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Research Article

A Multivariate Analysis of Learner Attitude, Usability, Learning Environment, and Infrastructure in Determining E-Learning Satisfaction and Effectiveness

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ABSTRACT

E-learning has brought about a change in conventional teaching techniques that stressed flexibility, critical thinking, and providing learners with fast feedback. This change has been brought about by the rapid expansion of technology, which has propelled the recent emergence of e-learning. Several educational institutions, including colleges, schools, basic and secondary schools, and higher education centers, were forced to close their doors as a result of the Covid19 outbreak. The new model for education in the modern day is e-learning, which is becoming more popular. To put it another way, the conventional approach is being phased out in favor of the one that is now being used during this pandemic. During the course of the pandemic, the use of web-based educational programs became highly common. The purpose of this research is to evaluate the link between independent and dependent characteristics, including learner attitude, ease of use, infrastructure support, evaluation of the efficacy of the learning environment, and overall satisfaction with the learning experience. This study is a cross-sectional investigation. There has been a collection of both primary and secondary data. For the purpose of this research, a snowball sampling strategy was used, and there were a total of 300 respondents. Using the Partial Least Squares (PLS) software, the model was put through an empirical test in the study that is now being presented.

Keywords: E-learning, Internet, learner ‘s attitude, ease of use, infrastructure support, learning environment, learning satisfaction, Effectiveness

INTRODUCTION

Learning experiences that are adaptable and driven by technology have been made possible by e-learning, which has completely changed the educational environment. According to Sun et al. (2008), the efficacy and satisfaction of e-learning are dependent on a number of elements, including the attitude of the student, the usability of the learning environment, the infrastructure, and the learning environment. According to research conducted by Al-Fraihat et al. in 2020, learner attitude, which is influenced by several factors including motivation and digital literacy, has a substantial impact on the results of e-learning. According to Wang et al. (2021), there is a significant correlation between usability and learner engagement and satisfaction. Usability encompasses both the simplicity of navigation and the user-friendliness of interfaces. According to Eom and Ashill (2016), the learning environment, which includes pedagogical design and interaction quality, is one of the most important factors in the development of an efficient digital learning experience overall. In addition, infrastructure, which includes things like internet connection, accessibility of devices, and support from institutions, serves as a basic component that ensures smooth learning). Nowadays various Interactive features are available in e-learning methods via numerous new tools too (Putra et al., 2024).

A strong framework is provided by multivariate analysis, which allows for the examination of the interrelationships among these aspects as well as the cumulative influence that they have on the efficacy and satisfaction of e-learning.

The previous study has examined these factors in isolation; however, there has been a limited amount of research that has investigated the combined impact of these variables using an integrated model (Selim, 2007). With the use of a multivariate approach, this research endeavors to bridge this gap by evaluating the complicated connections that exist between these factors. In doing so, it will contribute to the continuing discussion over the optimization of e-learning experiences.

Especially E learning started when during Covid state of Kerala made the first report of an illness with the Indian Corona virus on January 30, 2020. These flights from Wuhan to India had an effect on the person. Colleges and schools were shuttered before to the commencement of a nationwide shutdown on March 24, 2020, in an effort to prevent the further spread of the Corona virus. The outbreak caused over 1.2 billion students in India and 186 other countries to be unable to attend school as a result of the interruptions. While the epidemic was going on, the government published recommendations about lockdowns and unlocks. According to Kostaki and Karayianni (2021), e-learning is a type of education that incorporates the electronic transmission of teaching, training, or digital learning materials. These resources may include video, audio, text, animations, and pictures. Additionally, e-learning is supported by digital media and resources. According to Di Vaio et al. 2020a, the conventional technique of teaching has been replaced by the current way of learning as a result of technological advancements. According to Adams et al. (2018) and Chopra et al. (2019), e-learning has shown to be effective in boosting not only the knowledge of learners but also that of instructors and those from the industry. There has been a fast increase in the number of higher education institutions, and these institutions are exploring for alternative ways to distribute information for online learning. For a variety of reasons, an increasing number of students are enrolling in online courses as technology continues to advance at a fast pace. Compared to a non-adaptive platform, the e-learning platform shown a significant improvement in learners' critical thinking abilities, as well as their ability to acquire and retain information (Kovanović et al., 2019). Learners are able to improve their communication skills via the usage of e-learning since it allows them to engage with other members of their peer group, allowing them to exchange resources and assignments (Wang et al., 2020). Additionally, it enhances the learner's capacity to apply ideas in situations that resemble those that occur in the actual world (Zou et al., 2020; Li et al., 2021). The learners are provided with tailored feedback via the use of an e-learning platform, which enables them to distinguish between their strengths and limitations. When compared to more conventional teaching approaches, the use of an e-learning platform resulted in higher levels of motivation and engagement among students (Jang et al., 2020). The market for e-learning in India is expected to increase at a compound annual growth rate (CAGR) of 18.57% from 2023 to 2029, according to research that provides industry insights. Nowadays E-learning is now being associated with AI too (Halkiopoulos & Gkintoni, 2024). The analysis highlights an increasing trend. According to projections, the market is anticipated to expand, going from 10.24 billion USD in 2023 to 28.46 billion USD by 2029.According to learners, the most significant challenges they encounter are ease of access, flexibility, and pedagogical technique (Murgatrotd, 2020). Today, e-learning has emerged as a strong alternative to traditional classroom learning via the use of the internet. Learners have uneven learning chances because of digital inequalities and a lack of technology. Learners from lower-income households do not have access to e-learning courses, and the cost of internet is one of the key obstacles that prevents them from accessing e-learning (Clemens et al., 2021). The learning environment is a significant factor, according to research that was done in the past. According to Bisht et al.'s research from 2020, almost thirty percent of students feel that the most significant challenge they face while taking online tests is a lack of adequate connection. The instructors themselves have a wide range of tasks, which include teaching, doing research, evaluating the performance of the students, and enhancing the level of interaction within the classroom setting.

Because of the present pandemic period, there has been a huge growth in the employment of e-learning techniques. It was never possible for electronic learning to completely replace the conventional classroom method of education, despite the fact that there had been a change in the way that teaching was done and that electronic learning had grown increasingly prominent before the Covid 19 conference. There has been a significant increase in the number of online teaching opportunities all across the globe, especially in India, as a result of the epidemic. By 2025, it is anticipated that global expenditures in educational technology would reach $350 billion, which is an increase from the amount of US$18.66 billion in 2019.

This has occurred as a result of progress and acceptance. Byjus and Vedantu are two of the most prominent players in the sphere of online education at the present very moment. Since the beginning of the pandemic, software costs have increased, and as a result, the National Institutional Ranking Framework (NIRF) in India has begun offering online degree programs that make use of virtual coaching apps and online learning beginning on May 30, 2020.

According to the results of a survey conducted by the World Economic Forum, the use of applications like as WhatsApp, Google Meet, Microsoft Team, and Zoom in the classroom has recently become the standard for both students and teachers. According to Singh and Thurman (2019), the greatest aspect in e-learning is the use of technology.

The performance of instructors and the attitudes of students both improved as a result of Covid 19. Every educational establishment has to find a way to achieve a balance between traditional classroom teaching and the increased use of technology. A great number of organizations all over the globe have brought their operations into the digital realm in response to this urgent need. Through the use of online learning, confusion is being eliminated. Since COVID-19, Chinese institutions have expanded the amount of online learning they provide. There are still problems with accessibility, flexibility, student attitudes, teacher effectiveness, and infrastructure support for online education, according to a number of studies. This is despite the fact that e-learning proved to be advantageous throughout the crisis.

The survey that was compiled by QS I Gauge, which is located in London, indicates that the most significant concerns of online educators and students are related to connection and infrastructure problems. When the moderating effect of perceived COVID-19 injury is taken into consideration, Kumar, Saxena, and Baber (2021) investigated as to how learner-content and e-learning quality influence the level of satisfaction experienced by learners. There is a correlation between the substance of e-learning, the satisfaction of students, and the quality of the experience. There is not much of an impact that perceived harm has on student satisfaction. According to the findings of the research, the presence of COVID-19 on campus did not have any impact on the robustly positive link that exists between the effectiveness of online education and the satisfaction of students. E-learning quality also has a significant impact on the content and the satisfaction that students get from it. The influence of COVID-19 on Sustainable Development Goal 4 (education) was explored by Xin-Yu Wang and colleagues (2022). The COVID-19 outbreak compelled educational institutions all over the globe to rapidly expand their e-learning systems in order to combat the epidemic. Within the scope of this project, convenience sampling was used in order to obtain data from middle school pupils. In order to conduct an analysis of this interaction inside a single setting, we constructed an integrated model that included five dimensions: the student, the design, the technology, the teacher, and the environment. A considerable influence has been made on the education industry as a result of COVID-19. There is no way for stakeholders in higher education to continue doing business as usual, and there is no chance that anything will change. Only online operations are conducted by global colleges and institutes. This study's purpose is to investigate the relationship between learner attitude, ease of use, learning environment, and infrastructure support and the level of satisfaction experienced by those who participate in e-learning. Before the COVID 19 conference, e-learning was a different method of instruction; now, it is rapidly becoming an essential component of the educational system. A gap in the research is filled by this effort. The study investigates the ways in which the educational setting is undergoing change and the degree to which it is meeting the needs of students.

LITERATURE REVIEW

E-learning has gained prominence as an essential mode of education, particularly in the wake of technological advancements and global disruptions such as the COVID-19 pandemic. Several factors contribute to the effectiveness and satisfaction of e-learning, including learner attitude, usability, learning environment, and infrastructure. This review synthesizes existing literature on these key determinants and their interrelationships. Learner Attitude and E-Learning Effectiveness Learner attitude significantly influences e-learning outcomes, as it affects engagement, motivation, and adaptability to digital platforms (Al-Fraihat et al., 2020). Positive attitudes toward technology and self-directed learning enhance participation and knowledge retention (Park, 2009). Conversely, reluctance to use e-learning tools due to technical anxiety or lack of digital literacy can hinder learning effectiveness (Bhuasiri et al., 2012). Usability and User Experience in E-Learning The usability of an e-learning platform—including its interface design, navigation ease, and accessibility—plays a crucial role in learner satisfaction (Wang et al., 2021). A user-friendly platform enhances engagement, reduces cognitive load, and facilitates seamless learning experiences (Sun et al., 2008). Poor usability, characterized by complex navigation or lack of mobile compatibility, often leads to frustration and disengagement (Selim, 2007). Learning Environment and Pedagogical Design The effectiveness of e-learning is also determined by the instructional design, interaction quality, and collaborative features of the learning environment (Eom & Ashill, 2016). Studies highlight that active engagement through discussion forums, real-time feedback, and multimedia integration improves learning outcomes (Means et al., 2013). Additionally, social and peer

interactions in virtual environments contribute to student satisfaction (Arbaugh, 2014). Infrastructure and Technological Support Reliable infrastructure, including internet connectivity, device accessibility, and institutional support, is fundamental to e-learning success (Cohen et al., 2021). Insufficient infrastructure, especially in developing regions, limits access to e-learning and creates digital divides (Adedoyin & Soykan, 2020). Institutional support, such as IT assistance and training programs, enhances digital readiness and mitigates technical barriers (Bolliger & Wasilik, 2009). Multivariate Approaches in E-Learning Research While prior studies have examined these factors individually, there is a growing need for multivariate analysis to understand their combined effects (Šumak et al., 2011). Multivariate statistical techniques, such as structural equation modeling (SEM) and regression analysis, provide deeper insights into the complex relationships between these determinants and their influence on e-learning satisfaction and effectiveness (Roca et al., 2006).

Learning Attitude: A student's learning attitude is his or her willingness to learn. E-learning is not new. Recent expansion has been amazing. Students can connect with professors and peers from anywhere using technology (Singh & Thurman, 2019). Chen et al. (2005) conducted research on student acceptability of Internet-based learning tools. The mentality of a learner determined whether they would use an online learning medium. According to Sun et al. (2008), the primary factors influencing learners' happiness include learner computer anxiety, instructor attitude towards e-Learning, e-Learning course flexibility, quality, utility, ease of use, and variety in assessments. Piccoli et al. (2001) observed that online learners who have a positive attitude and are not afraid of IT complexity are happier and more effective. E-learning succeeds if people like it (Liaw et al., 2007). E-learning will succeed if people like it (Liaw et al., 2007). COVID 19 has forced educators, professors, and students to rethink online education (Ribeiro, 2020).

Ease of Use: A system, technology, or other item's ease of use is described. E-learning is available 24/7. Haifa (2020) found that Ease of Use strongly impacts e-learning platform acceptability. Naim et al. (2019) found that computer anxiety impairs information system usability. E- Learning improves the quality of teach also help learner to complete the assignment quickly. E-Learning can affect learner performance in saving resources, higher productivity, and competency. With the help of learning analytics process model, we can monitor learner individual performance (Verbert et al., 2013). Some researchers contend that such monitoring can help in improving self-regulation skills as well improve the learning outcome (Reigeluth 1983; Schunk 2012). E- Learning may cause learner to feel isolated, which can impact on their academic performance. Several studies also reported that e-learning improve learner performance. E- learning improve the learner performance as compared to traditional method the reason is learner can access the content anytime anywhere (Alshammari et al., 2020). Many learners are in favor interactive learning in classroom to interactive learning on e-learning (Yates et al., 2020)

Learning Environment: The learning environment enhances problem-solving and critical thinking skills. Seating, light, noise, and even color may all have an impact on student progress, according to research (Bransford et al., 2000).). Positive learning environments motivate, engage, and expand learning. Hendrix, J. (2019). To improve e-learning, identify the aspects that cause difficulty for students. Students do better in peaceful situations. To understand the basics of a strong E-learning environment, instructors must be innovative. Multimedia, such as photos, graphics, and video, aids in keeping students' attention. The learning environment changed dramatically throughout the epidemic. Distance learning offers both advantages and disadvantages. Distractions, sophisticated technology, limited social connections, and communication difficulties with academics may make remote learning challenging (Cao etal, 2020).

Infrastructure Support: E-Learning tools abound today. Infrastructure issues can make learning and teaching challenging. E-Learning classes bore students. Teachers and students struggle with internet apps. Teachers struggle to use technology, engage kids, and keep them interested. Student engagement and interest are crucial. Feedback and assessment will improve learning. Ed Tech companies and application have proven great help to students. (Brianna etal.,2019). Byjus, Lido Learning, Zoom, Google Classroom, and SWAYAM promoted E- Learning. 2020 (Alam; Bao) Though E-Learning is the ideal option for classroom class, some learners have shown unfavorable attitudes about E-learning behavior (Rohman, Marji, Sugandi, & Nurhadi, 2020). Jaeger & Blaabæk (2020) found uneven learning chances. E-Learning programs are harder to obtain for low-income and rural students due to high internet costs. (Adam,Kaye, &Haßler,2020)

Learners' Satisfaction: Satisfaction influences e-learning quality and efficacy, According to Serhii et al. (2020). E-Learning success is measured by learner satisfaction, according to de Oliveira Araújo et al. (2020). Amir et al.

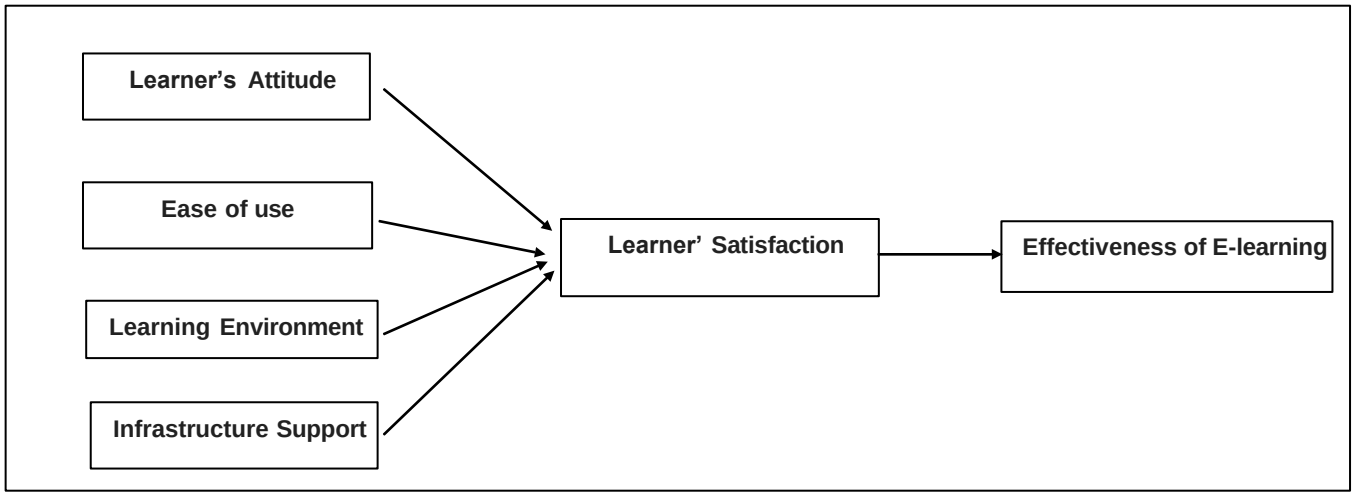
(2020) discovered that remote learners had poorer learning satisfaction and greater difficulty communicating with instructors and peers. Internal issues such as student preparation for distant learning, time management, and incapacity to remain focused online learning were cited. Learner satisfaction in e- learning plays important role, which is also influenced by many factors that helps to improve the quality of course content, which should be well structured and includes interactive components like videos, puzzles, and quizzes to maintain the learner engagement and learner motivation-learning has seen huge growth in recent times, partially due to COVID 19 pandemic (Alqahtani & Rajkhan, 2020; Mehla et al., 2021). E- learning provides the platforms to the learner to complete course anytime and anywhere. Some learner face problem regarding e- learning which can be related to learning environment and infrastructure support, which can cause technostress among learners (Abbas et al., 2023). To improve this dissatisfaction, e- learning use gamification element, to enhance learner satisfaction. In e-learning learner satisfaction can enhanced by engagement, motivation, performance, and gamification as each variable contributes positive learning experience. Learner engagement allows the learner to feel class enjoyable, Motivated learners are more committed and obtain satisfaction from achieving their goals. Improved performance boosts leaner confidence and gamification adds an element of challenge and games makes the learning enjoyable.

Effectiveness of E-Learning: E-learning is the only option during COVID-19. Internet access is crucial in school and college. (Vrielink, 2006). Online courses offer convenient, useful tools for today's learners. Student and teacher attitude determine e-learning performance. Learner satisfaction measures e-learning efficacy. Verkhova and Akimov (2019) state that good distance education includes accessibility, feasibility, education, student and teacher happiness, and lasting economic sustainability. Islam et al. (2023) examined COVID-19-related e-learner satisfaction factors. 650 university students were surveyed randomly. CFA found e-learner satisfaction factors. A reliability test and frequency distribution determined respondents' demographics. SEM was used to assess how six independent factors affect e-learner satisfaction. Psychological variables, instructional materials and design, technical device accessibility, teacher attributes, perceptions, and expectations greatly affect e-learner satisfaction, according to regression study. Student engagement was insignificant.

Based on the literature, this research analyzes the link between independent and dependent variables. Learners' attitude, ease of use, learning environment, and infrastructural support are independent factors, whereas learners' satisfaction and e-learning effectiveness are dependent variables. The research examined and verified the author's independent and dependent variable model.

METHODOLOGY

Figure 1: Conceptual Framework of the Study



The graphic above depicts the study's conceptual framework and the interrelationship between dependent and independent variables. Learner Attitude, Ease of Use, Learning Environment, and Infrastructure Support are the independent variables considered in the research. The dependent variables in the study are learner satisfaction and learning effectiveness. During Covid19, the connection between the dependent and independent variables reveals the learner's attitude towards E-Learning education.

The following hypotheses are proposed for empirical investigation in this study.

•Hypothesis1: Learner attitude affect learner 's satisfaction

•Hypothesis2: Ease of use affect learner's satisfaction

•Hypothesis3: Learning Environment affect learner 's satisfaction

•Hypothesis4: Infrastructure Support affect learner 's satisfaction

•Hypothesis5: Learner satisfaction affect effectiveness of learning.

Data collection and sample selection

This study sought to determine COVID-19-related learner attitudes, ease of use, infrastructure support, learning environment, satisfaction, and efficacy of e-learning. This cross-sectional study observed a collection of students at a certain period. The study uses qualitative and quantitative methods. Collecting main and secondary data. Snowball sampling was used to recruit 300 higher education students from Dehradun, Uttarakhand. The study samples graduates and post-grads. Using prior study papers, structured questionnaires collected primary data. Based on student strength, 10 institutions and 20 colleges delivered 365 questionnaires. 300 people returned questionnaires, 82% responded.

Reliability and validity of scale

Learner 's attitude, ease of use, infrastructure support, learning environment learner 's satisfaction and effectiveness of e- learning are measured by using applicable construct from past studies. Quantitative values are attached to these factors based on the responses to the statements drawn from the literature, with the answers fluctuate from _strongly disagree '(1) to _strongly agree '(5). Partial Least Square (PLS) software has been used in the current study for testing the model empirically. The construct reliability has been tested using both the Cronbach 's Alpha and Composite Reliability (Table 1). All the values are greater than 0.7 (alpha coefficient of 0.70 or higher is acceptable suggested by Hair et al., 2009). The construct validity has been tested using both Convergent Validity (Average Variance Explained) and Discriminant Validity (Table 1 and Table 2). The values of average variance explained are close to 0.5 or above. (AVE value close to 0.5 or above is acceptable suggested by Hair et al., 2009). Discriminant validity evidence distinguishes different concept measures.

Table 1: Construct Reliability and Validity

Construct	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Learner's Attitude	0.915	0.892	0.627
Ease of use	0.824	0.816	0.483
Learner 's satisfaction	0.816	0.87	0.574
Effectiveness of E-Learning	0.805	0.865	0.562
Infrastructure Support	0.756	0.86	0.672
Learning Environment	0.711	0.817	0.529

Table 2

Discriminant Validity-HTMT Ratio						
Construct	EEL	EOU	IS	LA	LE	LS
Effectiveness of E-Learning						
Ease of use	0.081					
Infrastructure Support	0.768	0.111				

Learner ‘s Attitude	0.08	0.687	0.076			
Learning Environment	0.677	0.156	0.764	0.159		
Learner ‘s satisfaction	0.386	0.082	0.371	0.077	0.334	

It should be demonstrated that discriminant validity by showing that unrelated measurements are unrelated. Cross-loading and Heterotrait - monotrait (HTMT) ratio of correlation helps assess discriminant validity. If the HTMT is over 0.85, discriminant validity is lacking (Kline, 2011). Table 4, Discriminant Validity-HTMT Ratio values are acceptable.

Analytical Approach

Table 3

	β value	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	Hypothesis Supported?
H1 EOU -> LS	0.225	0.044	0.09	2.282	0.048<0.05	Yes
H2 IS -> LS	0.212	0.206	0.074	2.878	0.004<0.05	Yes
H3 LA -> LS	0.074	0.042	0.026	2.819	0.013<0.05	Yes
H4 LE -> LS	0.155	0.163	0.07	2.207	0.028<0.05	Yes
H5 LS -> EOEL	0.322	0.325	0.088	3.645	0<0.05	Yes

Hypothesis testing is frequently performed in the context of PLS-SEM by generating a P value for each route coefficient, which can be one-tailed or two-tailed dependent on the researcher's prior knowledge of the path's direction and the sign of its associated coefficient (Kock, 2015). The P value in the present analytical technique (Table 3) is two-tailed and less than 0.05. At the 95% level of significance, t values are more than 1.96 (two-tail). Hair and colleagues (2009). The findings show that Hypothesis 1 is accepted, with a value of 0.025, a t value of 2.282, and a p value of 0.048. The ease of use of technology in online teaching methodology has a substantial impact on Learners' satisfaction levels. In the instance of Hypothesis 2, infrastructure support has a value of 0.212, a t value of 2.878, and a p value of 0.004. For Hypothesis 3, the values 0.074, 2.819, and 0.013 indicate that the hypothesis is accepted. As a result, it is discovered that learners' attitudes have a major influence on learners' satisfaction. In the instance of Hypothesis 4, learners’ environment influences their pleasure with values 0.155, 2.207, and 0.028. For Hypothesis5, the values 0.322, 3.645, and 0 indicate that the hypothesis is accepted. As a result, learner satisfaction has a substantial impact on the efficacy of e-learning.

Table 4

Model Fit	
SRMR	0.077
d_ULS	2.238
d_G	0.656
Chi-Square	1063.094

NFI	0.731

The values of the model fit are shown in Table 4. A result for the Standardized Root Mean Square Residual (SRMR) that is less than 0.10 or less than 0.08 (Hu and Bentler, 1999) is considered to be a good match. The SRMR falls within a range that is considered to be acceptable, as stated by the model referenced earlier. The NFI generates values that fall somewhere between 0 and 1. To a greater extent, the fit is improved when the NFI is closer to one. In spite of the fact that the theoretical boundary of NFI is one, it is possible that NFI will not reach this upper limit in small samples, even if the model that was provided is accurate (Bentler , 1990). The model fit indicates that the NFI value is 0.731, which is rather close to 1.

DISCUSSION

The use of e-learning has attained widespread popularity. This trend was embraced by educational institutions in developing countries during the course of the previous decade (Bhuasiri, 2012). It is not the case that all educational institutions, countries, and cultures have implemented online learning in the same manner. Learning and teaching have evolved ever since the World Health Organization (WHO) declared COVID-19 to be a pandemic on March 11, 2020. This unpredictability and upheaval has led to an increase in the demand for online education. The implementation of e-learning during the COVID-19 epidemic brought to light a number of aspects that had an influence on the level of satisfaction experienced by learners and the efficiency of e-learning. When it comes to deciding how successfully learners adapt to e-learning, each aspect plays a vital role. These variables include the learners' attitudes, the ease of use of e-learning platforms, the learning environment, and the support provided by infrastructure. The learner's attitude toward e-learning is one of the most essential aspects being considered. When a learner has a positive perspective, they are more likely to appreciate the atmosphere of online learning. Another key factor is the simplicity of use of e-learning, which also plays a significant part in the process of e-learning education. In situations where e-learning is user-friendly and easily available, it becomes much simpler to take part in educational activities. Similarly, the learning environment and the supports provided by the infrastructure also play a vital part in ensuring that learner experiences are satisfied. Learners were expected to design their own learning place in order to enrol in e-learning. It is not a traditional classroom. Additionally, with the help of infrastructure, students must have access to internet facilities and devices that are in good working order in order to attend e-learning sessions without experiencing any disruptions. However, some who have had regular connection issues have reported feeling dissatisfied with the service. During COVID-19, the efficacy of e-learning was impacted by a variety of elements, such as the attitudes of learners, the convenience of use, the learning environment, and the support provided by infrastructure. Some students were confronted with considerable obstacles that had an impact on their level of pleasure and the consequences of their learning. According to the findings of the present research, the degree of satisfaction and efficacy of e-learning is influenced by factors such as learner attitude, convenience of use, learning environment, and infrastructure support. Because of the significant impact that these factors have on the technique of online instruction, the education sector have to address them in order to guarantee that online classrooms in schools, colleges, and universities run smoothly.

Managerial implications and Theoretical implications

The findings of this research provide higher education institutions with insights that may be used to improve student satisfaction and results in digital learning settings. The instructors may make use of these results by concentrating on the design of the course and making certain that the content of the e-learning course is in accordance with the new education policy and is able to meet the needs of the learners. Given the positive effects of gamification, it is recommended that teachers include gamified components into their lessons, such as leaderboards and badges, since these characteristics contribute to increased student satisfaction, decreased stress, and a diminished interest in the subject matter. Additionally, educational institutions of higher learning should classify learning as either user-friendly or adaptive. This kind of learning gives learners the opportunity to get tailored feedback, which is beneficial for determining their areas of strength and weakness. It is possible for this customization to boost student performance and satisfaction (Deng et al., 2019). This is accomplished by assisting educators and executives in the creation of targeted intermediation. Taking action to address the digital inequities that were found in the research is very necessary for policymakers. This includes providing training to instructors on how to provide effective digital help in order to overcome hurdles such as poor student engagement. Additionally, this includes enhancing access to

technology and infrastructure support, particularly for learners from remote regions, in order to guarantee that all learners have equal possibilities. The theoretical implications place an emphasis on the crucial roles that factors such as ease of use, learning environment, and infrastructure support play in a key part in increasing learner satisfaction. In the first place, the research provides evidence that provides support for the positive link between independent factors and dependent variables (Mehrvarz et al., 2021). This is shown by the fact that greater levels of engagement are directly associated with learning experiences. This is consistent with the self-determination idea, which maintains that allowing students to make their own decisions throughout the learning process makes them more intrinsically motivated and produces exceptional outcomes. Furthermore, the notion of competence in digital environments demonstrates a positive correlation between performance and satisfaction. Specifically, performance may be improved by including flexibility, ease of access, and quick feedback, which can also enhance the overall result. Additionally, the outcomes of the research emphasize the importance of gamification in supporting motivational theories, which in turn fosters increased learner satisfaction, decreases anxiety and tension, and promotes positive educational involvement (Chang, 2019). In addition, the findings lend credence to theories of engagement, which propose that learner experience, absorption, attention, and motivation are all enhanced. In addition to this, it tackles digital inequality, which has theoretical implications for access and integrity in educational research. These implications highlight the need of technology for a varied learner base. Through the validation of the mediating function that gamification plays in increasing the effectiveness and panoramic landscape of e-learning settings, this study contributes to the expansion of theoretical frameworks surrounding e-learning pleasure.

Discussion & Findings

The findings of this study reveal that learner attitude, ease of use, learning environment and infrastructure support positively impact the learner satisfaction, highlights the role of engaging content in continuing learner interest during the shift to e-learning. Learner attitude revealed a positive co-relation with learner satisfaction, as the flexibility, ease of access of e-learning platforms allows learner to access the content anytime, anywhere, which increase their productivity and capability (Seery et al., 2021). Motivation is operated by the capacity to make your own decisions and self- determination provided by e-learning, which influenced learner satisfaction. Moreover, gamification come out as a valuable mediating factor in e-learning satisfaction, which provides instant feedback, progress report and leader board. The use of gamified features improves learning process more enjoyable, thus improves satisfaction. These findings underline the effectiveness of e-learning when designed to key elements of learner engagement, performance, and motivation, with gamification plays important role in encouraging learner satisfaction. The study also recognizes challenges, such as digital inequalities, that controls access for some learners, which refers to the requirement for improved infrastructure support and learning environment.

Overall, the study strengthens, e-learning as a powerful, appealing alternative to traditional learning methods when these important factors are optimized.

Future Scope

The future scope of this study is that it can investigate several areas to grow and broaden the understanding of e-learning that impact the learner satisfaction. Firstly, the studies can explore the long- term effect of learner attitude, ease of use, learning environment and infrastructural supports. Secondly, future research can be conducted on e-learning impact various demographic groups, perceived usefulness, and role of gamification in e-learning also it can focus on socio-economic, age and geographic area, to address the problem of digital inequalities. The future of e-learning holds huge potential, which operates by advancement in technology. Personalized learning is one of them as traditional learning uses one approach for all, personalized learning works on learner need and preferences. Additionally, the integration of artificial intelligence and machine learning will change the educational practices by examining vast amount of data will provide personalized course and real time feedback. Even virtual reality and augmented reality will help in improving the learner overall performance and satisfaction. Together, these technologies will male education more relevant and helps in learner personal development. Moreover, longitudinal research or Experimental research can be used to examine the effect of learner`s attitude, ease of use, learning environment and infrastructural support on learners' satisfaction and effectiveness of e-learning change over time also by using experimental research we can manipulate the independent variable to see the cause-and-effect relationships between variables, especially more mediating factors like content creation and adaptive learning (Giray, 2021) Expanding the sample size beyond Uttarakhand will provide wide and comparative studies across region. Future research could also investigate the role of immersive technology, such as artificial intelligence that can

enhance the learner satisfaction. These future studies would provide to define e-learning models, making them more engaging, and effective for a various range of learners.

CONCLUSION

The study concludes that e-learning embody learner attitude, ease of use, learning environment, and infrastructure support key elements can significantly improve the learner satisfaction and effectiveness positioning it as a feasible and effective alternative to traditional education. Gamification can be used as an important mediating factor which helps in reinforce the e-learning experience by providing interactive components that increase the learner satisfaction and reduces stress and anxiety. Also, the next challenge is learner retention in e- learning it can be described to several factors, one of the major reasons are learner Attitude, Ease of Use, Learning Environment, and Infrastructure Support are the factors which effect e- learning engagement. This research highlights the importance's of personalized feedback and importance's of ease of use and accessible of content in improving the outcome and learner satisfaction. Though, the study also recognizes constant challenges like ease of access, ease of use and infrastructure support.

The findings of this research contribute to the theoretical and managerial knowledge of e-learning by demonstrating the importance of learner attitude, simplicity of use, and perceived utility in boosting learner satisfaction. Additionally, the study provides instructors with practical suggestions to assist them improve their teaching practices. According to the findings of the research, there should also be greater emphasis placed on bridging digital divides and continuing to investigate adaptive and gamified aspects in order to enhance learning settings that are more inclusive and successful. In order to investigate the impact of learner satisfaction and efficacy of e-learning, it is essential to establish a robust theoretical framework. This will allow for the examination of learner attitudes, ease of use, and perceived utility. In this particular investigation, the Social Cognitive Theory developed by Albert Bandura is the first theoretical approach that may be used. Through the use of incentive and monitoring, this idea may be used to make the most of learning situations. It focuses on the complicated relationship that exists between human behavior and the contexts in which it occurs. SCT has the ability to provide valuable insights into the ways in which learner satisfaction may be influenced by factors such as learner attitude, perceived utility, simplicity of use, learning environment, and infrastructural support variables , There are a number of significant theories that may be used in order to investigate the link between the independent factors and the dependent variable in the present investigation. These theories include the Social Cognitive Theory (SCT) and the Self-Determination Theory (SDT).

Social Cognitive Theory: Developed by Albert Bandura in (1986), which focuses on the role of observing the behavior of others, social interactions and obtaining information. Social Cognitive Theory can be used to magnify learning experiences by motivation, monitoring, and emulation. E- learning has changed the way knowledge is delivered and gained, which enables the learner to access content anytime and anywhere. Although, the satisfaction of e- learning is not only dependent on technology but also on the pedagogy used by institution and instructor. Learner can examine the behavior of instructor or peers, through Asynchronous learning which includes recorded lectures or assignments. This helps students learn difficult concept by seeing them. It tells abouts the learner trust in their ability to be successful in a specific task. In e- learning environment the instructor can track the progress of learner by giving them quizzes with feedback and encourage them to complete the task. self-determination theory focuses on instructor emotional support plays significant role in enhancing learner motivation, engagement and learning outcome in e- learning (Patall & Zambrano, 2019). Self Determination Theory is universally used to understand how social background impact the motivation and prosperity (Ryan & Deci, 2020). Three crucial needs are highlighted by SDT are relatedness, competence, and autonomy, all of which encourages motivation and effective functioning (Reeve, 2002; Gagné, 2003). SDT also helps to investigate how instructor and learner interactions can impact learning outcomes by satisfying these psychological needs in the e – learning environment.

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