure 2.2, two key variables in the TAM framework, Perceived Usefulness (PU) and Perceived Ease of Use (PEU) explain users' intent of accepting technology (Davis, 1989; Bazelais *et al.*, 2018).

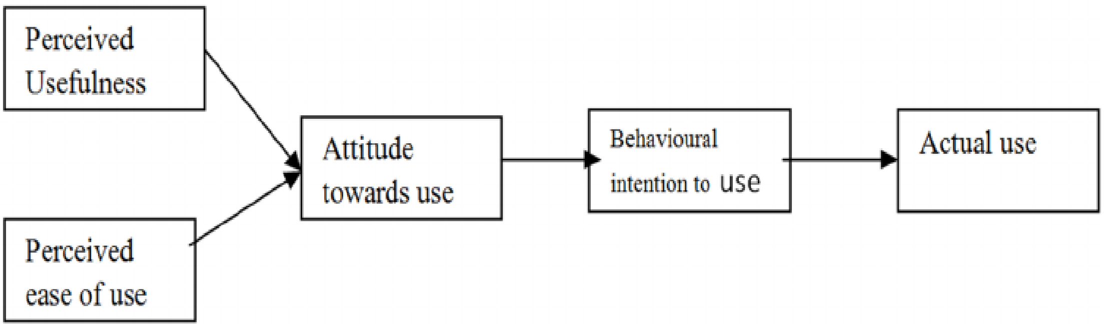

Fig.2.2: Technology Acceptance Model (TAM)

PEU denotes the opinion that using technology is simple, whereas PU refers to an individual's view that using technology will enhance efficiency and work performance (Teo and Noyes, 2011). As per Davis's (1989) findings, PEU influences PU, and both of these variables are linked to Attitudes (ATU), which measures a person's propensity towards technology, Behavioural Intention (BI) measures how much a person wants or is willing to use technology and is influenced by both ATU and PU. Perceived ease of use and perceived usefulness, according to Liu, Liao, and

Peng (2005), were successful in explaining users' intent to keep using technology in educational situations. This study is in line with those made public by Ibrahim *et al.* (2017) and Purnamasari & Advensia (2014), who showed that PEU and PU can affect users' intentions to use e-learning platforms in the future. Benito *et al.* (2019) used TAM to gauge students' acceptability of AI-based tests within an e-learning environment. The utilization of a system is regulated by behavioural intention, as postulated by TAM. Behavioural intention is predicated upon behavioural attitude and perceived usefulness. Perceived usefulness and ease of use influence attitude, and perceived usefulness is influenced by perceived ease of use and other external factors. Furthermore, attitudes can be broken down into perceived utility, perceived simplicity of use, and universality in accordance with Taylor and Todd’s theory of planned behaviour (1995) decomposition. An important factor in determining a user's behavioural intention is perceived utility and simplicity of use, both of which have a favourable impact on behaviour (Wenting and Guangrong, 2008).

TAM was employed in the Malaysian context to clarify students' acceptance of e-learning in university settings (Ibrahim *et al.*, 2017). Along with TAM, they added three external variables—instructor qualities, self-efficacy, and course design—to further their research. TAM was used in the United Arab Emirates to elaborate on the main elements influencing the acceptability of e-learning (Al-Kurdi, *et al.*, 2020). TAM was extended in Jordan to look into the adoption of online learning (Tarhini *et al.*, 2013) They discovered that the use and acceptability of e-learning by students was significantly influenced by attitudes and perceived usefulness. In a similar view, Sûmak *et al.* (2011), in their TAM-based study found that attitudes and perceived usefulness were strong indicators of students' utilization and acceptance of e-learning. Furthermore, according to their TAM-focused research, (Qteishat, 2013) revealed that attitudes and facilitating situations highly influenced the variance in e-learning utilization. Several studies have shown that using technology empowers teachers and students while also improving teaching and student accomplishment. Students find well-planned classes that include technology to be more interesting, memorable, and motivating (Tornabene, 1998).

2.1.2 Extrinsic Factors, Intrinsic Factors, and Perceived Enjoyment

Challenges to effective technology integration in the online course encompass both extrinsic and intrinsic factors. Extrinsic factors comprise technical support, readily accessible resources, and internet connectivity. Intrinsic factors comprise perceived utility (PU) and self-efficacy. (Teo and Noyes, 2011; Brinkerhoff, 2006; Shamburg, 2004; Butler and Sellbom, 2002 and Davis 1989). Self-efficacy is described as a person’s view that he or she is capable of doing a specific behaviour (Bandura, 1986). The likelihood that an individual will engage in a particular behaviour increases when that behaviour is associated with the belief that the behaviour can be mastered or a desired end achieved. For instance, greater levels of perceived self-efficacy in the utilization of computational technology were associated with greater levels of intention to employ that technology. Lack of self-efficacy will have negative effect on the use of technology and this will prevent students to integrate technology in their learning (Piper & Yan, 2001). Perceived Usefulness (PU) is the user's personal belief that using a certain application system will improve their job performance in an organizational environment (Davis, 1989). Learners are more inclined to make use of any technology when they believe it to be user-friendly and simple, as well as if it improves their academic progress and performance (Yeap *et al.,* 2016). Extrinsic factors include persons’ assessment of the level of support provided by the organisational and technological infrastructure and resources to encourage them to use the system (Venkatesh *et al.,* 2003).

Previous studies have found that extrinsic factors influence users to use technology to a great extent (Ain *et al.,* 2016; Zhou & Xiaoting, 2014 and Venkatesh *et al.,* 2003). Warner *et al.* (1998) defined online learning readiness primarily in terms of three factors namely, the student's preference for online learning instead of traditional classroom education, the conviction with which a learner uses electronic communication for learning comprising proficiency in internet and computer-based communication, and the student's ability to engage in independent learning. McVay (2000, 2001) and other researchers improved upon the concept by creating a 13-item scale to assess student behaviour and attitude as predictors. Smith *et al.* (2003)

conducted a study to assess the effectiveness of McVay's (2000) online readiness questionnaire. The questionnaire had a two-factor structure, one, ‘Comfort with e-learning’ and second, ‘Self-management of e-learning’. Online technologies, such as email, learning management systems, discussion boards, video conferencing, and social media, can offer effective and easy methods for online education students to achieve their learning goals (Chen *et al.,* 2010). Research has shown that students' attitudes towards computers have an impact on their future utilization of this technology in educational environments (Wei & Chou, 2020; and Alzahrani & O'Toole, 2017 and Joyce & Kirakowski, 2015). Bertea (2009) discovered that students' views and interactions with the internet can greatly impact their success in learning through online mode. The users' utilization of the technology is significantly impacted by their behavioural intention, which is in turn influenced by their previous experience with this technology (Šumak *et al.,* 2011). According to a poll conducted in Vietnam, both undergraduate and postgraduate students who pursued online education during the epidemic identified the stability and speed of the internet as the primary factors influencing their learning experiences. Three more crucial factors that impact students' online learning experiences are a conducive and serene studying environment, teacher assistance, and the user-friendliness of the learning platform (B & Company, 2020). A few studies show that a variety of characteristics like tech skills, access to resources, internet availability, etc. have an impact on how learners perceive learning (Shreshta *et al.,* 2019; Salloum at el., 2019 & Pérez-Pérez *et al.,* 2020). A study by the Ke & Kwak (2013) investigated that students' opinions of online learning are connected to their learning performance and critical components like access to internet and reading material may influence student performance. The students in rural Bangladesh had trouble attending online classes because of the sluggish internet connectivity. They regularly lost connection with their online classes, which made it difficult for them to interact effectively with their professors and classmates (Subedi *et al.,* (2020). Additionally, Blizak *et al.* (2020) pointed out that lack of access to necessary electronic devices made it difficult for students to participate in online classes.

2.1.3 Institutional Support, Perceived Enjoyment and Learning Intentions

Institutional support pertains to the technological and organizational resources that users perceive as readily accessible to aid them in the integration of information systems during their online learning pursuits (Venkatesh *et al.*, 2003). Simpson and Du (2004) in their study discovered that students' engagement and active involvement in synchronous online sessions significantly influence their learning experience. To reduce the limitations of asynchronous learning, most instructors have adjusted their instruction to use synchronous learning mode (Hsiao, 2012). The satisfaction of students with their online learning is influenced by all educational activities conducted during synchronous sessions. If students experience a lack of sense of belongingness and feel alone in online education, this may significantly impact their engagement with classmates and teachers. The availability of institutional support for users would decrease the cognitive effort required to interact with a particular ICT tool, thereby enhancing their perception of the system's simplicity of use (Bhuasiri *et al.*, 2012; Jawadi & El Akremi, 2006; Martins & Kellermanns, 2004). According to Asaari and Karia (2005), ICT availability (PC ownership and internet connection) influences users' opinions of the utility and convenience of use of online education systems, and thus their levels of online education preparedness. Lim (2001) established a direct correlation between learners' perceived satisfaction and their intention to enrol in online courses. The incorporation of appropriate learning activities in the course, together with the integration of classroom activities, enhances class involvement and enhances learners' motivation to engage in online learning (Hung and Jeng, 2013). The study found that there is a positive correlation between perceived enjoyment and attitude towards use and online learning aspirations. Additionally, the study revealed that perceived enjoyment is influenced by extrinsic factors. The availability of devices, internet connection, speed, and ICT infrastructure support indirectly influence online learning intentions. This outcome corroborates the notion that online learning is only enjoyable when there is a reliable and fast internet connection, as well as timely help to assist students in resolving their ICT-related problems (Kaur & Gopal, 2022). Various research studies have indicated that the level of interaction between an instructor and students has a substantial influence on how students perceive online learning (Muthuprasad *et al.*, 2021). Researchers from Japan, Bray and his associates, have combined the several aspects that affect the satisfaction of learners with online learning. These elements include of student-teacher interactions, student interactions, engagement with instructional materials, and platform interface user experience (Hung and Jeng, 2013). In a different study, students were randomised to take either a standard in-person class or an experimental online class by Lin Haiyan and Yu Jianning (2016). Students completed a questionnaire survey at the end of the semester, and the outcomes of their exams were compared. The findings showed that students in the controlled group achieved higher grades as compared to their peers in the standard class. Furthermore, the experimental class reported much higher satisfaction levels than the regular class's perceived contentment (Haiyan *et al.*, 2016). Hongpu and Congcong (2013) present the argument that, from a student's point of view, instructors play a crucial and indispensable role in the online teaching process using the Moodle learning platform as an example. Demuyakor (2020) carried out a survey to find out how satisfied overseas Ghanaian students were with online education at Chinese higher education institutions. The study's conclusions showed that students were in favour of the use of online educational resources. High levels of satisfaction with online learning were stated by these students, especially with the change from traditional classroom to virtual formats. Additionally, they said the online courses helped them achieve their learning objectives. However, the studies by Agha (2020), Lewis (2020), and Awasthi (2020) highlighted various challenges faced by students including network connectivity issues, data constraints, storage problems for e-resources, and a deficiency in teacher-student interactions. Since the COVID-19 pandemic compelled educational institutions to switch to remote or hybrid learning formats, there has been substantial concern about accessing online classrooms and properly connecting with teachers and peers during virtual learning (Sarkar et el., 2021). According to the results of the online student survey done in 2020, students' attendance and involvement in online classes were further complicated by the burdensome homework assignments that required a large amount of time (Online Students Survey, 2020). In the findings of the study by Gopal *et al.*

(2021), the majority of students believe that traditional in-person classes offer a higher level of difficulty and learning than online courses. Many students said they had trouble understanding the material covered in class and taking useful notes when participating in online sessions. Most of the students thought that online tasks were useless. These findings are consistent with a number of earlier research carried out in other countries worldwide, including India, Saudi Arabia and Jordan (Khalil *et al.*, 2020; Bisht *et al.*, 2020 and Alawamleh *et al.*, 2020). Students frequently had trouble incomprehending lectures, study material, and finding relevant reading material in the online learning environment. According to the results of the Online Student Survey (2020), learners complained that virtual classrooms did not accurately reflect the real thing, which prevented them from having meaningful interactions with classmates and professors. Blizak *et al.* (2020) and Alawamleh *et al.* (2020) determined that a significant majority of the students expressed a preference for traditional, face-to-face classroom instruction as opposed to virtual courses. This research showed that participants did not feel as at ease in virtual classes, and many claimed that traditional classroom settings were more comfortable.

2.1.4 Intrinsic Factors, Perceived Usefulness and Learning Intentions

Intrinsic considerations such as self-efficacy and perceived usefulness are important consideration in online education. Learners who believe they are extremely self-efficacious are better able to overcome difficulties or hurdles (Bandura, 1986) and will work harder and longer. Learners who are confident in their abilities and experience will gradually enhance their intentions to learn (Yoo, Han, & Huang, 2012). Many studies (Islam, 2013; Weibel, Stricker, & Wissmath, 2012) have discovered that user perceptions of ease of use, usefulness, enjoyment and service quality all influence learner attitudes about a technology. Both self-efficacy and motivation theory support the idea that in technology-mediated environments, learners who are confident in their abilities and the usefulness of a task will do better (Huang & Liaw, 2007). Students' views about the value-addition created by online education is another factor that might improve their performance in online classes (Proffitt, 2008).

2.1.5 Perceived Enjoyment, Perceived Usefulness and Attitude

Perceived enjoyment is an intrinsic motivator that focuses on the usage process and represents the enjoyment and pleasure involved while using a technology. The attitude toward using a given source is positively connected to perceived enjoyment. One of the main reasons users use technology for online learning is to have fun (Moon and Kim, 2001). If learners can have fun while adopting new technology, their attitude toward adoption will be positive (Suki and Suki, 2011). It's been known for a long time that attitude is a strong factor of intention. Many users today are probably exposed to online education and have formed an opinion towards using the same, ranging from positive to negative (Suki and Suki, 2011). Learners who embrace constructivist views exhibit more positive attitudes regarding technology in the classroom, according to the findings (Alzahrani *et al*. 2017). According to the TAM model, perceived usefulness influences behavioural attitudes and intentions to use.

2.1.6 Attitude and Online Learning Intention

Attitude, as described by Davis *et al.* (1989), refers to an individual's evaluative affect, which can be either good or negative, towards doing the desired behaviour. The proposal suggests that an individual's intention to efficiently utilize an information system is directly impacted by one’s attitude. This is based on the theories of reasoned action and planned behaviour, as proposed by Ajzen (1991) and Fishbein & Ajzen (1980). An individual's willingness to effectively utilize a technology should be determined by the positive beliefs about the outcomes and consequences associated with its use. This is because the process of effectively employing a technology is more intricate and time-consuming compared to simply using it (Davis *et al.,* 1989). In the context of online and distance learning, the findings show that attitudes regarding technology utilization have favourable positive impact on the system's intention to be used (Hernandez *et al.,* 2011; Jawadi & El Akremi, 2006). The Theory of Planned Behaviour (TPB) explains a variety of behaviours and behavioural intentions that are not under the will of an individual (Ajzen 1991, 2001). The concept is an extension of the Theory of Reasoned Action

(TRA), which posits that individuals are influenced by their personal views and societal expectations (Fishbein and Ajzen, 1980). In other words, behavioural intent is determined by an individual's attitude towards a specific behaviour and their subjective norms regarding it. Ajzen (1991) defines the first element of the Theory of Planned Behaviour (TPB) as the attitude towards behaviour. This refers to the extent to which the performance of an activity is valued positively or negatively. It is shaped by beliefs about the expected outcomes of the behaviour.. The more favourable an individual's attitude toward a behaviour is, the more likely that person will engage in that behaviour (Ajzen and Driver 1991; Miesen 2003). The decision was made to use behavioural intention as the dependent variable as opposed to actual behaviour, as it was believed to be the direct precursor to real behaviour. In essence, a person's behavioural intention is a highly reliable indicator of how they behave in reality (Davis 1989; Davis *et al.*, 1989; Sheppard *et al.*, 1988; Venkatesh and Davis 2000; Venkatesh *et al.*, 2000). A study by Kaur & Gopal (2022) stated that a positive relationship occurs between the attitude of the learners towards online classes and their intention to use online learning in future. According to Cheon *et al.* (2012), individuals are more likely to engage in a behaviour when they have a stronger intention to do so. The learners’ preference is determined by their level of preparedness or willingness to engage in collaborative learning, as well as the factors that influence their readiness for online learning (Muthuprasad *et al.*, 2021). Prior studies have demonstrated that an individual's attitude is a robust indicator of their purpose (Glasman and Albarracin, 2006 and Ajzen and Fishbein, 2000). The perceptions that students have of online learning influence their decision to join in an online course (Zebregs *et al.*, 2015). Age, gender, pre-existing computer literacy skills, and individual learning styles are significant factors that influence a student's embrace of technology (Al Kurdi *et al.*, 2020). Factors such as the social effect of students' reference groups and their attitudes towards online learning might affect individuals' desire to adopt technology and engage in online learning (Bertea, 2009; Shen *et al.*, 2006). Students' perspective of online learning can be influenced by elements such as the design of the course, psychological characteristics, and the support provided by the institution (Lee and Choi, 2011). A study conducted by Cheung and Vogel (2013) demonstrates that users with positive views are more likely to have stronger intents to use e-learning technologies. The presence of positive sentiments among users will enhance their inclination to utilize e-learning technologies (Cheung and Vogel, 2013). A study conducted by Thomas *et al.* (2020) during the COVID-19 lockdown in India on medical students revealed a notable lack of enthusiasm for online classes. The primary reasons cited included issues with network connectivity, limited interaction between teachers and students, fatigue, and restricted access to data. Students suggested introducing shorter periods to alleviate these issues, lessen weariness, and improve interaction.

2.1.7 Hypothised Research Model

Based on the review of literature, the proposed conceptual framework to examine the learners' intentions towards technology adoption for online teaching is given in Figure 2.3.

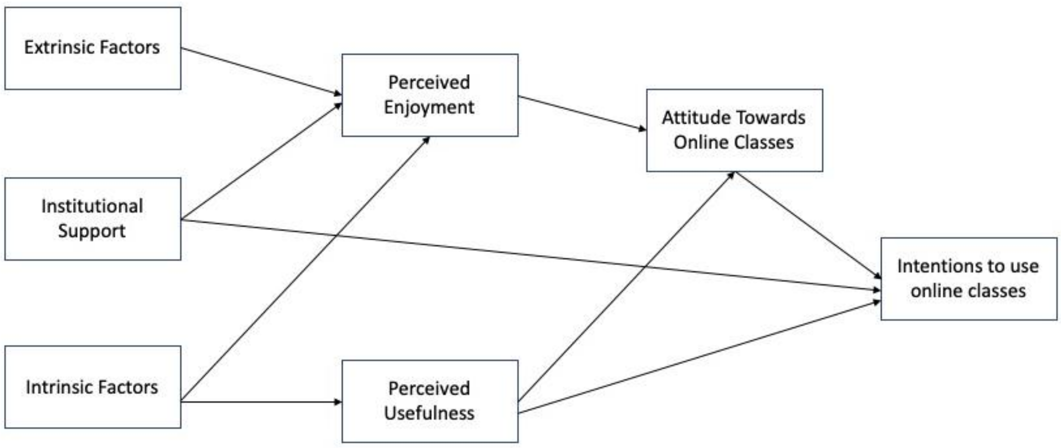

Fig.2.3: Proposed Hypothised Model

2.2 STUDIES PERTAINING TO THE EFFECT OF TECHNOLOGY DIFFERENTIATION AND GADGET CATEGORY ON LEARNING EFFECTIVENESS

Technology's adoption into our daily lives has been a tremendous advancement. Complex jobs have been made amazingly simple and effective by it. The instantaneous broadcast of information and the facilitation of quicker and more efficient communication made possible by technology have revolutionised the way knowledge is transmitted in the field of education. Additionally, it has changed how kids learn, engaging them in creative ways that were previously unthinkable in conventional classroom settings.

Information Technology (IT) greatly influences all aspects of university operations, including teaching, learning, research, and administration. According to Khan *et al.* (2020), it is a powerful instrument for spreading knowledge and information. A blend of traditional in-person instruction and online learning is replacing the traditional classroom arrangement in the rapidly changing global educational setting. Online learning platforms and resources were often viewed as supplementary tools to support traditional classroom instruction in schools and colleges prior to COVID-19. The pandemic forced an extraordinary change in which learning had to switch to an 'online-only' format. Without any prior strategic planning or worldwide preparation, educators were forced to provide lessons via a variety of online platforms (Abidah *et al.,* 2020).

As stated by Schiffer (2002), technological differentiation is the emergence of multiple functional variants within a technology. This idea can be used with a variety of platforms, including web browsers (like Chrome, Firefox, Microsoft Edge, MacOS, or MacOS, as mentioned by Tiwana (2015), mobile apps that are available on app stores (like Google Play or Apple's App Store), as mentioned by Liu *et al.* (2014), and social media sites (like Facebook and LinkedIn, as mentioned by Claussen *et al.* (2013). It is noteworthy that, according to Tiwana (2015), an application (app) is a software that is particularly created to function on a specific development platform. On the other hand, gadgets are portable electronic equipment such as laptop, personal digital assistants (PDAs), tablet/iPads, and mobile phone. According to Sung *et al.* (2016), these tools have significant potential for learning in both classroom and outdoor settings. Students' unprecedented engagement with technology is shaping their expectations for higher education instruction and their future leadership roles in organizations after graduation (Tapscott 1998). Honicke and Broadbent (2016) concluded in their study that utilizing an online learning platform is logical due to the fact that modern students are proficient in digital technology and are capable of effectively using various technologies for educational purposes. Furthermore, they found a strong correlation between a learners' belief in their own academic abilities and their academic performance. Considering the various modes of student interaction, such as internet and online social media and networks, the presence of diverse opinion leaders (including popular bloggers or individuals similar to them, who may not necessarily be wealthy or famous), and the decline in reading text due to the prevalence of YouTube (Au-Yong-Oliveira *et al.*, 2015), it is crucial to determine the most effective teaching methods for the classroom. During their time in university, students from all over the world commonly carry compact computing and communication devices, such as smartphone and tablet, mostly for personal use (Evans 2008). According to Barbosa and Geyer (2005), students perceive a cell phone as an essential item rather than a luxury. This transition is being driven by the broad accessibility and affordability of devices such as laptop and smartphone, together with the proliferation of other applications like Facebook, WhatsApp, YouTube, and others. Patten *et al*. (2006) categorized the utilization of portable devices (mobile and laptop) in the educational institutes into three primary classifications: the resources available (reference materials such as dictionaries and e-books), administrative tools for managing timetables and schedules, and interactive features that involve response mechanisms and feedback activities. A substantial amount of research has shown that most online learning environments designate sections for managing administrators, teachers, and students. Numerous functionalities are covered by these submodules, such as interactive features, game components, evaluation tools, and course management (Shao, 2019). The goal of this strategy is to support students' capacity for self-directed learning. Along with changing how people live and engage with one another, these variables are also changing how people approach education (Tiyar & Khoshsima, 2015). With their significant impact on so many facets of people's life, including education, gadgets have become an essential component of modern society. These days, they are frequently used for things like snapping pictures, recording audio, and filming lectures, rapidly replacing more conventional note-taking techniques. However, technology is being used in education for purposes other than only recording; it allows students to easily communicate information with one another in the classroom. The ability to operate these gadgets can increase the student participation in the learning process. Bayanova *et al.* (2019) emphasises how technological instruments improve learners' academic achievement. They stress how important these gadgets are for students' access to scientific content, information sharing, involvement in the class assignments and class preparation. Their study signifies the utility of technology for improving students' performance, especially when it comes to their passion in studying literature in Indonesian higher education settings.

Zhuo and Xiaoting (2013) proposed that the online teaching platform's dependability, information richness, system navigation, page aesthetics, and interface friendliness were positively connected with satisfaction, based on the viewpoint of students' learning styles and personality factors. The relationship between resource creation on online learning platforms, learner interactions, teacher assistance, behaviour and attitude, and student satisfaction is examined in the research findings. Proficiency with technology is associated with higher levels of student involvement in the learning process. Through their research, they have determined the main reasons why teachers believe that students use their devices: to meet learning goals, to double-check information from teachers, to find enjoyment, and to obtain short-term knowledge. Additionally, Bayanova *et al.* (2019) contend that using technology in the classroom allows students to engage with the outside world, which is frequently more appealing than face-to-face instruction. As Kukulska-Hulme *et al.* (2011) found, mobile learning allows people to develop, compile, and access useful information using smartphone, laptop, and the like. Additionally, it encourages innovative communication with a range of people and communities, enabling students to use their time no matter where they are. As mentioned by Chen & Huang (2010), Beckmann (2010) and Saccol *et al.* (2011), this involves using learning management systems made especially for mobile devices, which let students finish courses, interact with classmates, and share knowledge while looking for or uploading materials from anywhere at any time. The study emphasises the benefits of using tablet, such as its flexibility and mobility, and argues that this technology can help students develop creativity, self-directed learning, and intrinsic motivation (Chen & Huang, 2010). Tablet enabled and promoted group discussions, fostering learning centered around students and working together within small teams (Devey *et* *al.*, 2012 and Rossing *et al.*, 2012). Zucker and Light (2009) asserted that the incorporation of laptop in educational settings yields beneficial outcomes for student learning. However, they also held the belief that the usage of laptop did not fulfill the objectives of enhancing higher-level cognitive processes and revolutionizing classroom instructional approaches. Students employed smartphone applications to create notes for studying and collaborate on shared information for assignments (Miller, 2012). According to Ferreira *et al.* (2013), the use of mobile learning in HEIs is ranging from basic applications that enhance traditional teaching methods to advanced systems specifically tailored for the mobile learning approach. Few of the researches that were carried out in United Kingdom (Green and Hannon, 2007), United States of America (Kvavik, 2005) and Australia (Kennedy *et al.,* 2006; Kennedy *et al.*, 2008) Indicates that the majority of students possess internet-capable devices, such as computers and smartphone. They interact with these digital gadgets through formal and informal channels of communication, such as emails, blogging, and other means.

Teachers can use technology platforms to assign work to students individually, in small groups, or to the whole class (Allison & Hudson, 2020; Pretorius, 2018). In response to the pandemic, in-person classes were switched to 40-minute Zoom lectures. 77 students were asked to provide input on their impressions after the lecture series. With 97% of the students saying that the sessions were extremely relevant to their educational requirements and clinical practice, the results were overwhelmingly positive. Furthermore, a staggering 99% of participants expressed satisfaction with the sessions' ability to appropriately match their level of learning. Interestingly, every participant suggested that Zoom lectures be added to the medical curriculum (Agarwal & Kaushik, 2020). As stated in the study by Tuladhar *et al.* (2020), during the COVID-19 outbreak, in Nepal, a medical college's undergraduate students attended online lessons using Google Classroom. In order to attend these classes, students used a variety of devices, including desktop computers, laptop, tablet, and cellphone. Wang *et al.* (2018) carried out research on a blended synchronous learning environment (BSLE). In this study, the majority of students participated in the course in person, although others joined virtually via Google Meet for two-way videoconferencing. Understanding students' perspectives of this hybrid synchronous learning strategy and their learning experiences was the goal. The results showed that students valued the convenience and flexibility of using Google Meet to participate in classes from a distance. It's interesting to note that no serious technological problems were reported, and joining was simple for online students. Some students even used more than one device. As hosted on the internet digital hub that effortlessly unifies files, applications, discussions, chats, and meetings into a single Learning Management System (LMS), Microsoft Teams is an incredibly successful online learning platform. Standing out for having an extensive feature set, it provides features that are similar to those found on well-known social media platforms. These include chat rooms, group conversations, video conferencing and sharing of content (Ilag, 2020; Henderson *et al.*, 2020; McVey *et al.*, 2019; Buchal & Songsore, 2019; Hubbard & Bailey, 2018; and Tsai, 2018). Because of the flexibility that such platforms offer, teachers are able to modify assignments to fit the different learning styles and academic backgrounds of their students. All things considered, these platforms offer a number of useful features, such as the ability to schedule meetings, send invitation links to students so they can participate in them, interactive web conferences, file and document sharing, screen or desktop sharing, real-time chat communication, participant role adjustments (e.g., attendee or presenter), record web conferences, and download these recordings.

The proliferation of the internet and its impact on education has led to the adoption of many web-based applications, leading to the emergence of the e-learning trend in education (Liao & Lu, 2008). As stated by Petrova (2007), wireless and mobile technology are becoming more widely available, e-learning is becoming more common and pervasive. E-learning technology allows for new modes of engagement and encourages novel pedagogies (Li *et al.*, 2012). Students today, powered by the widespread utilization of technology, not only consumes but also creates material on their technical devices, both individually and in groups, and shares it on social media (Palacios-Marqués *et al.*, 2015). Students use technology far more than any preceding generational cohort. They commonly possess mobile phone, tablet and laptop. They exhibit a notable proficiency in multitasking with many electronic devices (Taleb & Sohrabi, 2012). Mobile technology in learning can greatly increase motivation levels among learners, especially those who are usually disengaged or perform poorly in the course (Mahat *et al.,* 2012).

As per the study by Fortune *et al.* (2011), for students to meet their learning goals, access to materials, chances for interaction, and the general learning environment are essential. In another study by Grey and DiLoreto (2016), the organisation and structure of the course, student's interaction with peers and instructor, student engagement, teacher's presence, and student perceived enjoyment are all important factors that determine how well online learning goes. Since educational institutions were closed in that turbulent scenario, it is crucial to make sure that the online delivery platforms utilized for instruction are seen as useful and efficient, especially from the viewpoint of the students. In this context, perceived usability is an essential component that shapes the total user experience (UX) (Diefenbach, Kolb, & Hassenzahl, 2014). Various factors, including technological aspects, user-friendly online platforms, class activities, and assessments, might influence the success of online learning (Wijekumar *et al.,* 2006; Shuey, 2002). System quality is the general quality of a website or e-learning platform that makes it easy for students to access courses and instructional materials. In an e-learning environment, system quality is enhanced more when a website is more user-friendly and well-organized (Zheng *et al.,* 2013). The quality of e-learning portal systems was evaluated by Dobbs (2000) and Fabianic (2002) through an evaluation of the site's speed, design, extra features, navigation, content display, search capabilities, and ability to foster trust among users. Trentin (2009) discovered that a badly maintained and designed website can impede students' motivation and interest, which are critical for their participation in self-disciplined and self-motivated e-learning. For this reason, these evaluation criteria are imperative. According to Waight and Stewart (2005), designing learning assignments with interesting tasks can speed up the learning process and help students apply their newly gained knowledge, abilities, and concepts in the workplace in a way that will ultimately increase their level of satisfaction. Additionally, Wang *et al.* (2007) offered a number of parameters for ensuring high-quality content in an e-learning environment. These requirements highlight how crucial it is that the system provide accurate, timely, and thorough information that is pertinent to the workplace, simply understood, and supportive of efficient learning.

Online platforms offer clear benefits for developing an environment which fosters conducive and immersive learning (Bakerson *et al.,* 2015). In this digital environment, traditional face-to-face interactions are replaced with virtual interactions, providing increased flexibility and convenience (Landrum *et al.*, 2020; Hoi *et al.*, 2018 and Bower *et al.*, 2015). Through the use of a learning management system, virtual learning offers special features like assignment submission, chat discussions, comment sections, authoring tools, rubrics, and feedback methods.

Due to the growing popularity of mobile devices, there have been studies investigating their impact on student learning. Empirical research on deploying tablet and laptop in higher education revealed that this technology has a favourable impact on student engagement and participation (Koile & Singer, 2008), as well as creating flexibility and a more informal learning environment (Kenney & Newcombe, 2011). According to a study by Fleischer (2017), it was found that students held a favourable attitude towards laptop. They reported feeling more motivated and involved in their learning when using laptop. According to Yengin *et al.* (2011), user satisfaction and net benefits are the two main components that must be evaluated when determining how effective e-learning platform is. DeLone and McLean (1992, 2003) framework consists of a number of dependent variables that are further divided into elements like user satisfaction, (Holsapple and Lee-Post, 2006), performance in academics (Lee and Lee, 2008), student advantages (Klobas and McGill, 2010), and grades of students (McGill and Klobas, 2009). User satisfaction is defined by Kim and Malhotra (2005) as the perceived knowledge acquired from an online learning platform. The significance of user enjoyment in determining the effectiveness of online learning platform has been highlighted by a number of research (Samarasinghe, 2012). According to Chiu *et al.* (2007), learners' satisfaction can be assessed based on the experience of user, the system's functioning, and its usefulness to the end user. User satisfaction, according to Shneiderman (1987), is the user's reaction to the knowledge or skill development obtained through a certain e-learning system, showing the degree to which job performance increases as a result of the system's skill enhancement. According to Reynolds (2011), contented users are those who believe their skills relevant to their jobs have improved. Several scholars have noted that if a system benefits the student, it is effective (Somers *et al.*, 2003; Zviran *et al.,* 2005). Numerous research (Sedera and Tan, 2007; Boshoff, 2007; Park and Gretzel, 2007; Bressolles *et al.,* 2007; Chiu *et al.,* 2007; Sedera and Gable, 2004; Zeithaml, 2002; and Arbaugh, 2000) have used the user satisfaction as one of the constructs to assess the efficacy of online learning. According to Bokhari (2001), a measure of how well an e-learning system satisfies users' needs and expectations and eventually increases contentment is user satisfaction.

2.3 STUDIES RELATED TO ONLINE CLASSROOM ENVIRONMENT AND STUDENTS' ENGAGEMENT

2.3.1 Online Classroom Environment

Institutes' instructional landscape underwent a significant upheaval as a result of the pandemic, COVID-19 and subsequent lockdowns. This sudden outbreak reduced the options available to traditional educational institutions, who previously had access to a variety of instructional delivery techniques, to just one: e-learning. Students of all ages were unsure about the long-term effects of this abrupt change to digital platforms, which brought about an emergency phase of government-mandated e-learning. The students and instructors in this online learning environment are geographically separated. Online learning can be seen as a part of remote learning (Watson *et al.*, 2012). It uses web-based delivery techniques and internet technology to enable structured learning experiences. It is a contemporary web-based system that makes use of digital technologies and a variety of educational resources, according to Rodrigues *et al.* (2019). Its main goal is to give students access to a personalized, learner-centric, open, fun, and interactive learning environment that supports and enhances the educational process.

To better understand how higher education students felt about emergency e-learning during the pandemic, an international comparison study was done in response to this upheaval. This study was set out to understand the perspectives of college students from three distinct nations, paying particular attention to their unique learning environments, levels of engagement, options in participation, and potential effects on their future job possibilities (Cranfield *et al.*, 2021). The findings of the study showed that students at the participating universities had a range of experiences, with the most notable differences being found in aspects of engagement, home learning environments, and assumptions about the impact on learning capacities. Underscoring the impact of cultural backgrounds on students' interest, participation, and learning was the study's notable demonstration of significant differences in the home learning environments across the three countries studied, viz., South Africa, Wales, and Hungary. Recent research (Valantinaitė *et al.,* 2020) highlights the dual nature of employing online learning environments within a digital learning strategy to advance education for sustainable development. As a result of technological progress, conventional in-person classrooms have transitioned into online and hybrid learning environments. The success and overall satisfaction of students in hybrid learning setups are significantly influenced by their positive attitudes, personal experiences, and expectations (Northrup *et al.,* 2002). In a quasi-experiment (Young, 2006), the primary objective was to discern students' perspectives on the advantages and disadvantages associated with studying in an online learning environment (OLE). Online learning environments advocates argue that Web 2.0 platforms' innovative and helpful technologies are essential for 21st century learners to succeed. On the other hand, naysayers contend that asynchronous interactions lack the rigour and level of participation required for higher education (Waites, 2003). A balanced online environment should provide a combination of synchronous and asynchronous choices, promoting good communication and collaboration between students and teachers (Reese, 2015).

Online education needs to be more than just knowledge sharing if it is to be effective and worthwhile. Students should be able to actively participate and create, just like they do in their everyday lives. According to research in favour of the growth of online learning, in order to increase their engagement, involvement, and participation, modern learners need possibilities for collaboration, the flexibility to actively construct knowledge, and a real audience (Rheingold, 2010). Research suggests that online learning shouldn't just be used to convey knowledge; it should also encourage students to participate in courses with the help of instructors and their peers (Cranfield *et al.,* 2021).

Critics of online education point out the potential disconnection that can occur within virtual learning environments. This emphasizes how crucial it is for teachers to foster an environment in online settings that cultivates both student autonomy and a sense of community (Reese, 2015). Supporters of this point of view emphasize that online education should stop being just a means of delivering information and instead become a constructivist activity in which students proactively participate in creating new knowledge (Hamilton *et al.,* 2004). According to Bell (2011), many online learning systems used in higher education are static and walled off, failing to take advantage of Web 2.0's interactive features. Bell (2011) contends that conventional learning theories developed for face-to-face instruction are insufficient to comprehend digital learning. Teachers as well as learners must adjust their roles in the learning environment and align their expectations with the dynamics of blended, conventional, and online learning in order for online courses to be successful. According to Hoskins (2011), while students' duties tend to be more flexible and independent, instructors frequently find their roles becoming more complex and demanding. A study by O’Shea *et al.* (2015) investigated how people adjust to online learning environments. Out of 38 people who had completed the survey, 19 participants were interviewed. All of the participants were enrolled in online programmes at different Australian universities in 2012. The main goal of this study was to comprehend how students described their involvement in learning environment, taking into account things like their interactions with institutions, teachers, other students, and themselves. One significant inference for educators in the business realm is the crucial role of instructors in the online educational environment. The degree to which instructors have an impact on elements like the standard of interactions, the importance given to involvement, and the general dynamics of the virtual classroom can range from substantial to total. This emphasizes how crucial it is for teachers to hone their teaching skills, such as how to expertly divide courses into smaller, more effective groups of students, create stimulating discussion topics, and cultivate an intimate atmosphere inside the online learning environment (Arbaugh, 2000). A study (Lou *et al.,* 2022) aims to investigate the importance of a favourable learning environment in raising students' sentiments of engagement and belonging. The contact between learners and teachers as well as among students themselves are two essential components of a pleasant learning environment in the classroom (Rushton *et al.,* 2020 and Dennie *et al.,* 2017). The impact of time on student achievement is a crucial feature of online learning. Based to certain data, students who take classes online devote more time to their studies than those who attend traditional, in-person classes (Jaschik, 2009). This might be ascribed to the flexibility that online learning provides, which lets students complete their work whenever and wherever it is most convenient for them. Both teachers and students profit from online education's "anytime, anywhere" appeal (Mayadas *et al.*, 2009). It gives them the freedom and flexibility typical of online educational experiences, freeing them from the restrictions of specific physical venues and strict schedules. However, due to its distant nature, some studies think that online learning may result in issues including loneliness, dissatisfaction, overload, low course completion rates and boredom (Berge, 1999; Hara and Kling, 2001; Northrup *et al.*, 2002). However, it can aid students in concentrating on accomplishing their learning objectives when instructors organise how they use the course material, and interact with the teacher, and their peers (Moore 1989; Berge, 1999). Because they are asynchronous and learner-centered, online classes can actually encourage student cooperation and discussion, which increases equality and democracy in participation (Maloney 2011; Northrup, 2009). According to Northrup's *et al.* (2002), instructors should foster interaction and collaboration with their online students. In addition to improving learning, well-planned interactive activities also increase motivation (Berge, 1999; Northrup, 2009). Additionally, a comprehensive model with elements for cognitive (Ding *et al.,* 2018), affective (Mcleod *et al.,* 2019; Lashari, 2012) and behavioural (Fredricks *et al.,* 2016) engagement is used to analyse student involvement. This study (Lou *et al.,* 2022) incorporates the elements of positive relationships and a sense of community to explain why students are engaged in the online learning environment. The results highlight how crucial it is for educational institutions to build social components into their platforms to encourage and support student involvement.

2.3.2 Students' Engagement

It is generally recognised that there is no single, all-encompassing definition of student engagement (Kahu, 2013), and that no single research endeavour can exhaustively examine every aspect of the topic (Solomonides, 2013). Consequently, every study is required to develop its own interpretation-based definition (Boekaerts, 2016).

Stovall (2003) has characterized engagement as a result of students' willingness to participate in events as well as their commitment of time. Engagement includes both pleasure and learning results (Maloney *et al.*, 2011; Harrington and Walker, 2009; and Jung *et al.,* 2002). It is the level of dedication to meaningful educational activities that directly contribute to the desired outcomes Krause and Coates (2008). Furthermore, according to Chen *et al.* (2008), the word engagement is defined as "the extent to which learners actively engage with their educational tasks," and it is favourably associated with a number of beneficial outcomes, including strong academic performance, student satisfaction, and tenacity. According to Finn (2006) and Kuh *et al.* (2008), student involvement has been linked to better academic performance, and retention, whereas non engagement has a negative impact on cognitive development and learning outcomes. As explained by Ben-Eliyahu *et al.* (2018) and Appleton *et al.* (2008), student engagement is a multifaceted term with many different aspects. It has even been compared to a "meta-construct" by some researchers (e.g., Kahu, 2013 and Fredricks *et al.*, 2004), while others have compared it to the "parable of the blind men and the elephant" by Eccles (2016). Student engagement is a visible manifestation of energy and effort in action, according to many indicators (Eccles & Wang, 2012; Skinner & Pitzer, 2012; Kuh & Hu, 2008; and Appleton *et al.,* 2008). The intricate interplay of connections, learning environment and learning activities are a few examples that influence engagement (Bernard *et al.,* 2009). The greater the number of students who experience empowerment and active participation within their learning community, as indicated by Kim & Kim (2020), the more likely it is that students will reinvest their energy into their learning. This, in turn, can yield a positive influence on their engagement. Students who actively participate in learning activities, make sincere efforts in a variety of learning pursuits, and exhibit a deep interest in the subject matter are said to be engaged (Christenson, Reschly & Wylie (2012). According to Wonglorsaichon *et al.* (2014), student engagement, which measures students' thoughts, attitudes, and actions during the learning process, has complex structural characteristics. As stated by Datu (2018) and Reyes *et al.* (2012), students' engagement has demonstrated a high, positive link with crucial learning outcomes, including academic accomplishment. The studies on the factors that influence student engagement currently focuses mainly on three key areas, students' characteristics (Davis *et al.*, 2018), instructors' competence (Tas *et al.*, 2019), and technology used (Heflin *et al.*, 2017). In summary, these studies explore how technology, instructional quality, and unique student traits contribute to and enhance student engagement. In their online learning activities, engaged students frequently display qualities like focus, zeal, and dedication (Luo *et al.*, 2022; Bernard *et al.*, 2009; Eccles, 2016; Chen *et al.* (2008). In the words of Luo *et al.* (2022), students' engagement pertains to the degree of enthusiasm and commitment students devote to their educational endeavors. This may be assessed using a spectrum of affective, cognitive and behavioural indicators. As depicted in the studies by Kim & Kim (2020), Ding *et al.* (2018), and Quin *et al.* (2017), engagement is a complex idea that encompasses three different levels; cognitive, emotional, and behavioural involvement. There is ongoing discussion about whether there are three components, such as cognitive, affective/emotional and behavioural (Eccles, 2016), or five, now that social involvement (Fredricks, Filsecker, & Lawson, 2016) and agentic engagement (Reeve, 2013; Reeve & Tseng, 2011) and have been added.

The mental effort and cognitive commitment that students make in their learning are known as **cognitive engagement**. As defined by Ding *et al.* (2018), cognitive engagement is essentially the focused thinking and mental processing that a student engages in when participating in a learning task. By Reyes *et al.* (2012), affective/emotional engagement is concerned with the emotional commitment and reactions that support a student's attention, identification, and the development of positive attitudes or values during the learning process. Nguyen (2017) emphasises that student personal commitment and involvement in the learning process are the foundation of cognitive engagement. It entails looking at the intangible elements or psychological traits that motivate students' efforts to comprehend, master, and acquire the abilities and knowledge required for their academic work. When analysing the level of commitment necessary by pupils to comprehend and master the skills and knowledge expressly taught in schools, the area of cognitive engagement is particularly pertinent. Understanding the connection between psychological motivation in students and their general participation depends on knowing this. Cognitive engagement, as explained by Bircan (2015), focuses on students' willingness to invest time and effort to fully comprehend an idea or acquire a critical skill. It also has to do with the different processing techniques people use to learn. For learning and academic success, cognitive engagement is crucial. Cognitively engaged students frequently use a variety of worthwhile learning techniques, which are essential for supporting fulfilling educational experiences. These learners have a passion for learning, readily accept difficult assignments, clearly define their objectives and goals, and have the capacity to govern and regulate their development.

The observable behaviours and participation that students display in their learning activities are referred to as **behavioural engagement**. According to studies by Sinatra *et al.* (2015), behavioural engagement is the focus of the majority of research on student engagement and entails students' active effort and participation as they immerse themselves in various areas of the learning process. As stated by Hospel *et al.* (2016), behavioural engagement is a term that can be interpreted differently in various educational contexts and domains. It includes a student's behaviour and behaviours when completing learning tasks, including their effort, perseverance, and active participation in their own learning process. According to Fredricks *et al.* (2016), this idea of behavioural engagement is defined in terms of a student's participation, attention, effort, positive behaviour, and perseverance in their learning activities. Wang *et al.* (2016) further define behavioural engagement as including activities like asking and responding to questions, participating, being willing to persevere rather than giving up easily, and the level of attention provided to the job at hand within the framework of domain-specific engagement. Students' behaviours can vary, despite the fact that our understanding of behavioural engagement has advanced significantly and has been thoroughly investigated in face-to-face educational environments. High levels of school involvement, active participation in school events, and obedience to classroom regulations are frequently found in those who display behavioural engagement.

The satisfying emotional experiences that students have when engaging in online learning are related to **affective engagement**. As examined by Wang *et al.* (2018), emotional involvement has to do with how students feel about their educational experiences and the setting in which they are taught. Students who show emotional engagement feel a sense of belonging in the institute, show excitement for their classes and learning, and form opinions about academic and social aspects of campus life that can be either positive or negative. In the opinion of Kanaparan *et al.* (2017), emotional involvement in the setting of the classroom includes emotions like interest, zeal, hope, enjoyment, vitality, contentment, and pride. Simply being satisfied is different from being emotionally engaged because satisfied students contribute little to the organisation. The delicate integration of behaviours, results, and attitudes is at the heart of the complicated and varied idea of emotional engagement. It appears when people voluntarily devote their time, energy, and life experiences to creating joyful feelings connected to their work and connections with others. Students who are emotionally involved are more likely to go above and beyond and put in extra effort, which is essential for the long-term success of educational institutions. According to Cirica & Jovanovic (2016), students who are dedicated to completing their academic duties and are deeply involved in their work are much more likely to feel positive emotions in their work, such as feelings of joy, enthusiasm, contentment, optimism, and a calm and relaxed outlook. On the other hand, people who are less engaged are more prone to experience unpleasant feelings like anxiety, melancholy, depression, discomfort, tension, or hopelessness. As a result, emotional involvement is crucial in the academic world.

Reeve and Tseng (2011) firstly introduced the concept of **agentic engagement**. In this, students actively participate in the learning process by influencing how instruction is delivered. This idea emphasises how learners actively and sometimes consciously work to enrich and personalise their educational experiences. For instance, throughout the learning process, students may offer feedback, express preferences, make suggestions, ask questions, share their thoughts and needs, propose goals, indicate their level of interest, request materials or additional learning opportunities, attempt to relate the lesson to their own experiences, influence problem-solving techniques, seek clarification, generate ideas, express their preferences, or ask for assistance such as modelling, tutoring, or feedback (Reeve & Tseng, 2011; Reeve, 2013).

Despite the fact that there are few studies that look at the growth of student participation via the lens of relationships, it is critical to understand that education is, at its core, a **social activity** (Fredricks, Filsecker & Lawson, 2016), another add on in the students' engagement. Instructors and students are the two main characters in it. Students are encouraged to form a variety of relationships with both their teachers and their peers during their interactions because they are the main players in the learning process. These relational networks might be seen as important resources, in line with the social capital theory. They are important in encouraging specific behaviours and actions among individuals (Coleman, 1988). Hence, it is plausible that the efficacy of interactions among students and their instructors, as well as amongst students themselves, could significantly influence student engagement. Social engagement includes a person's desire to engage in conversation and establish connections with others. It stands for the active effort and passion put into establishing and fostering relationships with other people.

Student engagement is significantly increased by a number of factors, including academic behaviours involving the application of self-regulated learning strategies, quantitative reasoning, activities that stimulate critical thinking, as well as integrative and reflective learning (Kuh 2001). According to Ormrod (2011) and Pascarella and Terenzini (2005), these factors are linked to improvements in cognitive processing, achievement, and success in a variety of domains. Prior to the widespread use of online or web-based courses, class attendance was the primary focus of previous research on gauging student participation (Douglas & Alemanne, 2007). Attendance has been found to be a key element in influencing student performance, despite the fact that it may be a simple statistic that only partially reflects participation and frequently ignores the level of engagement (Douglas & Alemanne, 2007). Student engagement requires attendance, relationships with peers through collaborative learning, and participation in conversations with people from various backgrounds (Cabrera *et al.,* 2002). Interactions between students and faculty members and the efficient teaching strategies used by faculty members are equally crucial (Kuh and Hu, 2001).

In addition, there are environmental factors that enhance student engagement, including the quality of interactions with fellow students, teachers, and other staff members, as well as a general perception of a supportive atmosphere (Baird, 2005). A study conducted by Dumford & Miller (2018) found that online classes have a positive effect on various indicators of engagement, such as higher-order learning, integrative and reflective learning, learning strategies, quantitative reasoning, student-faculty interaction, and a supportive environment. However, online classrooms appeared to have a less favourable effect on markers such as collaborative learning, quality of interactions and discussions with others. Online learning has been found to have several strengths. This involves factors such as consistent design of the course (Swan *et al.,* 2000), instructors' ability to stimulate critical thinking and information processing (Duffy *et al.,* 1998; Picciano, 2002; Hay, 2013), active participation within the virtual environment (Arbaugh, 2000; Hay, 2013), fostering positive perception of one’s academic abilities (Lim, 2001), and proficiency in utilizing technology (Wagner *et al.,* 2000). Therefore, the effectiveness of an online course hinges on well-structured course content, well-prepared instructors, the integration of modern technologies, and the provision of clear instructions and feedback (Sun and Chen, 2016; Gilbert 2015).

2.3.3 Hypothised Research Model

The proposed hypothised model, based on the review of literature, to understand the impact of online classroom environment on students’ social, emotional, cognitive, and behavioural engagement, is given in Figure 2.4.

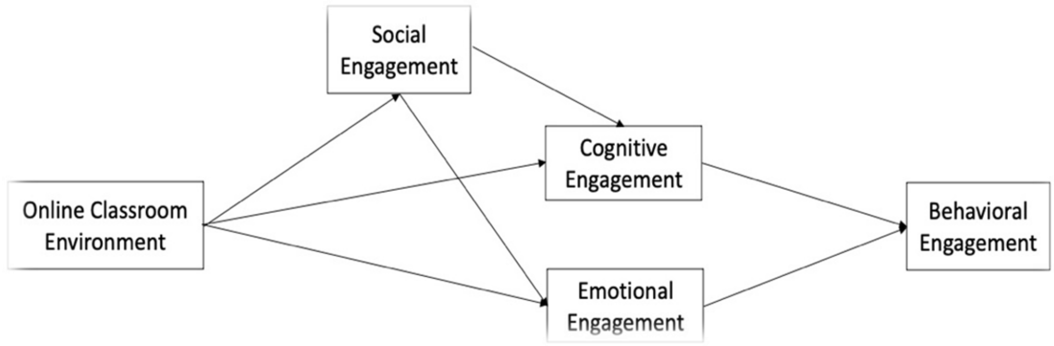

Fig. 2.4: Proposed Hypothised Model

2.4 STUDIES RELATED TO CHALLENGES IN ONLINE TEACHING

Online education has emerged as a transformative force in modern pedagogy, revolutionizing traditional learning models and enhancing educational experiences. It has become increasingly prevalent in HEIs, especially with the shift to online teaching. While this form offers numerous advantages, it also brings into light unique concerns both for the students and the teachers.

2.4.1 Challenges in online teaching

Because of its adaptability, digital education may facilitate any kind of learning that takes place through the internet. (Haleem *et al.*, 2022). Both educators and students must accept the online learning process for e-learning to be victorious (Lederman (2020). As never before, the field of education was profoundly affected by the quick and widespread development of COVID-19. As a result of the abrupt shutdown of schools, colleges and institutions were compelled to switch to online learning without enough time to prepare (Graham and Sahlberg, 2020). The abrupt transition from traditional education to a fully online model has presented significant challenges for both teachers and students as discussed by Adnan and Anwar (2020) and Bdair (2021). However, research in related literature demonstrates the need for nations to be prepared for scenarios like a pandemic with regard to education. As highlighted by Siegal *et al.* (1996), effective interaction in the absence of regular classes hinges on the motivation of various stakeholders. According to previous studies, there are a number of challenges facing online teaching and learning that can be divided into four groups: personal difficulties, course-related difficulties, teaching-related difficulties, and cultural difficulties, which can differ from one country to another due to context and readiness variations (Sahito and Vaisanen, 2021). Teachers agree that there are three key areas where online learning implementation issues can be broken down. These factors include support and facilitation-related concerns including internet connectivity, equipment requirements for students, and data usage caps on the internet. The learning process itself also faces difficulties because of the limited time that teachers and students have to connect during activities. Due to this restriction, it is challenging to give thorough explanations of the subject matter and to monitor and control students' emotional states while they study. Therefore, teachers have identified technology proficiency, methods for carrying out efficient online learning activities, resolving support and facilitation issues, and showcasing creativity as their main obstacles to implementing online teaching (Rosalina *et al.*, 2020). In developing countries, connectivity issues, a lack of ICT (Information and Communication Technology) understanding, issues with content distribution, and students' low IT abilities are the main obstacles to the deployment of online learning (Aung and Khaing, 2016). According to Kanwal and Rehman (2017), the Pakistani educational system confronts issues with digitalization linked to computer self-efficacy, system attributes, and internet expertise.

There is a lot written on integrating learning technologies into teacher practice in the past studies. In 2013, Ertmer & Ottenbreit-Leftwich's seminal study identified two categories of impediments to teacher acceptance of new technologies in the classroom. These are divided into two types: first-order and second-order barriers. First-order barriers encompass external elements such as resources, access, professional development, and school support. On the other hand, second-order barriers refer to internal factors like teacher beliefs, educational strategies, and technology knowledge. In addition, research has shown that despite colleges and universities' growing commitment to integrating information technology into instruction and learning, teachers have been generally slow to adopt this technology (Abrahams, 2010). Moser's research revealed that faculty apprehensions regarding the utilization of technology in education were similar in both the United States and Europe. The problem of faculty opposition within institutions was particularly evident (Moser, 2007).

According to research, educators faced a number of difficulties when teaching online courses, such as a lack of technological know-how, declining student intention, and low overall participation. Furthermore, students frequently offered a variety of justifications for their challenges, making it harder for instructors to identify the true underlying problems (Yusnilita, 2020). Another study investigated the types of difficulties teachers have while switching from face-to-face teaching to online teaching. The creation of top-notch instructional content was one of these hurdles, as was actively engaging students and inspiring their participation during online teaching. Teachers faced a variety of challenges related with technology, such as issues in downloading materials, issues installing apps, unstable internet connections, trouble with login IDs, and problems with audible audio and video (Sangeeta and Tandon, 2020). In the context of Pakistan's medical universities, faculty members expressed their opinions regarding e-learning during the lockdown period. Some acknowledged that e-learning promoted student-centered approaches, while others encountered challenges when teaching clinical and practical courses (Mukhtar *et al.*, 2020). During the COVID-19 pandemic, most teachers at institutions in Uttarakhand had favourable opinions about online learning, especially the younger ones who actively participated in it. E-learning increased teachers' knowledge while also enhancing their proficiency related with technology. However, it did result in a communication gap between teachers and students and required teachers to put in additional work hours and grasp advanced multimedia teaching technologies (Dubey and Singh, 2020).

Online teaching complicates the job of the instructors by requiring them to gather, prepare, and facilitate the delivery of the knowledge online (Adedoyin & Soykan, 2023; Bdair, 2021; Buzzetto-Hollywood, 2007). The complex nature of online instruction has significantly enhanced the workload for instructors (Adnan & Anwar, 2020; Connolly & Begg, 2006). These challenges for Indian students include psychological well-being in addition to issues with technology infrastructure (Pandita *et al.* (2021). As documented by Pandita *et al.* (2021); Bashir *et al.* (2020) and Hasan and Bao (2020), the psychological effects of digital education on students in India include depressive and anxious sensations. University instructors in Bangladesh, meanwhile, had trouble delivering online courses because of a lack of technology, infrastructure restrictions, pricey and poor internet connections, and financial troubles. In comparison to traditional classrooms, they also needed to put in more time and effort to create successful online courses. Some disciplines, such as those that required hands-on work or specialised laboratory equipment, were not appropriate for online learning (Ramij and Sultana, 2020). During pandemic, teachers were urged to recognise the indisputable advantages of employing technology for continuing education (United Nations, 2020; UNESCO, 2020) as they see the necessity of having online classes as a tool to control the virus outbreak and continue teaching from home. Technology-enhanced learning requires the right equipment, expertise, and endurance in the face of unforeseen events (Bao, 2020). Many problems were encountered by the teachers as they navigate through the pandemic. With regard to their proficiency in managing technology, teachers face new obstacles as a result of the digital mindset (Moser, 2007). Several university teachers had a bad view point of distant learning. They voiced discontent with the training and assistance provided by the university and held that virtual learning environments couldn't replace the interpersonal connections made in conventional classrooms. Others were concerned that it would result in teacher layoffs (Kulal and Nayak, 2020). Teachers today not only need to use effective teaching techniques to accomplish their class objectives, but they also need to take into account other outside aspects like infrastructure, stable internet connectivity, digital literacy, support services that may help make online teaching successful (Zhang *et al.,* 2020; Khan *et al.,* 2020). The way instructors use pedagogies and deliver their lectures during online teaching (T&L) is influenced by their efficacy, knowledge and expertise (Mishra & Mehta, 2017). Abdous (2011) concluded that the process of digital learning involves three main phases: preparation, implementation, and reflection. In the preparation phase, the lesson is carefully planned and designed. The implementation phase refers to the actual teaching and learning that takes place during the lesson. Lastly, the reflection phase occurs after the lesson, where the outcomes and effectiveness of the lesson are evaluated. These different phases demand multiple specific competencies for each stage of online instruction and learning. One key challenge highlighted is the need for instructors to acquire digital literacy skills to effectively utilize digital tools and platforms (Joshi *et al.,* 2021). This includes proficiency in digital inter-personal communication, content creation, and data analysis. Technostress, another challenge, comprises any unhealthful condition brought on by attempting to deal with new technology, such as stress and addiction (Brod, 1984; Verkijika, 2019). In this study, technostress is the anxiety that teachers experience as a result of trying to meet the expectations of the now-required online learning environment, particularly during the pandemic. The Person-Environment (P-E) fit theory was implemented to investigate whether this technological stress affects instructors' intentions to continue using online instruction after the epidemic. According to this hypothesis, stress arises when an individual's qualities and their surroundings are not aligned (Edwards & Cooper, 1990; Van Vianen, 2018).

When examining this process, Ayyagari *et al.* (2011) extended on the P-E fit hypothesis by taking technological aspects into account. This concept has frequently been used to investigate the stress connected to using technology with respect to education (Califf & Brooks, 2020; Penado Abilleira *et al.,* 2016). According to a preliminary study by Jena (2015) technostress has a detrimental effect on organizational commitment and job satisfaction. Same kind of result was found for K-12 teachers in USA (Califf & Brooks, 2020). The possible stresses include low self-efficacy, unstable employment, work-life balance issues, information overload, and privacy worries (Ayyagari *et al.,* 2011; Chen *et al.,* 2019; Qi, 2019). Technology related stress has an adverse impact on secondary education teachers' desire to employ technology in the classroom in the setting of technology integration (Joo & Shin, 2020). In South Africa, it also results in a decline in adolescents' intentions to keep using digital textbooks (Verkijika, 2019). Similar to this, it has been discovered that one component of technostress known as "techno complexity" has a negative impact on the work performance of university professors but another part known as "techno overload" does not (Li & Wang, 2021).

Another study divided the challenges instructors face into four areas. The absence of basic amenities and disruptions from family obligations while teaching at home were obstacles. Obstacles to institutional support included a lack of training and ambiguous curriculum standards. Less than 20% of teachers received training on how to give education in a distance learning format, and 84% of them believe digital learning to be a difficult undertaking, according to a Learning Spiral poll (Roshini, 2021). In addition to facing professional and personal challenges, teachers also have a negative outlook on e-learning (Joshi *et al.,* 2021). Concerns about information privacy have been brought up in the context of e-learning, influencing teachers' choices on integrating virtual instruction (Chou & Chen, 2016). Technology-related stress is thought to be fueled by privacy concerns (Ayyagari *et al.,* 2011; Lee, Lee, & Kim, 2016). It represents a barrier to utilizing technology to its full potential (Joo & Shin, 2020; Zhou & Li, 2014 and Zhou & Xiaoting, 2014).

Another significant challenge is the issue of student engagement and motivation in the digital learning environment (Maheshwari, 2021). Teachers found it difficult to keep an eye on students' emotional well-being, academic engagement, and phone usage during online classes as the change to online learning progressed (Sumanth, 2021). It was also challenging to give students who needed physical care extra time (Hindocha, 2020). Many teachers believed they could deliver superior instruction in traditional classrooms due to insufficient training and a lack of expertise in virtual teaching, despite this, some teachers continued to have a positive and encouraging perspective on online education. (Sareen and Nangia, 2020). Instructors must find innovative ways to foster collaboration, provide timely feedback, and maintain student interest. They also face the challenge of addressing the digital divide ensuring equitable availability of internet connectivity and technology to every student.

In offline learning, teachers can closely monitor students and assess their achievements based on their individual abilities. However, in online learning, teachers feel that the process of assessing student achievement is similar, relying on quizzes and exercises. The challenge arises from the inability to control students as effectively as in offline settings. Teachers are uncertain about whether students' achievements truly reflect their own abilities because tasks, tests, or exercises completed at home may involve help from parents, siblings, or other family members. This lack of control over external assistance is a significant challenge faced by teachers (Rosalina *et al.,* 2020).

The difficulty of teaching and studying practical and clinical topics online has raised concerns from both academics and students. This is due to the fact that online instruction primarily emphasises knowledge-based learning, lacks quick feedback, and makes it challenging for instructors to gauge their students' comprehension during online lectures. According to Mukhtar *et al.* (2020), students often have short attention spans and can get distracted while taking online classes by trying to access other resources while doing examinations.

Vonderwell (2003), Petrides (2002) and Hara and Kling (1999) have pointed out that learners are laid back when it comes to responses in digital environments, which can hinder their learning progress. Furthermore, Petrides (2002) has raised doubts about the expertise of peers in online discussions, potentially affecting the quality of interactions. Feelings of seclusion and a lack of belonging have been identified as barriers by Woods (2002) and Vonderwell (2003). Song *et al.* (2004) and Piccoli *et al.* (2001) have emphasised the challenges of collaborating with peers and technological problems. Furthermore, Muilenburg and Berge (2005) have addressed issues pertaining to instructors, such as insufficient assistance or guidance. Frankola (2001), Ryan (2001), and Laine (2003) have conducted research that indicate higher rates of student attrition in online learning. The problems associated with online learning encompass the need for enhanced self-control, writing aptitude, and self-drive, along with the demand for online participants to allocate a substantial portion of their time to their academic pursuits. (Joshi *et al.*, 2021). Moreover, some other researchers investigate the emotional and psychological effects on educators, including heightened workload, social isolation, and the necessity for ongoing professional development to stay abreast of advancing technologies (Muthuprasad *et al.,* 2021).

COVID-19 had forced majority of educational institutions to shift to online teaching because in many countries face-to-face teaching was not possible due to closing down of educational facilities. This has bought focus on the factors that influence students' satisfaction and their intentions to adopt technology or learn through the online mode in the future.

2.4.2 Online Education in Post-pandemic Era or the '*Next Normal*'

Initially, traditional offline learning was the norm, with in-person interactions between learners and instructors in traditional classrooms. However, with the advancement and growth of internet and technology the shift to online learning became possible, enabling remote access to educational resources and facilitating virtual communication and collaboration. The global COVID-19 pandemic, which emerged in 2020, expedited the already rapid expansion of online education (Twist, 2021; Martin, Budhrani, Kumar, & Ritzhaupt, 2019). The shift from offline to online teaching and eventually to blended learning has been a significant progression in the realm of education. The advantages of digital education, including flexibility, easy access to information, efficiency, worldwide reach and have led to a notable increase in the number of academic institutions providing degree programmes in distance and hybrid education. Hybrid courses, also known as blended courses or mixed-mode instruction courses, combine elements of both physical class and online learning (Dziuban, Hartman, & Moskal, 2018). Blended learning is often regarded as one of the most effective forms of online learning (Hiltz, 1998; Dziuban *et al.*, 2018). Aftermath of the COVID-19 pandemic, often referred to as the "next normal," digital education is believed to maintain its significant role. Through the integration of mobile education and artificial intelligence online learning will coexist alongside conventional education, offering a broader range of educational opportunities, fostering educational equity, and driving innovation in education field (Xie *et al.*, 2020). Higher education institutions are progressively incorporating innovative online teaching methods into their classrooms, leveraging cutting-edge technologies such as Augmented Reality (AR), and Virtual Reality (VR) and Artificial Intelligence (AI) (Stephanidis *et al.*, 2019; Siau *et al.*, 2010). AI finds application in various educational aspects, including automated evaluation systems like Gradescope and proctoring tools like Proctorio. Virtual Reality based lessons offer students an immersive comprehension of course content, such as virtual field trips to natural landscapes like canyons or volcanoes, as well as experiences related to different cultures and historical periods. It is believed that blended learning facilitates deeper learning experiences for students by offering a balance between in-person engagement and the flexibility and reinforcement provided by the online environment.

In a study in Bangladesh, the researchers mentioned that blended learning has the ability to enhance the impact of education. Hence, it is very important not to diminish online learning after the pandemic. In fact, online learning has unveiled new opportunities and possibilities for teaching and learning activities (Jahan *et al.*, 2021).

Online courses and hybrid education are poised to be critical factors in ensuring the long-term sustainability of numerous universities. High tuition fees often deter many students from pursuing higher education. However, through digital education, universities have the potential to reduce the marginal cost of their operations and reach a broader student population, including those residing in rural areas or different countries. By offering more affordable and accessible learning options, institutions can attract a more diverse and global student body, securing their viability in the evolving landscape of higher education. The future of education will be significantly impacted by technology. Even before the pandemic, worldwide investments in edtech amounted to over US$18.66 billion in 2019. Looking ahead, the online education market is anticipated to grow substantially, with projections indicating it could reach a value of 350 USD billion by 2025 (IBEF, February 2022).

Research Gap

While doing review of literature, it was observed that substantial amount of research has been conducted to evaluate students' perception of online teaching, including the benefits and drawbacks of the same, in countries such as the United States of America, United Kingdom, Australia, China, Malaysia, South Africa, and the Middle East, shedding light on the topic from various perspectives but research to analyse this in the Indian context is limited. Hence, the present study attempts to address this gap.

The current study is useful for examining the ways in which the technology enhances or hinders learning and teaching. It sheds light on knowing how willing the students are in technology adoption when it comes to online classes. While studying the students' perception towards online education, most studies have ignored importance and role of technology differentiation and gadgets employed while attending online classes. Hence, the present study also considers the effect of technology platform used and the gadget employed in learning effectiveness. The technology platform under the scope of the study includes Blackboard, My Class, Zoom, Google Meet, Microsoft Teams and the gadgets under the purview of the study include desktop, laptop, tablet/iPad and smart phone.

The present study further focuses on knowing the learners' engagement during online classes as not much is known in this area especially with respect to the Punjab context, conditions and environment. Further, academic learning witnessed a change in pedagogy from the traditional approach to the modern technique of teaching-learning from the classroom to Zoom, from the individual to the virtual, and from seminars to webinars amidst COVID-19. However, this tremendous shift gave rise to numerous issues and challenges that needed to be addressed.

Overcoming these obstacles is essential for educational institutes to fully leverage the advantage of asynchronous learning, which is most effective when implemented in the digital format. A few authors have published studies to explore the issues pertaining to remote teaching during pandemic, but most of them were from the students' perspective disregarding the challenges encountered by the teachers. Hence, the present study gains importance.

Additionally, in the current scenario, referred to as post-pandemic era, the concept of the "new normal" has emerged, comprising the post pandemic changes and adaptations that have become part of daily life today. Investigating the relevance of online teaching in the 'new normal' enable researchers to assess how well educational systems have adapted to this new mode of instruction. The concept of the "next normal" has emerged, referring to the changes and adaptations that have become part of daily life.

All the studies carried out in past were done in seclusion and did not cover all the aspects of the present study. So, it has the potential to influence the other and if they are not analysed together, the outcome could be erroneous. Holistic approach is bound to provide analysis which would assist all the stakeholders namely students, teachers, educational institutions, and society at large. The permanence of online education is evident, and a correct analysis, considering the conditions unique to India, can play a pivotal role in conserving significant human, intellectual, and financial resources. These resources hold particular value for a developing nation like India.

Online education is here to stay and correct analysis done by factoring Indian conditions can be instrumental in substantial saving of human, intellectual and financial resources which for a developing country like India are bound to be precious.

2.5 CHAPTER SUMMARY

This chapter evaluates the literature pertinent to the subject matter of the investigation. It begins with a general overview of online education and later delves down into a detailed examination of specific studies based on the four themes namely; learners' intentions towards technology adoption for online teaching, studies about the effect of technology differentiation and gadget category on learning effectiveness, studies related to the online classroom environment and its effect on students' engagement and studies related to challenges in online education.

The chapter helps in understanding how the learners perceive integrating technology into their education. The adoption of technology by students is essential in the context of online education. Research has identified both positive and negative perceptions of online learning, with key elements influencing learner satisfaction and outcomes. Technology integration is influenced by extrinsic factors (ICT infrastructure support and resources), support from the institution, and intrinsic factors (perceived ease of use, self-efficacy, perceived enjoyment and perceived usefulness). It further highlights that a stronger intention to participate in online learning is cultivated by a positive attitude.

The chapter further highlights the impact of various technology platforms and devices on learning effectiveness. The chapter examines a range of technology platforms used in online education, such as Microsoft Teams, Zoom, My Class, Google Meet, Blackboard, and Google Classroom and devices like desktop, laptop, tablet/iPad, and mobile phone. In light of this, it assesses how the online platform and the devise help in knowledge construction, student interaction and making optimal use of the instructor’s presence.

The chapter further evaluates the online classroom environment and its influence on student engagement by investigating a variety of engagement parameters, such as cognitive, behavioural, social, and emotional engagement. Cognitive engagement is investigated through multimedia content and interactive quizzes that facilitate critical thinking and profound learning. Participation metrics and responsiveness to interactive elements are used to evaluate behavioural engagement, with an emphasis on factors such as timely feedback and simplicity of navigation. Social engagement is assessed through collaborative tools that promote community and collaboration, while emotive engagement is evaluated in relation to the design's influence on students' interest and sense of belonging.

In addition, the chapter highlights the literature related to the obstacles that teachers encounter when teaching online. Online teaching presents teachers with numerous significant obstacles, such as the necessity of adjusting traditional teaching methods to digital formats, which can be time-consuming and necessitate the acquisition of new skills. Distractions, a lack of physical presence, and varying access to technology frequently make it challenging to ensure student engagement and participation in a virtual environment. Furthermore, teachers are required to accommodate the diverse learning paces and requirements of students in the absence of the immediate feedback that in-person interactions provide. The teaching process is further complicated by technical issues, such as unreliable internet connections and platform malfunctions. In a remote teaching environment, instructors must also manage their own work-life balance as the boundaries between professional and personal time blur, which can make it difficult to maintain effective communication and provide timely feedback in the absence of face-to-face interaction. To surmount these obstacles, it is necessary to implement comprehensive strategies that encompass inclusive policies, targeted support, and robust infrastructure. The necessity of this research is emphasised by the identification of voids in previous studies.

Chapter – 3

RESEARCH METHODOLOGY

This chapter presents a summary of the research methodology used to achieve the objectives of the present study. It encompasses the need and scope of the research, the objective and major hypotheses, research design and sampling techniques, procedure for gathering data, description of the sample, and the research instruments employed to accomplish the states objectives.

3.1 NEED AND SCOPE OF THE STUDY

According to the Indian Telecom Services Performance Indicator Report (September 2022), the number of internet customers in India rose significantly from 836.86 million in June 2022 to 850.95 million by September 2022, indicating a quarterly growth rate of 1.68%. Projections indicate that the country will have more than 900 million internet users by 2025. The internet penetration rate in urban India is currently 71%, and it is expected to expand by 6% in terms of active users by 2022. Simultaneously, there was a 14% increase in the availability of internet access in rural areas compared to the previous year. This resulted in a total of 360 million urban and 399 million rural individuals actively using the Internet. Moreover, projections indicate that by 2025, approximately 56% of new internet users will come from rural areas in India, highlighting the expanding digital presence throughout the country (IBEF, Ministry of Commerce and Industry, Government of India, 2022). Punjab exhibits a notable feature with around 86 internet subscribers per 100 individuals, indicating a significant level of internet penetration in the state. Punjab ranks among the regions in the country that have had substantial internet adoption. India's internet accessibility has achieved a commendable level, with a reported rate of over 64% of citizens having access to the internet, according to the Telecom Regulatory Authority of India (TRAI). This report emphasises the advancements made by the country in terms of digital connection, showcasing the extensive use of internet services and the growing significance of digital infrastructure in India's socio-economic environment. The increase in internet usage, particularly in Punjab, highlights the need to understand the behaviours and perspectives of learners with online education.

According to a forecast by KPMG India and Google (2021), the Indian ed-tech sector is expected to experience significant growth. Projections suggest that the market size will reach US$ 30 billion by 2031, which is a remarkable increase from the current worth of US$ 700-800 million in 2021. India's position in the global E-learning sector is second only to the US. The online education sector in India is expected to increase by around US$ 2.28 billion from 2021 to 2025, with a strong compound annual growth rate (CAGR) of nearly 20%. The market had a significant growth rate of 19.02% in 2021, indicating a growing demand for digital learning solutions throughout the country (IBEF, February 2024). The key factors driving the increase in online/blended education in India, as identified by KPMG India and Google, are the significant growth in internet and smartphone usage, the cost-efficiency of online education, favourable digital policies implemented by the government, and the growing demand among working professionals and job-seekers for continuous education.

The scope of the study was the state of Punjab. For this purpose, all universities of Punjab as per University Grants Commission (UGC) website was referred. Thereafter, the universities that are ranked under National Institute Ranking Framework (NIRF) were selected for drawing the sample. The study’s population consists of the students studying in the selected universities. Additionally, the technology platform under the scope of the study included Blackboard, My Class, Zoom, Google Meet, Microsoft Teams and the gadget category comprised desktop, laptop, tablet/iPad and smart phone.

3.2 OBJECTIVES OF THE STUDY

Considering the gap in existing literature below objectives have been framed which would help in filling the existing gap:

1. To examine learners’ willingness towards technology adoption for online classes.

2. To evaluate the effect of technology differentiation and gadget category on learning effectiveness.

3. To measure the influence of online classroom environment on students' engagement.

4. To assess the bottlenecks of online teaching and exploring ways to mitigate them.

3.3 HYPOTHESES

In order to accomplish the goals of the current investigation, the following hypotheses were formulated:

$H_{0(1.1)}$: There is no significant relationship between extrinsic factors and perceived enjoyment.

$H_{0(1.2)}$: There is no significant relationship between institutional support and perceived enjoyment.

$H_{0(1.3)}$: There is no significant relationship between intrinsic factors and perceived enjoyment.

$H_{0(1.4)}$: There is no significant relationship between intrinsic factors and perceived usefulness.

$H_{0(1.5)}$: There is no significant relationship between institutional support and intention to use online classes.

$H_{0(1.6)}$: There is no significant relationship between perceived enjoyment and attitude towards online classes.

$H_{0(1.7)}$: There is no significant relationship between perceived usefulness and attitude towards online classes.

$H_{0(1.8)}$: There is no significant relationship between perceived usefulness and intention to use online classes.

$H_{0(1.9)}$: There is no significant relationship between attitude towards online classes and intention to use online classes.

$H_{0(2.1)}$: There is no significant difference in knowledge construction dimension across the technology platforms.

$H_{0(2.2)}$: There is no significant difference in student's interaction dimension across the technology platforms.

$H_{0(2.3)}$: There is no significant difference in instructor's presence dimension across the technology platforms.

$H_{0(2.4)}$: There is no significant difference in knowledge construction dimension across the gadget category.

$H_{0(2.5)}$: There is no significant difference in student's interaction dimension across the gadgets category.

$H_{0(2.6)}$: There is no significant difference in instructor's presence dimension across the gadgets category.

$H_{0(3.1)}$: There is no significant relationship between online classroom environment and cognitive engagement.

$H_{0(3.2)}$: There is no significant relationship between online classroom environment and social engagement.

$H_{0(3.3)}$: There is no significant relationship between online classroom environment and emotional engagement.

$H_{0(3.4)}$: There is no significant relationship between social engagement and cognitive engagement.

$H_{0(3.5)}$: There is no significant relationship between social engagement and emotional engagement.

$H_{0(3.6)}$: There is no significant relationship between cognitive engagement and behavioural engagement.

$H_{0(3.7)}$: There is no significant relationship between emotional engagement and behavioural engagement.

$H_{0(3.8)}$: Social engagement does not mediate the relationship between online classroom environment and cognitive engagement.

$H_{0(3.9)}$: Social engagement does not mediate the relationship between online classroom environment and emotional engagement.

Statistical techniques applied to achieve each research objective is given in the following table:

Table 3.1: Statistical Technique associated with Research Objectives

Objective	**Hypothesis**	**Statistical Technique**
To examine learners' willingness towards technology adoption for online classes	**$H_{0(1.1)}$:** There is no significant relationship between extrinsic factors and perceived enjoyment. **$H_{0(1.2)}$**: There is no significant relationship between institutional support and perceived enjoyment. **$H_{0(1.3)}$**: There is no significant relationship between intrinsic factors and perceived enjoyment. **$H_{0(1.4)}$**: There is no significant relationship between intrinsic factors and perceived usefulness. **$H_{0(1.5)}$**: There is no significant relationship between institutional support and intention to use online classes.	Structural Equation Modeling (SEM)

Objective	Hypothesis	Statistical Technique
	$H_{0(1.6)}$: There is no significant relationship between perceived enjoyment and attitude towards online classes. **$H_{0(1.7)}$:** There is no significant relationship between perceived usefulness and attitude towards online classes. **$H_{0(1.8)}$:** There is no significant relationship between perceived usefulness and intention to use online classes. **$H_{0(1.9)}$:** There is no significant relationship between attitude towards online classes and intention to use online classes.	
To evaluate the effect of technology differentiation and gadget category on learning effectiveness	**$H_{0(2.1)}$:** There is no significant difference in knowledge construction dimension across the technology platforms. **$H_{0(2.2)}$:** There is no significant difference in student's interaction dimension across the technology platforms. **$H_{0(2.3)}$:** There is no significant difference in instructor's presence dimension across the technology platforms. **$H_{0(2.4)}$:** There is no significant difference in knowledge construction dimension across the gadgets. **$H_{0(2.5)}$:** There is no significant difference in student's interaction dimension across the gadgets.	One-Way ANOVA

Objective	Hypothesis	Statistical Technique
	$H_{0(2.6)}$: There is no significant difference in instructor's presence dimension across the gadgets.	
To measure the effectiveness of online classes on students' engagement	**$H_{0(3.1)}$:** There is no significant relationship between online classroom environment and cognitive engagement. **$H_{0(3.2)}$:** There is no significant relationship between online classroom environment and social engagement. **$H_{0(3.3)}$:** There is no significant relationship between online classroom environment and emotional engagement. **$H_{0(3.4)}$:** There is no significant relationship between social engagement and cognitive engagement. **$H_{0(3.5)}$:** There is no significant relationship between social engagement and emotional engagement. **$H_{0(3.6)}$:** There is no significant relationship between cognitive engagement and behavioural engagement. **$H_{0(3.7)}$:** There is no significant relationship between emotional engagement and behavioural engagement. **$H_{0(3.8)}$**: Social engagement does not mediate the relationship between online classroom environment and cognitive engagement.	Structural Equation Modeling

Objective	Hypothesis	Statistical Technique
	$H_{0(3.9)}$: Social engagement does not mediate the relationship between online classroom environment and emotional engagement.	
To assess the bottlenecks of online teaching and exploring ways to mitigate them		Content Analysis using NVivo

3.4 RESEARCH DESIGN AND METHODOLOGY

Many researchers have given different definitions of research design. Campbell, Stanley (2015) and Gage & Stanley (1963) and Johnson (2001) explains research design as systematic and controlled method of research study that deals with the process of collecting and analysing the required information. Malhotra & Dash (2013) defines research design as the plan of research study that explains the data collection methodology, tool for data collection, sampling technique and data analysis.

The present study used both descriptive and exploratory research design. Exploratory qualitative research, using in-depth interviews, was conducted to understand the teachers' views about the online teaching, developing themes based on those views regarding bottlenecks faced by them and finally ways of mitigating them. Descriptive research design involves studying of characteristics, attitude and behaviour of population under study without any wilful manipulation of variables. Following steps was included in the research design of present study:

3.4.1 Secondary Sources

Secondary data provides a basis for conceptual framework to build a theoretical model that has been used as a blue print to get empirical observations. A careful investigation of secondary sources is very important because understanding of secondary data is very helpful in identifying the gaps and deficiencies. In the current study, secondary data related with the main theme of present study has been collected from research papers, review papers, articles, government websites, government reports, news articles, books, magazines, etc. All the efforts were made to get the complete clarity and understanding of the concepts related with the study (Online education, technology differentiation, students' engagement, challenges of online teaching, technology adoption). Secondary data helped in identification of all the important and relevant dimensions of online education, technology adoption, technology differentiation, students' engagement in online classes and challenges of online teaching for designing the research instrument.

3.4.2 The Study Population

The aim of the study was to carry out four objectives related with the online teaching in Punjab. For this purpose, all universities of Punjab as per University Grants Commission (UGC) website was referred. Thereafter, the universities that are ranked under National Institute Ranking Framework (NIRF) were selected for drawing the sample. The study's population comprised all the students and teachers in the chosen universities.

3.4.3 Sample Size and Selection

a) In the current study, sample survey was conducted to gather primary data from the respondents. The quantitative nature of data and large size of population under study were two decisive considerations in support of selection of sample survey method. For achieving first three objectives of the study, a total of 600 students were the respondents. The sample size was calculated considering the number of students enrolled in the institute 1, 44, 826 during the academic year 2021-22. Multistage sampling technique was used to select the appropriate sample. In the first stage, all universities of Punjab as per University Grants

Commission (UGC) website was referred to and in the second stage, universities that are ranked under National Institute Ranking Framework (NIRF) was selected for drawing the sample. In the third stage, within the selected universities, the respondents were chosen from different academic fields like Management, Commerce, Humanities, Science and Engineering.

b) For achieving the fourth objective of the study, data was gathered through semi-structured interviews of 32 teachers from the sample selected. Out of the 32 participants, 18 had a Master's degree and 14 held a PhD degree. The study sample consisted of 17 males and 15 females, aged between 30 and 57 years, all of whom had at least five years of teaching experience. The sample included the instructors from different academic fields like Management, Commerce, Humanities, Science, and Engineering. A semi-structured interview style was determined to be the best qualitative research methodology (David & Sutton, 2004).

3.4.4 Research Instrument

For achieving the first three objectives namely, examine learners' willingness towards technology adoption for online classes, evaluate the effect of technology differentiation and gadget category on learning effectiveness and measure the effectiveness of online classes on students' engagement primary data was collected from the student's by adopting well known and widely accepted method of sample survey. A scientifically structured questionnaire based on comprehensive literature review and secondary data was used to take response from the respondents.

For achieving fourth objective namely, to assess the bottlenecks of online teaching and exploring ways to mitigate them, semi structured in-depth interviews were taken to obtain the data. Development of interview questions for the semi-structured interviews was a crucial aspect of the study's preparation. Open-ended questions were utilized, without predetermined limits or boundaries.

To ensure their reliability and validity, these questions underwent verification by ten experts from different domains like management, social sciences, engineering, and science. Modifications were made based on their feedback. The revised questions were then administered to six teachers who were not part of the study, ensuring the construct validity of the questions.

3.4.5 Development of the Instrument

The questionnaire used in the current study was developed after comprehensive investigation of secondary sources and extensive review of literature. One of the most critical steps was to decide what exactly falls under the constructs specified for the study and what does not. To decide what is required to be included and what is not to be considered, an extensive literature review on online education, technology adoption for online education, technology differentiation influence on learners' effectiveness, online classroom environment and students' engagement and bottlenecks of online teaching were undertaken. It was decided to use five metric scale to examine learners' willingness towards technology adoption for online classes, evaluating the effect of technology differentiation and gadget category on learning effectiveness and measuring the effectiveness of online classes on students' engagement. To achieve the objective of assessing the bottlenecks of online teaching and exploring ways to mitigate them, semi structured in-depth interviews were taken. Finally, the demographic information of respondents was captured.

Each scale was developed by researching the previously published and tested instruments. With the exception of the technology adoption model, there were no standardised scales available to measure the intentions of adopting the new technology. After conducting an extensive analysis of the existing literature, the scale of technology adoption that was already accessible was modified to align with the requirements of the study. The survey comprised five items. The development of it is explained in terms of scale as follows:

Scale 1: Dimensions of Technology Adoption

This part consisted of items related with dimensions of technology adoption for online classes. Five technology adoption dimensions were identified namely **extrinsic factors** represented by nine items adapted from Maheshwari (2021), Moreno, Cavazotte & Alves (2017), Lee, Srinivasan, Trail, Lewis & Lopez (2011), Çinar, Ekici & Demir (2021), Yurdagül & Soydal (2014). **Institutional support,** represented by seven items, adapted from Muthuprasad *et al*. (2021), Maheshwari (2021), Lee, Srinivasan, Trail, Lewis & Lopez (2011). **Intrinsic Factors** represented by twenty items adapted from Ibrahim *et al. (*2007), Teo & Noyes (2011), Davis (1989), Lee *et al.* (2008), Praveena & Thomas (2014), Rizun & Strzelecki (2020), Moreno, Cavazotte & Alves (2017), Teo, Lim & Lai (1999), Teo & Noyes (2011), Liaw & Huang (2013), Huang *et al.* (2020), Yurdugul & Demir (2017), Maheshwari (2021), Rizun & Strzelecki (2020), Yurdagül and Soydal (2014). **Attitude towards Online Learning** represented by five items adapted from Ibrahim *et al.* (2007), Praveena & Thomas (2014), Rizun & Strzelecki (2020), Moreno, Cavazotte & Alves (2017) Teo and Noyes (2011), Yurdagül & Soydal (2014). **Intentions to Use Online Learning** represented by five items adapted from Davis, F. (1989); Ibrahim *et al.* (2007); Maheshwari, G. (2021), Rizun, M. and Strzelecki, A. (2020); Teo and Noyes (2011).

Scale 2: Effect of Technology Platform and Gadget on Learning Effectiveness

This part consisted of items related with effect of technology platform and gadget on learning effectiveness. Three dimensions of learning effectiveness were identified after the in-depth and comprehensive review of literature; **knowledge construction** represented by seven items adapted from Tseng, Lin & Chen (2011), Nketiah-Amponsah, Asamoah, Allassani & Aziale (2017), Serhan (2020), Rojabi (2020), Mahdizadeh, Biemans & Mulder (2008), Gray & DiLoreto. (2016); **student's interaction** represented by six items adapted from Tseng, Lin & Chen (2011), Serhan (2020), Chopra, Madan, Jaisingh & Bhaskar (2019), Rojabi (2020), Mahdizadeh, Biemans & Mulder (2008), Raes *et al.* (2020), Bayanova *et al.* (2019), Gray & DiLoreto (2016) and **instructor's presence** represented by five items adapted from Tseng, Lin & Chen (2011), Serhan (2020), Mahdizadeh, Biemans & Mulder (2008); Bayanova *et al.* (2019), Gray & DiLoreto. (2016)

Scale 3: Online Classroom Environment

This scale consisted of variables related with online classroom environment. This scale was developed after having extensive review of literature to understand the different dimensions of online classroom environment. Fourteen items in this scale were adapted from Anderson (2004), Bernard *et al.* (2009), Masika & Jones (2016), Dennie *et al.* (2017), Gillenoneel (2019), Rushton *et al.* (2020), Luo *et al.* (2022) and Mcleod *et al.* (2019).

Scale 4: Students' Engagement

The scale to measure the effectiveness of online classes on students' engagement was developed after the in-depth review of literature. Four types of students' engagements were identified; **cognitive engagement** represented by eleven variables adapted from Coates (2010), Carini, Kuh, and Klein (2006), Li *et al.* (2013), Trowler & Trowler (2010), Bond *et al.* (2020), Appleton *et al.* (2008); Finn (2006), Fredricks, Blumenfeld, and Paris (2004), Furrer and Skinner (2003); **behavioural engagement** represented by six variables adapted from Coates (2010), Handelsman *et al.* (2005), Meyer *et al.* (2018), Petty & Farinde (2013), Pittaway & Moss (2014), Reeve & Tseng (2011), Shea *et al.* (2006), Cheng, Liang, & Tsai (2013), Fredricks *et al.* (2004), Petty & Farinde (2013), **social engagement** represented by five variables adapted from Chen *et al.* (2008), Cheng, Liang & Tsai (2013), Dennen (20082), Knight (2013), Pittaway & Moss (2014), Wright, Jones, & D'Alba (2013), Watson *et al.* (2017), Billet (2008) and **emotional engagemen**t represented by five variables adapted from Dennen (2008), Billet (2008), Chen *et al.* (2010), Cheng, Liang, & Tsai (2013), Knight (2013), Pittaway & Moss (2014), Watson *et al.* (2017), Wright, Jones, & D'Alba (2013).

Scale 5: Bottlenecks of Online Teaching

To assess the bottlenecks of online teaching, semi-structured interviews were conducted. Sixteen questions were identified after in-depth review of literature taken from Hassan et al. (2020), Arora and Srinivasan (2020), Verma et al. (2020), Comas-Quinn (2011), Kebritchi *et al.* (2016), Gratz and Looney (2020), Joshi, Vinay & Bhaskar (2021), Prottas *et al.* (2016), Keengwe *et al.* (2008), Yuen and Ma (2008), Chen *et al.* (2010), Peralta and Costata (2007), Buabeng-Andoh (2012), Mishra (2020), Sharma (2020), Kaup *et al.* (2020)

Demographic Profile

This section of the questionnaire collected the demographic profile of the respondents, including their gender, academic field, degree, and the name of their university or institute. In order to obtain impartial responses and maintain confidentiality and anonymity, the survey did not inquire about personal details such as name, phone number, and address of the respondents. Furthermore, the study's aims did not necessitate the collection of personal information from the participants.

3.4.6 Validity of Questionnaire

In simple words, validity means accuracy and in research, the validity of instrument means how accurately the instrument measures the information what it is supposed to measure (Johnson, 2001). It is very critical for the researcher to ensure the accuracy of the instrument to produce accurate results. To establish the face validity of the instrument, the questionnaire was presented to the industry experts and academicians. The industry experts were from the Edtech Industry and academicians were from different academic institutes. On the suggestions from experts, certain items in the questionnaire were added, modified and deleted and revised questionnaire was developed. The details of experts are given in the Table 3.2:

Table 3.2: Experts of Content Validity

Sr. No.	Name	Designation	Institute	Area
1	Dr Mandeep Kaur	Professor, Marketing	Guru Nanak Dev University, Amritsar	Academics
2	Dr Lokesh Jasrai	Professor, Marketing	Lovely Professional University, Phagwara	Academics
3	Dr Rahul Sharma	Professor, Marketing	Lovely Professional University, Phagwara	Academics
4	Dr Tanima Dutta	Professor, Economics	Lovely Professional University, Phagwara	Academics
5	Dr Satinder Kumar	Assistant Professor, Marketing	Punjabi University, Patiala	Academics

Sr. No.	Name	Designation	Institute	Area
6	Dr Anand Thakur	Professor, Marketing	Central University of Punjab, Bathinda	Academics
7	Dr Ankur Sodhi	AVP	Hero Vired/UpGrad	Industry
8	Mr Udit Sawhney	CEO	Edfora	Industry
9	Dr Prateek Kalia	Assistant Professor, Economics	Masaryk University, Brno, Czechia	Academics
10	Mr Sonu Sood	Zonal Business Head	Codetantra	Industry
11	Mr Anil Gupta	CFO/Senior Consultant	FIITJEE	Industry

To measure magnitude of attributes the finalized items were scaled (Malhotra and Dash, 2013). To measure the variables under study five-point Likert scale was used.

3.4.7 Pilot Testing

The subsequent phase in the development of the questionnaire was conducting a *pretest* of the initial questionnaire. A pilot study was done to assess the internal consistency of the instrument. The survey was conducted on a sample size of 10 percent of the respondents, as mentioned by Cann *et al.* (2008) and Bajpai (2011). In order to assess the internal consistency of the instrument, respondents were asked to submit their responses after thoroughly reading the questionnaire. Internal Consistency, commonly referred to as "internal reliability," indicates the degree to which the data acquired by the instrument is reliable. The calculation of Cronbach's alpha is a mandate to assess the internal consistency of the instrument. Its value may vary from 0 to 1 and if it is less than 0.7, the instrument is considered to be unsatisfactory as far as reliability of data is concerned (Cortina, 1993). In the current study Cronbach Alpha was calculated for every construct and value for the same was more than .7 (Table 3.3) which proved the internal reliability of the instrument.

Table 3.3: Internal Consistency (Cronbach alpha)

Sr. No.	Construct	No. of items	Cronbach Alpha	Range of Cronbach Alpha
1	Extrinsic Factors	9	.925	Acceptable
2	Institutional Support	7	.905	Acceptable
3	Intrinsic Factors	20	.853	Acceptable
4	Attitude Towards Online Classes	5	.800	Acceptable
5	Intentions to Use Online Classes	5	.850	Acceptable
6	Knowledge Construction_ Technology Platform	7	.880	Acceptable
7	Student’s Interaction_ Technology Platform	6	.859	Acceptable
8	Instructor’s Presence_ Technology Platform	5	.847	Acceptable
9	Knowledge Construction_ Gadget Category	7	.891	Acceptable
10	Student’s Interaction_ Gadget Category	6	.878	Acceptable
11	Instructor’s Presence_ Gadget Category	5	.880	Acceptable
12	Online Classroom Environment	14	.905	Acceptable
13	Cognitive Engagement	11	.937	Acceptable
14	Behavioural Engagement	6	.902	Acceptable
15	Social Engagement	5	.891	Acceptable
16	Emotional Engagement	5	.924	Acceptable

Once the internal reliability of the instrument was confirmed, the subsequent task was gathering data from the participants.

3.4.8 Administration of the Questionnaire

The questionnaire was administered personally after checking its reliability and validity. In the present study, to get the response from the respondents’ researcher personally visited all the selected universities. Response was collected through personal interviews. Two instruments were framed, one for getting the quantitative data from the students for achieving the first three objectives and another for getting the qualitative data from the teachers through the semi-structured interviews to achieve the fourth objective. These semi-structured interviews were conducted through various means such as Zoom, telephone calls, and in-person meetings between July 1 and September 15, 2022. The duration of each interview ranged from 25-54 minutes, with audio recordings made for documentation purposes. At the initial stage, teachers were presented with specific questions designed to elicit their responses. These questions covered aspects including the transition from face-to-face to digital teaching, challenges faced in online teaching within a home environment, personal and technical barriers and the support provided by universities for online teaching. Suggestion were also sought from the instructors on how the digital education can be made effective despite the challenges.

3.4.9 Sample Description

The demographics of respondents under study are given in the Table 3.4:

Table 3.4: Sample Description

Variable	Detail	Number of respondents (First 3 Objectives)	Number of respondents (Fourth Objective)
Gender	Male	308	17
	Female	292	15
Academic Field	Management	129	7
	Commerce	114	6
	Humanities	110	6
	Science	127	7
	Engineering	120	6

Variable	Detail	Number of respondents (First 3 Objectives)	Number of respondents (Fourth Objective)
Degree	Undergraduate	342	0
	Post Graduate	258	18
	PhD (Doctorate)	0	14
University/ Institute	Central University of Punjab, Bathinda	60	3
	Chandigarh University, Mohali	60	3
	GNDU, Amritsar	60	3
	Panjab University, Chandigarh	60	3
	Punjabi University, Patiala	60	3
	Lovely Professional University, Phagwara	60	4
	Chitkara University, Rajpura	60	3
	Thapar Institute of Engineering & Technology, Patiala	60	3
	Punjab Agriculture University, Ludhiana	60	4
	Sant Longowal Institute of Engineering & Technology, Sangrur	60	3

3.4.10 Statistical Tools

It is very critical to use the correct statistical tools to analyze the data to draw correct and meaningful results. The statistical tools give real life to data and provide meaning to the raw data. The results will reflect the true picture only when right kind of statistical tools are applied (Ali &Baskar, 2016). The current investigation utilized SPSS 21.0, the Statistical Package for Social Sciences, and NVivo to record and analyse the data that was collected. To achieve the first and third objective (to examine learners' willingness towards technology adoption for online classes and to measure the influence of online class environment on students' engagement), Structural Equation Modeling (SEM) was used which is one of the most popular and powerful statistical technique to analyze the association between different latent variables in the conceptual model (Akter *et al.,* 2017). To analyze the second objective (To evaluate the effect of technology differentiation and gadget category on learning effectiveness), one-way ANOVA was used. And lastly, to assess the bottlenecks of online teaching and exploring ways to mitigate them, qualitative technique of content analysis was used. Furthermore, the descriptive statistics of data was calculated using SPSS 21.0.

3.5 CHAPTER SUMMARY

This chapter offers a comprehensive detail of the research methodology applied to accomplish the objectives of the study. It specifies the research's need and scope, defines the research objectives and main hypotheses, lays out the research design and sampling techniques, and specifies the data collection procedures. Furthermore, it provides a comprehensive account of the research instrument and finally the statistical approach used.

The chapter commences with a discussion of the research's need and scope. It identifies the gaps in current knowledge and elucidates the approach that this study has taken to resolve them.

The scope of the study was the state of Punjab. For the study, descriptive and exploratory research designs were implemented. A multistage sampling technique was used to select the appropriate sample. The website of the University Grants Commission (UGC) was accessed to refer to all universities in Punjab for this purpose. Subsequently, the sample was drawn from institutions that were ranked under the National Institute Ranking Framework (NIRF). The students enrolled in the universities that were chosen for the investigation comprise the population. The sample consisted of 600 students, taken from academic fields comprising management, commerce, humanities, science and engineering for achieving the first three objectives and 32 teachers participated in the in-depth interview for achieving the fourth objective.

The questionnaire used for the present study was formulated after a thorough examination of secondary sources and an exhaustive literature review. The decision was made to employ five metric scales to assess learners' willingness to adopt technology in online classes, evaluate the impact of technology differentiation and gadget category on learning effectiveness, and measure the effectiveness of online classes on student engagement. To evaluate the constraints of online teaching and investigate potential solutions, semi-structured in-depth interviews were conducted. Lastly, respondents' demographic data was obtained.

Part I of the instrument comprised items related to dimensions of technology adoption for online classes. Five technology adoption dimensions were identified namely extrinsic factors represented by nine items, institutional support is represented by seven items, intrinsic factors are represented by twenty items, attitude towards online learning is represented by five items and intentions to use online learning is represented by five items. Part II consisted of items related with the effect of technology platforms and gadgets on learning effectiveness. Three dimensions of learning effectiveness were identified after the in-depth and comprehensive review of literature; knowledge construction is represented by seven items, student interaction by six items and instructor's presence is represented by five items. Part III of the instrument consisted of fourteen items related with the dimensions of online classroom environment. Part IV, to measure the effectiveness of online classes on students' engagement was developed after the in-depth review of literature. Four types of students' engagements were identified comprising cognitive engagement represented by eleven items, behavioural engagement represented by six, social engagement represented by five and emotional engagement represented by five items. Part V, to assess the challenges of online teaching, sixteen questions were identified after in-depth review of literature.

Lastly, the chapter describes the statistical analysis techniques used to achieve the objectives. These are Structural Equation Modeling (SEM), one-way ANOVA, content analysis and measurement of scale using Cronbach's alpha. The analysis was done using SPSS (21.0) and NVivo.

Chapter – 4

STUDENTS' INTENTION OF TECHNOLOGY ADOPTION FOR ONLINE TEACHING

Technology greatly influences all aspects of university operations, such as teaching, learning, research, and administration. It is a powerful instrument for spreading knowledge and information. The achievement of students in online education is reliant upon their ability to incorporate technology into their educational endeavours (Muthuprasad *et al.,* 2021). The objective of the current chapter is to examine the learners' intentions towards technology adoption for online teaching. A framework is offered based on the Technology Acceptance Model (TAM) (Davis *et al.*, 1989) to understand students' intention to adopt online education effectively, that is, to fully use the system's features in learning processes. A questionnaire was administered to determine the intention of students regarding technology adoption for online teaching based on five constructs namely, extrinsic factors including ICT infrastructure support and resources; institutional support; intrinsic factors including perceived ease of use, perceived usefulness, self-efficacy, and perceived enjoyment; attitude toward online classes and intention to use online classes.

4.1 EXTRINSIC FACTORS

To assess the extrinsic factors that influence the learners' intentions to use technology, a 9-item scale, developed after the comprehensive and extensive review of literature, was used. The scale was found to be reliable as Cronbach's alpha was .925, which is more than the minimum threshold limit of .70 (Hair *et al.,* 2013). Responses were collected using a five-point Likert scale, where a rating of 5 indicated strong agreement and a rating of 1 indicated strong disagreement. Table 4.1 presents the descriptive statistics of the extrinsic factor response.

Table 4.1: Extrinsic Factors affecting Learners' intentions to use Technology for Online Classes (ICT Infrastructure Support)

Variable	Mean	Std. Deviation
ICT Infrastructure Support		
I have received the required training to use the platform for online classes effectively.	3.57	1.154
I know how to login and access the platform for online classes.	4.43	0.787
I know where to ask for help when I have any technical issue.	3.84	1.071
Technical support always responds to my issue in a timely manner.	3.45	1.092
Technical support is available to assist when difficulty arises.	3.23	1.108
Average	**3.70**	**1.042**
N=600		

From the table it can be seen that the respondents knew the procedure to log in into the platform and accessing the same (mean score of 4.43) whilst the on-time response of technical support as and when required (mean score of 3.45) and availability of technical support was an issue with the mean score of 3.23.

It is significant to mention that the respondents strongly agreed to the fact that they had a fair idea of logging into the platform and accessing it. They disagreed when asked about the timely address to the technical issues and availability of technical support for seamless conduct of the classes which means there was no one to address the technical difficulty faced by the respondents.

Table 4.2: Extrinsic Factors affecting Learners' Intentions to use Technology for Online Classes (Resources)

Variable	Mean	Std. Deviation
Resources		
I have a device with reasonable configuration to access the online classes.	4.35	.818
I always have access to the internet for accessing online classes.	4.08	.982
I have access to the required bandwidth and reasonable internet speed to access online classes in a seamless manner.	3.66	1.034
Recurring cost for desired internet bandwidth is affordable and reasonable.	3.57	1.051
Average	**3.91**	**0.971**
N=600		

It is indicated from the table 4.2 that the respondents agreed to that they have a device with reasonable configuration for accessing the online classes with the mean score of 4.35 and also had access to the internet for accessing the online classes with the mean score of 4.08. On being asked about the affordability of the internet bandwidth, the respondents somewhat disagree with the mean score of 3.57.

It is inferred from the score that the respondents strongly agreed to the fact that they had a well configured device for accessing the online classes along with the internet access. Their only concern under the variable resources was the cost associated with it as they found that installing wi-fi or using mobile data for accessing the online is a costly affair.

4.2 INSTITUTIONAL SUPPORT

The next section of the questionnaire was to examine the institutional support that was made available to the respondents. A 7-item scale, developed after the comprehensive and extensive review of literature, was used. The scale was found to be reliable as Cronbach's alpha came out to be .905 which is more than the minimum threshold limit of .70 (Hair *et al.*, 2013). Responses were collected using a five-point Likert scale, where a rating of 5 indicated strong agreement and a rating of 1 indicated strong disagreement. Table 4.3 presents the descriptive statistics of the institutional support response.

Table 4.3: Institutional Support as a factor affecting Learners' Intentions to use Technology for Online Classes

Variable	Mean	Std. Deviation
Class activities (discussion/role plays/quizzes) are properly planned and sufficient for effective learning.	3.52	1.075
I have easy access to the academic resources (power point presentations, teaching notes, videos and class recordings).	3.95	.977
The instructor is always available as per the schedule for seamless conduct of classes.	3.75	.991
The instructor is properly trained to conduct online classes.	3.67	1.021
I get detailed individual feedback.	3.31	1.121
I get feedback on time.	3.34	1.105
Interaction with instructor is satisfactory for effective learning.	3.63	1.019
Average	**3.60**	**1.044**
N=600		

It is indicated from the table that the respondents agreed that the academic resources comprising power point presentations, teaching notes, videos and class recording are accessible (with the mean score of 3.95) to them while the individual feedback (mean score of 3.31) and timely feedback (mean score of 3.34) were two variables on which the respondents did not agree which means that the feedback to the students were neither given individually nor on time which hampered their learning in the online classes.

4.3 INTRINSIC FACTORS

The intrinsic factors comprised the variables, Perceived Ease of Use, Self-efficacy, Perceived Enjoyment and Perceived Usefulness. A 20-item scale, developed after the comprehensive and extensive review of literature, was used. The scale was found to be reliable as Cronbach's alpha came out to be .853 which is more than the minimum threshold limit of .70 (Hair *et al.*, 2013). Responses were collected using a five-point Likert scale, where a rating of 5 indicated strong agreement and a rating of 1 indicated strong disagreement. Table 4.4 presents the descriptive statistics of the intrinsic factors response.

Table 4.4: Intrinsic Factors affecting Learners' Intentions to use Technology for Online Classes (Perceived Ease of Use)

Variable	Mean	Std. Deviation
Perceived Ease of Use		
Learning through online classes is easy.	3.28	1.242
Online classes allow me to control the pace of my learning.	3.51	1.098
I can access online classes from anywhere.	4.13	1.016
Acquiring new skills through online classes is easy.	3.45	1.155
I have the necessary skills for accessing online classes.	3.98	.919
Average	**3.67**	**1.086**
N=600		

The table indicates that the respondents strongly agreed to the statement that they can access the online classes from anywhere (mean score of 4.13) and also possess necessary skills for accessing the online classes (mean score of 3.98). On being asked about the affordability of the internet bandwidth, the respondents somewhat disagree with the mean score of 3.57. When asked about the ease of learning through online class, the respondents find it difficult (mean score of 3.28) which means learning through online classes is not easy.

Table 4.5: Intrinsic Factors affecting Learners' Intentions to use Technology for Online Classes (Self-Efficacy)

Variable	Mean	Std. Deviation
Self-Efficacy		
I am confident in using the platform of online classes.	3.68	.883
I am able to use the platform of online classes without the help of others.	4.19	.872
I am able to troubleshoot problems associated with online classes platform.	4.18	.934
Online classes make learning more interesting.	3.72	.972
Learning through online classes make me feel happy.	3.82	.958
Average	**4.01**	**0.924**
N=600		

It is easily understood from the table 4.5 that students were able to navigate through the online class platform independently (mean score of 4.19) followed by the fact that they were equipped with skills to troubleshoot problems associated with online platform (mean score of 4.18). The table illustrates a strong agreement among participants, who express a high degree of agreement regarding the significance of certain factors in fostering confidence in utilizing online class platforms. Notably, students were sceptical when it comes confidence in using the online class platform (mean score of 3.68). Hence it is a crucial element for feeling at ease with the technology. Furthermore, when evaluating the impact of online classes on the perceived interest in learning, students opine that to some degree (mean score of 3.72), online classes have the potential to increase the overall appeal and engagement of the learning experience.

Table 4.6: Intrinsic Factors affecting Learners' Intentions to use Technology for Online Classes (Perceived Enjoyment)

Variable	Mean	Std. Deviation
Perceived Enjoyment		
I like using different gadgets for online classes.	3.17	1.192
I feel delighted on completing the assignment/tasks on time.	3.19	1.203
Online classes improve my learning outcomes (knowledge/ application of the concept).	3.57	1.149
Online classes enable me to accomplish academic tasks quickly.	3.86	.993
With online classes, I can track my progress.	3.40	1.009
Average	**3.44**	**1.109**
N=600		

As seen in the table 4.6, the respondents strongly agreed that online classes enable them to accomplish academic tasks quickly (mean score of 3.86). While taking their opinion if they feel delighted on completing the assignment/tasks on time (mean score of 3.19) and using different gadgets for online classes (means score of 3.17), the respondents slightly disagreed which means that they do not feel happy in case they are not able to complete their assignments on time, nor they like using or experimenting with different gadgets.

Table 4.7: Intrinsic Factors affecting Learners' Intentions to use Technology for Online Classes (Perceived Usefulness)

Variable	Mean	Std. Deviation
Perceived Usefulness		
With online classes, I can improve my academic performance (grade/marks).	3.26	1.111
With online classes, I can increase my academic productivity (managing time/ability to prioritize the tasks).	3.41	1.060
Online classes improve my learning outcomes (knowledge/application of the concept).	3.47	1.139
Online classes enable me to accomplish academic tasks quickly.	3.50	1.190
With online classes, I can track my progress.	3.53	1.150
Average	**3.43**	**1.130**
N=600		

When evaluating the perceived usefulness, the table 4.7 reveals a general consensus among participants that online classes provide the benefit of progress tracking, as evidenced by a mean score of 3.53. However, when appraising the impact of online classes on improved academic performance (mean score of 3.26), increased academic productivity through time management and task prioritization (mean score of 3.41), and enhanced learning outcomes through the application of knowledge and concepts (mean score of 3.47), respondents exhibited a slight disagreement. This suggests a level of scepticism regarding the potential for online learning to significantly enhance their academic achievements.

4.4 ATTITUDE TOWARDS ONLINE CLASSES

To examine the attitude of students towards online classes, a 5-item scale, developed after the comprehensive and extensive review of literature, was used. The scale was found to be reliable as Cronbach's alpha came out to be .800 which is more than the minimum threshold limit of .70 (Hair *et al.*, 2013). Responses were collected using a five-point Likert scale, where a rating of 5 indicated strong agreement and a rating of 1 indicated strong disagreement. Table 4.8 presents the descriptive statistics of the attitude of learners to use technology response.

Table 4.8: Factors affecting Attitude of Learners to use Technology for Online Classes

Variable	Mean	Std. Deviation
I feel relaxed when I learn through online classes.	3.71	1.118
I feel online classes helps me improve my creativity.	3.18	1.206
I feel I can have a variety of experiences (sharing screen/attending poll/group discussion/annotation) while learning through online classes.	3.89	1.010
I remain focussed while learning through online classes.	2.98	1.183
I am not concerned about the time I spend in front of a device/screen.	2.99	1.297
Average	**3.35**	**1.163**
N=600		

The evaluation of learners' attitudes towards online classes indicates varied experiences, as reflected by a mean score of 3.89. These experiences encompass activities such as screen sharing, poll participation, group discussions, and annotation. However, a closer examination reveals a divergence in perspectives regarding the impact of online classes on certain aspects. Specifically, the respondents express a mild disagreement with the notion that online classes contribute to the enhancement of creativity, as evidenced by a mean score of 3.18. Additionally, there is a perceived challenge in maintaining focus during online learning, as indicated by a mean score of 2.98. Concerns are also raised about the duration spent in front of a device or screen, reflected in a mean score of 2.99. This suggests that respondents are apprehensive about potential eye strain and fatigue associated with prolonged screen time.

4.5 INTENTIONS TO USE ONLINE CLASSES

To examine the intentions of students to use online classes, a 5-item scale, developed after the comprehensive and extensive review of literature, was used. The scale was found to be reliable as Cronbach's alpha came out to be .850 which is more than the minimum threshold limit of .70 (Hair *et al.*, 2013). Responses were collected using a five-point Likert scale, where a rating of 5 indicated strong agreement and a rating of 1 indicated strong disagreement. Table 4.9 presents the descriptive statistics of the factors affecting intentions to use technology.

Table 4.9: Factors affecting Intentions to use Technology for Online Classes

Variable	Mean	Std. Deviation
I am willing to participate in online classes.	3.51	1.147
I intend to use the online classes for upskilling myself in future.	3.45	1.128
I intend to use and depend upon online classes heavily.	2.93	1.211
I can explore in-depth about any subject through online classes.	3.32	1.211
I will recommend learning through online classes to other students.	3.11	1.210
Average	**3.26**	**1.181**
N=600		

From the table, it can be seen that the respondents are willing to participate in the online class as indicated by the means score of 3.51. However, when asked if the respondents intend to use the online classes for upskilling themselves in future, the mean score of 3.45 indicates that respondents somewhat disagree to the fact that online classes help in enhancing the skills. Further, to know their intentions to use and the dependency upon online classes, the mean score of 2.93 indicates that the respondents are not much willing to either use or depend on the online classes. When asked if they can explore in-depth about any subject through online classes, the mean score of 3.32 reveals that to some extent they are able to dig out the information about any subject. Finally, to know their intentions to recommend learning through online classes to other students, the mean score of 3.11 indicates that the respondents somewhat agreed to their intention of recommending learning through online classes.

4.6 STRUCTURAL EQUATION MODELING

Structural Equation Modeling (SEM) is a statistical method used to elucidate the connections between various variables. This approach comprises two primary components:

1. Measurement Model
2. Structural Model.

The measurement model, also referred to as the outer model, allows researchers to include several variables for either the dependent or independent variable. The structural model, also known as the inner model, is responsible for connecting the independent variables to the dependent variables in the path model (Hair *et al.*, 2010).

SEM includes various statistical techniques for assessing a hypothetical causal network of relationships among latent constructs, each explained by several indicators (Esposito *et al.*, 2010). SEM determines variables related to each construct and afterwards loadings are assessed. In situations where the variables are linked to the construct, cross loadings must be avoided (Hair *et al.*, 2010).

In the area of consumer behaviour and marketing, two widely accepted methods in Structural Equation Modeling are:

1. Covariance-based Structural Equation Modeling (SEM)
2. Partial Least Squares-based Structural Equation Modeling (SEM)

Both of the above-mentioned methods are acknowledged as second-generation approaches (Gefen *et al.,* 2000). Covariance-based SEM uses model fit for comparing research models and also used to support the theory that proposes the most ideal model fit. In short, the output gives the indices and residuals that indicates how closely proposed model fits the data rather than best fitted covariance structural model. Therefore, covariance-based SEM stresses on explanation and suitable theory testing (Chin, 2001).

On the other hand, Partial Least Squares (PLS) based SEM is a path modeling technique that uncover the complex multivariate relationships between exogenous and endogenous variables (Esposito *et al.,* 2016). So, the PLS technique is designed to provide explanation on the basis of variance, like "Ordinary Least Squares Multiple Regression technique" (OLS) (Hair *et al.*, 2011 and Chin, 2001). PLS-SEM technique predicts the parameters to reduce the residual error of dependent variables used in the proposed research model rather than finding out the variance of all the observable variables in the covariance-based SEM technique (Gefen *et al.,* 2000). It is evident that Partial least square technique is a very popular technique to confirm the theory, it can also be used to suggest whether the relationship found between different variables or not and provides recommendations for further advance testing of the model (Chin, 2001). At last, for applying PLS-SEM, smart PLS software is required whereas for applying CB (SEM) AMOS software is required. Although there are few differences in PLS (SEM) and CB (SEM) but the basic condition to assess the structural model is same (Hair *et al.,* 2011).

It is worth noting that PLS-SEM has gained increasing popularity for structural analysis in comparison to covariance based (SEM) technique. Partial least square technique is most preferred technique particularly in social sciences and for assessing the respondents' motivations (Hair *et al.*, 2013; Fornell and Larcker, 1981).

The following sections presents the data analysis conducted to identify the predictors for learners' willingness towards technology adoption for online classes. Table 4.10 presents all the variables included in the study along with their code for easy understanding of the result.

Table 4.10: List of Variables and their Codes projected

Variables	Codes
I have received the required training to use the platform for online classes effectively.	IFS1
I know how to login and access the platform for online classes.	IFS2
I know where to ask for help when I have any technical issue.	IFS3
Technical support is available to assist when difficulty arises.	IFS4
Technical support always responds to my issue in a timely manner.	IFS5
I have a device with reasonable configuration to access the online classes.	IFS6
I always have access to the internet for accessing online classes.	IFS7
I have access to the required bandwidth and reasonable internet speed to access online classes in a seamless manner.	IFS8
Recurring cost for desired internet bandwidth is affordable and reasonable.	IFS9
Class activities (discussion/role plays/quizzes) are properly planned and sufficient for effective learning.	IS1
I have easy access to the academic resources (power point presentations, teaching notes, videos and class recordings).	IS2
The instructor is always available as per the schedule for seamless conduct of classes.	IS3
The instructor is properly trained to conduct online classes,	IS4
I get detailed individual feedback.	IS5
I get feedback on time.	IS6
Interaction with instructor is satisfactory for effective learning.	IS7
Learning through online classes is easy.	IF1
Online classes allow me to control the pace of my learning.	IF2
I can access online classes from anywhere.	IF3
Acquiring new skills through online classes is easy.	IF4

Variables	Codes
The platform used to access online classes is user friendly.	IF5
I have the necessary skills for accessing online classes.	IF6
I am confident in using the platform of online classes.	IF7
I am able to use the platform of online classes without the help of others.	IF8
I am able to troubleshoot problems associated with online classes platform.	IF9
I am able to overcome challenges faced during the online classes.	IF10
Online classes make learning more interesting.	PE1
Learning through online classes make me feel happy.	PE2
I like using different gadgets for online classes.	PE3
I feel delighted on completing the assignment/tasks on time.	PE4
Performing academic tasks in online classes is captivating.	PE5
Online classes improve my learning outcomes (knowledge/application of the concept).	PU1
Online classes enable me to accomplish academic tasks quickly.	PU2
With online classes, I can track my progress.	PU3
With online classes, I can improve my academic performance (grade/marks).	PU4
With online classes, I can increase my academic productivity (managing time/ability to prioritize the tasks).	PU5
I feel relaxed when I learn through online classes	AOC1
I feel online classes helps me improve my creativity.	AOC2
I feel I can have a variety of experiences (sharing screen/attending poll/group discussion/annotation) while learning through online classes.	AOC3
I remain focussed while learning through online classes.	AOC4
I am not concerned about the time I spend in front of a device/screen.	AOC5
I am willing to participate in online classes.	IOC1

Variables	Codes
I intend to use the online classes for upskilling myself in future.	IOC2
I intend to use and depend upon online classes heavily.	IOC3
I can explore in-depth about any subject through online classes.	IOC4
I will recommend learning through online classes to other students.	IOC5

Following the establishment of face validity and internal reliability (Cronbach's alpha) of individual constructs in the pilot study, the next step was to validating convergent and discriminant validities. This involved employing confirmatory factor analysis (CFA), a technique within Structural Equation Modeling (SEM) that explores relationships between observed (manifest/exogenous) and unobserved (latent/endogenous) variables. SEM, as opposed to structural relationships like regression, detect relationships among latent variables and are depicted as covariance/correlations (Gallagher & Brown, 2013). Common applications of CFA include scale and construct validation. So, while applying CFA, it is imperative to check the convergent and discriminant validity of constructs. It is also very much required to ascertain the composite reliability of individual constructs.

4.6.1 Outer Loadings

In the measurement model outer loadings represent estimated relationships in reflective measurements. The measurement model comprises the unidirectional predictive relationship between the latent construct and its observed predictive variables. The strength of these relationships is denoted by 'r' or 'beta.' Table 4.11 displays the outer loadings of each relationship between the latent construct and its observed indicators. In the measurement model ‘r’/beta of every relationship will influence the value of AVE and convergent validity of the construct. The indicator loadings must be more than .7 (Hair *et al.*, 2013). Because the outer loading of the relationship between the observed item IF10 (.673) and its construct latent construct intrinsic factors was less than .7 the same was removed and was not considered for further estimations. After deleting the item IF10 from the conceptual model, the PLS was again run and the revised outer loadings are shown in the Table 4.11.

Table 4.11: Outer Loadings

Exogenous/ Endogenous Variables	Items	Loadings
ICT Infrastructure Support	IFS1	0.727
	IFS2	0.777
	IFS3	0.769
	IFS4	0.845
	IFS5	0.753
	IFS6	0.846
	IFS7	0.780
	IFS8	0.772
	IFS9	0.843
Institutional Support	IS1	0.758
	IS2	0.815
	IS3	0.810
	IS4	0.786
	IS5	0.822
	IS6	0.808
	IS7	0.787
Intrinsic Factors	IF1	0.738
	IF2	0.727
	IF3	0.795
	IF4	0.787
	IF5	0.778
	IF6	0.785
	IF7	0.732
	IF8	0.786
	IF9	0.786
Perceived Enjoyment	PE1	0.764
	PE2	0.751
	PE3	0.741
	PE4	0.771
	PE5	0.813

Exogenous/ Endogenous Variables	Items	Loadings
Perceived Usefulness	PU1	0.780
	PU2	0.748
	PU3	0.786
	PU4	0.800
	PU5	0.809
Attitude Towards Online Classes	AOC1	0.775
	AOC2	0.721
	AOC3	0.879
	AOC4	0.752
	AOC5	0.879
Intentions to use Online Classes	IOC1	0.802
	IOC2	0.815
	IOC3	0.781
	IOC4	0.761
	IOC5	0.790

4.6.2 Composite Reliability

Internal consistency refers to the situation where respondents react consistently to the same instrument under similar or nearly identical circumstances. Ensuring the consistency of the measuring instrument is crucial before collecting data from the respondents. Various methods exist to establish internal consistency of the measuring instrument. One of the most important and widely accepted measure to establish internal consistency is Cronbach Alpha. Another approach is the use of Composite Reliability (CR) to assess the internal consistency of scale items for each construct or variable in the research. Composite Reliability is often considered more robust than Cronbach alpha for establishing internal consistency. While applying partial least squares (PLS) as the analysis method, the reliability of the constructs or variables in the model needs to be scrutinized (Aguirre-Urreta, Marakas & Ellis, 2013). In the present study, researcher utilized composite reliability to establish the internal consistency of the measuring instrument. If the Composite Reliability of each construct or variable exceeds 0.7, the reliability of that particular construct or variable corresponding to the measuring instrument is established (Hair *et al.*, 2016). The composite reliability for all exogenous and endogenous variables was confirmed, as composite reliability value of each variable was more than 0.7 (Table 4.12). By establishing the CR for the exogenous and endogenous variables in this research, the internal consistency of the instrument was also established paving the way for instrument validation.

Table 4.12: Reliability Analysis Measurement

Exogenous/ Endogenous Variables	Composite Reliability	Cronbach's Alpha
ICT Infrastructure Support	.938	.925
Institutional Support	.925	.905
Intrinsic Factors	.909	.887
Perceived Enjoyment	.878	.828
Perceived Usefulness	.889	.844
Attitude Towards Online Classes	.863	.800
Intentions to use Online Classes	.893	.850

4.6.3 Convergent Validity

One of the very critical aspects of scale validation is convergent validity. Validity, in its literal sense, refers to acceptability, and in the context of scale validation, it measures the extent to which a scale or instrument accurately measures what it is supposed to measure (Krabbe, 2016). Therefore, the data is supposed to be collected through a validated questionnaire. Validity is required to be established. The first and foremost step in validating a scale confirming the convergent validity of constructs, factors or variables. The confirmation involves of convergent validity of an individual factor or construct also means that items in that factor /construct are highly corelated (Chin & Yao, 2014). The convergent validity also ensures that the specific items used to measure the construct or factor or exogenous or endogenous variable are able to measure the specific one. The minimum Average Variance Extracted (AVE) value required to establish the convergent validity of a construct is 0.5 (Fornell & Lacker, 1981). Therefore, measuring the AVE of every construct is required to measure the convergent validity of that particular construct. Convergent validity results based on the AVE statistics in the current study show that all the constructs are above the required standard which proves the scale validity. Table 4.13 shows the convergent validity of each construct.

Table 4.13: Convergent Validity

Construct	AVE
ICT Infrastructure Support	.627
Institutional Support	.637
Intrinsic Factors	.527
Perceived Enjoyment	.590
Perceived Usefulness	.616
Attitude Towards Online Classes	.564
Intentions to use Online Classes	.624

4.6.4 Discriminant Validity

After confirming the convergent validity of the constructs, the next step in validating the scale involved ascertaining its discriminant validity. Campbell and Fiske (1959) were the first to introduce the concept of discriminant validity. Discriminant validity supposed to be confirmed when the different constructs are not highly correlated (Hubley, 2014). Failure to establish discriminant validity proves that significant correlations exist between different constructs, which is violation of core principle of discriminant validity. In such cases, scale validation cannot be confirmed and the scale becomes unsuitable for data collection. To ascertain discriminant validity, researchers often compare the square root of the Average Variance Extracted (AVE) of each construct (found on the diagonal) with the correlation coefficients (off-diagonal) for each construct. If the square root of the AVE for a construct is greater than the correlation coefficients of that construct, discriminant validity is considered to be proved. On the other hand, if the square root of the AVE is less than the correlation coefficients, discriminant validity is not proved in that case. In such cases where discriminant validity is not confirmed, a common approach is to eliminate an item having least significant beta value from the construct. The removal of item with least beta value will improve the AVE of the corresponding construct, aiding in the confirmation of discriminant validity. If needed, additional items with least beta values from the same construct can be removed sequentially until discriminant validity is established for each construct. It is mandatory to establish the discriminant validity of each construct. In the present study, discriminant validity was confirmed (Table 4.14) for each construct which is evident by the square root of the AVE (highlighted) for each construct on the diagonal being more than the correlation coefficients between constructs in the respective rows and columns (Fornell & Lacker, 1981).

Table 4.14: Discriminant Validity

	IFS	**IS**	**IF**	**PE**	**PU**	**AOC**	**IOC**
IFS	.585						
IS	.567	.690					
IF	.549	.510	.657				
PE	.372	.497	.629	.744			
PU	.391	.519	.619	.736	.799		
AOC	.389	.519	.587	.736	.710	0.727	
IOC	.362	.441	.362	.663	.709	.707	.803

4.6.5 Heterotrait- Monotrait Ratio (HTMT)

Initially, researchers used to establish discriminant validity using criteria proposed by Fornell and Lacker (1981). However, some researchers were not in agreement with the criteria of Fornell and Lacker (1981). Henseler *et al.* (2015) introduced an alternative method for assessing discriminant validity, namely the heterotrait-monotrait (HTMT) ratio of correlations between constructs. The HTMT is defined as "the mean value of the item correlations across constructs (i.e., the heterotrait-hetero method correlations) relative to the (geometric) mean of the average correlations for the items measuring the same construct (i.e., the monotrait-hetero method correlations)". Different researchers have proposed different threshold values of HTMT to establish the discriminant validity of construct. Kline (2015) suggested the threshold value of 0.85 whereas, Hair *et al*. (2019) suggested the more liberal value of .90 of HTMT ratio to establish the discriminant validity. In the present study, the HTMT ratio between different constructs was less than .90 (Hair *et al.,* 2019) as depicted in the Table 4.15, so the discriminant validity between the constructs was confirmed.

Table 4.15 : Heterotrait- Monotrait Ratio (HTMT)

	IFS	IS	IF	PE	PU	AOC	IOC
IFS							
IS	0.650						
IF	0.539	0.497					
PE	0.550	0.360	0.492				
PU	0.477	0.497	0.573	0.500			
AOC	0.644	0.596	0.761	0.608	0.662		
IOC	0.447	0.497	0.532	0.460	0.396	0.521	

4.6.6 Collinearity Diagnosis

Diagnosis of collinearity or multicollinearity is very important condition of scale validation. Multicollinearity refers to the condition in which independent/predictive variables are highly correlated. (Belsley *et al.,* 1980). If such a situation exists, the validation of instrument is not feasible (Allen, 1997). So, for scale validation it is very much essential that there must not be collinearity between predictor variables of the measurement model. Different diagnostic tools are available to ascertain the multicollinearity between the exogenous/independent/predictor variables. Variation inflation factor (VIF) is one of the widely accepted and critical tool to measure the multicollinearity (Kim, 2019). The VIF value between 5 and 10 depicts the problem of multicollinearity in the scale (Kim, 2019), meaning there by that VIF value must be less than 5 to rule out the multicollinearity between the predictor variables which is essential for scale validation (Hair *et al.*, 2011; Kock & Lynn, 2012). One of the other important techniques to determine multicollinearity is tolerance value. If the tolerance value is more than .02 then there is no issue of multicollinearity (Hair *et al.*, 2011).

For the proposed model, multicollinearity was ascertained based on values of VIF and Tolerance. Because the value of VIF for every relationship between the dependent and independent variables was less than 5, there was no problem of multicollinearity among the independent variables. Also, because the tolerance value was more than .02, it was found that there was no multicollinearity among the independent variables. Table 4.16 depicts the results of collinearity diagnosis.

Table 4.16: Collinearity Diagnosis (Intentions to Use Online Classes as Endogenous Variable)

Dependent Variable	**Independent Variable**	**Collinearity Statistics**	
		Tolerance	**Variance Inflation Factor (VIF)**
IOC	IFS	.653	1.534
	IS	.558	1.789
	IF	.628	1.592
	PE	.608	1.756
	PU	.539	1.933
	AOC	.571	1.520
	IOC	.655	1.526
IOC: Intentions to Use Online Classes			

4.6.7 Structural/ Path Model

The path model illustrates the relationship between the independent (predictive) and dependent (Latent) variables. The relationship between the independent and dependent variables is depicted in the conceptual model developed on the basis of extensive literature review. The structural model functions on relevance and significance of path coefficients and the model's explanatory (R^2) and predictive power (Q^2). The evaluation of model depends on the metrics that evaluate the path model's explanatory power (Ali *et al.*, 2018; Ringle *et al.*, 2020). Majority of the researchers interpret the coefficient of determination (R^2) to predict the relevance and significance of relationships between the dependent (Latent) and independent (Predictive) variables. The relevance and significance of the relationship between the variables needs to be measured before measuring and discussing the proposed model's explanatory power. In Partial Least Square-SEM, the same is executed using bootstrapping. If path coefficients have t-statistics value of more than 1.96 with a two-tailed t-test at 95 percent confidence level, the significance and relevance of relationships are believed to be established (Wong, 2013). Because the t-statistics of all the relationships was greater than 1.96 (Table 4.17), except for the IF -> PE, the relationship between the dependent (Latent) and independent (Predictive) variables found to be significant.

Table 4.17: Hypothesis Testing

Relationship	**Original Sample (O)**	**Sample Mean (M)**	**Standard Deviation (STDEV)**	**Beta Value**	**T statistics**	**P value**	**Alternative Hypothesis Status**
IFS -> PE	0.523	0.521	0.020	0.825	4.95	.000	**Accept**
IS -> PE	0.469	0.464	0.059	0.367	2.765	.006	**Accept**
IF -> PE	0.734	0.732	0.014	0.479	1.595	.111	**Reject**
IF -> PU	0.812	0.835	0.167	0.839	23.383	.000	**Accept**
IS -> IOC	0.814	0.816	0.016	0.911	16.485	.000	**Accept**
PE -> AOC	-0.346	-0.349	0.133	0.766	29.007	.000	**Accept**
PU -> AOC	0.649	0.645	0.026	0.123	3.929	.000	**Accept**
PU -> IOC	0.127	0.124	0.031	0.060	4.306	.000	**Accept**
AOC -> IOC	0.185	0.182	0.014	0.032	8.177	.000	**Accept**

It is clear from the above table that the t statistics for all the relationships except, IF->PE, was more than 1.96, the alternative hypothesis and relationships were confirmed. The relationship between IFS -> PE had t value of 4.95 which clearly confirmed the significant influence of extrinsic factors on perceived enjoyment in attending the online classes. In the same way, institutional support (IS) significantly influenced the perceived enjoyment (PE) in attending the online classes as this relationship had t value of 2.765. The relationship between the Intrinsic factors (IF) and perceived enjoyment (PE) was found to be insignificant as the t statistics of this relationship was 1.595 which is less than 1.96. Finally intrinsic factors (IF) played a significant role in perceived usefulness (PU) of online classes as this relationship had very high t statistics of 23.383.

Similarly, t-value for the relationship between institutional support and intentions to use online classes was 16.485 which clearly confirmed the significant influence of institutional support on students' intentions to use online classes. The relationship between perceived enjoyment (PE) in attending online classes and attitude towards online classes (AOC) was significant as the t value was 57.458. The relationship between PU -> AOC was also significant as t statistics has the value of 3.929 which clearly confirmed the influence of perceived usefulness of online classes on students' attitude towards online classes. Also perceived usefulness of online classes (PU) significantly influence the students' intentions to use online classes (IOC) which is evident from the high t statistics of 4.306. Finally, the relationship between attitude towards online classes (AOC) and intentions to use online classes (IOC) found to be significant as the t statistics of this relationship was 8.177 which is less than 1.96. As majority of the relationships in the proposed model was significant because t statistics of all the relationships except one relationship (IF -> PE), was greater than 1.96, so all the null hypothesis were rejected except one. Therefore, all the alternative hypothesis were accepted except one. Table 4.18 depicts the acceptance and rejection of alternate and null hypothesis.

Table 4.18: Acceptance and Rejection of Alternate and Null Hypothesis

Null/ Alternative Hypothesis	Status
$H_{0(1.1)}$: There is no significant relationship between extrinsic factors and perceived enjoyment. **H_1:** There is significant relationship between extrinsic factors and perceived enjoyment.	Rejected Accepted
$H_{0(1.2)}$: There is no significant relationship between institutional support and perceived enjoyment. **H_2:** There is significant relationship between institutional support and Perceived enjoyment.	Rejected Accepted
$H_{0(1.3)}$: There is no significant relationship between intrinsic factors and Perceived enjoyment. **H_3:** There is significant relationship between intrinsic factors and perceived enjoyment.	Accepted Rejected
$H_{0(1.4)}$: There is no significant relationship between intrinsic factors and perceived usefulness. **H_4:** There is significant relationship between intrinsic factors and perceived enjoyment.	Rejected Accepted
$H_{0(1.5)}$: There is no significant relationship between institutional support and intention to use online classes. **H_5:** There is significant relationship between institutional support and intention to use online classes.	Rejected Accepted
$H_{0(1.6)}$: There is no significant relationship between perceived enjoyment and attitude towards online classes. **H_6:** There is significant relationship between perceived enjoyment and attitude towards online classes.	Rejected Accepted
$H_{0(1.7)}$: There is no significant relationship between perceived usefulness and attitude towards online classes. **H_7**: There is significant relationship between perceived usefulness and attitude towards online classes.	Rejected Accepted
$H_{0(1.8)}$: There is no significant relationship between perceived usefulness and intention to use online classes. **H_8:** There is significant relationship between perceived usefulness and intention to use online classes.	Rejected Accepted
$H_{0(1.9)}$: There is no significant relationship between attitude towards online classes and intention to use online classes. **H_9:** There is significant relationship between attitude towards online classes and intention to use online classes.	Rejected Accepted

4.6.8 Coefficient of Determination (R^2)

The coefficient of determination often described as $R^{2,}$ determines the proportion of variance in the dependent (Latent) variable that can be explained by independent (Predictive) variables. Coefficient of determination is always represented in percentage and determines the variance explained for each dependent variable. So, coefficient of determination is also used to measure the model explanatory power (Shmueli & Koppius, 2011). A higher R^2 value signifies higher variability explained by independent variables in the dependent variable. In explaining the model's explanatory power, R^2 values of 0.25, 0.5, and 0.75 are commonly used, which reflects weak, moderate, and substantial explanatory power of model (Hair *et al.*, 2011; Henseler *et al.*, 2009). For the present research work, the range specified by Hair *et al.* (2011) and Henseler *et al.* (2009) was considered. Table 4.19 presents the coefficients of determination for various models (inner and outer), revealing that the independent variables " IFS, IS and IF " accounted for 76.80% of the variability in the dependent variable "PE" (perceived enjoyment). Independent variable IF explained 60.40% variability in the dependent variable “PU” (perceived usefulness). In the same way, the independent variables "PE and PU "were able to predict 63.80% of the variability in the dependent variable “AOC" (Attitude towards online classes). Also, independent variables “IS, PU and AOC were able to predict 78.40% of variability in the dependent variable “IOC” (Intentions to use online classes).

Table 4.19: Coefficient of Determination (R^2)

Endogenous Variable	R^2	Explanation
Perceived Enjoyment	76.80%	Substantial
Perceived Usefulness	60.40%	Moderate
Attitude towards online classes	63.80%	Moderate
Intentions to use online classes	78.40%	Substantial

4.6.9 Cross Validated Redundancy Measure (Q^2)

To measure the explanatory power of model, coefficient of determination (R^2) is not the only way. Another method to measure the predictive accuracy of the PLS path model involves computing the Q^2 value, as proposed by Geisser (1974). The Q^2 can be calculated through the blindfolding procedure in PLS-SEM. Blindfolding is a technique that involves systematically deleting the data points. The procedure of blindfolding depends on omission distance represented by D. Hair *et al.* (2016) suggests that omission distance (D) may range from 5 to 12, with a default value of 7. It is important that the value of 'D,' when divided by the sample size 'n,' shall results quotient in a fractional value rather than a whole number. Therefore, it is mandatory to check the quotient before applying the blindfolding technique.

According to Sarstedt *et al.* (2017), Q^2 values of 0.35, 0.15 and 0.02 denotes large, medium and small predictive relevance of an exogenous construct. Because the Q^2 for the endogenous variable perceived enjoyment (PE) was .3619, perceived usefulness (PU) was .2330, attitude towards online classes (AOC) was .2591 and for intentions to use online classes (IOC) was .3924 (Table 4.20). So, the predictive relevance for the exogenous variable ‘perceived usefulness’ and ‘attitude towards online classes’ was meduim whereas the predictive relevance for the exogenous variable ‘perceived enjoyment’, ‘and ‘intentions to use online classes’ was large (Bin-Nashwan *et al.*, 2019; Sarstedt *et al.*, 2017).

Table 4.20 :Cross Validated Redundancy Measure (Q^2)

Endogenous Variable	**SSO**	**SSE**	**Q^2 = 1-SSE/SSO**	**Predictive Relevance**
Perceived Enjoyment	4458	2844.62	.3619	Large
Perceived Usefulness	3226	2474.15	.2330	Medium
Attitude towards online classes	3548	2628.46	.2591	Medium
Intentions to use online classes	4234	2572.48	.3924	Large

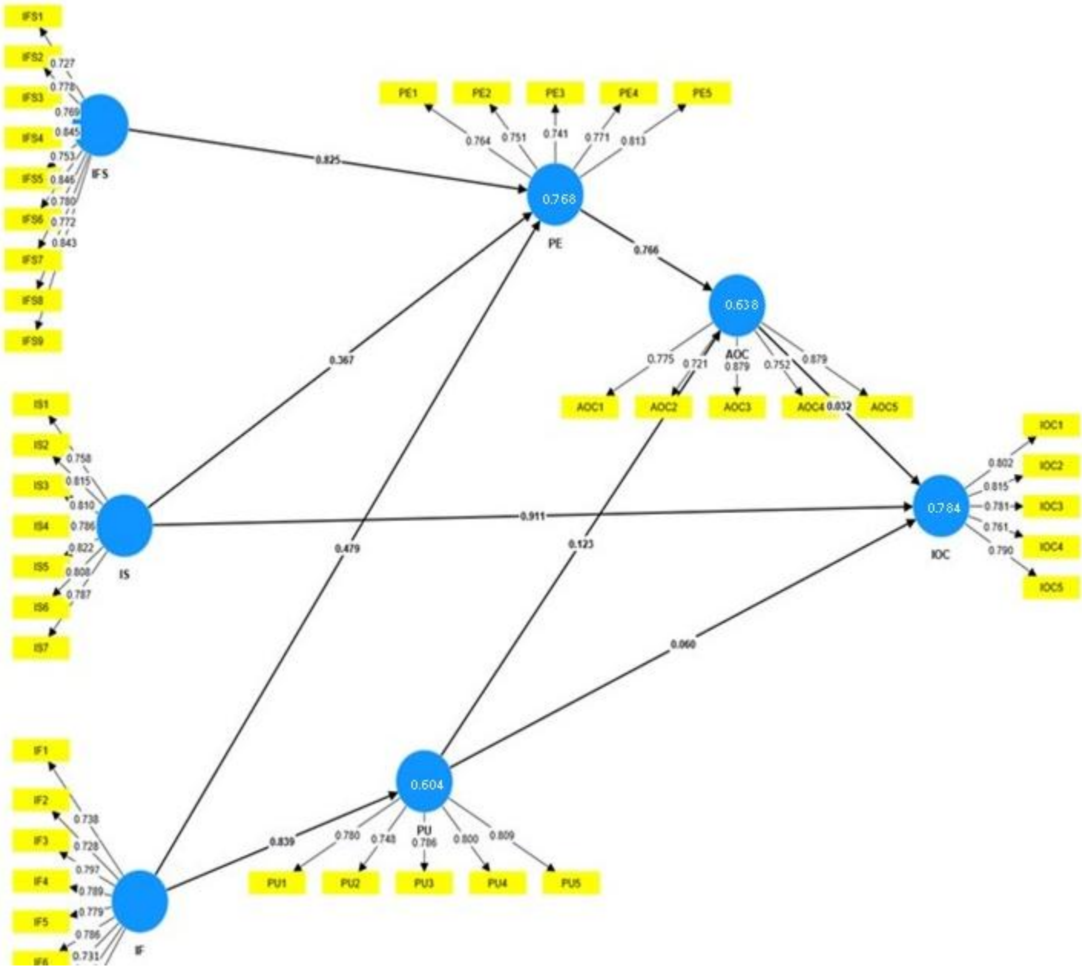

Figure 4.1: Structural Model

4.7 CHAPTER SUMMARY

This chapter presents the analysis of the first objective, i.e., students' intentions towards technology adoption with respect to online classes. A questionnaire was administered to determine the intention of students regarding technology acceptance for online teaching based on five constructs namely, extrinsic factors including ICT infrastructure support and resources; institutional support; intrinsic factors including perceived ease of use, perceived usefulness, self-efficacy, and perceived enjoyment; attitude toward online classes and intention to use online classes.

The chapter examines the factors that influence students' intentions to adopt technology for online learning, providing a comprehensive analysis of the ways in which various elements influence their willingness to engage in online learning. To investigate these factors, a research model was developed after an extensive review of literature which provided valuable insights into the dynamics of online education. Thereafter, hypotheses were developed to test the model. Partial Least Squares Structural Equation Modeling (PLS-SEM) was employed to evaluate the model.

The findings highlights that perceived enjoyment and self-efficacy are critical intrinsic factors that influence students' adoption of technology in online courses. Students are more inclined to cultivate a favourable attitude towards online learning when they perceive it as user-friendly and enjoyable. The perceived usefulness (PU) of the technology complements these intrinsic motivators.

The findings emphasise that students are more likely to use technology if they find it both beneficial and enjoyable in relation to their academic achievements. Another critical factor that influences students' online learning intentions (OLI) is institutional support (IS). The findings point out that the perceived enjoyment (PE) in attending online classes is significantly influenced by institutional support. Extrinsic factors, particularly the support of ICT infrastructure (IFS), are also crucial in determining the experiences of students with online learning. Access to the requisite technology, internet connectivity, and training on the use of online platforms are essential for a positive online learning experience, as the findings reveal a correlation between perceived enjoyment (PE) and IFS. These resources are essential for ensuring that students can effectively engage with online classes, thereby increasing their overall satisfaction and willingness to use technology for learning. The results also highlight a positive correlation between students' intentions to utilise online learning (OLI) and their attitudes towards them (ATT). The likelihood of utilising technology for educational purposes increases when students have a positive attitude towards online learning, as reflected in their intentions to use online classes and their overall attitude towards these classes (ATT).

Chapter – 5

EFFECT OF TECHNOLOGY DIFFERENTIATION AND GADGET USED ON STUDENTS' LEARNING EFFECTIVENESS

Information technology plays a pivotal role in students' lives. They cannot imagine their education taking place without the aid of modern technologies. In education industry, the use of technology and gadgets have grown exponentially over past few years (Bayanova, *et al*., 2019). E-learning platforms, unlike traditional face-to-face learning techniques, allow teachers to engage with students and discuss course content at any time and from any location. Zoom, Google Meet, and Microsoft Team, to name a few, were employed by several institutions as a delivery tool (Serhan, 2020) during the imposed lockdown. These platforms have a cutting-edge technology that offer a number of unique features that can assist students in learning effectively (Rojabi, 2020). Over the years, these platforms have become widely available for students and teachers at many educational institutes. At the same time, the gadgets like mobile phone, iPad/tablet, desktop, and laptop are used by students to enhance their learning experience (Bayanova, *et al.*, 2019). They can use these devices to access online libraries, research materials, and educational applications that provide interactive and engaging content. The objective of the current study is to determine the effect of technology differentiation and gadget on students' learning effectiveness. A questionnaire was administered to students to ascertain how effective the learning had been based on the technology platform used and gadget employed. The learning effectiveness was measured on the basis of three dimensions namely, knowledge construction, student's interaction and instructor's presence both for the technology platform used and the gadget employed. Section A throws light on the effectiveness in terms of the technology platform used while section B includes the effectiveness of learning with respect to the gadget used:

Section A:

5.1 KNOWLEDGE CONSTRUCTION

In order to examine the effectiveness of the technology platform on knowledge construction, a 7-item scale, developed after the comprehensive and extensive review of literature, was used. The scale demonstrated high reliability, as evidenced by a Cronbach's alpha coefficient of .880, surpassing the minimal acceptable threshold of .70 (Hair *et al.*, 2013). The data was gathered by the utilization of a five-point Likert Scale, ranging from 1 to 5. A rating of 5 indicates a significant degree of effectiveness, while a rating of 1 indicates a minimal amount of effectiveness. The statistical analysis of the response about knowledge construction is presented in Table 5.1.

Table 5.1: Effect of the technology differentiation on learning effectiveness *wrt* knowledge construction

Variable	Mean	Std. Deviation
Knowledge Construction		
Understanding of the course content	3.60	.937
Application of theoretical concepts	3.44	1.027
Development of critical thinking skills	3.30	1.146
Development of creative thinking skills	3.37	1.165
Development of communication skills	3.51	1.222
Development of team skills	3.13	1.288
Development of leadership skills	3.06	1.311
Average	**3.34**	**1.156**
N=600		

The primary goal of any learning platform is to enrich the knowledge of the learners. The table reveals that students perceive the technology platform to be particularly effective in aiding their understanding of course content, as evident by the high mean score of 3.60. Following closely, the platform is also seen as contributing to the enhancement of communication skills, with a mean score of 3.51, and understanding theoretical concepts, with a mean score of 3.44. However, the data indicates that the technology platform has a relatively weaker impact on the development of leadership skills (mean score of 3.06) and team skills (mean score of 3.13). It is noteworthy that, while the students acknowledge significant improvement in understanding course content and theoretical concepts through the learning platform, the influence on variables like team skills and communication skills appears to be less pronounced.

5.2 STUDENT'S INTERACTION

In order to examine the effectiveness of the technology platform on student's interaction, a 6-item scale, developed after the comprehensive and extensive review of literature, was used. The scale was found to be reliable as Cronbach's alpha was .859, which is well above the minimum acceptable limit of .70 (Hair *et al.*, 2013). The data was gathered by the utilization of a five-point Likert Scale, ranging from 1 to 5. A rating of 5 indicates a significant degree of effectiveness, while a rating of 1 indicates a minimal amount of effectiveness. Descriptive statistics of response on student's interaction is tabulated in Table 5.2.

Table 5.2: Effect of the technology differentiation on learning effectiveness wrt student's interaction

Variable	Mean	Std. Deviation
Student's Interaction		
Interaction with the instructor	3.62	1.117
Discussion among students	3.25	1.250
Ease of answering questions	3.57	1.203
Synchronous and/or asynchronous sessions during the class	3.58	1.092
Opportunities for active learning (hands- on/flipped class/breakout rooms)	3.28	1.241
Continuous feedback from peers/classmates	3.24	1.254
Average	**3.42**	**1.193**
N=600		

Any learning platform must give the opportunities to the students to interact with the instructor and the peer group as and when needed so that effective learning can take place. The table reveals that students perceive the technology platform to be particularly effective in interacting with the instructor as revealed by the mean score of 3.62, following closely by the type of session, whether synchronous, where the instructor and students gather at the same time and place and interacting in "real-time" as compared to asynchronous, where students interact with each other over longer periods and access study material at their own speed (mean score of 3.58). Following this is the ease of answering questions (mean score of 3.57) which means that students perceive that answering to the queries is relatively easy in online learning platforms.

However, the data suggests that the technology platform is relatively weaker when it comes to the continuous feedback from peers/classmates (mean score of 3.24) which means that students either do not get feedback on time or they get the delayed response from the peer group. The data also reveals that discussion among students (mean score of 3.25) while using the technology platform appears to be not very effective.

5.3 INSTRUCTOR'S PRESENCE

In order to examine the effectiveness of the technology platform on instructor's presence, a 5-item scale, developed after the comprehensive and extensive review of literature, was used. The scale demonstrated high reliability, as evidenced by a Cronbach's alpha coefficient of .847, surpassing the minimal acceptable threshold of .70 (Hair *et al.*, 2013). The data was gathered by the utilization of a five-point Likert Scale, ranging from 1 to 5. A rating of 5 indicates a significant degree of effectiveness, while a rating of 1 indicates a minimal amount of effectiveness. The descriptive statistics of the response about technology differentiation is presented in table 5.3.

Table 5.3: Effect of the technology differentiation on learning effectiveness *wrt* instructor's presence

Variable	Mean	Std. Deviation
Instructor's Presence		
Instructor's explanation of the course content	3.78	.974
Instructor's presentation of course material	3.82	1.012
Instructor's feedback on assignments	3.57	1.138
Instructor's preference for class discussion	3.52	1.137
Instructor's guidelines for student participation	3.63	1.115
Average	**3.67**	**1.075**
N=600		

The role of an instructor is very crucial in any online learning platform. Any learning platform must give the opportunities to the students to interact with the instructor whenever needed so that effective learning can take place. The table reveals that students perceive the technology platform to be particularly effective for presentation of the course material (high mean score of 3.82) followed by instructor's explanation of the course content (mean score of 3.78), and instructor's guidelines for students' participation (mean score of 3.63).

However, the data suggests that the technology platform is not very effective when it comes to the instructor's feedback on assignments (means score of 3.57) followed by class discussion (mean score of 3.52).

Section B:

5.4 KNOWLEDGE CONSTRUCTION

In order to examine the effect of gadget used in attending the online classes on learning effectiveness on the dimension of knowledge construction, a 7-item scale, developed after the comprehensive and extensive review of literature, was used. The scale demonstrated high reliability, as evidenced by a Cronbach's alpha coefficient of .891, surpassing the minimal acceptable threshold of .70 (Hair *et al.,* 2013). The data was gathered by the utilization of a five-point Likert Scale, ranging from 1 to 5. A rating of 5 indicates a significant degree of effectiveness, while a rating of 1 indicates a minimal amount of effectiveness. The descriptive statistics of the response about knowledge construction is presented in table 5.4.

Table 5.4: Effect of gadget on learning effectiveness *wrt* knowledge construction

Variable	Mean	Std. Deviation
Knowledge Construction		
Understanding of the course content	3.81	1.027
Application of theoretical concepts	3.66	1.037
Development of critical thinking skills	3.57	1.093
Development of creative thinking skills	3.57	1.126
Development of communication skills	3.68	1.121
Development of team skills	3.33	1.199
Development of leadership skills	3.26	1.304
Average	**3.55**	**1.130**
N=600		

According to the table, students perceive the gadget as highly effective in facilitating their comprehension of course content, as indicated by the notably high mean score of 3.81. Additionally, the gadget is recognized for its contribution to the improvement of communication skills, garnering a mean score of 3.68, and understanding theoretical concepts, with a mean score of 3.66.

However, the data indicates that the gadget's impact on the development of leadership skills is comparatively weaker, reflected in a mean score of 3.26, as well as on team skills, where the mean score is 3.33. It is noteworthy that, while students acknowledge significant enhancements in understanding course content and theoretical concepts through the learning platform, the influence on variables such as team skills and communication skills appears to be less pronounced.

5.5 STUDENT'S INTERACTION

In order to examine the effectiveness of the gadget on student's interaction, a 6-item scale, developed after the comprehensive and extensive review of literature, was used. The scale demonstrated high reliability, as evidenced by a Cronbach's alpha coefficient of .878, surpassing the minimal acceptable threshold of .70 (Hair *et al.*, 2013). The data was gathered by the utilization of a five-point Likert Scale, ranging from 1 to 5. A rating of 5 indicates a significant degree of effectiveness, while a rating of 1 indicates a minimal amount of effectiveness. The descriptive statistics of the response about student's interaction is presented in Table 5.5.

Table 5.5: Effect of gadget on learning effectiveness *wrt* student's interaction

Variable	Mean	Std. Deviation
Student's Interaction		
Interaction with the instructor	3.77	1.070
Discussion among students	3.50	1.212
Ease of answering questions	3.71	1.126
Synchronous and/or asynchronous sessions during the class	3.38	1.096
Opportunities for active learning (hands- on/ flipped class/ breakout rooms)	3.47	1.180
Continuous feedback from peers/ classmates	3.48	1.213
Average	**3.55**	**1.149**
N=600		

The table demonstrates that students perceive the gadget used in online classes as highly effective in facilitating learning during interactions with the instructor, as indicated by the mean score of 3.77. Additionally, the ease of answering questions, with a mean score of 3.71, suggests that students find it relatively straightforward to respond to queries in the online class environment.

However, the data suggests that the gadget does not contribute much to effective learning as it is relatively weaker when it comes to synchronous and/or asynchronous sessions during the class (mean score of 3.38). Additionally, the opportunities for active learning (hands- on/flipped class/breakout rooms) are also limited (mean score of 3.47) as students perceive that online classes are one-sided communication and they feel disengaged. Continuous feedback from peers/classmates (mean score of 3.48) indicates that students either do not get feedback on time or they get the delayed response from the peer group.

5.6 INSTRUCTOR'S PRESENCE

In order to examine the role of gadget in enhancing the learning effectiveness on the dimension of instructor's presence, a 5-item scale, developed after the comprehensive and extensive review of literature, was used. The scale demonstrated high reliability, as evidenced by a Cronbach's alpha coefficient of .880, surpassing the minimal acceptable threshold of .70 (Hair *et al.*, 2013). The data was gathered by the utilization of a five-point Likert Scale, ranging from 1 to 5. A rating of 5 indicates a significant degree of effectiveness, while a rating of 1 indicates a minimal amount of effectiveness. The descriptive statistics of the response about instructor's presence is presented in table 5.6.

Table 5.6: Effect of gadget on learning effectiveness *wrt* instructor's presence

Variable	Mean	Std. Deviation
Instructor's Presence		
Instructor's explanation of the course content	3.78	1.030
Instructor's presentation of course material	3.79	1.072
Instructor's feedback on assignments	3.69	1.110
Instructor's preference for class discussion	3.64	1.142
Instructor's guidelines for student participation	3.67	1.137
Average	**3.71**	**1.098**
N=600		

Any learning device must give the opportunities to the students to interact with the instructor whenever needed so that effective learning can take place. The table reveals that students perceive that gadget used to be particularly effective for the presentation of the course material (high mean score of 3.79) followed by instructor's explanation of the course content (mean score of 3.78), and the instructor's feedback in the assignment's (mean score of 3.69). On the flip side, it can be seen from the data that the device employed during the online classes was not very effective for enhancing the class discussion (mean score of 3.64).

5.7 HYPOTHESIS TESTING AND RESULTS

Learning Effectiveness dimension: Knowledge Construction: To study whether knowledge construction varies significantly across the six chosen technology platforms namely Zoom, Blackboard, Google Classroom, My Class, Google Meet and Microsoft Teams, hypothesis $\mathbf{H_{0(2.1)}}$ was framed:

$\mathbf{H_{0(2.1)}}$: There is no significant difference in Knowledge Construction dimension across the technology platforms.

The mean scores of knowledge construction dimension across the technology platforms are tabulated in Table 5.7. An analysis of variance (ANOVA) was conducted to compare the mean scores across the six technology platforms. The F-value of 7.685 was statistically significant at the 0.05 level, as indicated in Table 5.8. The ANOVA results indicate significant difference in the knowledge construction dimension across various technology platforms. Therefore, the null hypothesis H_0(2.1) was rejected. While performing multiple comparisons, through Least Square Difference (LSD) method (Table 5.9), knowledge construction dimension, in case of My Class and Microsoft Teams, was found to be significantly different from Black Board, Google Classroom and Google Meet platforms at .05 level of significance. Whereas, there was no significant difference in knowledge construction dimension among My Class, Microsoft Teams and Zoom platforms. The results indicated that the most effective platform for knowledge construction was My Class with mean score of 3.9743 while the least effective was Google Classroom with mean score of 3.2023.

Table 5.7: Knowledge Construction Mean Score

Technology Platform	Mean	Std. Deviation
Zoom	3.6775	.90132
Black Board	3.3557	.83731
Google Classroom	3.2023	.85651
My Class	3.9743	.98999
Google Meet	3.3600	.69150
Microsoft Teams	3.7274	.81003

Table 5.8: ANOVA of Knowledge Construction dimension across Technology Platforms

Variations	Sum of Squares	Df	Mean Square	F	*p-value
Between Groups	28.653	5	5.731	7.685	.000
Within Groups	442.922	594	.746		
Total	471.575	599			

Table 5.9: Post-Hoc Tests of Multiple Comparison of Knowledge Construction dimension across Technology Platforms

Technology Platform (A)	Technology Platform (B)	Mean Difference (A-B)	Std. Error	Sig.
Zoom	Black Board	.19821	.12464	.605
	Google Classroom	.12679	.12464	.912
	My Class	-.52321	.12464	.472
	Google Meet	.03750	.12464	1.000
	Microsoft Teams	-.48988	.09654	.721

Technology Platform (A)	Technology Platform (B)	Mean Difference (A-B)	Std. Error	Sig.
Black Board	Zoom	-.19821	.12464	.605
	Google Classroom	.07143	.15766	.998
	My Class	-.42143*	.15766	.000
	Google Meet	.23571	.15766	.668
	Microsoft Teams	-.29167*	.13653	.035
Google Classroom	Zoom	-.12679	.12464	.912
	Black Board	-.07143	.15766	.998
	My Class	-.45000*	.15766	.012
	Google Meet	-.16429	.15766	.904
	Microsoft Teams	-.36310*	.13653	.038
My Class	Zoom	.52321	.12464	.472
	Black Board	.42143*	.15766	.000
	Google Classroom	.45000*	.15766	.012
	Google Meet	.18571*	.15766	.004
	Microsoft Teams	.01310	.13653	.374
Google Meet	Zoom	.03750	.12464	1.000
	Black Board	.23571	.15766	.668
	Google Classroom	.16429	.15766	.904
	My Class	.45000*	.15766	.004
	Microsoft Teams	-.52738*	.13653	.021
Microsoft Teams	Zoom	.48988	.09654	.721
	Black Board	.29167	.13653	.035
	Google Classroom	.36310*	.13653	.038
	My Class	-.01310	.13653	.374
	Google Meet	.52738*	.13653	.021

Learning Effectiveness dimension: Student's interaction: To study whether student's interaction varies significantly across the six chosen technology platforms namely Zoom, Blackboard, Google Classroom, My Class, Google Meet and Microsoft Teams hypothesis $\mathbf{H_{0(2.2)}}$ was framed:

$\mathbf{H_{0(2.2):}}$ There is no significant difference in Student's interaction dimension across the technology platforms.

The mean scores of student's interaction dimension across the technology platforms are tabulated in the Table 5.10. An analysis of variance (ANOVA) was conducted to compare the mean scores across the six technology platforms. The F-value of 6.985 was statistically significant at the 0.05 level, as indicated in Table 5.11. The ANOVA results indicate significant difference in the student's interaction dimension across various technology platforms. Therefore, the null hypothesis $\mathbf{H_{0(2.2)}}$ was rejected. While performing multiple comparisons, through Least Square Difference (LSD) method (Table 5.12), student's interaction dimension in case of My Class Platform found to be significantly different from Zoom, Black Board, Google Classroom and Google Meet platforms at .05 level of significance. Whereas there was no significant difference in student's interaction dimension between My Class and Microsoft Teams Platform. The results indicated that the most effective platform for student's interaction was My Class with mean score of 3.7706 while the least effective was Google Classroom with mean score of 3.3104.

Table 5.10: Student's Interaction Mean Score

Technology Platform	Mean	Std. Deviation
Zoom	3.4583	.97841
Black Board	3.3611	.79670
Google Classroom	3.3104	.95225
My Class	3.7706	.84615
Google Meet	3.4333	.8335
Microsoft Teams	3.5472	.77061

Table 5.11: ANOVA of Student's Interaction dimension across Technology Platforms

Variations	Sum of Squares	Df	Mean Square	F	*p-value
Between Groups	27.850	5	5.570	6.985	.000
Within Groups	473.640	594	.797		
Total	501.490	599			

Table 5.12: Post-Hoc Tests of Multiple Comparison of Student's Interaction dimension across Technology Platforms

Technology Platform (A)	Technology Platform (B)	Mean Difference (A-B)	Std. Error	Sig.
Zoom	Black Board	.33681	.12889	.812
	Google Classroom	.12292	.12889	.932
	My Class	-.59692*	.12889	.013
	Google Meet	.14792	.12889	.861
	Microsoft Teams	-.46014	.09984	.246
Black Board	Zoom	-.33681	.12889	.812
	Google Classroom	.21389	.16303	.778
	My Class	.28611*	.16303	.004
	Google Meet	.18889	.16303	.856
	Microsoft Teams	-.22333	.14119	.611
Google Classroom	Zoom	-.12292	.12889	.932
	Black Board	-.21389	.16303	.778
	My Class	-.43722*	.16303	.025
	Google Meet	-.02500	.16303	1.000
	Microsoft Teams	.07222	.14119	.812

Technology Platform (A)	Technology Platform (B)	Mean Difference (A-B)	Std. Error	Sig.
My Class	Zoom	-.59692*	.12889	.013
	Black Board	-.28611*	.16303	.004
	Google Classroom	43722*	.16303	.025
	Google Meet	.09722*	.16303	.000
	Microsoft Teams	.50944	.14119	.348
Google Meet	Zoom	.14792	.12889	.861
	Black Board	-.18889	.16303	.856
	Google Classroom	.02500	.16303	1.000
	My Class	-.09722	.16303	.000
	Microsoft Teams	-.41222	.14119	.497
Microsoft Teams	Zoom	.46014	.09984	.246
	Black Board	.22333	.14119	.611
	Google Classroom	.43722*	.14119	.812
	My Class	50944	.14119	.348
	Google Meet	.41222	.14119	.497

Learning Effectiveness dimension: Instructor's Presence: To study whether instructor's presence varies significantly across the six chosen technology platforms namely Zoom, Blackboard, Google Classroom, My Class, Google Meet and Microsoft Teams hypothesis $\mathbf{H_{0(2.3)}}$ was framed:

$\mathbf{H_{0(2.3)}}$**: There is no significant difference in Instructor's Presence dimension across the technology platforms.**

The mean score of instructor's presence dimension across the technology platforms are tabulated in the Table 5.13. An analysis of variance (ANOVA) was conducted to compare the mean scores across the six technology platforms. The F-value of 3.482

was statistically significant at the 0.05 level, as indicated in Table 5.14. The ANOVA results indicate significant difference in the instructor's presence dimension across various technology platforms. Therefore, the null hypothesis $\mathbf{H_{0(2.3)}}$ was rejected. While performing multiple comparisons, through Least Square Difference (LSD) method (Table 5.15), instructor's presence dimension, in case of My Class Platform found to be significantly different from Zoom and Google Classroom platforms at .05 level of significance. Whereas there was no significant difference in instructor's presence dimension between My Class, Black Board, Google Meet and Microsoft Teams platforms. The results indicated that the most effective platform for instructor's presence was My Class with mean score of 3.9083 while the least effective was Zoom with mean score of 3.5233.

Table 5.13: Instructor's Presence Mean Score

Technology Platform	Mean	Std. Deviation
Zoom	3.5233	.87851
Black Board	3.7300	.81247
Google Classroom	3.5967	.75401
My Class	3.9083	.93726
Google Meet	3.6900	.78927
Microsoft Teams	3.7700	.78297

Table 5.14: ANOVA of Instructor's Presence dimension across Technology Platforms

Variations	Sum of Squares	Df	Mean Square	F	*p-value
Between Groups	12.265	5	2.453	3.482	.004
Within Groups	418.478	594	.705		
Total	430.742	599			

Table 5.15: Post-Hoc Tests of Multiple Comparison of Instructor's Presence dimension across Technology Platforms

Technology Platform (A)	Technology Platform (B)	Mean Difference (A-B)	Std. Error	Sig.
Zoom	Black Board	-.23667	.12115	.371
	Google Classroom	-.08333	.12115	.983
	My Class	-.37500*	.12115	.001
	Google Meet	-.15667	.12115	.789
	Microsoft Teams	-.08000	.09384	.842
Black Board	Zoom	.23667	.12115	.371
	Google Classroom	.15333	.15324	.918
	My Class	.15667	.15324	.910
	Google Meet	.08000	.15324	.995
	Microsoft Teams	-.13833	.13271	.903
Google Classroom	Zoom	.08333	.12115	.983
	Black Board	-.15333	.15324	.918
	My Class	-.29167*	.15324	.000
	Google Meet	-.07333	.15324	.997
	Microsoft Teams	-.23347	.13271	.240
My Class	Zoom	.37500*	.12115	.001
	Black Board	.15667	.15324	.910
	Google Classroom	.29167*	.15324	.000
	Google Meet	.07667	.15324	.996
	Microsoft Teams	.29500	.13271	.229
Google Meet	Zoom	.15667	.12115	.789
	Black Board	-.08000	.15324	.995
	Google Classroom	.07333	.15324	.997
	My Class	-.07667	.15324	.996
	Microsoft Teams	-.23347	.13271	.240
Microsoft Teams	Zoom	. 08000	.09384	.842
	Black Board	.13833	.13271	.903
	Google Classroom	.29167	.13271	.240
	My Class	-.29500	.13271	.229
	Google Meet	.21833	.13271	.569

Learning Effectiveness dimension: Knowledge Construction: To study whether knowledge construction varies significantly across the four chosen gadgets namely Desktop, Laptop, Tablet/iPad Mobile, hypothesis $\mathbf{H_{0(2.4)}}$ was framed:

$\mathbf{H_{0(2.4)}}$: There is no significant difference in Knowledge Construction dimension across the gadgets.

The mean score of knowledge construction dimension across the gadgets are tabulated in the Table 5.16. An analysis of variance (ANOVA) was conducted to compare the mean scores across the gadgets. The F-value of 23.194 was statistically significant at the 0.05 level, as indicated in Table 5.17. The ANOVA results indicate significant difference in the knowledge construction dimension across various gadgets. Therefore, the null hypothesis $\mathbf{H_{0(2.4)}}$ was rejected. While performing multiple comparisons, through Least Square Difference (LSD) method (Table 5.18), knowledge construction dimension in case of Laptop and Desktop was found to be significantly different from Tablet/iPad at .05 level of significance. Whereas there was no significant difference in knowledge construction dimension between Laptop, Desktop and Mobile Phone. Multiple comparison also revealed that there is no significant difference in knowledge construction dimension between Mobile Phone and Tablet/iPad. The results indicated that the most effective gadget for knowledge construction was laptop with mean score of 3.8520 while the least effective was Tablet/iPad with mean score of 3.2486.

Table 5.16: Knowledge Construction Mean Score

Gadget	Mean	Std. Deviation
Desktop	3.6981	.83992
Laptop	3.8520	.78490
Mobile phone	3.6061	1.03942
Tablet/iPad	3.2486	.85445

Table 5.17: ANOVA of Knowledge Construction dimension across Gadgets

Variations	Sum of Squares	Df	Mean Square	F	*p-value
Between Groups	48.671	3	16.224	23.194	.000
Within Groups	416.892	596	.699		
Total	465.563	599			

Table 5.18: Post-Hoc Tests of Multiple Comparison of Knowledge Construction dimension across Gadgets

Gadget (A)	Gadget (B)	Mean Difference (A-B)	Std. Error	Sig.
Desktop	Laptop	-.15395	.13673	.674
	Mobile Phone	.09199	.19260	.964
	Tablet/iPad	.44949*	.13587	.005
Laptop	Desktop	.15395	.13673	.674
	Mobile Phone	.24594	.15490	.386
	Tablet/iPad	.60344*	.07321	.000
Mobile Phone	Desktop	-.09199	.19260	.964
	Laptop	-.24594	.15490	.386
	Tablet/iPad	.35750	.15414	.095
Tablet/iPad	Desktop	-.44949*	.13587	.005
	Laptop	-.60344*	.07321	.000
	Mobile Phone	-.35750	.15414	.095

Learning Effectiveness dimension: Student's Interaction: To study whether student's interaction varies significantly across the four chosen gadgets namely Desktop, Laptop, Tablet/iPad Mobile, hypothesis $\mathbf{H_{0(2.5)}}$ was framed.

$H_{0(2.5)}$: There is no significant difference in Student's Interaction dimension across the gadgets.

The mean score of student's interaction dimension across the gadgets are tabulated in the Table 5.19. An analysis of variance (ANOVA) was conducted to compare the mean scores across the gadgets. The F-value of 15.845 was statistically significant at the 0.05 level, as indicated in Table 5.20. The ANOVA results indicate significant difference in the student's interaction dimension across various gadgets. Therefore, the null hypothesis **$H_{0(2.3)}$** was rejected. While performing multiple comparisons, through Least Square Difference (LSD) method (Table 5.21), student's interaction dimension in case of Laptop and Desktop found to be significantly different from Mobile phone and Tablet/ iPad at .05 level of significance. Multiple comparison also revealed that there is no significant difference in student's interaction dimension between Desktop and Laptop and also between Mobile phone and Tablet/ iPad. The results indicated that the most effective gadget for student's interaction was laptop with mean score of 3.8547 while the least effective was Tablet/iPad with mean score of 3.3278.

Table 5.19: Student's Interaction Mean Score

Gadget	Mean	Std. Deviation
Desktop	3.7414	.93490
Laptop	3.8547	.86118
Mobile phone	3.4327	.94108
Tablet/ iPad	3.3278	.86819

Table 5.20: ANOVA of Student's Interaction dimension across Gadgets

Variations	Sum of Squares	Df	Mean Square	F	*p-value
Between Groups	36.338	3	12.113	15.845	.000
Within Groups	455.607	596	.764		
Total	491.944	599			

Table 5.21: Post-Hoc Tests of Multiple Comparison of Student's Interaction dimension across Gadgets

Gadget (A)	Gadget (B)	Mean Difference (A – B)	Std. Error	Sig.
Desktop	Laptop	-.27133	.14294	.230
	Mobile Phone	.03809*	.20134	.023
	Tablet/iPad	.25549*	.14203	.015
Laptop	Desktop	.21325	.14294	.230
	Mobile Phone	.35627*	.16193	.006
	Tablet/iPad	.52683*	.07654	.000
Mobile Phone	Desktop	-.03809*	.20134	.023
	Laptop	-.35627*	.16193	.006
	Tablet/iPad	.16358	.16114	.210
Tablet/iPad	Desktop	-.25549	.14203	.015
	Laptop	-.52683*	.07654	.000
	Mobile Phone	-.16358	.16114	.210

Learning Effectiveness dimension: Instructor's Presence: To study whether instructor's presence varies significantly across the four chosen gadgets namely Desktop, Laptop, Tablet/iPad Mobile, hypothesis $\mathbf{H_{0(2.6)}}$ was framed.

$\mathbf{H_{0(2.6)}}$: **There is no significant difference in Instructor's Presence dimension across the gadgets.**

The mean score of instructor's presence dimension across the gadgets are tabulated in the Table 5.22. An analysis of variance (ANOVA) was conducted to compare the mean scores across the gadgets. The F-value of 21.245 was statistically significant at the 0.05 level, as indicated in Table 5.23. The ANOVA results indicate significant difference in the instructor's presence dimension across various gadegts. Therefore, the null hypothesis $\mathbf{H_{0(2.3)}}$ was rejected. While performing multiple comparisons, through Least Square (LSD) method (Table 5.24), instructor's presence dimension in case of Laptop and Desktop found to be significantly different from Tablet/iPad at .05 level of significance. Whereas there was no significant difference in Instructor's Presence dimension between Mobile phone and Tablet/iPad. Multiple comparison also revealed that there is no significant difference in Instructor's Presence dimension between Desktop and Laptop. The results indicated that the most effective gadget for instructor's presence was laptop with mean score of 4.0112 while the least effective was Tablet/iPad with mean score of 3.4161.

Table 5.22: Instructor's Presence Mean Score

Gadget	Mean	Std. Deviation
Desktop	3.8900	.82081
Laptop	4.0112	.78676
Mobile phone	3.5436	.99556
Tablet/iPad	3.4161	.91267

Table 5.23: ANOVA of Instructor's Presence dimension across Gadgets

Variations	Sum of Squares	Df	Mean Square	F	*p-value
Between Groups	47.201	3	15.734	21.245	.000
Within Groups	441.384	596	.741		
Total	488.585	599			

Table 5.24: Post-Hoc Tests of Multiple Comparison of Instructor's Presence dimension across Gadgets

Gadget (A)	Gadget (B)	Mean Difference (A-B)	Std. Error	Sig.
Desktop	Laptop	-.08636	.14069	.661
	Mobile Phone	.34267*	.19817	.026
	Tablet/iPad	.43388*	.13980	.011
Laptop	Desktop	.08636	.14069	.661
	Mobile Phone	.48756*	.15939	.004
	Tablet/iPad	.59508*	.07533	.000
Mobile Phone	Desktop	-.34267*	.19817	.026
	Laptop	-.48756*	.15939	.004
	Tablet/iPad	.14752	.15860	.127
Tablet/iPad	Desktop	.43388*	.13980	.011
	Laptop	.59508*	.07533	.000
	Mobile Phone	-.14752	.15860	.127

5.8 CHAPTER SUMMARY

This chapter highlights the effect of technology differentiation and gadget category on students' learning effectiveness. Online platforms namely Zoom, Blackboard, Google Classroom, My Class, Google Meet and Microsoft Teams and gadgets comprising Desktop, Laptop, Tablet/iPad and Mobile Phone were included in the present study. A survey was conducted among students to determine the learning effectiveness based on the technology platform and gadget utilised. The learning effectiveness was assessed based on three dimensions namely, knowledge construction, student interaction, and instructor's presence, for both the technology platform and the gadget used. One-way ANOVA was applied to analyse the collected data.

The findings revealed that a significant difference exists among the technology platforms for knowledge construction dimension. My Class was found to be the most successful in facilitating knowledge construction among the students, followed by Microsoft Teams. The design of My Class is tailored to specifically meet academic requirements. The least effective platform came out to be Google Classroom in case of knowledge construction. This platform did not support direct practical exercises, leaving students with predominantly theoretical content.

The findings highlighted a significant difference among the technology platforms regarding the level of student engagement. My Class and Microsoft Teams were identified as the most significant platforms in fostering an interactive learning environment among students thereby enhancing their learning outcomes. Both platforms provided a variety of features and promoted collaboration, fostering an environment that motivated users to engage in discussions, contribute their expertise, and demonstrate their understanding of the course content. The least effective platform under student's interaction came out to be Google Classroom because the platform did not provide the opportunities for effective interaction. With regard to instructor's presence in the online class, a significant difference was found among technology platforms. My Class platform came out to be most effective followed by Microsoft Teams and Blackboard. All these three platforms facilitate direct interactions between students and instructors enabling instructors to offer guidance and support in virtual settings. However, Zoom was found to be least effective in terms of instructor presence. The Zoom platform lacks features that enable instructors to enhance the educational experience for students.

The study's findings indicate that the laptop was the most effective gadget in terms of knowledge construction. The advantages of using laptop includes its multifunctionality, improved readability due to larger screens, and mobility. The study also reveals that laptops can aid in the development of students' creativity, independent learning, and intrinsic motivation. It was found that, in terms of knowledge construction, there was no major difference between laptops and desktops whereas significant difference found between laptop, mobile phone and tablet/iPad. The small screen size of tablet/iPad hindered effective display and readability of content, rendering it less usable for students. It was also found that the laptop was the most effective device in facilitating increased collaboration and interaction among students, with the desktop following closely behind. Therefore, there was no discernible difference between desktops and laptops as far as students' interaction dimension was concerned. According to the current study analysis, tablet/iPad were found to be least effective device in students' interaction and a significant difference was found when compared to laptops and desktops. The results of the study also indicates that there is no significant difference between laptop and desktop for the dimension of instructor's presence. The findings revealed that students have a more immersive learning experience when they use laptops and desktops due to their larger screens and enhanced functionality. This enables them to concentrate more effectively on the teacher's instructions, visual aids, and interactive qualities. In the current study, the least effective device for instructors' presence came out to be tablet/iPad. A significant difference was found between the laptop and desktop and tablet/iPad for the instructor presence dimension.

Chapter – 6

INFLUENCE OF ONLINE CLASSROOM ENVIRONMENT ON STUDENTS' ENGAGEMENT

The influence of online learning environments on the engagement of learners is an essential element of contemporary education, which has been moulded by the swift incorporation of technology into educational endeavours. The literature review demonstrates that student involvement encompasses cognitive, behavioural, emotional (Fredricks *et al.,* 2004), and social (Klassen *et al.,* 2013) aspects, forming a motivational framework.. There are advantages and disadvantages for student engagement associated with the shift from traditional classrooms to virtual environments. One way that online classes promote a customised approach to learning is by providing students with the flexibility to access educational content from the comfort of their homes. By accommodating a range of learning styles and preferences, the integration of interactive tools and multimedia features further improves engagement. However, there are additional challenges brought about by the online learning environment that may have a negative effect on students' participation. Technical impediments such as software glitches and inadequate internet connectivity might hinder the learning process. Moreover, the lack of in-person connections and the possibility of distractions in a home setting can exacerbate feelings of detachment, which can impair students' motivation and concentration. For educators and organisations looking to maximise the overall influence of the online learning environment on students' engagement and academic success, finding a balance between utilising the benefits of online learning and minimising its drawbacks is essential. The objective of this chapter is to look into how students' participation in online classes is affected by the setting of the online learning environment. Students were given a questionnaire to determine the effect of the online learning environment on their participation. The questionnaire comprised the statements related to the online classroom environment which focused on three important aspects of any online class, i.e., the instructors, the peers and the online platform used in the class. The students' level of participation was assessed using four distinct dimensions: cognitive engagement, behavioural engagement, social engagement, and emotional engagement.

6.1 ONLINE CLASSROOM ENVIRONMENT

A 14-item scale, constructed after a thorough and exhaustive literature search, was utilized to assess the online classroom setting. The reliability of the scale was confirmed with a Cronbach's alpha coefficient of .905, surpassing the minimal permissible threshold of .70 (Hair *et al.,* 2013). The response was recorded using a five-point Likert Scale, with a range of 1 to 5. A rating of 5 indicates a high level of influence, while a rating of 1 indicates no influence at all. The descriptive statistics of the responses about the online classroom setting is presented in Table 6.1.

Table 6.1: Online classroom environment

Dimension	Mean	Std. Deviation
Online Classroom Environment		
I get timely feedback from my instructor.	3.53	.978
I receive the desired support from my instructor.	3.55	1.033
I openly discuss course topics/concepts with my instructor.	3.34	1.147
I get opportunity to discuss my career plans with my instructor.	3.13	1.233
I get opportunity to collaborate with my instructor on academic activities like projects, consultancy, etc.	3.22	1.160
My peers help me with course material/assignments.	3.67	1.055
I share knowledge with peers.	3.71	1.012
I get the opportunity to work with my peers on projects or assignments.	3.66	1.057
I am able to participate in group discussion with my peers.	3.61	1.039
I am able to establish personal contact with some peers.	3.68	1.023

Dimension	Mean	Std. Deviation
The online class interface which we have the access to is well-designed.	3.69	.952
Online class interface enables two-way communication.	3.79	1.008
Online class interface enables instructor to take a poll or run a quiz during the class.	3.80	1.038
It is easy to navigate through the online class interface.	3.70	.983
Average	**3.58**	**1.051**
N=600		

The data from the table indicates positive aspects of the online classroom environment, with high mean scores for features such as the ability to conduct polls and quizzes (3.80), fostering two-way communication (3.79), and facilitating knowledge-sharing among peers (3.71). These results indicate positive aspects of online classroom environment. On the flip side, the data reveals areas for improvement. Students reported limited opportunities to discuss their career plans with instructors (mean score of 3.13) and collaborate with them on academic activities (mean score of 3.22), such as projects or consultancy. Unlike the ease of interaction with peers, engagement with teachers appears to be less supported in the online classroom environment.

6.2 COGNITIVE ENGAGEMENT

A detailed and extensive assessment of the literature led to the development of a 11-item scale, which was used to assess the students' cognitive engagement. The reliability of the scale was established with a Cronbach's alpha coefficient of .937, surpassing the minimal acceptable threshold of .70 (Hair *et al.*, 2013). The response was collected using a five-point Likert Scale, with a range of 1 to 5. A rating of 5 indicates a high level of influence, while a rating of 1 indicates no influence at all. The descriptive statistics of the response data collected from the online classroom environment is presented in table 6.2.

Table 6.2: Factors affecting cognitive engagement

Dimension	Mean	Std. Deviation
Cognitive Engagement		
Developing deep course understanding	3.43	.974
Developing critical thinking	3.27	1.027
Developing creative thinking	3.30	1.121
Solving complex, real-world problems	3.10	1.143
Justifying arguments/decisions	3.41	1.081
Activating your own thought process	3.44	1.132
Applying knowledge to practical problems	3.24	1.202
Summarizing the learning	3.56	1.021
Reaching conclusions based on analysis	3.46	1.086
Memorizing facts, ideas or methods	3.46	1.124
Combining ideas from different courses	3.42	1.125
Average	**3.37**	**1.094**
N=600		

Cognitive engagement pertains to the extent to students actively and intellectually commit themselves to the process of learning (Fredrick *et al.*, 2004). It is clear from the above table that students perceive that students were able to summarising the learning from the online classes (mean score of 3.56). They were able to memorise the facts, ideas or methods (mean score of 3.46) and basis their cognition, they were able to reach the conclusions based on analysis (mean score of 3.46). Students were able to developing deep course understanding as indicated by the mean score of 3.43.

However, when it comes to solving complex, real-world problems, low mean score of 3.10 indicates that students were not able to solve the problems. Nor they were able to apply their knowledge to practical problems (mean score of 3.24). Further, a low score of 3.27 indicates that students were not able to think critically in the online class.

6.3 BEHAVIOURAL ENGAGEMENT

To assess the students' behavioural involvement, a 6-item measure was employed. This scale was created based on a thorough and complete examination of existing research. The reliability of the scale was determined to be high, with a Cronbach's alpha coefficient of .902, surpassing the minimal acceptable threshold of .70 (Hair *et al.*, 2013). The response was collected using a five-point Likert Scale, with a range of 1 to 5. A rating of 5 indicates a high level of influence, while a rating of 1 indicates no influence at all. The statistical analysis of the responses about the online classroom setting is presented in Table 6.3.

Table 6.3: Factors affecting behavioural engagement

Dimension	Mean	Std. Deviation
Behavioural Engagement		
Expressing opinions in academic discussions	3.61	.997
Offering suggestions for improvements in class	3.53	1.073
Supporting and encouraging peers	3.57	1.088
Willingness in attending the class	3.42	1.191
Making efforts to meet instructor’s expectations	3.50	1.146
Fulfilling my responsibilities in group tasks	3.66	1.077
Average	**3.55**	**1.095**
N=600		

Behavioural engagement pertains to the visible behaviours displayed by students during their participation in learning activities. One can observe the degree of attendance, level of activeness, and extent of participation. In learning activities, engaged students are seen being attentive, making efforts and delightful. The data reveals that students were fulfilling their responsibilities in group tasks (mean score of 3.66) and were able to express their opinions in academic discussions (mean score of 3.61) in the online class. However, a low score of 3.42 indicates that most of the students were not willing to attend classes in online mode.

6.4 SOCIAL ENGAGEMENT

A 5-item measure that was created following a thorough and detailed examination of the literature was used to assess the students' social involvement. The reliability of the scale was confirmed with a Cronbach's alpha coefficient of .891, surpassing the minimal acceptable threshold of .70 (Hair *et al.*, 2013). The response was collected using a five-point Likert Scale that ranged from 1 to 5. A rating of 5 indicated a high level of influence, while a rating of 1 indicated no influence at all. The statistical analysis of the responses about the online classroom setting is presented in Table 6.4.

Table 6.4: Factors affecting social engagement

Dimension	Mean	Std. Deviation
Social Engagement		
Connecting learning to societal problems or issues	3.58	1.120
Making connect with students from different backgrounds (social, racial/ethnic, religious, etc.)	3.73	1.107
Engaging in cross-cultural discussion	3.55	1.131
Accepting diverse perspectives during discussion	3.56	1.084
Strong sense of being a part of the class	3.43	1.200
Average	**3.57**	**1.128**
N=600		

Social engagement refers to a student's active involvement in collective endeavors that involve establishing social connections. According to the table, a score of 3.73 suggests that students were successful in establishing connections with others from diverse backgrounds, including social, racial/ethnic, religious, and other origins. The students enrolled in the online courses showed a capacity to relate their learning to social problems or challenges, as indicated by an average score of 3.58. Additionally, they displayed an ability to accept multiple opinions during discussions, with an average score of 3.56.

6.5 EMOTIONAL ENGAGEMENT

To assess the emotional involvement of the learners, a 5-item scale was employed. This scale was created based on a thorough and broad analysis of existing research. The scale demonstrated high reliability, as evidenced by a Cronbach's alpha coefficient of .924, surpassing the minimal acceptable threshold of .70 (Hair *et al.*, 2013). The response was collected using a five-point Likert Scale, with a range of 1 to 5. A rating of 5 indicates a high level of influence, while a rating of 1 indicates no influence at all. The statistical analysis of the responses about the online classroom setting is presented in Table 6.5.

Table 6.5: Factors affecting emotional engagement

Dimension	Mean	Std. Deviation
Emotional Engagement		
Creating curiosity in the class	3.53	1.196
Developing interest in the class/being enthusiastic in the class	3.46	1.146
Enjoying learning new things in the class	3.61	1.169
Looking forward to the next class/eagerly waiting for the next class	3.18	1.297
Feeling happy in the class	3.42	1.286
Average	**3.44**	**1.219**
N=600		

Emotional engagement is related to intangible experience in an online class. The students were asked how often they felt happy, interested, curious, passionate, monotonous and anxious in the online class. As indicated in the table, a mean score of 3.61 indicated that the students enjoy learning new things in the class succeeded by creating curiosity in the class (mean score of 3.53). On the flip side, a low score of 3.18 reveals that students who were less engaged did not look forward/eagerly waited for the next class.

6.6 STRUCTURAL EQUATION MODELING

Structural Equation Modeling (SEM) is a statistical method used to elucidate the connections between various variables. This approach comprises two primary components:

1. Measurement Model
2. Structural Model.

The measuring model, also referred to as the outer model, allows researchers to include several variables for either the dependent or independent variable. The structural model, also known as the inner model, is responsible for connecting the independent variables to the dependent variables in the path model (Hair *et al.*, 2013).

SEM includes various statistical techniques for assessing a hypothetical causal network of relationships among latent constructs, each explained by several indicators (Esposito *et al.*, 2010). SEM determines variables related to each construct and afterwards loadings are assessed. In situations where the variables are linked to the construct, cross loadings must be avoided (Hair *et al.*, 2013).

In the area of consumer behaviour and marketing, two widely accepted methods in Structural Equation Modeling are:

1. Covariance-based Structural Equation Modeling (SEM)
2. Partial Least Squares-based Structural Equation Modeling (SEM)

Both of the above-mentioned methods are acknowledged as second-generation approaches (Gefen *et al.,* 2000). Covariance-based SEM uses model fit for comparing research models and also used to support the theory that proposes the most ideal model fit. In short, the output gives the indices and residuals that indicates how closely proposed model fits the data rather than best fitted covariance structural model. Therefore, covariance-based SEM stresses on explanation and suitable theory testing (Chin, 2001).

On the other hand, Partial Least Squares (PLS) based SEM is a path modeling technique that uncover the complex multivariate relationships between exogenous and endogenous variables (Esposito *et al.,* 2010). So, the PLS technique is designed to provide explanation on the basis of variance, like "Ordinary Least Squares Multiple Regression technique" (OLS) (Hair *et al.*, 2011 and Chin, 2001). PLS-SEM technique predicts the parameters to reduce the residual error of dependent variables used in the proposed research model rather than finding out the variance of all the observable variables in the covariance-based SEM technique (Gefen *et al.,* 2000). It is evident that Partial least square technique is a very popular technique to confirm the theory, it can also be used to suggest whether the relationship found between different variables or not and provides recommendations for further advance testing of the model (Chin, 2001). At last, for applying PLS-SEM, smart PLS software is required whereas for applying CB (SEM) AMOS software is required. Although there are few differences in PLS (SEM) and CB (SEM) but the basic condition to assess the structural model is same (Hair *et al.,* 2011).

It is worth noting that PLS-SEM has gained increasing popularity for structural analysis in comparison to covariance based (SEM) technique. Partial least square technique is most preferred technique particularly in social sciences and for assessing the respondents' motivations (Hair *et al.*, 2013; Fornell and Larcker, 1981).

This following section presents the data analysis conducted to measure the effectiveness of online classes on students' engagement. Table 6.6 presents all the variables included in the study along with their code for easy understanding of the result.

Table 6.6: List of Variables and their Codes projected

Variables	Codes
I get timely feedback from my instructor.	OCE1
I receive the desired support from my instructor.	OCE2
I openly discuss course topics/concepts with my instructor.	OCE3
I get opportunity to discuss my career plans with my instructor.	OCE4
I get opportunity to collaborate with my instructor on academic activities like projects, consultancy, etc.	OCE5
My peers help me with course material/assignments.	OCE6
I share knowledge with peers.	OCE7
I get the opportunity to work with my peers on projects or assignments.	OCE8
I am able to participate in group discussion with my peers.	OCE9
I am able to establish personal contact with some peers.	OCE10
The online class interface which we have the access to is well-designed.	OCE11
Online class interface enables two-way communication.	OCE12
Online class interface enables instructor to take a poll or run a quiz during the class.	OCE13
It is easy to navigate through the online class interface.	OCE14
Developing deep course understanding	CE1
Developing critical thinking	CE2
Developing creative thinking	CE3
Solving complex, real-world problems	CE4
Justifying arguments/decisions	CE5

Variables	**Codes**
Activating your own thought process	CE6
Applying knowledge to practical problems	CE7
Summarizing the learning	CE8
Reaching conclusions based on analysis	CE9
Memorizing facts, ideas or methods	CE10
Combining ideas from different courses	CE11
Expressing opinions in academic discussions	BE1
Offering suggestions for improvements in class	BE2
Supporting and encouraging peers	BE3
Willingness in attending the class	BE4
Making efforts to meet instructor's expectations	BE5
Fulfilling my responsibilities in group tasks	BE6
Connecting learning to societal problems or issues	SE1
Making connect with students from different backgrounds (social, racial/ethnic, religious, etc.)	SE2
Engaging in cross-cultural discussion	SE3
Accepting diverse perspectives during discussion	SE4
Strong sense of being a part of the class	SE5
Creating curiosity in the class	EE1
Developing interest in the class/being enthusiastic in the class	EE2
Enjoying learning new things in the class	EE3
Looking forward to the next class/eagerly waiting for the next class	EE4
Feeling happy in the class	EE5

Following the establishment of face validity and internal reliability (Cronbach's alpha) of individual constructs in the pilot study, the next step was to validating convergent and discriminant validities. This involved employing confirmatory factor analysis (CFA), a technique within Structural Equation Modeling (SEM) that explores relationships between observed (manifest/exogenous) and unobserved (latent/endogenous) variables. SEM, as opposed to structural relationships like regression, detect relationships among latent variables and are depicted as covariance/corelations (Gallagher & Brown, 2013). Common applications of CFA include scale and construct validation. So, while applying CFA, it is imperative to check the convergent and discriminant validity of constructs. It is also very much required to ascertain the composite reliability of individual constructs.

6.6.1 Outer Loadings

In the measurement model outer loadings represent estimated relationships in reflective measurements. The unidirectional predictive link between the latent construct and its observable predictive variables makes up the measurement model. The strength of these relationships is denoted by 'r' or 'beta.' Table 6.7 displays the outer loadings of each relationship between the latent construct and its observed indicators. In the measurement model ‘r’/beta of every relationship will influence the value of AVE and convergent validity of the construct. The indicator loadings must be more than .7 (Hair *et al.*, 2013). Because the outer loading of the relationship between the observed items OCE13 (.588) and OCE 14 (.635) and its latent construct online classroom environment was less than .7 the same were removed and was not considered for further estimations. After deleting the item OCE13 and OCE14 from the conceptual model, the PLS was again run and the revised outer loadings are shown in the Table 6.7.

Table 6.7: Outer Loadings

Exogenous /Endogenous Variables	Items	Loadings
Online Classroom Environment	OCE1	0.775
	OCE2	0.711
	OCE3	0.732
	OCE4	0.744
	OCE5	0.746
	OCE6	0.753
	OCE7	0.754
	OCE8	0.731
	OCE9	0.703
	OCE10	0.714
	OCE11	0.751
	OCE12	0.776
Cognitive Engagement	CE1	0.760
	CE2	0.748
	CE3	0.700
	CE4	0.793
	CE5	0.771
	CE6	0.790
	CE7	0.769
	CE8	0.754
	CE9	0.766
	CE10	0.716
	CE11	0.763

Exogenous /Endogenous Variables	Items	Loadings
Behavioural Engagement	BE1	0.772
	BE2	0.745
	BE3	0.799
	BE4	0.776
	BE5	0.806
	BE6	0.771
Social Engagement	SE1	0.771
	SE2	0.799
	SE3	0.819
	SE4	0.804
	SE5	0.777
Emotional Engagement	EE1	0.830
	EE2	0.874
	EE3	0.841
	EE4	0.844
	EE5	0.819

6.6.2 Composite Reliability

Internal consistency refers to the situation where respondents react consistently to the same instrument under similar or nearly identical circumstances. Ensuring the consistency of the measuring instrument is crucial before collecting data from the respondents. Various methods exist to establish internal consistency of the measuring instrument. One of the most important and widely accepted measure to establish internal consistency is Cronbach Alpha. Another approach is the use of Composite Reliability (CR) to evaluate the internal consistency of scale items for each construct or variable in the research. Composite Reliability is often considered more robust than Cronbach alpha for establishing internal consistency. While applying partial least squares (PLS) as the analysis method, the reliability of the constructs or variables in the model needs to be scrutinized (Aguirre-Urreta, Marakas & Ellis, 2013). In the present study, researcher utilized composite reliability to establish the internal consistency of the measuring instrument. If the Composite Reliability of each construct or variable exceeds 0.7, the reliability of that particular construct or variable corresponding to the measuring instrument is established (Hair *et al.*, 2016). The composite reliability for all exogenous and endogenous variables was confirmed, as composite reliability value of each variable was more than 0.7 (Table 6.8). By establishing the CR for the exogenous and endogenous variables in this research, the internal consistency of the instrument was also established paving the way for instrument validation.

Table 6.8: Reliability Analysis Measurement

Exogenous/ Endogenous Variables	Composite Reliability	Cronbach's Alpha
Online Classroom Environment	.884	.905
Cognitive Engagement	.926	.937
Behavioural Engagement	.87	.902
Social Engagement	.848	.891
Emotional Engagement	.897	.924

6.6.3 Convergent Validity

Convergent validity is a highly important element in the process of scale validation. Validity, in its literal sense, is the degree of acceptability. In the context of scale validation, it quantifies the extent to which a scale or instrument precisely measures what it is intended to measure. (Krabbe, 2016). Therefore, the data is supposed to be collected through a validated questionnaire. Validity is required to be established. The first and foremost step in validating a scale confirming the convergent validity of constructs, factors or variables. The confirmation involves of convergent validity of an individual factor or construct also means that items in that factor /construct are highly corelated. (Chin & Yao, 2014). The convergent validity also ensures that the specific items used to measure the construct or factor or exogenous or endogenous variable are able to measure the specific one. Table 6.9 shows the convergent validity of each construct.

Table 6.9: Convergent Validity

Construct	AVE
Online Classroom Environment	.644
Cognitive Engagement	.774
Behavioural Engagement	.706
Social Engagement	.621
Emotional Engagement	.708

6.6.4 Discriminant Validity

Once the convergent validity of the constructs was confirmed, the subsequent stage in validating the scale was to determine its discriminant validity. Campbell and Fiske (1959) proposed the notion of discriminant validity. Discriminant validity is verified when different constructs are not highly correlated (Hubley, 2014). Failure to establish discriminant validity proves that significant correlations exist between different constructs, which is violation of core principle of discriminant validity. In such cases, scale validation cannot be confirmed and the scale becomes unsuitable for data collection. In order to determine discriminant validity, researchers frequently compare the square root of the Average Variance Extracted (AVE) for each construct (located on the diagonal) with the correlation coefficients (located off the diagonal) for each construct. If the square root of the average variance extracted (AVE) for a construct exceeds the correlation coefficients of that construct, it can be concluded that discriminant validity has been established. Conversely, if the square root of the average variance extracted (AVE) is smaller than the correlation coefficients, then indicates that discriminant validity is not established in that particular example. In such cases where discriminant validity is not confirmed, a common approach is to eliminate an item having least significant beta value from the construct. The removal of item with least beta value will improve the AVE of the corresponding construct, aiding in the confirmation of discriminant validity. If needed, additional items with least beta values from the same construct can be removed sequentially until discriminant validity is established for each construct. It is mandatory to establish the discriminant validity of each construct. In the present study, discriminant validity was confirmed (Table 6.10) for each construct which is evident by the square root of the AVE (highlighted) for each construct on the diagonal being more than the correlation coefficients between constructs in the respective rows and columns (Fornell & Lacker, 1981).

Table 6.10: Discriminant Validity

	OCE	CE	BE	SE	EE
OCE	.686				
CE	.665	.758			
BE	.666	.749	.778		
SE	.651	.717	.728	.788	
EE	.609	.767	.724	.739	.842

6.6.5 Heterotrait- Monotrait Ratio (HTMT)

In the past, researchers would determine discriminant validity by employing the criteria put forth by Fornell and Lacker (1981). Nevertheless, certain scholars disagreed with the criteria proposed by Fornell and Lacker (1981). Henseler *et al.* (2015) proposed a different approach to evaluate discriminant validity called the heterotrait-monotrait (HTMT) ratio. This method measures the correlations between different constructs. The HTMT is defined as "the mean value of the item correlations across constructs (i.e., the heterotrait-heteromethod correlations) relative to the (geometric) mean of the average correlations for the items measuring the same construct (i.e., the monotrait-heteromethod correlations)". Various scholars have suggested varying threshold values of HTMT to determine the discriminant validity of the construct. Kline (2015) proposed a threshold of 0.85, but Hair *et al.* (2019) recommended a more lenient value of 0.90 for the HTMT ratio to determine discriminant validity. In the present study, the HTMT ratio between different constructs was less than .09 (Hair *et al.*, 2019) as depicted in the Table 6.11, the discriminant validity between the constructs was confirmed.

Table 6.11: Heterotrait- Monotrait Ratio (HTMT)

	OCE	CE	BE	SE	EE
OCE					
CE	.733				
BE	.781	.833			
SE	.749	.804	.843		
EE	.682	.841	.818	.840	

6.6.6 Collinearity Diagnosis

Diagnosis of collinearity or multicollinearity is very important condition of scale validation. Multicollinearity refers to the condition in which independent or predictive variables exhibit a strong correlation with each other (Belsley *et al.*, 1980). If such a situation exists, the validation of instrument is not feasible (Allen, 1997). So, for scale validation it is very much essential that there must not be collinearity between predictor variables of the measurement model. Different diagnostic tools are available to ascertain the multicollinearity between the exogenous/ independent/ predictor variables. Variation inflation factor (VIF) is one of the widely accepted and critical tool to measure the multicollinearity (Kim *et al.*, 2019). The VIF value between 5 and 10 depicts the problem of multicollinearity in the scale (Kim et al., 2019), meaning there by that VIF value must be less than 5 to rule out the multicollinearity between the predictor variables which is essential for scale validation (Hair *et al.*, 2011; Kock & Lynn, 2012). One of the other important techniques to determine multicollinearity is tolerance value. If the tolerance value is more than .02 then there is no issue of multicollinearity (Hair *et al.*, 2011).

For the proposed model, multicollinearity was ascertained based on values of VIF and Tolerance. Because the value of VIF for every relationship between the dependent and independent variables was less than 5, there was no problem of multicollinearity among the independent variables. Furthermore, the absence of multicollinearity among the independent variables was determined due to the tolerance value above 0.02. Table 6.12 displays the findings of the collinearity diagnosis.

Table 6.12: Collinearity Diagnosis (Behavioural Engagement as Endogenous Variable)

Dependent Variable	Independent Variable	Collinearity Statistics	
		Tolerance	**Variance Inflation Factor (VIF)**
BE	OCE	.516	1.908
	CE	.545	2.227
	SE	.431	1.834
	EE	.449	2.327
BE: Behavioural Engagement			

6.6.7 Structural/ Path Model

The path model depicts the connection between the independent (predictive) and dependent (latent) variables. The relationship between the independent and dependent variables is illustrated in the conceptual model, which was constructed based on a thorough analysis of existing literature. The structural model functions on relevance and significance of path coefficients and the model's explanatory (R^2) and predictive power (Q^2). The evaluation of model depends on the metrics that evaluate the path model's explanatory power (Ali *et al.,* 2018 and Ringle *et al.,* 2020). The majority of researchers view the coefficient of determination (R^2) as a means to forecast the relevance and significance of links between the dependent (latent) and independent (predictive) variables. Prior to assessing and evaluating the explanatory power of the suggested model, it is necessary to quantify and evaluate the importance and pertinence of the relationships among the variables. In PLS-SEM, the same is executed using bootstrapping. If path coefficients have t statistics value of more than 1.96 with a two-tailed t test at 95 percent confidence level, the significance and relevance of relationships are believed to be established (Wong, 2013). The associations between the dependent (Latent) and independent (Predictive) variables were determined to be statistically significant, as indicated by the t statistics exceeding the critical value of 1.96 (Table 6.13). *T* value greater than 1.96 confirms the acceptance of the alternate hypothesis and the rejection of the null hypothesis.

Table 6.13: Hypothesis Testing

Relationship	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	*Beta Value*	*t*-statistics	*P*-value	Alternative Hypothesis Status
OCE -> CE	0.491	0.486	0.039	0.344	8.773	.000	Accepted
OCE -> SE	0.325	0.313	0.027	0.651	24.574	.000	Accepted
OCE -> EE	0.215	0.212	0.041	0.221	5.446	.000	Accepted
SE -> CE	0.116	0.105	0.037	0.493	13.173	.000	Accepted
SE -> EE	0.552	0.554	0.036	0.595	16.695	.000	Accepted
CE -> BE	0.393	0.387	0.047	0.469	10.012	.000	Accepted
EE -> BE	0.425	0.419	0.051	0.365	7.211	.000	Accepted

The table above clearly indicates that the t statistics for all the associations exceeded 1.96, hence, the alternative hypothesis and relationships were confirmed. The relationship between OCE -> CE had t value of 8.773 which clearly confirmed the significant influence of online classroom environment on the cognitive engagement of students. Similarly, online classroom environment (OCE) significantly influenced the social engagement (SE) of students as this relationship had t value of 24.574. Online classroom environment (OCE) also significantly influences emotional engagement (EE) as the relationship had statistics of 5.446. Finally social engagement (SE) played a significant role in cognitive engagement of students (CE) as this relationship had high t statistics of 13.173.

Similarly, t value for the relationship between social engagement and emotional engagement was 16.695 which clearly confirmed the significant influence of social engagement on students ‘emotional engagement. The relationship between cognitive engagement (CE) and behavioural engagement (BE) was significant as the t value was 10.012. The relationship between EE -> BE was also significant as t statistics had the value of 7.211 which clearly confirmed the influence of emotional engagement on behavioural engagement. As all the relationships in the proposed model was significant because t statistics of all the relationships was greater than 1.96, so all the null hypothesis were rejected. Therefore, all the alternative hypothesis were accepted. Table 6.14 depicts the acceptance and rejection of alternate and null hypothesis.

Table 6.14: Acceptance and Rejection of Alternate and Null Hypothesis

Null/Alternative Hypothesis	Status
$H_{0(3.1)}$: There is no significant relationship between online classroom environment and cognitive Engagement. **H_1:** There is significant relationship between online classroom environment and cognitive Engagement.	Rejected Accepted
$H_{0(3.2)}$: There is no significant relationship between online classroom environment and social Engagement. **H_2:** There is significant relationship between online classroom environment and social Engagement.	Rejected Accepted
$H_{0(3.3)}$: There is no significant relationship between online classroom environment and emotional Engagement. **H_3:** There is significant relationship between online classroom environment and emotional Engagement.	Rejected Accepted
$H_{0(3.4)}$: There is no significant relationship between social engagement and cognitive engagement. **H_4:** There is significant relationship between social engagement and cognitive engagement.	Rejected Accepted
$H_{0(3.5)}$: There is no significant relationship between social engagement and emotional engagement. **H_5:** There is significant relationship between social engagement and emotional engagement.	Rejected Accepted
$H_{0(3.6)}$: There is no significant relationship between cognitive engagement and behavioural engagement. **H_6:** There is significant relationship between cognitive engagement and behavioural engagement.	Rejected Accepted
$H_{0(3.7)}$: There is no significant relationship between emotional engagement and behavioural engagement. **H_7:** There is significant relationship between emotional engagement and behavioural engagement.	Rejected Accepted

Table 6.15: Mediation Analysis Result (OCE>SE>CE)

Total effect (OCE-CE)			Direct effect (OCE-CE)			Indirect effects of (OCE-CE)				
Coefficient	t-value	p-value	Coefficient	t-value	p-value	$H_{0(3.8)}$: OCE>SE>CE	Coefficient	t-value	p-value	VAF
0.665	5.356	0.00	0.344	8.773	0.00		0.321	12.139	0.000	48%

$H_{0(3.8)}$: Social engagement does not mediate the relationship between online classroom environment and cognitive engagement

A mediation analysis was undertaken in this study to explore and understand the mediating role of social engagement (SE) in the relationship between online class environment (OCE) and cognitive engagement (CE). The aim of mediation analysis is to identify the mechanisms through which an independent variable online classroom environment (OCE) influences a dependent variable cognitive engagement (CE), by involving a mediator variable (SE). Mediation analysis can throw light on the underlying dynamics and offer explanations for mechanisms and rationales behind the occurrence of a relationship. In this study the mediation effect of social engagement (SE) was calculated through the value of variance accounted for (VAF) (Nitzl et al., 2016). The values below from 20% indicates the no mediation, values of VAF between 20% to 80% indicates the partial mediation and values above 80% indicates the full mediation (Rehman et al., 2022). The findings from the mediation analysis, as presented in the table 6.15 unveiled a various significant conclusion. The results showed that social engagement (SE) have a partial mediation (48%) in the relationship between online classroom environment (OCE) and cognitive engagement (CE). The analysis of indirect effect showed that social engagement served as a medium for online classroom (OCE) effect over cognitive engagement (CE). The statistically significant values of 0.321 for the effect size coefficient, 12.139 for the t-statistics, and 0.000 for the p values supports the indirect effect. These findings indicate that the existence of social engagement (SE) plays a role in mediating the significant indirect effect of online classroom environment (OCE) on cognitive engagement (CE). Furthermore, the analysis assessed the overall impact of online classroom environment (OCE) on cognitive engagement (CE) without any mediating variable. The statistically significant values ß of 0.655, t of 5.356 and p-value of 0.000, determined the overall effect was significant. This indicates that even without considering the social engagement (SE) as a mediator variable, online classroom environment (OCE) still has a direct effect on CE. Importantly, the effect of online classroom environment (OCE) on cognitive engagement (CE) persisted even when social engagement (SE) was added as a mediator. The p value of .0000, ß of 0.344, and t of 8.773 all proves this. These results suggest that online classroom environment (OCE) have a direct significant effect on cognitive engagement (CE) even after considering the social engagement (SE) as a mediator. By taking into account the findings, this study concludes with that social engagement (SE) partially mediates the relation between online classroom environment (OCE) and cognitive engagement (CE). In simple terms, whereas online classroom environment (OCE) directly impacts cognitive engagement (CE), some of its influence is also mediated by the presence of social engagement (SE). On the basis of this analysis null hypothesis $\mathbf{H_{3.8}}$ which suggested that social engagement (SE) had no mediating role between online classroom environment (OCE) and cognitive engagement (CE) is rejected.

Table 6.16: Mediation Analysis Result (OCE>SE>EE)

Total effect (OCE-EE)			**Direct effect (OCE-EE)**			**Indirect effects of (OCE-EE)**				
Coefficient	t-value	p-value	Coefficient	t-value	P-value	$H_{0(3.9):}$ OCE> SE> EE	Coefficient	t-value	p-value	VAF
0.608	4.307	0.000	0.221	5.446	0.000		0.387	13.784	0.000	63%

$H_{0(3.9):}$ Social engagement does not mediate the relationship between online classroom environment and emotional engagement

A mediation analysis was undertaken in this study to explore and understand the mediating role of social engagement (SE) in the relationship between online class environment (OCE) and emotional engagement (EE). The aim of mediation analysis is to identify the mechanisms through which an independent variable online classroom environment (OCE) influences a dependent variable emotional engagement (EE), by involving a mediator variable (SE). Mediation analysis can throw light on the underlying dynamics and offer explanations for mechanisms and rationales behind the occurrence of a relationship. In this study the mediation effect of social engagement (SE) was calculated through the value of variance accounted for (VAF) (Nitzl et al., 2016). The values below from 20% indicates the no mediation, values of VAF between 20% to 80% indicates the partial mediation and values above 80% indicates the full mediation (Rehman et al., 2022). The findings from the mediation analysis, as presented in the table 6.16 unveiled a various significant conclusion. The results showed that social engagement (SE) have a partial mediation (63%) in the relationship between online classroom environment (OCE) and emotional engagement (EE). The analysis of indirect effect showed that social engagement served as a medium for online classroom (OCE) effect over emotional engagement (EE). The statistically significant values of 0.387 for the effect size coefficient, 13.784 for the t-statistics, and 0.000 for the p values supports the indirect effect. These findings indicate that the existence of social engagement (SE) plays a role in mediating the significant indirect effect of online classroom environment (OCE) on emotional engagement (EE). Furthermore, the analysis assessed the overall impact of online classroom environment (OCE) on emotional engagement (EE) without any mediating variable. The statistically significant values ß of 0.608, t of 4.307 and p-value of 0.000, determined the overall effect was significant. This indicates that even without considering the social engagement (SE) as a mediator variable, online classroom environment (OCE) still has a direct effect on emotional engagement (EE). Importantly, the effect of online classroom environment (OCE) on emotional engagement (EE) persisted even when social engagement (SE) was added as a mediator. The p value of .0000, ß of 0.221, and t of 5.446 all proves this. These results suggest that online classrom environment (OCE) have a direct significant effect on emotional engagement (EE) even after considering the social engagement (SE) as a mediator. By taking into account the findings, this study concludes with that social engagement (SE) partially mediates the relation between online classroom environment (OCE) and emotional engagement (EE). In simple terms, whereas online classroom environment (OCE) directly impacts emotional engagement (EE), some of its influence is also mediated by the presence of social engagement (SE). On the basis of this analysis, null hypothesis $\mathbf{H_{3.9}}$, which suggested that social engagement (SE) had no mediating role between online classroom environment (OCE) and emotional engagement (EE) is rejected.

6.6.8 Coefficient of Determination (R^2)

The coefficient of determination often described as R^2 determines the proportion of variance in the dependent (Latent) variable that can be explained by independent (Predictive) variables. Coefficient of determination is always represented in percentage and determines the variance explained for each dependent variable. So, coefficient of determination is also used to measure the model explanatory power (Shmueli & Koppius, 2011). A higher R^2 value signifies higher variability explained by Independent variables in the dependent variable. In explaining the model's explanatory power, R^2 values of 0.25, 0.5, and 0.75 are commonly used, which reflects weak, moderate, and substantial explanatory power of model (Hair *et al.*, 2011; Henseler *et al.*, 2009). For the present research work, the range specified by Hair *et al.* (2011) and Henseler *et al*. (2009) was considered. Table 6.17 presents the coefficients of determination for various models (inner and outer), revealing that the independent variable "online classroom environment, accounted for 42.40% of the variability in the dependent variable "SE" (social engagement). Independent variables online classroom environment (OCE) and social engagement (SE) explained 58.20% variability in the dependent variable “CE” (cognitive engagement). In the same way, the independent variables "OCE and SE” were able to predict 57.40% of the variability in the dependent variable “EE" (emotional engagement). Also, independent variables “CE and EE” were able to predict 61.60% of variability in the dependent variable “BE” (behavioural engagement).

Table 6.17: Coefficient of Determination (R^2)

Endogenous Variable	R^2	Explanation
Social Engagement	42.40%	Weak to Medium
Cognitive Engagement	58.20%	Medium
Emotional Engagement	57.40%	Medium
Behavioural Engagement	61.60%	Medium

6.6.9 Cross Validated Redundancy Measure (Q^2)

To assess the model's explanatory power coefficient of determination (R^2) is not the only way. Another method to assess the predictive accuracy of the PLS path model involves computing the Q^2 value, as proposed by Geisser (1974). The Q^2 can be calculated through the blindfolding procedure in PLS-SEM. Blindfolding is a technique that involves systematically deleting the data points. The procedure of blindfolding depends on omission distance represented by D. Hair *et al.* (2016) suggests that omission distance (D) may range from 5 to 12, with a default value of 7. It is important that the value of 'D' when divided by the sample size 'n,' shall results quotient in a fractional value rather than a whole number. Therefore, it is mandatory to check the quotient before applying the blindfolding technique.

According to Sarstedt *et al*. (2017), Q^2 values of 0.02, 0.15, and 0.35 denotes small, medium, and large predictive relevance of an exogenous construct. Because the Q^2 for the endogenous variable social engagement was .2642, cognitive engagement was .3757, emotional engagement was .3229 and behavioural engagement was .4502 (Table 6.18). So, the predictive relevance for the exogenous variables 'social engagement' and 'emotional engagement' was medium, whereas for 'cognitive engagement' and 'behavioural engagement' it was large (Bin-Nashwan *et al.,* 2019; Sarstedt *et al.,* 2017).

Table 6.18: Cross Validated Redundancy Measure (Q^2)

Endogenous Variable	SSO	SSE	Q^2 = 1-SSE/SSO	Predictive Relevance
Social Engagement	3462	2547.16	.2642	Medium
Cognitive Engagement	4562	2847.75	.3757	Large
Emotional Engagement	4068	2754.26	.3229	Medium
Behavioural Engagement	5926	3258.05	.4502	Large

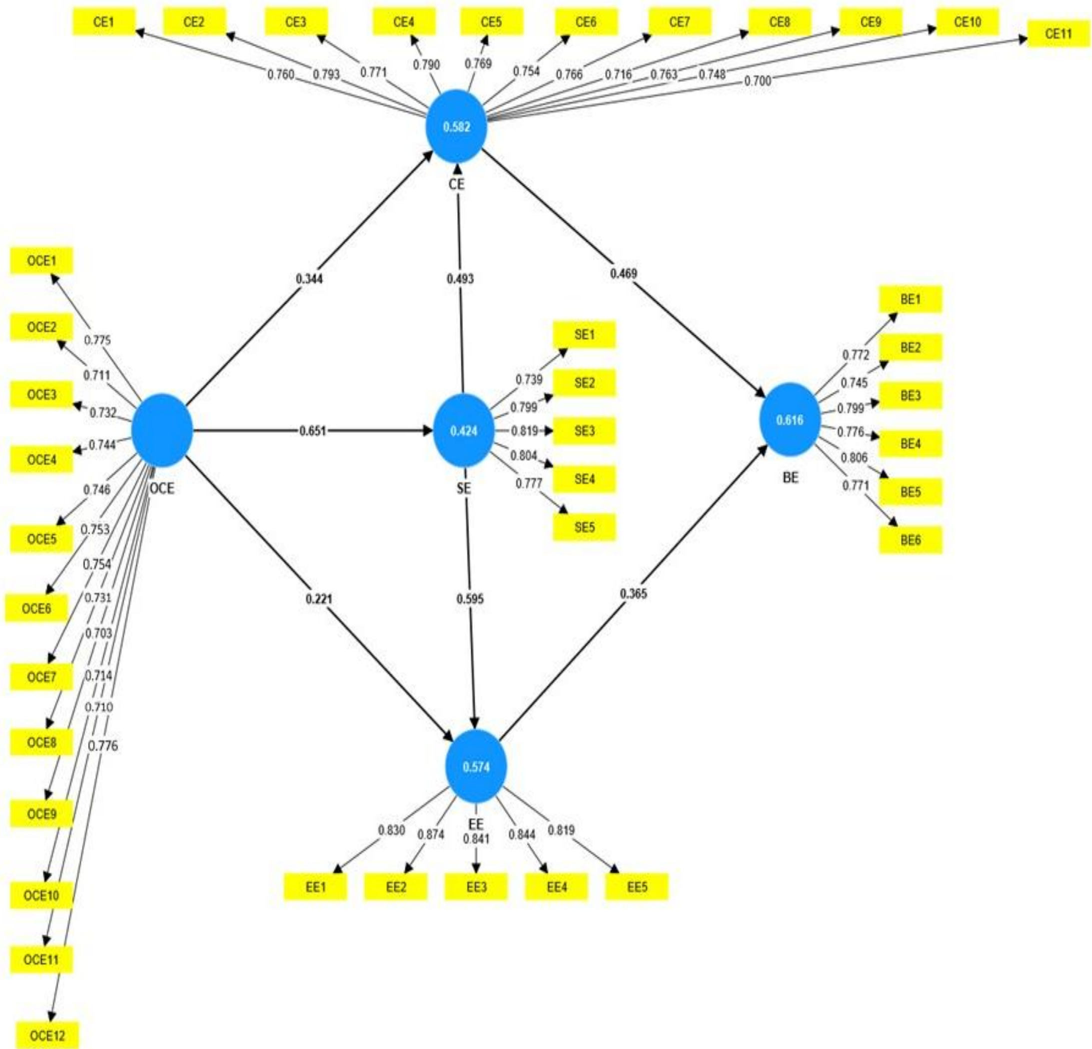

Figure 6.1: Structural Model

6.7 CHAPTER SUMMARY

This chapter presents the findings regarding impact of the online learning environment on the level of student engagement in online classes. For the achievement of this objective, a research model was developed after an extensive review of literature and thereafter hypotheses were developed to test the model. Partial Least Squares Structural Equation Modeling (PLS-SEM) was employed to evaluate the model. A questionnaire was administered to students to ascertain the impact of the online learning environment on their engagement. The questionnaire included statements regarding the online classroom environment, with a particular emphasis on the three critical components of online classroom environment: the instructors, the students, and the online teaching platform used. Four distinct dimensions were employed to evaluate the students' level of engagement, namely, cognitive engagement, behavioural engagement, social engagement, and affective engagement.

The findings revealed that the online classroom environment has a significant and direct impact on the social engagement of students, which in turn has a substantial impact on their cognitive and affective engagement. There is a positive mediating role of social engagement between the online classroom environment and students' cognitive engagement. The results of the present study also emphasised the positive mediating role of social engagement between online classroom environment and emotional engagement of student. Activities like discussion in classes and working on societal issues to foster a sense of community positively impacts students' emotional engagement like curiosity, developing interest and learning new things in class.

The findings also highlights that online classroom environment has a substantial and direct influence on the cognitive engagement of students, which subsequently has a considerable impact on their level of active participation. The finding highlights that the online classroom environment has a substantial impact on students' emotional involvement, which in turn plays a vital role in determining their behavioural engagement in online teaching. The emotional engagement of students in online classrooms is positively influenced by effective student-teacher interaction, prompt feedback from faculty, and amicable relationships with fellow students. The findings clearly indicates that emotional engagement can lead to improvements in students' behavioural engagement and academic achievement.

Chapter – 7

BOTTLENECKS OF ONLINE TEACHING

COVID-19 emerged as a significant disaster and is regarded as one of the most severe challenges humanity has ever faced (Alsafi *et al.*, 2020). The global spread of COVID-19 had far-reaching negative consequences on the economy worldwide. Its impact on education was substantial, with a staggering 1.3 billion students, across the globe, unable to attend schools or universities, and India alone witnessing an impact on 320,713,810 students (UNESCO, 2020). The government had declared that educational institutions will be placed under lockdown (Alsafi, Abbas, Hassan, & Ali, 2020; Harvard University, 2020; Pather *et al*., 2020), and closed as a reasonable way to enforce social segregation within communities (Impey, 2020; Panesar *et al.*, 2020). To address the educational needs of students, governments and policymakers worldwide recommended the implementation of remote teaching arrangements in educational institutions, aiming to provide virtual learning opportunities. Numerous HEIs began to make efforts to leverage technology to assist remote learning and digital education during the pandemic. While universities in developed countries relatively smoothly transitioned to digital and virtual learning environments (Langford & Dams, 2000), instructors in developing countries faced the urgent need to rapidly adapt and integrate technology during the COVID-19 pandemic. In India as well, the Ministry of Human Resource Development (MHRD) issued an advisory for HEIs to continue teaching through digital mode, indicating a shift from traditional teaching methods to the use of educational technology (EdTech) and through a press release (March 21, 2020) it shared a few digital platforms with the students so that they could benefit from and continue their education during lockdown (MHRD, 2020a). This included The National Programme on Technology Enhanced Learning (NPTEL), Study Web for Active Young Expiring Minds (SWAYAM), e-Pathshala, DIKSHA portal, SWAYAM Prabha, National Repository of Open Educational, etc.

This is one side of the story that addressed the concerns of the learners. But how about the teachers? Undoubtedly, the teachers played a pivotal role in this transition from traditional classroom teaching to online mode. For them, this shift was not less than climbing the Mount Everest in the education industry. Their role must not be overlooked. In the context of implementing learning strategies, teachers are instrumental in effectively utilizing various teaching methods, technologies, and resources to meet the diverse needs of students. They have the expertise to assess individual student progress, identify areas of improvement, and tailor instruction accordingly. Teachers also foster a positive learning environment, promote collaboration and critical thinking, and provide valuable feedback to students which helps them develop essential skills. The proficiency and unwavering commitment of teachers play a crucial role in the effective implementation of any educational method. It is important to note that many higher education institutions in India may not have access to institutionally supported technologies like Moodle and Learning Management Systems (LMS). Despite this, these institutions have required teachers to utilize digital methods of instruction by leveraging open-source online teaching platforms such as WhatsApp, YouTube, Skype, Zoom, Google Meet, and Google Hangout (Mishra *et al.*, 2020; Joshi *et al.*, 2021).

Teaching through online classes has encountered many challenges as it evolved and became more prominent. The teaching fraternity was not well informed about the challenges involved in transition amidst the uncertainty caused by the global pandemic. Teachers had to acquire new skills to effectively engage students in the online learning environment as students were merely the passive listeners. Teachers also needed to explore and implement innovative teaching methods suitable for remote instruction, such as creating interactive digital content, utilizing multimedia resources, and fostering virtual collaboration among students. Right from adopting the technology to the preparation and execution of the content was a herculean task. Similarly, students had to adjust to the online learning environment and adapt their study habits accordingly. They had to become more self-directed learners, managing their time effectively and engaging with digital resources and online discussions.

7.1 DATA ANALYSIS AND RESULTS

According to Naeem et al. (2023), Smith and Osborn (2003) and Moustakas (1994), following are the steps involved in the analysis of interview data as exhibited in Table 7.1.

Table 7.1: Steps involved in the analysis of interview data

Step	Title	Explanation
Step 1	Transcription, familiarization with the data and selection of quotation	Researcher transcribe the data (verbatim transcripts) and immerse into it to gain familiarity. They then delve into the content to identify initial themes and important sections. This involves quotes selection that represents the essence of the data and various perspectives relevant to the study objective.
Step 2	Keyword selection	This phase comprises analysing interview, focus group, and visual data. Keywords are reoccurring patterns, terminologies, or visual features identified by researchers. These data-derived keywords capture participants' experiences and perceptions.
Step 3	Coding	The third phase, coding, assigns brief phrases or words, called codes, to data segments to convey their main message, importance, or theme. This process simplifies complex textual material and helps develop research questions. Keywords are the foundation of coding analysis and help turn raw data into useful units.
Step 4	Theme Development	Theme development organises codes into meaningful groups to reveal patterns and correlations and answer the research question. After analysing codes and classifications, the researcher creates themes to understand them abstractly. These themes are more than just repeated features; they represent patterned meanings that relate research questions and data.
Step 5	Conceptualization by interpreting keywords, codes and themes	Conceptualization includes comprehending and defining data concepts. Researchers define social patterns to fit their research. Diagrams or models help them understand these concepts' linkages. These definitions are evaluated for clarity, accuracy, reliability, applicability, and theory and practice contribution.

The studies by Smith and Osborn (2003) and Moustakas (1994), also highlighted the same steps in the analysis of interview data.

The analysis of each interview in this study was conducted in accordance with the steps outlined by Naeem at al. (2023), Smith and Osborn (2003) and Moustakas (1994). Ryan and Bernard (2000) cutting and sorting procedures were applied to detect impediments in online classes. The data was then coded to identify the themes. The identified themes were thoroughly debated until there was consensus. The summary is described in the Table 7.2.

Table 7.2: Summary of the themes generated from analysis

Statements/Quotations	Keywords	Codes	Themes
"I do not have any sound proof room at my home. Traffic noise, street dogs, hawkers, etc. are not in my control".	Soundproof room, traffic noise, street dogs, and hawkers	External distractions	Domestic Barriers
"Construction work nearby my home was going on, it was a pain to take online classes in such a scenario".	Ongoing construction work, pain to take online classes		
"I did not have duster, marker, whiteboard and even printer at home".	Duster, marker, whiteboard, printer	Lack of basic facilities and resources at home	
"I missed the university library while teaching from home. I did not have enough books at my home to prepare my class and this shook my confidence".	University library and books, class preparation		
"I was assumed to be available to my family, hence, I was interrupted many a times during the class. For my family, online class was a time pass, both for the students and the instructor".	Available to the family, frequent interruptions, time pass	Family obtrusion	
"My pet use to jump into my lap and if I do not allow, it use to bark nonstop".	Disturbance by pet, nonstop barking		

Statements/Quotations	Keywords	Codes	Themes
"Students copied the content from internet, pasted it and then submitted the assignments. No learning was taking place". *"Since we are teaching online, there are more than 80 students in one class. It is a big number. Checking assignments online is a pain".*	Copied, pasted and submitted the assignment, no learning Number of students in one class, checking assignments online is painful	No intentions to learn Huge number of the assignments to be checked	Assessment and Invigilation Barriers
"No one in the family understood the gravity of online tasks/assignments. Too frequent interference eventually led to faulty evaluation ".	Gravity of assignments, faulty evaluation	Casual approach of family members	
"There are due dates for submission and evaluation. Due to internet connectivity issues at times, the dead lines were not met. So, checking the assignments was tedious and time consuming".	Due dates for submission & evaluation, checking was tedious and time consuming	Timelines for submission and evaluation	
"Invigilation was challenging as the students were not within our approach. They might had cheated, or some time a family member was helping them out".	Students not within approach, cheated or taken family member's help	Students beyond control	
"In terms of invigilation, students had a feeling who is watching them!!"	Fearless while taking test/exam	Negative attitude	

Statements/Quotations	Keywords	Codes	Themes
"Students never use to face the camera and sit in one corner and take help".	Not facing camera, sit in a corner		
"The students were not interacting in the class, they use to join the class and behaved like passive listeners. The engagement level was very low".	No interaction, passive listening, low engagement	Students' participation in online class	Engagement Barriers
"They don't participate as they are engaged in lot many things going on parallelly, they are in their comfort zones".	No participation, distractions, comfort zones		
"Many a times I felt as if I was talking to a wall or myself. There was a lack of energy in the class. This was irritating.	Talking to wall, lack of energy		
"Internet connection was not stable. Even the website used to crash due to high traffic of users".	Week internet connectivity, site crashing, high traffic of users	Lack of technical infrastructure	Technical Barriers
"Little did I know about multimedia and interactive presentations. At times, I was not able to deliver my best because of lack of technical skills",	Weak in making interactive presentation, lack of technical know-how	Poor technical skills	
"I did not know how to navigate through the platform". *"I did not know which platform will be best suited to the needs of the students".* *The platform that I was using was not compatible with Windows 7".*	Platform used, compatibility issues	Online technology platform	

Statements/Quotations	Keywords	Codes	Themes
"*I was apprehensive of using open-source platform as it is not safe. A student might have shared the link of the class and may even share any resource with an outsider*.	Open-source platforms, security concerns	Privacy and security concerns	
"Screen time went up, strain in the eyes, the migraine aggravated eventually".	Prolonged screen time, eye strain, migraine issue	Health concerns	Personal Barriers
"I started up sitting in my table and chair and later eased into my recliner, this led to lot of medical problems". *"Integrating the practical or skills-based course in online mode was a challenge".*	Comfort in the chair/recliner led to medical issues Technology in practical/skill-based course		
"There are working professionals and school going children in my family. Imagine the cost we are incurring every month on the mobile data and gadgets we are using".	Recurring cost incurred	Financial burden	
"My *family life got disturbed. I was not able to strike the balance".* *"Working from home was 24/7 job. It was frustrating".* *"I could not manage time owing to lecture preparation as it demanded extra time. It led to longer working hours".*	Disturbed family life, 24/7 job, frustration, poor time management, longer working hours	Work-life balance	

Statements/Quotations	Keywords	Codes	Themes
"I found online class just a formality, we were teaching for the namesake". *"Students were least interested, so was I. The teaching was not at all effective".* *"While teaching from home, I was in my comfort zone, at times I did not feel like taking the class"*	Online class a formality, least interested students, ineffective teaching, comfort zone	Negative mindset	
"Experiments are to be done in lab. How can you expect me to exhibit the chemical reactions while I am at home with no access to lab equipments?" *"I teach Accounting. It was impossible to make students understand without basic facilities. They need practical exposure".*	Experiments done in labs, chemical reactions, no lab equipments Practical exposure needed	Technology-integrated course	
"My institute did not provide any training on using the technology platform"	No training received	Lack of training	Institutional Support Barriers
"The institute should have taken care of the nominal amount for budget for those teachers who were not from sound economic background".	Nominal budget for economically weak teachers	Budget for needy ones	
"I did not have immediate access to technical support or IT professionals who could assist me in resolving technical issues".	No access to technical support	Lack of technical support	
"The institute must have used their own platform rather than using free-source platform. These free platforms are not safe to use and anyone with the link to join can enter the class".	Institute-owned platform, Not safe to use free platforms	Licensed platforms	

The analysis has been presented from the data of 32 interviews. The findings shed light on the problems faced by teachers when delivering online classes by employing different technology platforms and gadgets. This includes concerns regarding the comfort of navigating the digital platform, expensive internet plans, disengaged students, low attendance, lack of self-efficacy among teachers in handling technology, dearth of educational resources, scarcity of technical know-how, and subpar network infrastructure. The findings have been grouped under seven broad themes, i.e., domestic barriers, assessment and evaluation barriers, students engagement barriers, technical barriers, personal barriers, and institutional barriers. These themes are further elaborated hereunder:

7.1.1 Theme 1: Domestic Barriers

Factors that affected online teaching from home included:

a) External distraction like street hawkers, neighbours, street dogs, traffic noise, visitors, etc., were another cause of the worry. One respondent said, "*Continuity and lecture preparation gets affected with such noises and distraction. It was a pain to take class at times.* "*Construction work nearby my home was going on. It led to too much of sound while the class was going on", said another. One reported,* "*I do not have any sound proof room at my home. DJ sound, hawker, etc. are not in my control. There must be a room exclusively to manage your classes".*

b) Lack of basic facilities like whiteboard/blackboard, marker, duster, printer. In the home settings, these things were not accessible to the teachers. As per a respondents, "*it was difficult to interact with students on video conferencing in the absence of such facilities*". One more said, "*there are topics which can only be explained by using marker and whiteboard and these things were absolutely missing from home*".

c) Family obtrusion included intrusion from family members and pets were at the peak as the space was limited in the home setting. In the words of one more respondent, *"As I was taking the classes from home, I was assumed to be available to my family, I was interrupted many a times during the class. For* *them, online class was a time pass, both for the students and the instructor"*. One more reported, "*People have a tendency to walk in your home without even knocking".* Another said, *"My child was a continuous disturbance as he was too young to understand the meaning of online teaching"*. In a way it was very challenging to take classes from home. The teaching got compromised to some extent amidst the home setting.

7.1.2 Theme 2: Assessment and Invigilation Barriers

Teachers prefer to check the assignments on a hard copy as it is easy. But because of the limited available resources, somewhere the evaluation got affected. The barriers related to this themes are appended below:

a) No intentions to learn*:* Students were not applying their minds while working on the given tasks. They had just one weapon as a short cut. One respondent said, "*Virtual checking was a burden. Students were cheating, and copying from one file and pasting on other. Good and sincere students were at a loss because of this".* No learning was taking place at all.

b) Huge number of the assignments to be checked*:* Since the teachers were teaching online and unlike physical classes, the maximum number of students in the class was not a challenge. *One respondent shared, "There were more than 80 students in one class. It is a big number. Checking assignments online is a pain". Not only this, while entering the marks in the system, we were required to be double cautious as there was no option to edit the marks if by mistake wrong marks are entered*", reported a faculty from a government university.

c) Casual approach of family members*:* It was reported by a few respondents, *"No one in the family understood the gravity of online tasks/assignments. Too frequent interference eventually led to faulty evaluation".*

d) Timelines for submission and evaluation: "*The assessment is time bound. There are due dates for submission and evaluation. Due to internet connectivity issues at times, the dead lines were not met".* So checking the assignments was tedious and time consuming

e) Students beyond control: Students used to turn on their webcams as per their convenience or on being asked to turn on the camera as a mandate, they attributed the reasons of not switching it on to poor network or technology. *"Invigilation was challenging as the students were not within our approach. They might had cheated, or some time a family member was helping them out",* said a respondent.

f) Negative attitude: Students were just not willing to listen. One respondent shared, *"In terms of invigilation, students had a feeling who is watching them!!"* Another said, *"Students never use to face the camera and sit in one corner and take help".*

Reading, understanding, assessing, and deducing information are all necessary ingredients for assessment, but somewhere on online system of teaching disrupts the flow and causes dissatisfaction. Student evaluation became a herculean task as teachers were not comfortable reading from the screen. Online assessment was one of the big challenges that instructors had faced.

7.1.3 Theme 3: Engagement Barriers

One of the crucial tasks during online teaching was students' engagement, i.e. keeping the students involved and engaged throughout the class. According to Chen *et al.* (2008), engagement is defined as "the extent to which learners actively engage with their educational tasks," and it is favourably associated with a number of beneficial outcomes, including strong academic performance, student satisfaction, and tenacity. *"The students were not interacting in the class, they use to join the class and behaved like passive listeners. The engagement level was very low"* in the words of a respondent. Another shared, "*there are different reason for students non participation, one of them is the connectivity problem, other is rural background as students remain busy in agriculture field work and yet another is the distraction. Students were engaged in lot many things going on parallelly".* One mentioned, *"The students engagement was very good initially as everybody was excited. But after 10-15 days, it just went down. The students are in that stage where they feel no one is watching them. They were in lackadaisical mode. They were just not interested* *in the classes so they did not participate".* One respondent said, *"Students' engagement was very poor, merely 1-2 students used to speak. It was difficult to engage large groups online. Only those students who see the scope of the subject or were serious used to participate".* Yet another revealed, *"They don't participate as they are engaged in lot many things going on parallelly, they are in the comfort zones".* A few respondents shared that the engagement depended upon the time of the class. In morning it was excellent. Later during the day, it used to dip. Engagement also depends upon the teacher to a great extent. *"Many a times I felt as if I am talking to wall or to myself. There was a lack of energy in the class. This was irritating",* said one respondent. Engaging students in an online environment was like an uphill battle. Teachers really had a tough time in ensuring that students participate and add value to the online academic environment.

7.1.4 Theme 4: Technical Barriers

The instructors faced various technical difficulties while transitioning to online teaching. These included:

a) **Lack of technical infrastructure:** There was a dearth of technical infrastructure. There were teachers who did not have laptop at home or did not know how to operate a smart phone. As per one respondent, "I did not have laptop at home. It was so difficult to take online classes". Poor or unreliable internet connectivity was another significant issue. Teachers often struggled with slow internet speed, dropped connections, or complete outages, which disrupted their ability to deliver online classes effectively. As per one respondent, *"I faced a lot of technical glitches during the online classes owing to which sometimes I had to cancel my class. This was primarily due to poor internet connectivity, electricity cut in our area or site crashing due to high traffic*". Another reported, *"I was frustrated. I had to wait for all the students to join the class, as they hail from remote areas or tier 3 cities".*

b) **Poor technical skills:** Teachers who lacked the necessary tools or training found it challenging to deliver dynamic and interactive online lessons. "*This transition was sudden. Little did I know about multimedia and interactive* *presentations. At times, I was not able to deliver my best because of lack of technical skills*", said one respondent. Creating engaging multimedia content, such as videos or interactive presentations, required additional technical skills and resources. One respondent reported, *"I had a problem in designing the quiz online for students using some free software available, so made multiple errors while running the quiz and felt embarrassed".*

c) **Online technology platform:** The teachers had to quickly adapt to new digital platforms and tools that they were not familiar with before the pandemic. They faced various technical issues during live sessions, such as audio or video synchronization problems, freezing screens, or difficulties sharing the content. Teachers had to learn how to navigate through a video conferencing software, learning management systems, and other digital tools required for online teaching. In the words of a respondent, "*I did not know how to use the online platform. Many a times I had to cut a sorry figure in front of my students. This was so embarrassing".* Another said, *"I had to buy a new laptop because of compatibility issues. This was a burden on my pocket as well".* Such situations had interrupted the flow of lessons and made it harder for teachers to engage with students effectively.

d) **Privacy and security concerns:** Online teaching introduced new privacy and security concerns for teachers. They had to navigate data protection regulations, ensure the safety of student information, and manage online classroom environments to prevent unauthorized access or disruptions. As shared by a respondent, "*I was apprehensive of using open source platform as it is not safe. A student might have shared the link of the class and may even share any resource with an outsider. I remember, once a student with name, munna bhai ka daayan hath (right hand of munna bhai) entered my class. Although I did not allow this person to enter in my class, but yes, there are concerns*". Teachers using institutional-supported technologies had clarity regarding the designated teaching platform. However, confusion arose among teachers utilizing open-source software, as they faced uncertainty about the most suitable digital platform for delivering their lectures.

7.1.5 Theme 5: Personal Barriers

The transition to going digital often blurred the boundaries between personal and professional life. Teachers had to manage their workload and ensure they had time for lesson planning, assessment, and interacting with students while also attending to their personal responsibilities and family needs. Personal barriers included:

a) **Health concerns:** The most common of all was related to health. *"I underwent a huge emotional backlog as I was away from my family"; "The screen time went up, there was strain in my eyes at all times, my migraine aggravated eventually"*; *"There was time when I did not feel like opening my laptop"; "My health was costed by online classes. I do not have ergonomic chair. I started up sitting in my table and chair and later eased into my recliner, this led to lot of medical problems",* are some of the responses by the respondents during the interview.

b) **Financial burden:** Most of the respondents said that online teaching came as an additional burden on the pocket. "*We are six at home out of which three are working professionals and other three are school going children. Imagine the cost we are incurring every month on the mobile data and gadgets we are using"*, said one respondent.

c) **Work-life balance:** Teachers were not able to strike the balance between their personal life and professional. One respondent said, "My *family life got disturbed. I was not able to strike the balance", while another shared, "Working from home was 24/7 job. It was frustrating".* Yet another reported, *"I could not manage time owing to lecture preparation as it demanded extra time. It led to longer working hours"* .

d) **Negative mindset:** Teachers found online teaching uncomfortable and ineffective . In the words of a respondent, *"I found online class just a formality, we were teaching for the namesake".* Another said, *"Students were least interested, so was I. The teaching was not at all effective".* One more reported, *"While teaching from home, I was in my comfort zone, at times I did not feel like taking the class".*

e) **Technology-integrated course:** Few courses are skill based or purely lab based. Teaching such courses in an online mode was petrifying. When asked about the integration such courses with technology, the teachers seemed negative. As told by a respondent, *"Experiments are to be done in lab. How can you expect me to exhibit the chemical reactions while I am at home with no access to lab equipments. This is purely insane".* Another said anxiously, *"I teach Accounting. It was impossible to make students understand without basic facilities. They need practical exposure which was not possible in online teaching, hence for practical courses face-to-face interaction is required".*

Teaching online meant a significant reduction in face-to-face interactions with colleagues and students. Teachers missed the social connections and support they typically found in the face-to-face environment, which could lead to feelings of isolation and loneliness. Shifting to online teaching required additional effort and time investment from instructors. They had to adapt their teaching materials, develop new strategies for engaging students remotely, and provide individualized support through virtual platforms. This often resulted in longer working hours and eventually, added stress.

7.1.6 Theme 6: Institutional Support Barriers

During the shift to online teaching, training sessions and professional development programmes (PDPs) were implemented by institutions to facilitate the acquisition of essential skills and knowledge for online teaching by teachers. These sessions covered topics such as using online platforms, implementing digital tools, creating engaging online content, and managing virtual classrooms effectively. However, a few instructors were deprived of basic product training.

a) **Lack of technical support:** *"I did not have immediate access to technical support or IT professionals who could assist me in resolving technical issues"*, said one respondent. This lack of support further compounded the challenges they faced during online teaching. One said, *"The transition was very sudden and there was no time to think and act upon. We only got a WhatsApp message on a group that classes will now be online. I was in self-doubt as I am not* *trained in teaching online. Many times I found difficult to manage the camera, microphone and teaching together on Skype".*

b) **Licensed platforms:** *"The institute should spend on taking a licenced platform to ensure security and effective teaching". It was a pain to teach using open-source platforms",* reported another.

7.2 SUGGESTION TO MITIGATE THE BOTTLENECKS FACED BY THE TEACHERS

During the interview of the respondents, it was categorically asked about what they feel on how these bottlenecks or hindrances can be minimised so that the outcome is effective, i.e. online classes are effective. Teachers were quite open to share about what they feel. The suggestions received are appended below (verbatim):

a) *"If appropriate and adequate infrastructure is provided and proper training is given to both the teachers and the students, the online classes are going to be more effective".*

b) *"If the students are responsive and interactive in the class then we can continue having online classes. However, if students are not participating then it is difficult to engage them. In such a scenario, offline/face-to-face instruction works best. Otherwise online is preferable".*

c) *"A highly engaged content for the students is required and miracles can happen*".

d) *"Every institute should develop its own digital platform rather than using Zoom or Google Meet. This will make digital education more effective and serious".*

e) "*I'll prefer blended mode as I am always open to learning. Technical advancement is very important".*

f) *"It is important to orient the students first and understand the age of the learner. Maturity plays a huge role*".

g) *“The country talked a lot about digital education but did not take it seriously. There should be some guidelines from the government to combat these exigencies. All responsible stakeholders need to come forward and collaborate. Extensive training to students is also required”.*

h) *“First of all, the teacher needs to realize that this online system is not by choice. It is more like a compulsion and address it the same way. Nor it is the teacher’s fault; the students too have to realize this. A teacher has to understand that class is a class whether online or offline so that job of a teacher doesn’t change”.*

i) One respondent shared, *“To augment the pedagogical effectiveness of online instructors, I suggest to employ a diverse array of e-learning methodologies and strategies. The instructional methods encompass dynamic presentations, laboratory demonstrations, simulations, conceptual discussions, and the promotion of student interaction and collaboration. These methods encourage student engagement, investigation, and knowledge growth”.*

To summarise, for optimizing the effectiveness of online instruction, it is imperative to contemplate a number of critical elements. It is of the utmost importance to provide suitable infrastructure and training for both educators and learners. Ensuring student engagement and responsiveness is critical for the sustainability of online courses; in contrast, in-person instruction may prove more effective. Significantly positive outcomes can result from the use of engaging, high-quality content in digital learning. In lieu of depending on external services such as Zoom or Google Meet, academic institutions ought to contemplate the development of their own digital platforms as a means to guarantee a more substantive and efficacious educational experience. Certain individuals favour blended learning modes, which integrate both online and offline approaches, due to their flexibility and willingness to embrace technological advancements. Furthermore, orientation and maturity levels of students must be taken into account, as these variables have a substantial effect on their educational experience. Despite widespread discussion, the necessity for digital education remains inadequately implemented. Government directives, stakeholder collaboration, and comprehensive student training are all essential components in tackling these challenges. Both educators and learners ought to acknowledge that the transition to online learning is frequently a result of exigency rather than volition, and modify their perspectives accordingly. Online courses ought to prioritize the interests and requirements of both instructors and learners. It is crucial that participants possess the following qualities: readiness, efficiency, success-driven, self-control, and proficiency in digital technology. Digital learning is here to stay. No one can escape it; neither the teachers nor the students!

7.3 CHAPTER SUMMARY

This chapter brings out the challenges faced by the teachers while transitioning to the online classes. Teachers had a difficult time transitioning to online instruction, as they were responsible for adjusting to new instructional methods. The chapter highlights how teachers were required to swiftly acquire new skills, develop engaging digital content, and encourage virtual collaboration among students. Initially, teachers were compelled to utilise open-source platforms, including WhatsApp, YouTube, Skype, Zoom, and Google Meet, due to the absence of institutionally supported technologies, such as Learning Management Systems (LMS), at numerous higher education institutions in India.

At the start, this chapter explains the steps involved in the analysis of the interview data that comprises a) transcription, familiarization with the data and selection of quotation, b) keyword selection, c) coding, d) theme development, and finally e) conceptualization by interpreting keywords, codes and themes. The analysis has been presented from the data of 32 interviews. The findings shed light on the problems faced by teachers when delivering online classes by employing different technology platforms and gadgets. This includes concerns regarding the comfort of navigating the digital platform, expensive internet plans, disengaged students, low attendance, lack of self-efficacy among teachers in handling technology, dearth of educational resources, scarcity of technical know-how, and subpar network infrastructure.

Finally, the summary of the themes generated from analysis were presented in the chapter. The chapter talks about the six broad themes under which the barriers have been grouped after the analysis. This includes domestic barriers, assessment and evaluation barriers, students engagement barriers, technical barriers, personal barriers, and institutional barriers. Each theme has been discussed individually in the chapter.

Domestic barriers bring out the factors that affected online teaching from home. This includes external distraction like street hawkers, neighbours, street dogs, traffic noise, visitors, etc., lack of basic facilities like whiteboard/blackboard, marker, duster, printer and family obtrusion that comprise intrusion from family members and pets which was at the peak as the space was limited in the home setting. The chapter further pointed out the assessment & evaluation barriers that include concerns of the teachers related to the assignments checking and online invigilation. Reading, understanding, assessing, and deducing information are all necessary ingredients for assessment, but somewhere online system of teaching disrupts the flow and causes dissatisfaction. Student evaluation became a herculean task as teachers were not comfortable reading from the screen. Online assessment was one of the big challenges that instructors had faced. The chapter then discusses another major challenge during online teaching, i.e., students' engagement, i.e. keeping the students involved and engaged throughout the class. Engaging students in an online environment was like an uphill battle. Teachers really had a tough time in ensuring that students participate and add value to the online academic environment. After this, the chapter highlights the technical barriers. There are a multitude of technical obstacles that teachers had encounter when instructing online, such as the paucity of digital resources, poor infrastructure, lack of technical skills, unstable internet connectivity, and issues related to privacy and safety of the open-source platforms. Teachers using institutional-supported technologies had clarity regarding the designated teaching platform. However, confusion arose among teachers utilizing open-source software, as they faced uncertainty about the most suitable digital platform for delivering their lectures. The chapter further brings out the personal barriers faced by the teachers which were related to the health, financial burden, negative mindset, and integrating technology into a skill-based course. Finally, the chapter highlights the barriers related to the institution support such as lack of basic product training, technical support when needed and use of open-source online platforms.

Chapter – 8

FINDINGS, IMPLICATIONS, CONCLUSION AND LIMITATIONS

The study sought to discern the impact of technology on education, exploring whether its integration fosters or impedes learning outcomes. Through a multifaceted analysis encompassing various educational settings and technological applications, the research aimed to illuminate the nuanced relationship between education and technology. Through empirical investigations and theoretical frameworks, researchers delved into the complexities of technology-mediated education, considering both its potential benefits, such as increased access to information and interactive learning experiences, and its potential drawbacks, including digital distractions and disparities in access to technology. By synthesizing diverse perspectives and empirical evidence, the current investigation aimed to offer valuable insights into optimizing the integration of technology within educational contexts to maximize its benefits while mitigating its limitations, ultimately contributing to the ongoing discourse on technology-enhanced learning. The data was obtained from both secondary and primary sources. Keeping in mind the objectives of the study, appropriate statistical tool like ANOVA, PLS-SEM, content analysis were used. The conclusions were drawn based on the results and discussion and same has been presented in this chapter. In light of the findings, some recommendations have also been put forward.

8.1 SUMMARY AND FINDINGS

Chapter 1 provided a comprehensive look of the complex Indian education system, illustrating its intricacy that mirrors the cultural, economic, and social diversity of the nation. It further reflects upon the role of technology in education. Technology has provided a solution for every contemporary social need, and has had a profound influence on the field of education. Higher education has been radically transformed by technology which has changed how students learn and teachers teach. The rise in online learning opportunities is one of the biggest transformations that technology has brought about in higher education. The chapter further discusses the concept of online education and also throws light on its evolution. The concept of online education has evolved as technology has progressed. In the past ten years, there has been a substantial increase in online learning due to the integration of internet and education, which has allowed individuals to acquire new skills and competencies. Next, the benefits associated with online education has been discussed. Online education provides diverse benefits for learners of all ages and backgrounds. First, the flexibility of the system enables students to learn at their own preferred speed. Second. It can be accessed from anywhere, breaking down location barriers and enabling learners worldwide to access courses with an internet connection. Third, it is cost-effective, with lower tuition fees and savings on travel and other on-campus expenses. On the flip side, a significant issue associated with online education is the absence of resources like computers, laptop, or tablet, and limited internet access in remote areas where both students and staff reside. This underscores a substantial digital divide that extends not only across countries but also within countries, particularly among varying income levels.

Chapter 2 focused on conducting a comprehensive review of literature that pertained to the chosen subject of the thesis. A comprehensive analysis was conducted on over three hundred research papers, which were published in reputable national and international journals, as well as pertinent material from books, websites, and important reports on the issue. The investigations were utilization into four parts namely, studies on learners' intentions towards technology adoption for online classes; studies pertaining to the effect of technology differentiation and gadget category on learning effectiveness, studies related to the online classroom environment and its effect on students' engagement and studies related to challenges in online teaching.

The review found that learner-to-learner, learner-content, and learner-instruction interactions are the three interaction types that matter most in online learning (Moore, 1989). A number of studies have demonstrated that the Technology Acceptance Model (TAM), which investigates the acceptance and utilization of technology by users, was the pioneering model to incorporate technology adoption. Perceived Usefulness (PU) and Perceived Ease of Use (PEU) are two important factors in the TAM framework that help explain user’s intention to adopt technology. Extrinsic factors like Information and Communication Technology (ICT) infrastructure support and resource (gadget/device, internet connection); institutional support and self-efficacy also affects students’ intentions towards technology adoption. A study by Bandura (1986) found a positive correlation between higher levels of self-efficacy and a greater intention to use the technology. Several research have indicated that the level of contact between instructors and students has a substantial influence on students’ perception of online learning. A study also found that age, gender, past knowledge of computers, and specific styles of learning significantly influence students’ acceptance of technology. Technological differentiation is the emergence of multiple functional variants within a technology. The ability to operate these platform and gadgets can increase the student participation in the learning process. In one of the studies, it was found that the online teaching platform's dependability, information richness, system navigation, page aesthetics, and interface friendliness were positively connected with satisfaction of the learners.

It is crucial for teachers to foster an environment in online setting that cultivates both student autonomy and a sense of belonging. The review revealed that contact between learners and teachers as well as among students themselves are two essential components of a pleasant learning environment in the classroom. By reviewing the literature, it was found that engagement refers to the degree to which learners actively participate with their educational tasks and it is favourably associated with a number of beneficial outcomes, including strong academic performance, student satisfaction, and tenacity. Further, the review focused on assessing the engagement of students in an online classroom environment. The literature revealed that there are four crucial types of student engagement in online classes: cognitive, emotional, behavioural, and social engagement. The mental effort and cognitive commitment that students make in their learning are known as cognitive engagement. The observable behaviours and participation that students display in their learning activities are referred to as behavioural engagement. The satisfying emotional experiences that students have when engaging in online learning are related to emotional engagement. Social engagement includes a person's desire to engage in conversation and establish connections with others. It stands for the active effort and passion put into establishing and fostering relationships with other people. Prior research has identified several obstacles in the realm of online education, which can be categorized into four distinct groups: personal challenges, course-related challenges, teaching-related challenges, and cultural challenges. It is worth noting that these challenges may vary across different countries due to contextual and preparedness differences. According to the review of literature, teachers faced a number of difficulties when teaching online courses, such as a lack of technological know-how, waning student engagement, and a decrease in overall interest. Furthermore, students frequently offered a variety of justifications for their challenges, making it harder for teachers to identify the true underlying problems. The online learning system complicates the job of the instructors by requiring them to gather, prepare, and facilitate the delivery of the knowledge online as revealed by one study. Many teachers held a negative perception of remote education. They voiced discontent with the instructional materials and support provided by the university and held that virtual learning environments couldn't replace the interpersonal connections made in conventional classrooms. Others were concerned that it would result in teacher layoffs.

The literature review highlighted the necessity to carry out a thorough a comprehensive investigation on students' adoption of technology for online classes, influence of technology differentiation and gadget category on learning effectiveness, online classroom environment and its impact on students' cognitive, behavioural, emotional and social engagement and finally the challenges faced by the teachers while talking online classes due to the scarcity of research in the Indian context, especially in the State of Punjab. Past studies have been isolated and failed to cover all aspects addressed in this study, emphasizing the need for a holistic approach. The absence of a theoretical background regarding the technology platform and gadgets used underscores the need for research to contribute to the current knowledge base in management education especially in the state of Punjab. This investigation has the potential to benefit various stakeholders, including students, teachers, educational institutions, and society at large.

Chapter 3 elucidated the research methods employed to attain the goals of the study. Besides the need and scope of the study, the chapter included the research design, sampling technique, objectives and major hypotheses of the study, data collection process, description of the sample, research instrument, and statistical techniques employed to achieve the objectives. The study used both a descriptive and exploratory research design. The study employed a multistage sampling technique to select the relevant sample. Initially, all universities in Punjab, as per the University Grants Commission (UGC) website, were referred to, and in the second stage, universities that are ranked under the National Institute Ranking Framework (NIRF) were selected for drawing the sample. Thereafter, within the chosen universities, the respondents were selected from different academic fields like Management, Commerce, Humanities, Science and Engineering. A total of 600 students and 32 teachers were the respondents to the study. The data collection for current research utilized a research instrument comprising five scales: a) a self-developed 46-item scale that explores students' willingness towards technology adoption for online teaching; b) a self-developed 18-item scale to evaluate the effect of technology differentiation and gadget categories on learning effectiveness; c) a self-developed 41-item scale to assess the effect of the online classroom environment on students' engagement; and d)) a self-developed 16-item scale for understanding the bottlenecks faced by the teachers during online classes. The statistical analysis approach included measuring scale reliability with Cronbach‘s alpha, descriptive analysis, PLS-SEM, and one-way ANOVA. The qualitative technique of content analysis was used. Furthermore, the descriptive statistics of the data were calculated using SPSS 21.0.

Objective wise detailed findings are appended below:

8.1.1 Learners' Intentions towards Technology Adoption for Online Classes

Chapter 4 dealt with the analysis of the first objective, i.e., students' intentions towards technology adoption with respect to online classes. Change is an unavoidable aspect of life, and the advent of COVID-19 has had a substantial influence on other facets of society, such as the realm of education. It has necessitated the adoption of distance learning models as a mandatory measure to ensure continuity in education. For the achievement of this objective, a research model was proposed and basis that, hypotheses were developed to test the model. Major findings are mentioned below:

i) Shamburg (2004) and Teo and Noyes (2011) have identified intrinsic factors such as self-efficacy (Teo and Noyes, 2011; Brinkerhoff, 2006) and perceived usefulness (PU) (Davis, 1989) as impediments to the successful integration of technology in online courses. Self-efficacy is the belief that an individual has in their capacity to do a particular behaviour, as stated by Bandura in 1986. Perceived usefulness, on the other hand, relates to the user's personal assessment of the likelihood that using a specific technology will enhance their performance, as defined by Davis in 1989. The absence of self-efficacy has a detrimental impact on the utilization of technology, hence impeding students from incorporating technology into their learning (Piper & Yan, 2001). Students are more inclined to employ technology if they see it as both user-friendly and effective in functionality, as well as if it improves their academic progress and performance. Previous studies by Khalid (2014) and Balog and Pribeanu (2010) have consistently demonstrated that self-efficacy (SE) and perceived ease of use (PEU) play pivotal roles in influencing perceived enjoyment (PE). However, the current study presented a unique finding by deviating from these established observations. Notably, the study did not identify any significant impact of intrinsic factors on perceived enjoyment (PE). From the descriptive statistics as well, it was observed that most of the students were not confident in using the online platform which hampered their learning. The statistics also revealed that students did not perceive online learning as interesting which indicated that they feel online classes lack the potential to improve the overall appeal and engagement of the learning process. The result of the current study is backed by the study undertaken by Nguyen and Pham (2020) which highlight student concerns about online learning, including lack of confidence in their ability to learn effectively and uncertainty about whether online formats can offer the same benefits as traditional face-to-face instruction. According to the study's findings, there may be a gap between the apparent ease of use and self-efficacy of online learning and the real enjoyment that comes with it.

ii) Institutional support (IS) refers to the organisational and technological tools that learners perceive as being accessible to assist them in adopting IT systems for their online learning activities (Venkatesh *et al.*, 2003). The institutional support (IS) significantly influences the perceived enjoyment (PE) in attending the online classes. This study highlighted the significance of Institutional Support (IS) and its association with PE (student satisfaction). The support rendered by educational institutions encompassing activities in classroom, access to the academic resources, interactions with the teachers, their on-time availability and getting detailed and individual feedback from the teachers were quite pivotal for students to pursue online educational opportunities in the years to come. These findings echo the results of earlier studies by Lee *et al.* (2011) and Yukselturk and Yildirim (2008). Another study discovered that level of engagement between an instructor and students has a substantial influence on how students perceive online learning (Muthuprasad *et al.,* 2021). The result of previous study by Demuyakor, 2020 and the current study are in line with each other as both of these have proven that student-teacher interactions, students' engagement with academic resources/materials, and teachers' confidence in using technology leads to students' satisfaction (PE) with the online teaching. The results further indicated that the feedback to the students were neither given individually nor on time which hampered their learning in the online classes. Therefore, educational institutions must prioritise the implementation of an efficient feedback system to encourage students to engage in online learning in the future. Hence, it can be concluded that higher the contentment of the students with online classes, the more they will be intended towards online learning in future.

iii) The findings of the study indicated that the institutional support (IS) significantly influences the online learning intentions (OLI). The current study results have shown that the class activities, teacher's availability, interactions between the students and the teachers, students' engagement with academic resources/materials, and teachers' confidence in using technology with online teaching are a few reasons behind students' intentions to learn online. A study by Yoo, Han, & Huang (2012) revealed that learners who get the desired support from their institution gradually enhance their intentions to learn online and the same result is seen from the current study as well. The results of a previous study conducted by Hung and Jeng (2013) showed that including instructional elements along with course integration is crucial for designing courses with suitable learning activities. This method promotes increased active involvement in class discussions and boosts learners' enthusiasm to participate in online learning, aligning with the results obtained in the present study. The descriptive statistics has further shown that a few students intent to use online learning for upskilling themselves in future and also for getting the deep subject knowledge through various online resources available to them in abundance.

iv) The extrinsic factors included the ICT infrastructure support (IFS) and resources. The result showed that there is a relationship between ICT infrastructure support (IFS) and perceived enjoyment (PE) of the students in attending the online classes. This clearly indicates required training on using the platform, along with the access to the device for attending classes, internet connectivity and speed affects students' measure of enjoyment (PE). The results align with the previous research conducted by Lee *et al.* (2011). Essentially, higher satisfaction levels (PE) among students suggest a likelihood of them choosing online studies in the future. Furthermore, descriptive statistics revealed that students were more likely to have a favourable attitude towards online learning if they were given sufficient training to navigate and use the online platform. The results further indicated a relationship between the resources available to the students and perceived enjoyment. Having a device/gadget with reasonable configuration and the access to the internet are important factors for students' enjoyment (PE) from online classes. These results are in coherence with the older studies by Asaari and Karia (2005) and Maheshwari (2021).

v) Intrinsic considerations such as self-efficacy and perceived usefulness are important consideration in online education. Learners who believe they are extremely self-efficacious are better able to overcome difficulties or hurdles (Bandura, 1986) and will work harder and longer. The current study's findings indicated a correlation between intrinsic characteristics and perceived usefulness (PU) of the students in attending the online classes. The same result was also supported by another study that said learners who are confident in their abilities and experience will eventually find the technology useful. (Yoo, Han, & Huang, 2012). A considerable body of research (Islam, 2013; Weibel, Stricker, & Wissmath, 2012) has demonstrated that learner attitudes towards technology are influenced by user perceptions encompassing simplicity of use, usefulness, and enjoyment. This further supports the hypothesis of the current study. Descriptive statistics revealed that students were able to accomplish their tasks quickly and track their academic progress with online classes. This notion was further corroborated by the research conducted by Proffitt (2008), which posited that students' academic achievements in an online setting could be enhanced by their perception of the usability of online learning.

vi) Perceived enjoyment (PE) reflects the pleasure and enjoyment involved with using a technology. The attitude toward using a given source is positively connected to perceived enjoyment. One of the main reasons users use technology for online learning is to have fun (Moon and Kim, 2001). Perceived satisfaction has a substantial impact on how learners feel about utilizing technology for learning online. When students find online learning enjoyable, they are more inclined to develop a favourable perspective towards using technology for educational purposes. The results of the present study indicate a link between how much learners enjoy using technology and their views towards using it for online classes. It is supported by a previous study carried out by Suki and Suki (2011) which prove that if learners can have fun while adopting new technology, their attitude toward adoption will be positive. A study conducted by Venkatesh and Bala (2008) investigated the elements that affect students' willingness to adopt technology for education. The researchers discovered that the level of satisfaction that students experienced had a substantial impact on their views about using e-learning platforms. Furthermore, a meta-analysis conducted by Wang, Wang, and Shee (2007) examined various factors influencing students' attitudes towards online learning. Their findings indicated that perceived enjoyment had a substantial effect on shaping students' attitudes towards technology-mediated learning environment. All these studies are in line with the result of the current study. As observed by the descriptive statistics, students had a variety of experiences (sharing screen/attending poll/group discussion/annotation) while learning through online classes and this made the online class all the more enjoyable. Learners who embrace constructivist views exhibit more positive attitudes regarding technology in the classroom (Bhuasiri *et al.*, 2012) has further supported the hypothesis of current study.

vii) One important aspect affecting students' opinions about adopting technology for online learning is perceived usefulness. Students are more likely to adopt favourable attitudes towards using technology for online learning when they believe it can meet their educational needs (Huang & Liaw, 2007). Piper *et al.* (2001) found that perceived usefulness positively influenced students' attitudes towards using technology for educational purposes. These research corroborate the conclusions of the present investigation. Comparably, during the COVID-19 epidemic, Al-Fraihat *et al.* (2020) studied the variables influencing students' adoption of online learning identifying perceived usefulness as a key factor influencing attitudes towards online learning platforms. Perceived usefulness (PU), according to Liu, Liao, and Peng (2005), was successful in explaining users' intent to keep using technology in educational situations. This research aligns with the findings published by Ibrahim *et al.* (2017) and Purnamasari & Advensia (2014), which demonstrated that PU has the potential to influence future users' decisions to utilize e-learning platforms. There is a greater likelihood of positive attitudes towards using technology for learning among students who believe that online learning technologies can help them achieve their educational objectives.

viii) Attitude, as described by Davis *et al.* (1989), refers to an individual's evaluative affect, which encompasses their favourable or negative feelings about executing the goal behaviour. Drawing on theories of reasoned action and planned behaviour, it was suggested that an individual's intention to use an information system efficiently is directly determined by their attitude toward this activity (Ajzen, 1991; Fishbein & Ajzen, 1980). It's been known for a long time that attitude is a strong factor of intention. The current study has found that there exists a relationship between attitude of students towards online classes (ATT) and intentions to use online classes (OLI). These studies are in sync with each other and support the current hypothesis. Moreover, one's attitude toward the behaviour and subjective norms around it are the foundations upon which behavioural intention is built. An individual's propensity to engage in a behaviour increases with their positive attitude toward it (Ajzen and Driver 1991; Miesen 2003). A study conducted by Cheung and Vogel (2013) demonstrates that users with positive views are more likely to have stronger intents to use e-learning technologies. In one study, the factors influencing students' intents to adopt mobile learning technology were examined by Chiu and Huang (2016). They discovered that students' intentions to use mobile learning applications were positively influenced by their views towards mobile learning. Therefore, it can be inferred that students are more inclined to have the intention of utilising technology for educational purposes when they possess a positive disposition towards it. All these previous researches support the current study. To summarise, research undertaken by Liaw *et al.* (2013), Al-Adwan *et al.* (2018), and Chiu and Huang (2016) all lend credence to the idea that students' intentions to utilize technology for online learning are greatly influenced by their attitudes about using it. Finally, based on the descriptive statistics, to know their intentions to recommend learning through online classes to other students, the result indicated that the respondents somewhat agreed to their intention of recommending learning through online classes.

ix) Perceived usefulness (PU) is the personal evaluation made by individuals regarding the extent to which they believe that employing a specific technology would improve their efficiency and effectiveness in accomplishing specific goals or tasks. The study conducted by Venkatesh and Morris (2000) focused on understanding the factors influencing users' intentions to adopt and use technology. One of the key findings of their research was the link between usefulness and intentions to employ technology. This finding supports the current study as well which indicated when users perceive a technology as useful, they are more likely to intend to use it. Several research (Islam, 2013; Weibel, Stricker, & Wissmath, 2012) have found that user opinions of how easy it is to use technology, its utility, the satisfaction derives out of it, and service quality all impact learner attitudes towards technology. Both self-efficacy and motivation theory support the idea that in technology-mediated environments, learners who are confident in their abilities and the usefulness of a task will do better (Huang & Liaw, 2007).

8.1.2 Effect of Technology Differentiation and Gadget Category on Learning Effectiveness

Chapter 5 shed light on analysing the effect of technology differentiation and gadget category on students' learning effectiveness. In education industry, the use of technology and gadgets have grown exponentially over past few years (Bayanova *et al*., 2019). Zoom, Google Meet, and Microsoft Teams, to name a few, were employed by several institutions as a delivery tool (Serhan, 2020) during the imposed lockdown. At the same time, the gadgets like mobile phone, iPad/ tablet, desktop, and laptop are used by students to enhance their learning experience (Bayanova *et al.*, 2019). They can use these devices to access online libraries, research materials, and educational applications that provide interactive and engaging content. For the current study, the learning effectiveness was measured on the basis of three dimensions namely, knowledge construction, student's interaction and instructor's presence, both for the technology platform used and the gadget employed. The data analysis was done through descriptive statistics and one-way ANOVA. The findings suggest that technology platform used and the gadget employed effect the learning of the students. The major findings are appended below:

i) It has been found that a significant difference exists among the technology platforms for knowledge construction dimension. My Class was found to be most effective in knowledge construction among the students followed by Microsoft Teams. This means that both of these platforms had nearly the same mean scores for knowledge construction and facilitate effective learning basis the features provided. The design of My Class is tailored to specifically meet academic requirements. Such features foster an interactive environment among students, teachers, and the broader community leading to knowledge enhancement of the students (Bsharat & Behak, 2020). It also allowed the students to enhance their communication skills as lot of opportunities were provided to them in the class to table their thoughts and inputs. In addition to this, the provision of breakout rooms in these platforms enable the instructor to establish distinct smaller groups within a class. This functionality facilitates collaborative work in smaller teams, with the instructor having the ability to reunite these groups with the main session as necessary. This further helped the students to enhance their team skills, leadership skills and even critical and creative thinking skills (Buchal & Songsore, 2019). The least effective platform came out to be Google Classroom in case of knowledge construction. This platform did not support direct practical exercises, leaving students with predominantly theoretical content (Aditia, 2020). These limitations restricted the learning of the students.

ii) A notable disparity was discovered among the technology platforms in terms of the level of student interaction. As per the analysis, My Class and Microsoft Teams were found to be most significant in creating an interactive environment among students in the class which in turn enhanced their learning (Bsharat & Behak, 2020). These two platforms played a pivotal role in empowering students to articulate and present their ideas effectively, fostering a sense of confidence in utilising the knowledge gained from the course to tackle various challenges. Both platforms offered a range of features and facilitated collaboration, creating an environment that encouraged participants to actively participate in discussions, share their knowledge, and demonstrate their grasp of the course material. As a result, individuals not only refined their communication skills but also gained the assurance to apply acquired information creatively in problem-solving scenarios (Sobaih *et al.* 2021). This shows that the way the curriculum was structured and organized on these platforms piqued students' interest and promoted active engagement with the material. The results of the present study coincide with another study which concluded that effective interaction with the instructors enhanced the opportunities for active learning (Wea & Kuki, 2021). However, the least effective platform under student's interaction was Google Classroom because the platform did not provide the opportunities for effective interaction. It merely served as a tool for file-sharing between educators and students in the digital learning environment (Mainar & Karthiga, 2022).

iii) The presence of teachers holds significant role in online learning environments, serving as a crucial form of communication for guiding cognitive and social processes (Zilka *et al.,* 2018). Instructor's presence in the online class was the third dimension and a significant difference was found among technology platforms under this. My Class platform came out to be most significant followed by Microsoft Teams and Blackboard. All these three platforms facilitate direct interactions between students and instructors enabling instructors to offer guidance and support in virtual settings. These platforms offer unique features and functionalities that enhance communication, collaboration, and engagement between students and instructors (Poston *et al.,* 2020). By leveraging such means of interaction, instructors can effectively address learner needs and prevent feelings of isolation, a prevalent concern particularly heightened during the COVID-19 lockdown (Starr-Glass, 2020). The result of these studies coincides with the result of current study. Platforms like My Class, Microsoft Teams, and Blackboard offer a range of features that bolster instructor presence in online education. For instance, My Class provides structured channels for communication and collaboration, allowing instructors to maintain consistent interaction with students, Microsoft Teams integrates seamlessly with various communication tools, including video conferencing and chats, enabling real-time engagement between instructors and learners and Blackboard offers discussion forums and messaging functionalities, facilitating ongoing communication and support between instructors and students (Xu *et al.,* 2020). These features not only enhance instructor's presence but also contribute to mitigating learner isolation and promoting active engagement in virtual learning environments (Wang *et al.,* 2016). On the other hand, Zoom came out to be less significant in the instructor presence dimension. Zoom platform does not offer features that can help instructors to add values to the students learning. For example, it does allow instructors to upload more than one file (Yuldashev, 2021) which eventually became a matter of concern for the instructors. They were neither able to present the course content nor explain the content effectively as the platform did not allow for uploading multiple files at one time. Further, the Zoom platform's inability to adequately support student learning during online classes can be ascribed to multiple causes including technical limitations, insufficient features for educational purposes, and challenges in maintaining student engagement (Riedi, 2022).

iv) Bayanova *et al.* (2019) emphasises how technological instruments improve learners' academic achievement. Their study stressed upon the importance of gadgets for students' access to scientific content, information sharing, involvement in the class assignments and class preparation. The result of the study shows that most effective gadget under the knowledge construction dimension was laptop. A study by Chen & Sager (2011) laid stress upon the benefits of using laptop, such as multi-functionality, readability owing to larger display, mobility and claims that this tool can assist students develop creativity, independent learning, and intrinsic motivation. It was discovered that, in terms of knowledge construction, there was no discernible difference between laptop and desktop. Both laptop and desktop aided students in exchanging files and sharing content, along with offering screen-sharing for both students and teachers to display selected materials during classes leading in knowledge enhancement of the students. Both these devices supported the students to proficiently find, discern, assess, and integrate information from diverse media platforms, employing electronic resources and technological tools (NCREL & the Metiri Group, 2003). These results echo with the findings of the study by Gustanti & Education (2022). From the analysis, it was revealed that the construction of knowledge was weak when It comes to the tablet/iPad and also no significant difference in knowledge construction dimension was seen between Mobile Phone and Tablet/iPad. This finding aligns with Diefenbach, Kolb, & Hassenzahl's (2014) study, emphasizing the critical role of perceived usability in shaping overall user experience (UX). The small screen size hindered effective display and readability of content, rendering it less usable for students. Consequently, this inadequacy led to a deficiency in knowledge enhancement and eventual disengagement among students.

v) The nature and quality of student's interaction in online classes are significantly influenced by the gadgets they use. This assertion stems from the varying capabilities and functionalities of different devices, which in turn affect user experience, engagement, and participation levels (Kim *et al.,* 2019; Chen, Seilhamer, Bennett, & Bauer, 2015; Dahlstrom *et al.*, 2013 & Kim *et al.* 2019). The goal here was to find out if student's interaction varies significantly across the four chosen gadgets namely desktop, laptop, tablet/iPad and mobile. From the descriptive statistics it was analysed that the most effective gadget that helped students to collaborate and interact more was laptop followed by desktop. Hence, no significant difference was found between laptop and desktop. A study by Kim *et al.* (2014) revealed that the size and interface of laptop and desktop offer students a more comprehensive view of the course materials, which improves focus and encourages active participation in online classrooms. This finding coincides with the result of the current study. These devices often offer smoother multitasking capabilities, allowing students to engage with supplementary resources or collaborative tools simultaneously. Furthermore, research by Alzaza and Yaakub (2011) indicated that the kind of device used may impact collaboration and communication between classmates and some devices being more appropriate for group activities and discussions. However, research done by Tsai and Tsai (2019) highlighted that although mobile phone and tablet are convenient and portable, they could have drawbacks when it comes to processing speed, screen size and readability. This may make it more difficult for students to integrate themselves completely into the classroom, which will lower their levels of involvement and interaction. According to the current study analysis, tablet/iPad were found to be least effective device and a significant difference was found when compared to laptop and desktop. In conclusion, a variety of research findings support the idea that the choice of device has a substantial impact on student's interaction in online classrooms.

vi) Undoubtedly, the presence of an instructor has a significant impact on the learning outcomes of students in an online course. Students' choice of device, however, may affect how well the teacher is able to engage the class and improve academic achievement (Bayanova *et al.,* 2019). In the present study, the results indicate no significant difference between laptop and desktop for the dimension of instructor's presence. This finding is consistent with the research conducted by Xie *et al.* (2021) which revealed that students have a more immersive learning experience while using laptop and desktop because of their larger screens and improved functionality, which helps them concentrate better on the teacher's instructions, visual aids, and interactive aspects. Consequently, students using these devices are likely to be more directly and profoundly influenced by the instructor's presence in the virtual learning environment. (Chakraborty *et al.,* 2015). Conversely, studies such as those conducted by Shea *et al.* (2006) indicated that tablet/iPads, although portable and convenient, may pose limitations in terms of screen size and multitasking capabilities. This could potentially diminish the effectiveness of the teacher's presence as students using these devices may struggle to fully engage with the instructional content (Lehman & Conceição, 2010). In the current study also, the least effective device came out to be tablet/iPad. A significant difference was found between the laptop & desktop and tablet/iPad.

8.1.3 Effectiveness of Online Classroom Environment on Students' Engagement

Chapter 6 dealt with the influence of online classroom environment on students' engagement. For the achievement of this objective, a research model was developed after an extensive review of literature and thereafter hypotheses were developed to test the model. Partial Least Squares Structural Equation Modeling (PLS-SEM) was employed to evaluate the proposed model. Major findings are mentioned below:

i) It has been found that the online classroom environment has a noteworthy and direct effect on students' social involvement, which then consequently has an impact on their cognitive and emotional engagement. Martin and Collie (2019) identified that when students have positive relationships with both their teachers and peers in online classes, their sense of social engagement is heightened. Similarly, Masika and Jones (2016) as well as Gillenoneel (2019) suggested that students exhibit higher levels of engagement when they are comfortable with the online learning platform. Furthermore, results support the positive mediating role of social engagement between online classroom environment and students' cognitive engagement. This result is in sync with the results of study by Cheung *et al.* (2021) which highlighted that in virtual learning environments, social engagement acts as a crucial mediator between student's interaction with the instructor and their cognitive engagement. The study also highlighted the role of collaborative activities like group discussions and activities on societal problems in promoting social interactions. This in turn increases cognitive engagement by promoting knowledge construction and critical thinking. The results of Kyei-Blankson *et al.* (2019) emphasized the impact of social engagement on students' cognitive engagement in online learning, which is consistent with the current investigation. Interactive learning activities and effective use of communication tools that facilitates social interaction contributes significantly to students' cognitive engagement which ultimately impact their learning outcomes. The current study findings also underscored the positive mediating role of social engagement between online classroom environment and emotional engagement of students. The research conducted by Mihai *et al.* (2022) and Molinillo *et al.* (2018) demonstrated the influence of social engagement on students' emotional engagement in virtual learning environments. These studies highlight the importance of the activities like discussion in classes, and working on societal issues to foster a sense of community which can positively impact students' emotional engagement like curiosity, developing interest and learning new things in class. Through compassionate communication, encouragement and personalized feedback, teachers can create a supportive classroom environment that enhances social interaction which in turn promotes students' emotional engagement (Ullmanen *et al.,* 2016).

ii) It has been found that the online classroom setting has a significant direct impact on students' cognitive involvement, which in turn has a major effect on their active participation. The intellectual effort and commitment that students make to their education is known as cognitive engagement. As defined by Ding *et al.* (2018), cognitive engagement is essentially the focused thinking and mental processing that a student engages in while participating in a learning task. Online classroom environment mainly consists of dimensions of student-student relationships and student-teacher relationships, effective team-learning tasks, timely feedback, and support from the teachers. These dimensions stimulate student's course interaction. These results are consistent with the findings of earlier studies by Wang & Eccles (2012); Hu & Hui (2012); and Fredericks *et al*. (2004). The results clearly indicated that timely feedback, support from teachers and effective team-learning tasks are critical in developing cognitive engagement among students.

iii) It has been found that the online classroom environment significantly influences students' emotional engagement, which in turn plays a crucial role in shaping their behavioural engagement in online teaching. Emotional engagement involves the emotional commitment and reactions that support students' attention, identification, and the development of positive attitudes or values during the learning process (Nguyen, 2016). Effective student-teacher interaction, timely feedback from the faculty and cordial relationship with fellow students positively impact the emotional engagement of students in online classrooms (Yu, Jianhui, *et al.,* 2020). Additionally, user-friendly learning platforms have been shown to foster emotional engagement among students (Marcus, Valerie, *et al.,* 2021).

iv) Results revealed the positive impact of cognitive engagement on the behavioural engagement of students. Fredricks *et al.* (2016) provide a definition of behavioural engagement as the extent to which a student actively participates, pays attention, puts in effort, exhibits positive behaviour, and demonstrates determination in their learning activities. Wang *et al.* (2016) further define behavioural engagement as involving activities like asking and responding to questions, participating in tasks, being willing to persevere rather than giving up easily, and the level of attention provided to the task at hand. These results matched with the findings of Kim *et al.* (2020) and Lei *et al.* (2018). There is evidence that cognitive engagement determines the explicit learning behaviour to a certain extent (Ramey *et al.,* 2015).

v) The results also brought into light the positive impact of emotional engagement on the students' behavioural engagement. Many studies indicates that engaging students emotionally leads to changes in their behavioural and academic performance. The results are in line with the finding by Wang *et al.* (2016) that clearly describes that engaging and disengaging students' engagement emotionally leads to changes in their behavioural engagement and academic performance. When students identify and interacts positively with the fellow students and instructors, they participate more actively in class activities and present fewer behavioural problems. Emotional engagement is a very important prerequisite for student's efforts in the class (Fredricks *et al.,* 2004 and Pan & Shao, 2020).

8.1.4 Bottlenecks of Online Teaching

Chapter 7 highlights the bottlenecks faced by the teachers during online teaching. A semi-structured interview style was determined to be the best qualitative research methodology (David & Sutton, 2004) for achieving this objective. The data was analysed by doing the Content Analysis using NVivo. The major findings are given below:

i) The result of the current investigation indicated that the transition to online teaching was not easy for teachers. The same was stated by Adnan and Anwar (2020) and Bdair (2021) in their respective studies as well. Many teachers had to adapt to using new technology and online platforms for delivering their lessons. With the multitude of available options, each with its own features and limitations, teachers had to carefully evaluate and decide which platform best suited their specific teaching needs and the requirements of their courses. The decision required careful consideration of usability, reliability, assessment capabilities, accessibility, and compatibility with the technological landscape of both teachers and students. This result syncs with the study by Rosalina *et al.* (2020). The platform needed to have robust assessment capabilities to enable teachers to administer quizzes, assignments, and examinations effectively. They had to ensure that the chosen platform supported interactive features such as live video streaming, chat functionality, and collaborative tools to facilitate student engagement and participation. The selected platform had to be user-friendly, with clear navigation and intuitive interface, allowing for a smooth and seamless online learning experience.

ii) Next issue was the frequent interruption from the family members. This was at its peak and the concept of online teaching was not considered to be serious. According to a report from Press Trust of India (2020), the uninterrupted flow of teaching was negatively affected by outside factors such as disturbances from the surrounding area and interruptions from members of the family during lectures. This supports the result of current study also.

iii) It was found in the study that not all teachers had access to adequate resources, including stable internet connections, basic facilities (marker, duster and whiteboard) books, devices, and software. The same was also highlighted by Aung and Khaing (2016) and Sangeeta and Tandon (2020) in their studies. In another study undertaken by Shenoy *et al.* (2020), same findings were recorded, indicating that instructors experienced significant challenges and concerns when it came stable internet connectivity and a well configured device. The current study further indicated that teachers had to adapt their teaching materials, develop new strategies for engaging students remotely, and provide individualized support through virtual platforms and this challenge was seconded in the studies by Bdair (2021); Adedoyin & Soykan (2023); and Buzzetto-Hollywood (2007).

iv) The other important challenge faced by the teachers was students' engagement. The result of the study concluded that maintaining students' attention and engagement during online classes was an arduous task and the same was found in other study by Maheshwari (2021) and Sumanth (2021). Students were reluctant to participate, often keeping their webcams turned off. Teachers had to find innovative ways to keep students motivated, address distractions, and ensure effective communication and participation while keeping them engaged right from the beginning of the class towards the end so that the learning curve does not drop.

v) The other concern of the teachers amidst online teaching was striking a balance between personal and professional life. The findings of the present study indicates that the shift to online teaching blurred the boundaries between personal and work life. Similar results were found in the studies by Chen *et al.* (2019); Qi (2019) and Ayyagari *et al.* (2011). Teachers had to manage their workload and ensure they had time for lesson planning, grading, and interacting with students while also attending to their personal responsibilities and family needs. This finding is seconded by the study undertaken by Banihashem *et al.* (2023) and Dubey and Singh (2020) which concluded that managing online classes had been challenging, demanding additional preparation and workload.

Inability to manage the personal and professional life resulted in longer working hours and added stress. Studies by Adnan & Anwar (2020) and Connolly & Begg (2006) also opined the same and concluded that the complex nature of online instruction has significantly increased the workload for teachers. They faced the pressure of adapting to a new teaching format while dealing with their own personal concerns related to health, safety, and the well-being of their students. Similar to this was a study which concluded that technostress has a negative impact on the work performance of university professors (Li & Wang, 2021).

vi) The other challenge came out to be the negative mindset of the teachers. The online teaching experience was perceived as superficial and ineffectual. The instruction seemed to be provided merely for the purpose of formality as the students exhibited a lack of interest and enthusiasm. When teachers taught from home, they frequently lacked the motivation to conduct classes effectively due to their excessive comfort. This setting impeded substantial participation and fruitful knowledge acquisition, thereby diminishing the overall calibre of instruction delivered.

vii) The other area of concerns for the teachers was lack of support from institutions. When the universities had to quickly shift to online instruction, many institutions were unprepared to provide the necessary resources, training, and infrastructure to support their teachers adequately. Some teachers lacked sufficient training from their institutes on online teaching methodologies and techniques, which made it more challenging for them to deliver effective lessons in a virtual setting. The sudden shift to online teaching highlighted the need for clear and consistent communication channels between institutions and instructors. However, inadequate communication and guidance from the institution made it challenging for teachers to align their teaching practices with institutional expectations and policies. Few got support from their respective institutes while some felt abandoned. The undeniable significance of classroom learning is highlighted during this pandemic, indicating that not all HEIs and teachers were adequately equipped to handle this transition in teaching. Studies by Mahesh (2020) and Azevedo *et al*. (2020) support the findings of the current study. It's important to note that these challenges varied depending on individual circumstances such as the resources available, the grade level taught, geographic location, and the support provided by institutions**.**

It can be seen how tumultuous it was for instructors to deal with such tough times that challenged their skills, competencies, self-efficacy, technical know-how and above all, health.

8.2 KEY RECOMMENDATIONS / MANAGERIAL IMPLICATIONS

The COVID-19 pandemic presented an opportunity for educational institutions to assess and enhance their capacity for online learning and training. With the higher education sector experiencing significant growth in online education, it's crucial for both institutions and the government to proactively prepare for future uncertainties. The slow progress in implementing online teaching has left higher education system lagging behind its economic advancements in developing countries (Nguyen and Pham, 2020); India being one of them. This pandemic could serve as a catalyst for bringing transformation in digital education, integrating online learning permanently into its framework and moving to the hybrid mode. Achieving this requires comprehensive enhancements across various domains, including infrastructure, curriculum development, and the engaging training sessions of both teachers and students on the specific technologies being used.

Based on prior research findings and the outcomes of the present study, the key suggestions are as follows:

i) The adoption of online learning varies among individuals. Some are drawn to its flexibility and accessibility, while others struggle due to diverse learning styles, low self-confidence, unreliable internet connections, and inadequately designed instructional materials. These factors collectively influence students' intentions for future learning. The higher education institutes (HEIs) should consider different learning styles and provide a variety of formats, like online modules, in-person workshops, and peer-to-peer support groups to ensure that students develop a favourable disposition attitude towards the virtual learning.

ii) It is also recommended that HEIs should implement comprehensive training programmes to familiarize students with the online learning platform. These training programmes may include workshops, tutorials, and support resources to help students develop confidence in navigating the platform effectively. The institutes should integrate interactive learning platforms that encourage students' engagement in online classes. This may include discussion forums, screen sharing and multimedia content.

iii) Keeping in mind the results of the study which indicated that feedback to the students were neither given individually nor on time which hampered their learning in the online classes, the second recommendation for higher educational institutes is to develop online effective feedback mechanism so that students become certain of their academic progress and perceive online learning as a meaningful tool in future too.

iv) As the analysis revealed that technical support remained a concern for the students, it is recommended to HEIs to provide technical support services to assist students with any challenges they may encounter during online learning. This may include access to tutoring, easily accessible IT helpdesk support, online guides, counselling services, and knowledgeable staff. This will help both the students and the teachers to overcome any anxiety with respect to online education.

v) The result of the study indicated that online classes did not help students much to engage. In such a case, it is recommended to the HEIs to integrate interactive and multimedia-rich content that caters to different learning styles. Incorporating videos, animations, quizzes, and simulations can make learning more engaging. HEIs should also communicate clearly with students about expectations, course materials, assignments, and deadlines.

vi) It is further suggested that HEIs may facilitate platforms or forums where students can post testimonials, reviews, and recommendations, creating a peer-driven promotion of online learning. This may lead to a shift in the attitude of those students who perceive online learning cannot meet their educational needs.

vii) Also, HEIs are suggested to introduce and integrate MOOCs in the curriculum as a mandate. MOOCs often enrol hundreds or even thousands of students, necessitating a high degree of self-direction and self-discipline among learners. As indicated in a study by Liu *et al.* (2014), students will be expected to take responsibility for their own learning journey, actively engaging with course materials and managing their study schedules independently. This will not only build a positive attitude of the students towards online learning but also enhance their academic performance.

viii) It is further recommended to the HEIs to offer online doubt clearing sessions, where students can seek clarification and guidance from instructors or peers. A study by Alam *et al*. (2023) also concluded that such sessions are being offered by many institutes across the globe.

ix) The HEIs are further suggested to have their own learning platform especially designed for academic purposes only. For example, in case of Lovely Professional University, a private university in Punjab, has the learning platform My Class, which is purely for academic purpose. As revealed in the analysis, My Class came out to be the most effective platforms due to its interactive features facilitating multiple files upload (PPTs, word documents, PDFs, spreadsheets), file exchange, screen sharing, and breakout rooms for collaborative work, pulling video links directly from YouTube and integrating the same during the class by the instructor. And only because of these associated benefits, this platform aided in the construction of the knowledge. Such benefits may not be pulled from open source platforms. Hence, institutes should offer tailor-made platform to aid in knowledge construction.

x) It is also suggested to HEIs to continuously assess the effectiveness of technology platforms in supporting student interaction and learning outcomes. They may solicit feedback from both instructors and students on their experiences with different platforms and use this information to make informed decisions about platform selection and implementation. It is also recommended that the institutes regularly update and refine instructional strategies and technological infrastructure to optimize the interactive learning environment for students.

xi) The role of an instructor is very crucial in any online learning platform. It is recommended to HEIs that they should implement strategies to promote class discussions in online learning environment. This may include incorporating interactive elements such as discussion boards, group projects, and multimedia content to keep students actively involved in the learning process. Additionally, HEIs should prioritize providing regular and meaningful feedback to students in online classes. This could involve implementing peer review processes, automated grading systems, or personalized feedback from instructors. Additionally, incorporating collaborative learning activities that encourage interaction among students can enhance the feedback loop and foster a sense of community in the online classroom.

xii) It is further suggested that HEIs should ensure that online learning platform and associated materials are compatible with a wide range of devices, including laptop, desktop, iPad/tablet, and mobile phone. This ensures that students can access course materials and participate in online classes regardless of the device they are using.

xiii) As the result of the study indicated that the most effective gadget under the knowledge construction, student's interaction and teacher's presence was laptop, so it is suggested to HEIs should encourage students upon the benefits of using laptop which includes multi-functionality, readability owing to larger display, mobility and claims that this gadget can assist students develop creativity, independent learning, and intrinsic motivation. No doubt mobile phone and tablet are convenient and portable, but they are not free from drawbacks when it comes to processing speed, screen size and readability.

xiv) It is further suggested that HEIs should prioritize creating a conducive online classroom environment that fosters positive relationships between students and instructors, as well as among peers. This may involve providing training and support for instructors to effectively engage with students in virtual settings. The institutes may also consider integrating social engagement metrics (frequency of interactions, feedback to peers, collaborative activities completion, peer-review participation etc.) into evaluations of online learning programmes to ensure they adequately address students' cognitive and emotional needs.

xv) The HEIs may incorporate verified, empirical surveys into their systems in order to accurately assess and comprehend students' levels of engagement. These institutions may include tools like the Classroom Survey of Student Engagement (Ouimet and Smallwood, 2005) or the Student Course Engagement Questionnaire (Handelsman *et al.*, 2005) in their approach. These tools provide organized frameworks for collecting valuable data on several areas of student participation, such as cognitive, behavioural, emotional, and social dimensions. By using these surveys, HEIs can acquire valuable insights about student experiences, pinpoint areas that require improvement, and customize educational tactics to optimize overall engagement and learning outcomes.

xvi) It is suggested that HEIs should establish mentorship programmes where students can seek guidance and support for their academics and career plans from their instructors. Mentorship not only enhances student learning but also promotes a sense of belonging and accountability within the learning environment.

xvii) The HEIs may also integrate social learning tools (flipped classrooms, online forum for discussion, breakout rooms) in the learning platforms that enable students to collaborate on assignments, provide feedback to each other, and engage in group discussions. This fosters a collaborative learning environment and promotes deeper understanding of the subject matter.

xviii) To enhance the student-teacher relationship in online platforms, educational institutions must adapt to the unique characteristics of virtual learning environments rather than simply replicating offline models. Recognizing the absence of physical contact, institutions should acknowledge the limited mutual understanding between students and teachers. Drawing inspiration from platforms like Facebook, institutions could adopt a personalized approach by providing teachers and students with individual home pages. These pages would serve as spaces for sharing their learning experiences and facilitating direct interaction. This model encourages a more dynamic and engaging exchange between students and teachers, fostering a sense of community and enhancing the online learning experience.

xix) To ensure that students can effectively solve complex, real-world problems and apply knowledge to practical issues during online classes, HEIs can integrate case studies and simulations into online coursework to provide students with opportunities to apply theoretical knowledge to real-world scenarios. Additionally, fostering collaborative learning through virtual group projects and discussions enables students to collectively tackle complex problems and share diverse perspectives. HEIs should also leverage technology to facilitate hands-on learning experiences, such as virtual labs or interactive simulations, allowing students to gain practical skills in a digital environment. Furthermore, incorporating industry partnerships and guest lectures provides students with insights into current practices and real-world applications of their studies, enhancing their ability to address practical challenges effectively in online settings.

xx) To nurture students' sense of belonging, educational institutions can organize distinctive commemorative activities that set their learning community apart from others. For instance, offline gatherings on special occasions can highlight the collective identity of the group and subtly reinforce students' connection to the platform. These events create opportunities for students to bond with peers and faculty, fostering a sense of camaraderie and support within the learning community. By showcasing unique traditions and shared experiences, these activities strengthen students' commitment to the platform and enhance their overall sense of belonging.

xxi) The future remains uncertain, making it imperative to establish Standard Operating Procedures (SOPs) at both national and global levels for institutions, teachers, and students. These guidelines would serve as a proactive approach to tackle unforeseen events like natural disasters, allowing everyone to adapt swiftly and efficiently to such situations.

xxii) The study's findings offer valuable insights for regulatory authorities and employers of HEIs who are considering integrating online teaching and assessment as regular practices in the future. By identifying potential barriers in advance, HEIs can develop proactive strategies and roadmaps for the seamless implementation of online education. For instance, understanding the challenges faced by teachers during online assessments can inform the development of comprehensive examination guidelines. As HEIs transition to a "new normal," it's crucial to prioritize teacher training initiatives aimed at addressing these barriers, ensuring educators are equipped with the necessary skills and support to facilitate effective online teaching and assessment practices.

8.3 CONCLUSION

India is a vast country with considerable diversity in culture, language, and tradition. This is reflected in its education system as well. Many changes have happened in various aspects of life over a period of time and education system is no exception. With the advent of technology, the approach towards teaching and learning has radically changed. Gurukuls, where Guru-Shishya system was prevalent in an open space under trees, to a four-wall classroom with blackboard and chalk, to a class with white board and a marker, to an air-conditioned classroom with interactive white board (IWB) and presentation aids like LCD to the present time where not only smart classes with touch screens but also multiple learning apps are available in abundance. Not only this, the concept of online schools and universities has also been in place for past few years. Classrooms are no longer the same as they once were. The augmented leap of technological innovations over the years have changed the whole meaning of education and has created a pressing need for education research on how the learning has been mediated by emerging technologies (Xie *et al.*, 2020). In a way, the events that were expected to occur 20 years later have unfolded prematurely as a result of the pandemic.

The COVID-19 epidemic has brought online education to the forefront, serving as a crucial component amid this worldwide disaster. Higher education sector experienced a significant transition from face-to-face classes to online learning. The transition process and its acceptance might have varied across different countries, regions, and institutions based on local circumstances and guidelines and also on vaccination rates, and institutional capabilities. The teaching fraternity worldwide faced challenges in adapting to technology during online classes. Overcoming these challenges requires a combination of technological proficiency, pedagogical adaptation, and a student-centered-approach. Despite this, the COVID-19 pandemic has steered the education system into a teach-savvy path. The advantages it offers for education cannot be disregarded, particularly in the post-pandemic era. Therefore, the findings of this study underscore the importance of considering online education as a viable and valuable option to meet the evolving needs of higher education in the future.

In the light of the suggestions received from the respondents, the unexpected nature of the transition was generally not seen in a negative light by the instructors. While there may have been some initial concerns and reservations about the effectiveness and quality of online teaching, the circumstances compelled educators to make the best use of available technologies and tools. Most of them suggested about students' engagement in online environment, appropriate training to the teachers and the students, university's own learning platform and policy formulation at State of National level at government's end. The shift to digital teaching required instructors to develop new skills related to technology integration, online pedagogy, and effective communication in virtual environments which can be taken care by providing product training. Eventually, this forced skill development led to the acquisition of valuable digital skills that can enhance teaching practices in the long term. As a result, what began as an improvised response evolved into a best practice over time. This transition was unplanned and reactive, as institutions scrambled to find viable solutions to continue providing education while ensuring the safety of their students and staff. As time progressed and institutions gained more experience with digital teaching, many instructors discovered innovative strategies and approaches that maximized the benefits of online teaching. It is now recognized that digital modes of teaching can complement traditional classroom-based instruction and offer additional opportunities for personalized learning, student engagement, and educational inclusivity.

Online learning has played a significant role in opening doors to cross-border learning, enabling students and educators to transcend geographical boundaries and engage in educational opportunities beyond their local institutions. Top universities of the world are offering online courses that can be accessed from anywhere. It has empowered students around the world to access and join courses from prestigious institutes like Harvard University, University of Cambridge, Stanford University and Massachusetts Institute of Technology (MIT) which otherwise for any learner can be a dream to get through.

The extensive use of online education during the pandemic is likely to reshape student perceptions of this mode of learning and lead to a more widespread adoption of the same in the post-pandemic era, often referred to as the "next normal." As an emerging trend, digital education is poised to become an essential and integral component of education beyond the pandemic. The pandemic-induced shift highlighted advantages such as flexibility, convenience, and accessibility, underscoring the need for a blended approach that integrates online education with traditional face-to-face (F2F) methods. Lockee (2021) advocates for this blended model, emphasizing its ability to offer a versatile and inclusive learning environment.

8.4 LIMITATIONS OF THE STUDY

The study's limitations are outlined below:

1. While there was an attempt to conduct a thorough and detailed literature review, the interpretation and comprehension may have been limited to the researcher's own perspective and conceptualization.

2. The sample was exclusively drawn from Punjab state due to the necessity of conducting personal interviews for data collection in most instances. Consequently, the findings cannot be universally applied to all of India, as distinct regions and states possess their unique challenges and circumstances. Additionally, the acceptance of online learning is likely to fluctuate across different regions and states, owing to a multitude of factors influencing students' preferences for online education.

3. The abrupt shift brought on by the pandemic resulted in a lack of training in online teaching and learning techniques for both teachers and students, which constituted a weakness of this study. Hence, the outcomes of this investigation might differ in comparison to similar investigations carried out in more regulated or prearranged conditions. The absence of prior training could have influenced the effectiveness and outcomes of the online instruction, underscoring the need for future research to consider the impact of adequate preparation and training on the results obtained.

4. While the researcher had adequate literature backing for all the methodologies employed in this study, a significant portion of the statistical analyses relied on the sample size. Consequently, variations in the results may occur with a smaller or larger sample size, potentially affecting the credibility and dependability of the study's outcomes.

5. The current study gathered responses from students, which introduces the possibility of bias in how respondents answered particular questions. This bias could stem from various factors such as social desirability, personal beliefs, or the context in which the questions were asked. Thus, it's important to acknowledge the potential for skewed responses and consider how this might impact the overall findings and conclusions of the study.

8.5 SCOPE FOR FUTURE RESEARCH

In the future, conducting a comparative study between local and international universities could shed light on potential differences in students' attitudes and intentions towards online learning. Such research could explore various factors such as cultural influences, educational systems, and access to resources, which may impact students' perceptions and preferences regarding online education. By examining these differences, educators and policymakers can gain valuable insights into the effectiveness and acceptance of online learning within diverse academic settings, facilitating the development of tailored strategies to enhance online education initiatives globally. Moreover, it's important to note that this study exclusively concentrated on university students, potentially limiting the generalizability of its findings. Including school students in similar studies could yield different results due to varying educational contexts, teaching methods, and student demographics. Therefore, expanding the scope of research to encompass both university and school students would provide a more comprehensive understanding of the efficacy and implications of online learning across different educational levels. Conducting cross-country studies in Asia could provide valuable insights into whether learners' preferences for certain learning modes are influenced by cultural differences in learning styles. By comparing educational practices and cultural norms across diverse Asian countries, researchers can examine how cultural factors shape individuals' attitudes and inclinations towards online learning versus traditional methods. Understanding these nuances can inform the design of more culturally responsive and effective educational interventions, ultimately enhancing learning outcomes across various Asian contexts.

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Appendix – I

QUESTIONNAIRE

I am Navpreet Kaur, a PhD Research Scholar at Mittal School of Business, Lovely Professional University. I intend to study the learners' intention towards technology adoption with respect to online teaching in Punjab. I would appreciate if you can take out some time to help me with your response. Your response will be kept strictly confidential and to be used only by me for research purposes.

Q1. Please indicate your degree of agreement/ disagreement with the following dimensions of technology adoption for online classes.

Dimension	5 Strongly Agree	4 Agree	3 Neutral	2 Disagree	1 Strongly Disagree
EXTRINSIC FACTORS					
ICT Infrastructure Support					
I have received the required training to use the platform for online classes effectively.					
I know how to login and access the platform for online classes.					
I know where to ask for help when I have any technical issue.					
Technical support is available to assist when difficulty arises.					
Technical support always responds to my issue in a timely manner.					
Resources					
I have a device with reasonable configuration to access the online classes.					

Dimension	5 Strongly Agree	4 Agree	3 Neutral	2 Disagree	1 Strongly Disagree
I always have access to the internet for accessing online classes.					
I have access to the required bandwidth and reasonable internet speed to access online classes in a seamless manner.					
Recurring cost for desired internet bandwidth is affordable and reasonable.					
INSTITUTIONAL SUPPORT					
Class activities (discussion/role plays/quizzes) are properly planned and sufficient for effective learning.					
I have easy access to the academic resources (power point presentations, teaching notes, videos and class recordings).					
The instructor is always available as per the schedule for seamless conduct of classes.					
The instructor is properly trained to conduct online classes,					
I get detailed individual feedback.					
I get feedback on time.					
Interaction with instructor is satisfactory for effective learning.					
INTRINSIC FACTORS					
Perceived Ease of Use					
Learning through online classes is easy.					
Online classes allow me to control the pace of my learning.					

Dimension	5 Strongly Agree	4 Agree	3 Neutral	2 Disagree	1 Strongly Disagree
I can access online classes from anywhere.					
Acquiring new skills through online classes is easy.					
The platform used to access online classes is user friendly.					
Self-Efficacy					
I have the necessary skills for accessing online classes.					
I am confident in using the platform of online classes.					
I am able to use the platform of online classes without the help of others.					
I am able to troubleshoot problems associated with online classes platform.					
I am able to overcome challenges faced during the online classes.					
Perceived Enjoyment					
Online classes make learning more interesting.					
Learning through online classes make me feel happy.					
I like using different gadgets for online classes.					
I feel delighted on completing the assignment/tasks on time.					
Performing academic tasks in online classes is captivating.					

Dimension	5 Strongly Agree	4 Agree	3 Neutral	2 Disagree	1 Strongly Disagree
Perceived Usefulness					
Online classes improve my learning outcomes (knowledge/application of the concept).					
Online classes enable me to accomplish academic tasks quickly.					
With online classes, I can track my progress.					
With online classes, I can improve my academic performance (grade/marks).					
With online classes, I can increase my academic productivity (managing time/ability to prioritize the tasks).					
Attitude Towards Online Classes					
I feel relaxed when I learn through online classes.					
I feel online classes helps me improve my creativity.					
I feel I can have a variety of experiences (sharing screen/attending poll/group discussion/annotation) while learning through online classes.					
I remain focussed while learning through online classes.					
I am not concerned about the time I spend in front of a device/screen.					
Intentions to Use Online Classes					
I am willing to participate in online classes.					
I intend to use the online classes for upskilling myself in future.					

Dimension	5 Strongly Agree	4 Agree	3 Neutral	2 Disagree	1 Strongly Disagree
I intend to use and depend upon online classes heavily.					
I can explore in-depth about any subject through online classes.					
I will recommend learning through online classes to other students.					

Q2. Which technology platform do you mostly use to access online classes? (Tick one only)

Zoom	
Blackboard	
Google Classroom	
My Class	
Google Meet	
Microsoft Teams	
Any other, please specify	

Q3. Which gadget do you mostly use to access online classes? (Tick one only)

Desktop	
Laptop	
Tablet/iPad	
Mobile phone	

Q4. Please indicate the effect of technology platform and gadget that you use to access online classes, on your learning effectiveness:

5	4	3	2	1
Extremely Effective	Very Effective	Moderately Effective	Slightly Effective	Not at all Effective

Dimension	Technology Platform					Gadget				
	5	4	3	2	1	5	4	3	2	1
KNOWLEDGE CONSTRUCTION										
Understanding of the course content										
Application of theoretical concepts										
Development of critical thinking skills										
Development of creative thinking skills										
Development of communication skills										
Development of team skills										
Development of leadership skills										
STUDENT'S INTERACTION										
Interaction with the instructor										
Discussion among students										
Ease of answering questions										
Synchronous and/or asynchronous sessions during the class										
Opportunities for active learning (hands-on/flipped class/breakout rooms)										
Continuous feedback from peers/classmates										
INSTRUCTOR'S PRESENCE										
Instructor's explanation of the course content										
Instructor's presentation of course material										
Instructor's feedback on assignments										
Instructor's preference for class discussion										
Instructor's guidelines for student participation										

Q5. Please indicate your degree of agreement/disagreement on the following dimensions of online classroom environment:

Dimension	5 Strongly Agree	4 Agree	3 Neutral	2 Disagree	1 Strongly Disagree
Online classroom environment					
I get timely feedback from my instructor.					
I receive the desired support from my instructor.					
I openly discuss course topics/concepts with my instructor.					
I get opportunity to discuss my career plans with my instructor.					
I get opportunity to collaborate with my instructor on academic activities like projects, consultancy, etc.					
My peers help me with course material/assignments.					
I share knowledge with peers.					
I get the opportunity to work with my peers on projects or assignments.					
I am able to participate in group discussion with my peers.					
I am able to establish personal contact with some peers.					
The online class interface which we have the access to is well-designed.					
Online class interface enables two-way communication.					
Online class interface enables instructor to take a poll or run a quiz during the class.					
It is easy to navigate through the online class interface.					

Q6. Please indicate the degree of influence of online classroom environment on the following engagement indicators:

Dimension	5 Extremely Influential	4 Very Influential	3 Somewhat Influential	2 Slightly Influential	1 Not at all Influential
COGNITIVE ENGAGEMENT					
Developing deep course understanding					
Developing critical thinking					
Developing creative thinking					
Solving complex, real-world problems					
Justifying arguments/decisions					
Activating your own thought process					
Applying knowledge to practical problems					
Summarizing the learning					
Reaching conclusions based on analysis					
Memorizing facts, ideas or methods					
Combining ideas from different courses					
BEHAVIOURAL ENGAGEMENT					
Expressing opinions in academic discussions					

Dimension	5 Extremely Influential	4 Very Influential	3 Somewhat Influential	2 Slightly Influential	1 Not at all Influential
Offering suggestions for improvements in class					
Supporting and encouraging peers					
Willingness in attending the class					
Making efforts to meet instructor’s expectations					
Fulfilling my responsibilities in group tasks					
SOCIAL ENGAGEMENT					
Connecting learning to societal problems or issues					
Making connect with students from different backgrounds (social, racial/ethnic, religious, etc.)					
Engaging in cross-cultural discussion					
Accepting diverse perspectives during discussion					
Strong sense of being a part of the class					
EMOTIONAL ENGAGEMENT					
Creating curiosity in the class					

Dimension	5 **Extremely Influential**	4 **Very Influential**	3 **Somewhat Influential**	2 **Slightly Influential**	1 **Not at all Influential**
Developing interest in the class/ being enthusiastic in the class					
Enjoying learning new things in the class					
Looking forward to the next class/eagerly waiting for the next class					
Feeling happy in the class					

Demographics:

Your Gender	Male ○	Female ○			
Academic Field	○ Management	○ Commerce	○ Humanities	○ Science	○ Engineering
Degree	○ Under Graduate			○ Post Graduate	
Name of the University/ Institute	○ Central University of Punjab, Bathinda	○ Chandigarh University, Mohali	○ GNDU, Amritsar	○ Panjab University, Chandigarh	○ Punjabi University, Patiala
	○ Lovely Professional University, Phagwara	○ Chitkara University, Rajpura	○ Thapar Institute of Engg. & Technology, Patiala	○ Punjab Agriculture University, Ludhiana	○ Sant Longowal Institute of Engineering & Technology, Sangrur

Questions for semi-structured interview:

Statement
How you respond to the transition from face to face (F2F) to online teaching?
Which skills are needed to teach online effectively? Did you possess those skills during the transition?
Which online platforms do you use in teaching?
Which platform you feel is most effective and why?
Do you feel that self-efficacy plays an important role in using and operating online learning platform?
What kind of institutional support did you get for online teaching and assessments?
What resources are available to you to support online teaching?
What are the major barriers encountered in online teaching?
What are the Technical difficulties faced by teachers in online teaching and assessments
Personal problems faced by you in conducting online classes
Your views about students' engagement in the online class.
Do you face issues while assessing students during online classes?
How was your overall experience with the online teaching?
How do you control students and maintain discipline during online teaching?
Your preference related to online, face-to-face, or blended learning.
Any suggestion in order that online teaching can be more effective?

Annexure II

SAMPLE RESPONDENTS' TRANSCRIPTS

Sample 1:

1. The transition from face to face to online teaching was a new challenge. I was not prepared to take the classes online. Seriousness was not there initially. Students consider that this is for time being and never expected that it will last so long. Connectivity was a challenge with some of the students. Every student is not having availability of good quality of internet, which eventually led to communication gap and disengagement of the students. Providing a customised platform to students can be of some help, like in my university, we had a platform where attendance was automatically marked. The institutes may like to provide free internet to the students.

2. Communication skills are most important. It is needed in offline classes as well but effective communication skills will increase the engagement of the students. Apart from this, computer and technical skills on how to operate a platform are mandatory. We started using digital pins for my classes. At the time of transitions, technical skills were not possessed my me. I have learnt it over a period of time and capable now. Students were not that much sincere initially and when they understood that this new normal will continue, students became pro and doing more online courses.

3. Earlier we started with google meet platform and later my organization adopted a customised platform and today we are using the same. There are no such issues associated with this licenced platform but yes, when all the students turn on their cameras, the connection become unstable. I believe this may be cause of the consumption of the bandwidth and not the software. Technical support team is available 27/7.

4. Self-efficacy is important in any kind of work. So that dedication is required in whatever task you carry out. I am too confident to use the platform.

5. Facilities owned by me are pentab, laptop, web-camera. There was issue with internet connection and I had power backup.

6. Major barriers encountered by me are like internal, when it is WFH, being in family, there were certain issue, construction work, vehicle noise etc, were the few concerns. Organisation should provide separate space to the faculty.

7. The institutional support was good. Initially, any random person, especially in pen source platform use to come if link was shared by any student and this created nuisance in the class. So my university started with a customised software, 3 days training was provided to us. Technical support team is available and out IT team is available to resolve the query. WE have lot of groups to help resolving the issues.

8. No technical difficulty was found, there were minor issues with the software at times but that were taken care by. No security concerns were faced.

9. The first personal problem was connectivity issues sometimes. Online platform does not gel with practical courses. Apparatus, machinery etc does not turn out to be effective in online classes. We have used some simulation software to help he students out, they could understand but that personal touch or hands on was missing.

10. If faculty is motivated to take class online, and involve some activities in the lesson plan, certainly students will be engaged. We have poll, MCQs etc in the class to engage them. When covid started, classes were not less than vacations. So dedication was missing. They enjoyed initially thinking it is a matter of 203 months. The realization came later when everything including exams went online. So they became serious and started engaging.

11. I never controlled my students, rather my content and delivery controlled their behaviour in the class.

12. For assessment part, it was difficult. Screentime went up as everything was online. Students copied, pasted and submitted the assignments. So that was really painfully. So we played trickily. Question remained same but order was

changed, both for questions and options. Invigilation was challenging again as the students were not within our approach. They might had cheated, or some time a family member was helping them out. So this was frustrating. Submission of assignments were online through log in.

13. Suggestion to improve online; for each and every organization, training is required. Content and its delivery needs to be engaging.

14. At this present scenario, we should be ready for hybrid mode keeping in mind the current situation.

15. My overall experience was horrible initially, as no system was there. There was no engagement. Later when we adapted the new normal, it became convenient.

Sample 2:

1. The transition from offline to online was not so smooth. The biggest challenge was student engagement. I was not at all confident in adoption of technology bcos it came all of a sudden. For me it came out as a challenge. Initially it was a big challenge but by the efforts of the univ. We were online on fourth day of the lockdown.

2. Absolutely there are some skills necessary for a teacher to be effective. As of now I feel a faculty should be introduced to the use of online platforms, new technology apart from academic trainings. The major skills are require to make students attentive online. Empathy has a very strong role to play. Everybody was frustrated during that period and you need to evaluate the perspective of students. Some students or their family members were hospitalized, some lost their dear ones . So these things need to be considered. Being an authoritative teacher in the class I realised very late that empathy is very important.

3. Initially we used Google Meet and zoom for a short period, After that We used an in house platform ‘My Class’ developed by Code Tantra. The holistic training was given to use that platform. It has all the options to conduct an online class effectively. It has all the audio visual aids, you can directly pull a video from YouTube etc. Initially there were some problem associated with My

Class but later on with the efforts of the univ. Like taking feed backs from faculties, all problems were sorted.

4. Self-efficacy/self-confidence is very important . But I must say I was not so confident initially in adopting the technology. But as we get familiarize with the platform confident comes automatically. If you lack confidence then the best thing you can do is to seek an advice of help from the person around you. Sometimes you can do it yourself but it can take time. Thanks to our univ. Which has technical team to help us.

5. I had a laptop but it needs to be changed during the middle of the lockdown, smart phone and a stable internet connection, power backup etc.

6. There were lot many barriers, as you don't know with whom you are speaking behind the keyboard, sometimes you keep on calling and there is no response. This is really demotivating. Then I realised that I should have creative and interactive content to keep my audience engaged. A lot of noise disturbance from outside was there…It was like *band baja baarat* going on. But these are beyond our control. Sometimes inside noise of cooker whistle and tv create disturbance. These things were also there for the students also. So here we have to be empathetic towards them.

7. Institutional support was there. There was a technical team which was always there to help us and improvise on the platform. Proper holistic training was provided by the univ. To work on the platform.

8. The only technical difficulty was faced during the power cuts. Sometimes the devices were not charged and there was power cut.

9. There were some personal problems. I found myself incapable of teaching practical subjects, simulations, demonstrations online. It was really difficult for me. To overcome this, I conduct multiple sessions of the same topics in the evening for better understanding of the students. With extra inputs we can overcome this. Work life balance was completely shattered. You work like a robot. You keep on charging your devices.

10. In the offline mode you have full control in class but in online mode you don’t have full control. Level of engagement is related to empathy towards students. Your understanding of the students make them more engaged in the class.

11. Many a times I have to control students. Sometimes, I have to remove the students from the class.

12. In my point of view these deteriorated during this period. Students used to copy the answers, sometimes I have to punish the students, we have certain guidelines for this. Self-efficacy is also important in evaluation process. If you are not confident in using technology the student may also be not confident.

13. Clearly set ground rules from the institute, all students with camera on can really help in effectively conducting online classes. Professional etiquettes should be there.

14. I ll prefer online mode for some courses and offline mode for skill based courses.

15. Initially it was a nightmare but later on it was a good experience to learn new things and I am happy that I survived this period.

Sample 3:

1. The transition was not easy. It was full of challenges. But we started using the platform and knew how to operate it, things became easy. Yes, content development was difficult as I have never used laptop too much as it was not required. I was resisting the change but the taking the class sitting in your comfort zone, I started liking it.

2. Communication skills are most important I must say. Interpersonal skills were important but at number two. Empathy is desirable whether you are offline or online. We need to give some cushion to the students.

3. I have used Zoom initially but is had a restriction of 40 minutes. Every time I had to restart the class. So in a month we shifted to google Meet. The screensharing was a problem with Meet as navigating within the tables was creating trouble. No whiteboard was made available on Meet.

4. Yes the support was given from the institute. A desktop was given to all the faculty members. Other gadgets that were given to us was a mic, camera. Internet was also there in the office but at home I had my own broadband connection and a dongle as well.

5. Self-efficacy is very important for any teacher and any class. I come from computer background (MCA) so I was confident in handling the technology. With engaging content and my teaching pattern, come more confident.

6. A desktop, mic, web cam, internet and a dongle as well.

7. Major barriers encountered was the internal and external. Family interference, my pet used to get the vibe that she is in class (hahaha!!). External noise of hawkers, vendors, sabziwala etc was beyond my control. I had my own room for my classes so that these go smoothly.

8. Technical barrier was once my laptop broke down and getting it repaired during lockdown was impossible. Sometimes the issue with mic and camera were also there.

9. Personal barriers included some safety concerns. I was a victim of abuse once. This is the problem with open source platform like Meet. I did not take that class for 2 days just to avoid that person. When I reported this matter, my institute became conscious and made a mandate to enter the class with the name and UID issued to each student.

10. Students engagement depends upon the sincerity of the students, their personality and their intention. Extroverts will never hesitate to ask in contrast to the introverts. The do not participate because of the fear of giving the incorrect answer. Other is they may feel that the intelligent will answer so let me be quite (loafing). Another could be lack of the knowledge.

11. I was not allowed to remove any student from the class. I was required to bring it to the notice of the HOD and action was taken from that level. In case the students is disrespecting the class decorum, I use to remove then and there.

12. Checking of the notebooks on screen was painful as it consumed 20-25 minutes as compared to 8 minutes in offline mode. I have worked 16 hours a day during lockdown. So it was full of trouble.

13. I prefer offline class. But now the shift is not difficult. I am flexible.

14. Suggestion to make online class more effective is to make extensive use of white board given in the platform. Secondly, there must be a software which can list out those students who are not participating.

15. My overall experience was quite hectic but it was a learning experience altogether. I would never had known how to use a software and how to integrate our resources to the platform.

Sample 4:

1. Transition was smooth, but lot of challenges were involved. In regular teaching, I am using presentations, delivery was not a problem, In offline classes as well, I was using the presentations to teach. The physical presence of the students was a challenge. I do not know whether they were in the same state of mind as I was. The connect was missing in online mode. By looking at the face of a particular student, we can make out whether he is able to understand or not. You cannot force a students to switch on the camera, there may not some network issues at their end. I did not know whether I was able give my 100 percent. The reciprocation was another challenge and I was not able to view anyone. They were in passive mode. Though I tried to engage them through polls, MCQs, but I had no clue if they were listening to me and giving answers without googling it. Physical connectivity is very important. In online mode, outcome of the class I cannot guarantee.

2. With respect to the skills, I believe technical skills are most important with online classes. Computer skills are equally important. The platform institute is using should be user friendly. Communication skills are evident in both online and offline. Empathy and interpersonal skill are not that important, especially in online classes. In online class, I can be empathetic to an extent, eventually it will lead to frustration.

Not much is in the control of the teacher in an online mode as any teacher is not responsible for the connectivity of the student.

3. We started with the free platform, google meet, initially as the pandemic was sudden and no one was prepared. But later, our institute had bought a licenced platform for the conduct of the classes. No problem was associated with this platform.

4. Certainly self-efficacy is very important. You go ahead with any technology, if you are doubting yourself as a perpetrator, you cannot have command over any technology.

5. Facilities owned by me included a proper broadband connection, working webcam, power supply was uninterrupted.

6. Barriers encountered during online classes were that I do not have any sound proof room at my home. DJ, hawker, etc. are not in my control. There must be a room exclusively to manage your classes. Frustration was there, I had to wait for all the students to join in the class, as they hail from remote areas or tier 3 areas or at times coz of prevailing political issue, the internet was suspended etc.. Sometimes the mic of the students were on and all sort of noise I was able to hear, so eventually I had to mute all the students in the class.

7. The kind of institutional support that I got was the licenced platform, the training to use the same and today as well, we have whatsapp group where the support of technical team is available 24/7. Apart from this no support was there. The institute should have taken care of the nominal amount for budget for those faculty who were not from sound economic background.

8. Technical difficulty faced by me was that there is a limited capacity in the laptop. So more usage of same led to technical snag.

9. I had undergone a lot of personal problems like screen time went up, strain in my eyes, dry eyes, my migraine aggravated eventually. There was time when I did not feel like opening my laptop. So my health was costed by online classes. I do not have ergonomic chair. I started up sitting in my table and chair and

later eased into my recliner, this led to lot of medical problems. Practical and workshop related courses face tough time in online mode. Till the time students do not have same means as in institute, they ll not be able to understand. So one to one is not possible in online class.

10. The students engagement was very high initially as everybody was excited. But after 10-15 days, it just went down. The students are in that stage where they feel no one is watching them. They were in the lackadaisical mode and become passive listeners. I had an instance where student was watching some movie which means he was not at all listening to me. Basically, they were in the class for attendance. Also, students who are mature, dedicated, values the money will certainly understand the importance of these classes.

11. There is no method to control the student. The only option I had was to remove them from the class if they create some nuisance or do not respond to my question.

12. While checking assignments online, I had no issue as before pandemic the submissions were taken online. The instruction paid a huge role in online submission. Record maintenance was not a problem as I used to maintain the excel sheets. Online invigilation was a problem no doubt.

13. Suggestion to improve online teaching is to understand the age of the learner. Maturity plays a huge role.

14. Blended mode is best for me. No purely online nor purely offline.

15. My overall experience was good with a couple of hurdles and frustration.

Sample 5:

1. Everyone was in fear, the fear of unknown. I was shaken when I was told that the semester would go online. Transition was very sudden and none of the teacher was prepared. I did not like it initially but later I had no choice but to accept it. It seemed to be a new normal. I realized that most of my problems were due to my inhibitions. I was blaming other channels. But it was not so. So, the transition was bad earlier.

2. There are skills which are important to teach but before that there is the infrastructure that plays an important role and then the ability to handle that infrastructure. Skills that we exhibit in offline classes became more important in online classes, as students' visibility was not there. So, technical skills, basic computer skills and comm skills are very important. In F2F classes, you can see the students, you see their expressions. But in online classes, it becomes a challenge. You need to give students some shock by asking questions. Empathy is also important in such classes when we know students are not visible.

3. We started with google meet initially then Zoom as well. Later my institute bought a licensed platform which was far better than the open-source platforms. There was no issue with the platform as classes became smooth and easy and there were no security concerns associated with it. Yes, we were not able to switch on the camera as it consumes more bandwidth.

4. Efficacy comes from self-training. You cannot learn riding a cycle until you are on road. Simulation may help you with skills, but ultimately the hands-on is going to help you. I was confident in using the technology and the platform. We do have watchdogs sitting on our heads who may enter our class and inspect the same and give us the feedback. This has affected faculty's behaviour and their confidence was shaken.

5. I do have smart phone, desktop and my laptop, along with this I had internet connection. I wanted to buy pen tab bit could not purchase as it was costly.

6. The barriers: I started with white board, that was a bad plan. There was a board in my online platform, I started using that. Construction work nearby my home, hawkers, raddiwala, sabziwala, etc., was not in my control. We need to realize that you are in your office and plan your workstation accordingly.

7. Institutional support I got was training for 3 days, feedback from the people who used to visit the class, and the seniors also helped. Other than this, we do have technical support team 24/7.

8. Technical difficulty was that the platform that I was using was not compatible with Windows 7. So, I had to buy a new laptop. I started running from pillar to post.

9. As such, no personal problems were faced. My class was very good. Just that I need to have a device over which I could write clearly. Practical and workshop related courses face tough time in online mode. GoI actually did a good comeback with all IITs and IISc in collaboration with Amrita University to provide virtual platform for Biology based practical.

10. Students' engagement in the class is difficult as students do not listen to the teachers. They don't participate as they are engaged in lot many things going on parallelly. When either of the parties are not visible, they take the advantage. Basically, there was no eye contact and no mind contact.

11. Controlling them, the best way is to give them shocks. So, poll question, MCQs etc. I used to bombard. Summaries or give your critique on the topic, I use to adopt these tactics and it worked. Removing a student from class is also one way to control. So those who do not answer, I use to remove them. And yes, leave the ego outside the class. We should be mature and tactful enough to deal with critical students.

12. Assignments were tough to assess, we were not able to pull their ears (laughter). It was copy paste during online classes.

13. Face to face is always my preference

14. Suggestion to improve online teaching: Student should be visible first of all. This should be made a mandate. Teacher should also be visible to the students. This will create impact in the class. The country talked a lot about online education but did not take it seriously. All responsible stakeholders need to come forward and collaborate. Extensive training to students is also required.

15. Overall experience: I survived the online mode. It was a mixed experience. For students, they also have faced these kinds of challenges.

Sample 6:

1. The transition was same as I was already involved with UGS Swayam. I was already using YouTube for asynchronous learning and promoted the digital education since 2019. So to me, before pandemic and after, there is no change.

2. With respect to the skills, you need a minimum knowledge on how the internet works and basic skill related to recording lecture. Any faculty must be good with technical skills. The only problem with a few faculty was laid back attitude.

3. I have used you tube, Moodle and Google Classroom. I am not comfortable with Moodle, nor the students. These things are for LMS. Classroom is still better, But my personal preference is YouTube as your content is accessible to all across the world without registration. I want to keep my resources open to all.

4. O yes, I got all the support in terms of training and technical support.

5. Self-efficacy is important whether you teach online, offline, synchronous or asynchronous.

6. I do have my laptop, broadband connection, a high quality camera, very effective mic/recording system as I make videos for you tube. OBF I have which helped me in removing the background noise. Quantum of work is more, but I love to do that.

7. Barrier was non-verbal cues were missing, if you are in classroom, you can know by seeing the students face. In case of synchronous class, it is a monologue.

8. Technical difficulty, sometimes there was some issue with recording things and uploading the same on you tube. I took help of my assistant.

9. With respect to personal problems, Integrating skill based course with technology was a challenge. V-lab by government was a total fiasco.

Simulation is one way of giving practical input to the students. My WLB have improves in the COVID. This is the beauty of online education.

10. In my class engagement of the students was too good. My classes today too, are online with a great level of students participation and interaction.

11. I have never controlled students in my class. They were able to relate with my content so they were with me at all given time.

12. Evaluation of assignments was not easy. Proctored evaluation was easy. But I feel, in such evaluation, trust factor is most important. In my assignments, students simply cannot answer merely by googling.

13. I will prefer online as it is highly egalitarian. The students cannot afford to go to some good institutes, so for them online is the best option. It is cheaper as compared to offline. Blended is comparatively easy.

14. Suggestions are multiple to make online teaching more effective. First of all, the content is most important. Videos should never exceed 10 minutes. Attention grabbing is most important. Review what you have taught.

15. My overall experience was amazing with online teaching. I suggest, all faculty must enrol to at least one MOOC course.