# An Investigation into Use of Technology for Online Learning in Taraba State University, Nigeria

**Odaudu, Sunday Adejo, Ph.D, Oyeniyi, Solomon Olayinka**

**Department of Educational Foundations Taraba State University, Jalingo**

**DOI:** https://dx.doi.org/10.47772/IJRISS.2025.9020153

**Received: 17 January 2025; Accepted: 21 January 2025; Published: 08 March 2025**

## ABSTRACT

The innovative use of technology in promoting quality student learning offers significant opportunities for increased access to education, flexibility in developing skills, and personalized learning. This focus became a policy priority, especially following the COVID-19 pandemic, making effective policies regarding technology use critical. With schools across the country now shifting towards distance education and prospecting for online learning, analyzing education in the context of technological trends is to bring the future into the present and examine the chances to be ready for future of education. This study examines the role of technology in online learning at Taraba State University, Jalingo, and proposes a model for integrating ICT into online education. Utilizing a descriptive survey design with a quantitative approach, the research involved 660 respondents selected through multi-stage sampling, including administrators, teachers, and students. Grounded in the Technology Acceptance Model (TAM) and Activity Theory, the study assessed the relationships among variables such as ICT availability, challenges, ease of use, and actual use of ICT. The analysis revealed positive direct effects of ICT availability and ease of use on its application, alongside a negative indirect effect of challenges of ICT on use of ICT. SSITAAMS model was proposed as exploratory model for online learning as well as recommendations for policy practice were also provided.

**Keywords:** ICT, Online learning, Activity theory, COVID-19, Taraba State University.

## INTRODUCTION

Over the past decade, Information and Communication Technologies (ICT) have become essential tools for online learning, enabling schools to communicate, manage, and disseminate information effectively (Stosic et al., 2020; UNESCO/IIEP, 2023). Historically, literature on educational technology has focused on specific tools rather than broader educational processes or outcomes. The integration of technology in education facilitates various degrees and certifications, enhances skill acquisition, promotes social mobility, and helps students compete globally (UNESCO, 2014). In addition, the COVID-19 pandemic necessitated a rapid shift to online learning as schools closed worldwide, highlighting the need for increased technology use in reshaping educational environments (UNESCO, 2020; Squire, 2022). While many countries have embraced online learning, others struggle with existing educational inequities and lack the capacity for effective planning (Basar et al., 2021; Majumdar, n.d). This situation emphasizes the importance of a modeling methodology that integrates ICT into education to provide equitable access to knowledge and opportunities for lifelong learning (Asabere et al., 2017).

Studies leading to numerous theoretical models and empirical analyses have highlighted that online learning since COVID-19 allows educational institutions and instructors to connect with new learners remotely, enhance convenience, and broaden educational opportunities (Basar et al., 2021; Gherhes, 2021). Craig et al. (2012) noted that the range of e-learning technologies supporting teaching and learning is expanding rapidly. This unprecedented availability of technology affects all knowledge areas and has significantly influenced educational processes (Iyekekpolor & Iyekekpolor, 2016). There is increasing demand to provide support and build teachers, administrators and students competencies and knowledge of educational ICTs (Chai etal, 2013; Cheng & Yim, 2024).

Today, it is a standard global practice to integrate ICT in education, with wealthier institutions utilizing various

virtual learning technologies such as Canvas and Google Classroom (Squire, 2022) alongside platforms like Zoom and Microsoft Teams (Nasution et al., 2020). These tools enhance both synchronous and asynchronous discussions, improving educational quality and fostering innovation. Despite documented benefits of online learning technologies (Curtis & Lawson, 2001; Kulkal & Nayak, 2017), research gaps remain regarding their clear positive impacts and the models for effective ICT integration. For example, in Nigeria, while government funding aimed at enhancing ICT infrastructure in universities has increased, the journey toward effective integration of these technologies is fraught with significant challenges related to infrastructure and skilled human resources (Federal Republic of Nigeria, 2001). Also, concerns have been raised about the viability of fully online universities without quality assurances (NUC Bulletin, 2022). At the heart of this struggle is the persistent issue of unreliable power supply, interruptions in internet services, making it difficult for both student and educators to engage in online learning effectively. Such disruption leads to frustration but can also impede academic progress leaving students feeling disengaged and hopeless. This unreliability breeds a lack of trust in the technological tools meant to enhance students learning, leading to skepticism about the effectiveness of online learning. Amidst these challenges, stakeholders worry about the credibility and quality of education using technology for online learning. Against this backdrop, this study explores perceptions of technology use for online learning at Taraba State University.

## THEORETICAL FRAMEWORK AND HYPOTHESES DEVELOPMENT

The integration of ICT in education is grounded in several theoretical frameworks. These studies primarily utilize the Technology Acceptance Model (TAM) (Davis, 1989, cited in Mugo et al., 2017) and Activity Theory (Anthony, 2012). TAM posits that the intention to utilize technology is influenced by two key factors: perceived usefulness and perceived ease of use. Within university settings, this model helps elucidate how students, faculty, and staff adopt and utilize ICT tools and systems. Equally, Activity Theory emphasizes that teaching is a socially nuanced process that benefits from the interplay among culture, individuals, context, institutional norms, and innovative tools (Wang et al., 2017, cited in Maphalala and Mpofu, 2018). Activity theory provides a framework for analyzing both social and educational contexts and their interactions (Engestrom, 1987, cited in Anthony, 2012). Anthony (2012) asserts that activities shaping phenomena are embedded within their contexts, establishing a relationship between activities and individuals influenced by contextual distinctions referred to as a community of teachers and learners. In this regard, universities serve as communities where teaching and learning activities occur, mediated by innovative strategies such as technological tools. The significance of these theories to this study lies in their ability to explain the relationship between technological innovation and pedagogical intentions. They facilitate an exploration of the complex relationship between the availability of ICT resources, associated challenges, ease of use, and the actual use of ICT in education as perceived by ICT administrators, educators, and students at Taraba State University.

This research primarily explored the relationships among teachers, students, and administrators regarding their perceived availability, ease of use, challenges, and utilization of ICT for online learning at Taraba State University. The research conceptual framework and model is illustrated in Figure 1.

### Availability of ICT and use of ICT

Craig *et al.*, (2012) survey of e-learning technologies opined that a number of e-learning technologies available to support teaching and learning is growing exponentially. The availability of these technology is unprecedented, however, a major issue for faculty and educational administrators in higher education is how to ensure online tools are available to enable interactive communication between instructor and student without meeting face-to-face. Therefore, we argue that the decision to use a particular technology if based on sound research and clear evidence of its availability for faculty and learners, will impact on the use of ICT in online learning. Therefore, this research hypothesized that:

Ho1: Availability of ICT is positively related with the use of ICT for online learning.

### Perceived Ease of Use and Use of ICT

Perceived ease-of-use represents the extent to which students and teachers believe that using ICT tools will be

free from effort. Use of ICT relates to the behavioral intentions to use ICT. Based on the Technology Adaptation Model (TAM), perceived ease of use of ICT will affect the perceive use of ICT for online learning (Gunzo, 2020; Huang, 2021). Wu and Chen (2017) survey found that the perceived ease of use has an important impact on perceived usefulness. Accordingly, scholars such as Ryan and Deci (2020) maintained that students' and teachers' motivation to use technology as well as the ease of use as a tool for learning is an active research area. During school closures by COVID-19 pandemic, online learning was adopted to help students continue to learn (Chiu, 2021). But a lot of students and teachers struggled with their education and to stay motivated and engaged (UNESCO, 2020). Teachers' motivation can be accomplished by encouraging students' autonomy, by ensuring learning, and by being involved interpersonally (Hartneth, 2015). Based on these arguments, we hypothesized that:

Ho2: Ease of use is positively related with use of ICT for online learning.

Building on the previous hypotheses, a mediation model was proposed. While the availability of ICT and perceived ease of use both influenced the utilization of ICT, their effects were not uniformly interpreted by users. Teachers, students, and administrators engaging with ICT for online learning encountered varying levels of difficulty. According to the Technology Acceptance Model (TAM) and Anthony's (2012) perspective that schools function as communities where teaching and learning activities occur, the use of ICT was shaped by social and environmental factors, as well as individual differences, as highlighted by Bandura's theory of self-efficacy. Although existing studies established connections between the availability and ease of use of ICT and its overall utilization, there was a notable gap in research regarding how challenges associated with ICT mediated these relationships. It was contended that users who faced fewer challenges with ICT were likely to derive greater benefits from its use. Therefore, the following hypotheses were proposed:

Ho3: The presence of significant challenges (infrastructures and teacher competences) in ICT negatively predicts the effective use of ICT for online learning.

Ho4: The perceived availability of ICT mediated by challenges has a positive impact on use of ICT.

Ho5: The perceived ease of use of ICT mediated by challenges has a positive impact on use of ICT.

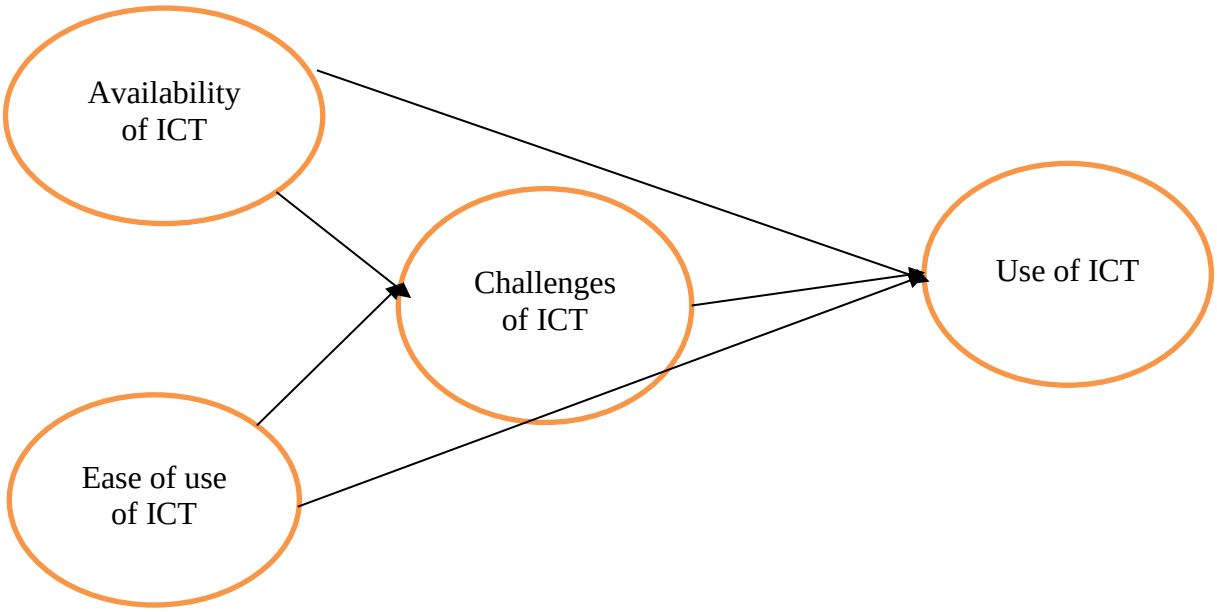


Figure 1: Research Conceptual Framework and Model

## METHODS

### The Study Design

This study adopted non-experimental design of descriptive survey research type. The descriptive survey was

used because it helped to explore a representative opinion of the respondents so that adequate generalization was made from the findings from the respondents (Adeleke etal., 2021). The study was carried out in Taraba State University, Jalingo, Taraba State, Nigeria to clarify the relationships among the availability of ICT, ease of use, challenges associated with ICT, and its use.

### Population and Sampling

The study population consisted of all teachers, students, and administrators in Taraba State University, Jalingo, Nigeria. Ten faculties out of eleven were purposively selected for the study. Thereafter, stratified sampling was conducted, based on the broad categorization of students, teachers and administrators from faculties of Education, Management Sciences, Social Sciences, Law, Agriculture, Engineering, Arts, Communication and Media Studies, Sciences and Health Sciences. A simple random sampling technique was employed to select participants from the university's ten faculties, comprising 50 teachers, 560 students, and 50 administrators, resulting in a total of 660 respondents for the study. Supporting Player-Koro's (2012) assertion, we recognize that a thorough examination of students, teachers' and administrators' technology usage - both in and outside the classroom - reveals a complex interplay of factors critical for successful ICT integration into online learning.

### Instrument for Data Collection

Data collection was conducted using a self-administered questionnaire, adapted from instruments previously utilized by researchers such as Neyland (2011), Iyekekpolor & Iyekekpolor (2016), Ghavifekr et al. (2016), Khan et al. (2021) and Vargas-Montoya etal., (2023). The four-point scale questionnaire, titled "Perception of ICT Use for online Education Questionnaire," originally contained 66 items designed to assess the latent constructs in the conceptual model. This included measures of perceived availability of ICT, challenges associated with ICT, ease of use, and overall use of ICT. However, after SEM analysis, 21 items remained and used to investigate the dimensions of ICT availability, challenges in ICT use, ease of use, and overall use of ICT for online learning based on prior instruments. The data for the analyses were collected via Google form supplemented with a printed questionnaire that sought the respondent's opinion for the study.

### Method of Data Analysis

To analyze the quantitative data collected from the survey, Partial Least Squares Structural Equation Modeling (PLS-SEM) was applied using SmartPLS software. SmartPLS was chosen for its ability to generate higher-order constructs and handle complex models with multiple latent variables (Hair et al., 2021). SEM is a widely used technique for exploring relationships among various variables, particularly in exploratory research with small sample sizes (Hair et al., 2016; Hair et al., 2019). In addition, the PLS Algorithm was implemented in SmartPLS4 to assess both measurement and structural models. The measurement model evaluated the validity and reliability of the data by reporting Average Variance Extracted (AVE) values, requiring a minimum of 0.5 for convergent validity. The Fornell-Larcker criterion, cross-loading, and Heterotrait-Monotrait Ratio (HTMT) were used to assess discriminant validity. Reliability was measured using two methods, both necessitating values greater than 0.7. Also, Hair et al. (2019) recommend that outer loadings exceed 0.70; however, for exploratory studies, indicators with loadings above 0.687 may also be retained (Hair et al., 2014; Hair et al., 2016). To enhance convergent validity, items with outer loadings below 0.5 were considered non-significant and removed, as those below 0.4 should always be eliminated (Hair et al., 2011). After the reliability and validity of the study were established, the final form of the scale was 21 and used to investigate the dimensions of ICT availability, challenges in ICT use, ease of use, and overall use of ICT for online learning based on prior instruments.

## RESULTS

Using a wide variety of statistical tools available in SPSS, and SmartPLS, we proceeded to present the values obtained and the results. Also, the study findings include demographic characteristics, descriptives, measurement model, structural models and structural path estimates. The demographic characteristics helped to show the categories of the participants that provided responses while the measurement models indicated validity and reliability. The structural and models estimate showed the influence of the dependent variables on the dependent.

**Participants demographic profiles**

The results of the demographic characteristics of the participants included sex, status of respondents. Table 1 presents the results.

**Table 1: Participants demographic profiles**

| Profiles | Categories | Frequencies | Percent |
|---|---|---|---|
| Sex | Male | 68 | 68% |
| | Female | 32 | 32% |
| Status | Students | 560 | 84% |
| | Teachers | 50 | 8% |
| | Administrative staff | 50 | 8% |

The results in Table 1 on participant demographic profile shows that the majority of the participants 68% were males while the females were 32%. The results on the status of participants indicated that the larger percentage 84% were students while 8% were teachers and 8% were administrative staff respectively. The participants demographic profile suggested that a variety of respondents participated in the study. Therefore, the data represented the views of various categories of members of the university.

**Availability, Ease of Use, Challenges, Use of ICT**

The factor loadings presented in Table 2 indicated that the indicators were good measures of their respective factors. The results of the factor analysis could be used to identify the strengths and weaknesses of ICT use for online learning at Taraba State University and to develop strategies for improvement. However, some indicators with low loadings of .50 and below were removed from the model.

Table 2: Factor loadings of the indicators

| Indicators | | Factor Loadings | | | |
|---|---|---|---|---|---|
| | Statements | Availability of ICT | Challenges | Ease of Use | Use of ICT |
| AV1 | Word processing | 0.894 | | | |
| AV12 | CD-ROM services | 0.921 | | | |
| AV3 | Web resources | 0.687 | | | |
| AV4 | Web-based course management systems | 0.929 | | | |
| AV9 | Conferencing tools (video, audio, chat) | 0.916 | | | |
| C2 | Lecturers' poor mastery of ICT | | 0.837 | | |
| C3 | High cost of equipment | | 0.870 | | |
| C5 | Dominating Lecturer talk | | 0.844 | | |
| C8 | Frequent power blackouts | | 0.850 | | |
| PE1 | I believe e-learning platforms are user friendly | | | 0.929 | |
| PE3 | I believe that using e-learning service can simplify the-learning process. | | | 0.888 | |
| PE5 | There is constant Computer Glitch | | | 0.885 | |

| | | | | | |
|---|---|---|---|---|---|
| PE6 | ICT is easier to finding resources to use in my courses | | | 0.770 | |
| PE7 | Dealing with emails are easier with the use of ICT | | | 0.903 | |
| PE8 | It makes it easier to surf the Web browsing faster | | | 0.821 | |
| PE9 | It makes easier to access Faculty records | | | 0.746 | |
| PU1 | Innovation in teaching and learning | | | | 0.914 |
| PU3 | Web based activities in and outside classroom | | | | 0.728 |
| PU4 | Teaching distance learning students | | | | 0.955 |
| PU6 | Course preparation | | | | 0.910 |
| PU8 | Managing administrative data about students | | | | 0.926 |

**Measurement model**

The measurement model (Table 3) presented results, including descriptive statistics that reflect how respondents rated the availability, ease of use, challenges, and utilization of ICT. The table also included the results of validity tests, such as average variance extracted (AVE), reliability values measured by Cronbach's alpha (α), and composite reliability (CR). These reliability measures demonstrated internal consistency among the indicator. However, the AVE values for convergent validity in Table 5 indicated that the constructs, availability of ICT, Ease of Use, Challenges, and Use of ICT met the required threshold, as all values exceeded 0.5 (Hair et al., 2021). This suggested that the indicators were appropriate measures for their respective constructs (dos Santos and Crilillo, 2021) and exhibited a good fit since their values were closely aligned (Hair et al., 2021), confirming the data's suitability for modeling. In addition, the reliability results in Table 5 showed that both Cronbach's alpha and composite reliability (CR) values surpassed the minimum threshold of 0.70 (Hair et al., 2021), indicating that the indicators were reliable measures of the variables. Consequently, these results were deemed suitable for further analysis

Table 3: Constructs Reliability and Validity for availability, ease of use and use of ICT for online learning

| **Constructs** | **Cronbach's alpha** | **Composite reliability (rho_a)** | **Composite reliability (rho_c)** | **Average variance extracted (AVE)** |
|---|---|---|---|---|
| Availability | 0.933 | 0.934 | 0.946 | 0.715 |
| Challenges | 0.923 | 0.923 | 0.940 | 0.725 |
| Ease of Use | 0.936 | 0.938 | 0.948 | 0.724 |
| Use of ICT | 0.934 | 0.937 | 0.949 | 0.755 |

**Structural equation model**

To establish the influence of availability of ICT, ease of use (independent variables) on the use of ICT (dependent variable), mediated by challenges of ICT, a structural equation model was carried out. The model presented in Figure 1 describes the links between availability of ICT, ease of use, challenges and use of ICT. Also, Figure 2 indicated that the constructs of availability, ease of use, challenges, and use of ICT were retained due to their factor loadings exceeding the minimum threshold of 0.40 (Hair et al., 2017). All indicators related to the use of ICT were included in the model. The model displayed path coefficients for these constructs, along with the coefficient of determination ($R^2$ and adjusted $R^2$) and associated statistics and p-values (Table 4). $R^2$ assessed the model's predictive power. Five hypotheses were tested, demonstrating a positive significant relationship with ICT use for online learning. The structural equation model estimates are detailed in Table 4.

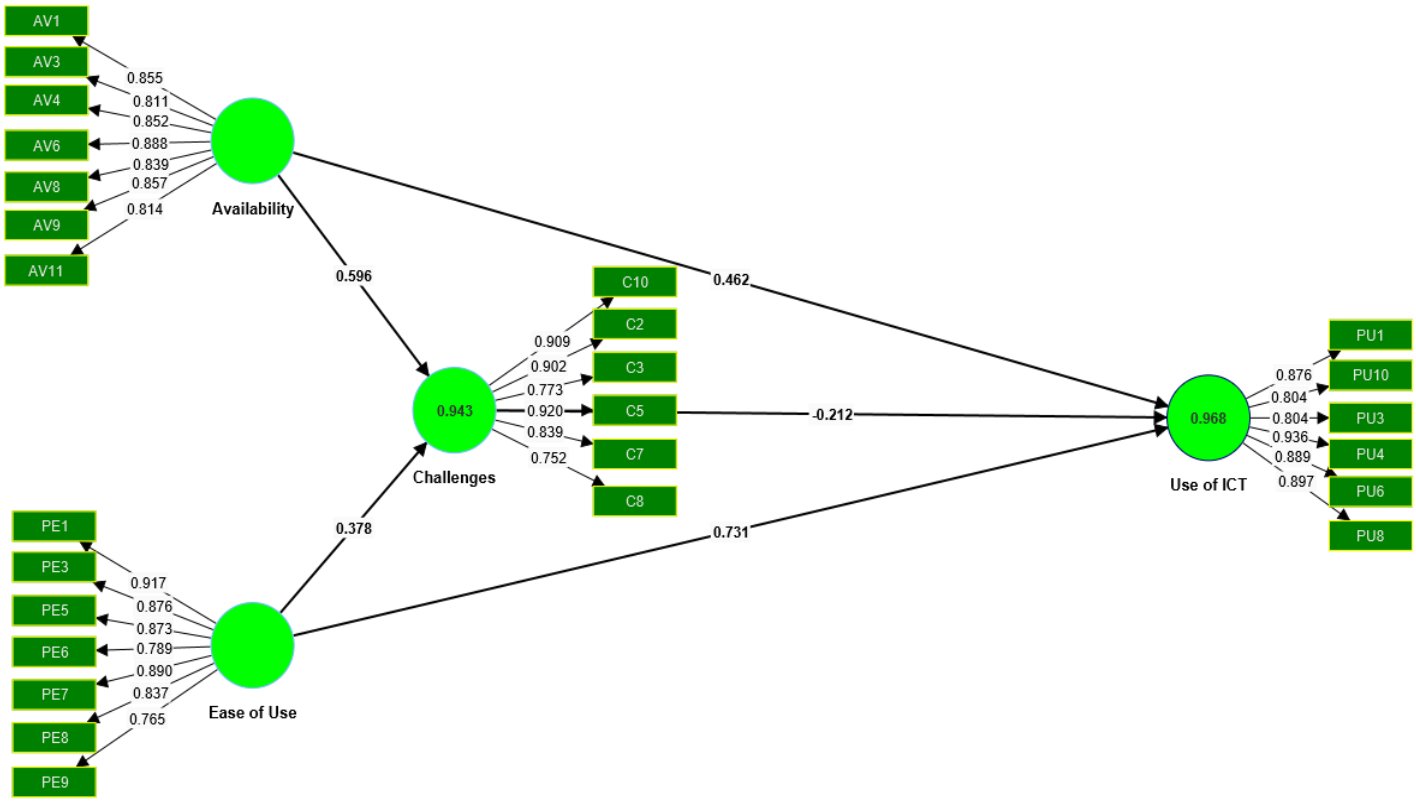


Figure 2: structural equation model of the constructs

In addition, the results of the structural models (Figures 2 and 3, Table 6) indicated that the availability of ICT ($\beta = 0.439$, $t = 6.422$, $p < 0.05$) and ease of use of ICT ($\beta = 0.700$, $t = 9.440$, $p < 0.05$) had a positive and significant relationship with ICT usage for online learning. In contrast, the challenges of ICT ($\beta = -0.156$, $t = 6.422$, $p < 0.05$) negatively predicted ICT use but did so insignificantly. The $R^2$ value showed that ease of use explained 94.3% ($R^2 = 0.943$) of the variation in ICT usage, while the adjusted $R^2$ indicated that both availability and ease of use accounted for 96.8% (adjusted $R^2 = 0.968$). This implies that 5.7% of the variation was influenced by factors other than these two constructs. Consequently, hypotheses one and two (H1 and H2) were supported, while hypothesis three (H3) was rejected. The beta values indicated that ease of use was the most significant predictor of ICT use for online learning in universities.

Table 4: Structural equation model estimates (Direct effect of the path coefficients)

| **Constructs** | β | **Std dev.** | **T statistics** | **P** |
|---|---|---|---|---|
| Availability -> Use of ICT | 0.439 | 0.068 | 6.422 | 0.000 |
| Ease of Use -> Use of ICT | 0.700 | 0.074 | 9.440 | 0.000 |
| Challenges -> Use of ICT | -0.156 | 0.052 | 6.423 | 0.000 |
| $R^2 = 0.943$ | | | | |
| Adjusted $R^2 = 0.968$ | | | | |

Also, Table 5 and Figure 3 illustrate the specific indirect effects of the path coefficients for hypotheses 4 and 5. A t-value greater than 1.96 indicates the presence of an intermediary effect. The analysis showed that the Challenges of ICT construct mediated the relationships between Availability of ICT and Use of ICT, as well as between Ease of Use of ICT and Use of ICT. Specifically, Availability of ICT had a statistically significant negative indirect impact on Use of ICT through Challenges of ICT ($\beta = -0.092$, $t = 3.402$, $p = 0.000$), while Ease of Use of ICT also had a significant negative indirect effect on Use of ICT via Challenges of ICT ($\beta = -0.060$, $t = 3.720$, $p = 0.000$). These results indicate that both pathways—Availability of ICT → Challenges → Use of ICT and Ease of Use → Challenges → Use of ICT—had significant negative impacts.

**Table 5: Specific Indirect Effect of the Path Coefficients**

| Constructs | Coef. | Std. Dev. | T statistics | P values |
|---|---|---|---|---|
| Availability -> Challenges -> Use of ICT | -0.092 | 0.027 | 3.402 | 0.000 |
| Ease of Use -> Challenges -> Use of ICT | -0.060 | 0.016 | 3.720 | 0.000 |

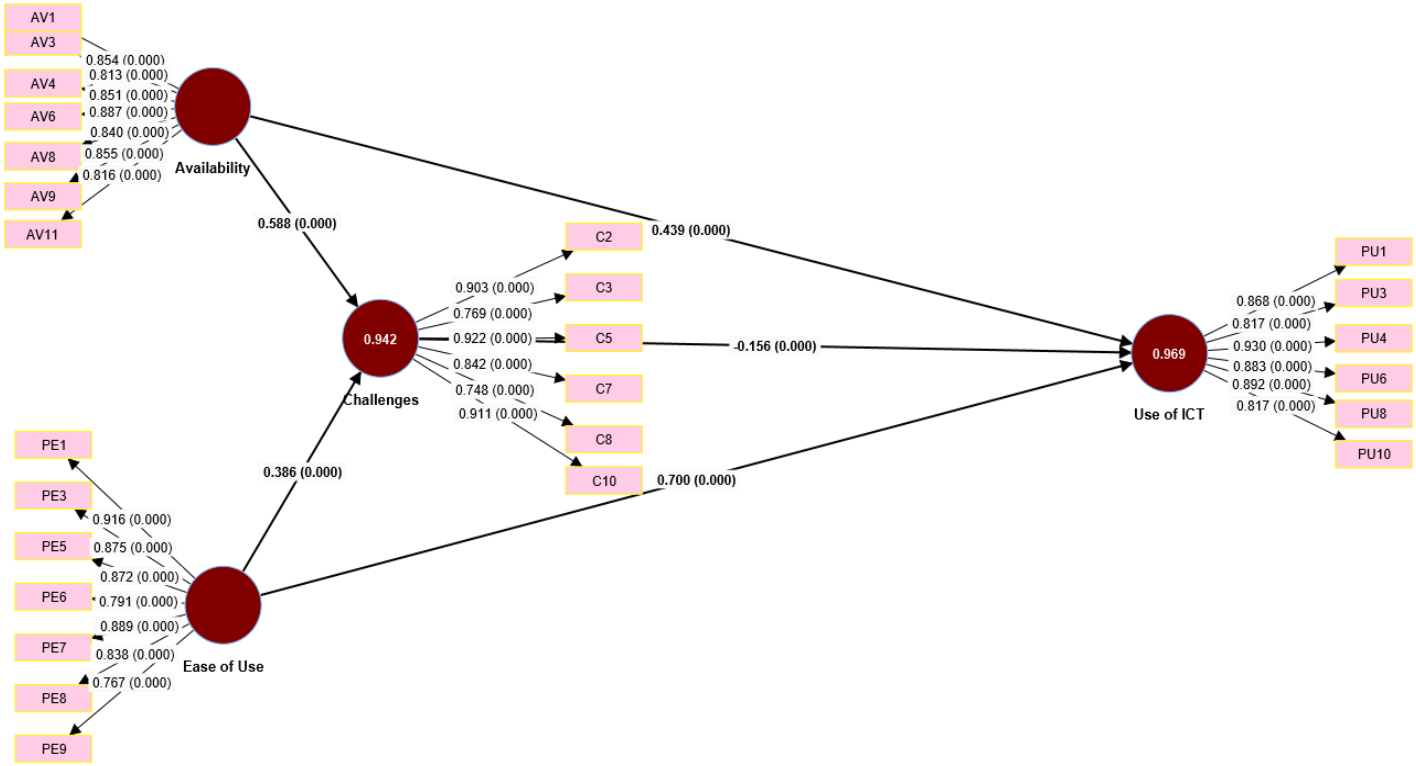


Figure 3: Path coefficients of the constructs

## DISCUSSION

The primary aim of this study was to investigate the use of Information and Communication Technology (ICT) for online learning at Taraba State University. During the COVID-19 pandemic, traditional teaching methods were disrupted, necessitating a shift to online learning. This study aligns with current trends by examining the relationships among perceived availability of ICT, ease of use, challenges, and the actual use of ICT for online learning at the university. The findings demonstrated satisfactory reliability for each construct, leading to the retention of hypotheses one and two (H1 and H2), while hypothesis three (H3) was rejected.

The first hypothesis (H1) assessed whether the availability of ICT significantly predicts its use for online learning at Taraba State University. The results revealed a direct, statistically significant positive relationship between ICT availability and its use in online learning, consistent with previous research by Erdogdu and Erdogdu (2015), which noted that internet access positively impacts student learning outcomes. However, there is a notable gap in literature regarding the specific impact of ICT availability on usage within Nigerian universities. While international studies provide useful insights, they often overlook Nigeria's unique socio-economic and educational contexts. Consequently, there is a common belief among educators and administrators that increased ICT availability will naturally enhance its usage.

Despite a strong correlation between ICT availability and usage (r = [insert value]), the path coefficient from availability to usage was modest ($\beta = 0.439$, $t = 6.422$, $p < 0.001$), indicating that availability alone is not sufficient to determine ICT use. This highlights the need for further exploration of mediating factors.

Given these findings, it is crucial for educators and institutional leaders to prioritize ICT availability as a foundational element for enhancing its use in educational settings. Adequate technological infrastructure—such

as Wide Area Networks, Microsoft tools, institutional websites, electronic mail systems, and mobile telephony resources—is essential for effective ICT utilization in universities. These tools facilitate convenient preparation, development, storage, retrieval, and sharing of teaching materials and research. Therefore, institutional managers should invest in robust ICT infrastructure to empower students, faculty, and administrators to effectively leverage these technologies for online learning.

The second hypothesis (H2) evaluated whether ease of use positively influences ICT usage for online learning. The findings indicated a direct, statistically significant positive relationship between ease of use and ICT utilization for online learning, aligning with Gunzo's (2020) research that found teachers generally view ICT as a valuable productivity tool in education. However, this contrasts with Eze, Obichukwu, and Kesharwani (2021),

who argued that perceived usefulness and availability alone do not fully explain ICT usage; rather, it involves various activities related to its application. Nonetheless, ease of use remains critical for both teachers and students in utilizing ICT effectively for online learning.

The third hypothesis (H3) examined the presence of significant challenges (infrastructures and teacher competences) in ICT negatively predicts the effective use of ICT for online learning at Taraba State University. The hypothesis reveals the presence of significant challenges statistically insignificantly negatively predicted ICT use. This indicates that issues such as infrastructures and teachers' competence s and skills with ICT are expected to power the use of ICT for online learning in Taraba State University. However, this prediction carries less weight suggesting that they could be other factors that predict ICT use. This supports the study by Scherer and Hatlevik (2017). Scherer and Hatlevic perspectives on other challenges of ICT such as digital technology distractions, complement the concepts of perceived usefulness of ICT. This finding contradicts studies by Noor et al. (2024), Al-Ruz and Khasawneh (2011), and Tezci (2011) and Ghavifekr etal., (2016), which found a positive association between ICT challenges and its integration into educational practices. Research by Fu (2013) highlighted several internal and external challenges hindering effective ICT integration in education. Administrators at the university need to reconsider other challenging factors and strategies for ICT use in online learning at Taraba State.

Hypothesis four (H4) investigated whether challenges of ICT have a positive impact on its use at Taraba State University. The results indicated that challenges have a statistically significant negative impact on ICT use. This suggests that the relationship between availability of ICT and its usage is partially mediated by these challenges. This is a major surprise of this study as the challenges of teacher competences and proficiency and power blackout are widely discussed as significant problem with integration of technology in online learning (Ghavifekr etal., 2016). Increasing the opportunities for teachers to use technology and provide necessary infrastructure enhances their competences to use and integrate technology in online learning is supported in literatures (Chiu, 2021; Ayawanle etal., 2024).

Hypothesis five (H5) aimed to determine if challenges significantly impact the use of ICT. The findings confirmed that challenges have a statistically significant negative effect on use of ICT, indicating that ease of use is also partially mediated by these challenges. This highlights a potential area of concern. Overall, this study underscores the significance of addressing ICT-related challenges to enhance its deployment and effectiveness in online learning at Taraba State University. These insights highlight the need to focus on overcoming obstacles associated with ICT to improve its usability within the university context.

**A Proposed Model for use of ICT for online learning in universities.**

Based on the findings of this study, the exploratory SSITAAMS model for online learning has been proposed (see Figure 4). The SSITAAMS model serves as a framework to analyze ICT usage and enhance understanding of how technology use, represented by the acronym SSITAAMS, functions as a distinct entity in online learning. This model emphasizes seven interrelated components: Situated Pedagogy, Social Interaction, Technological Tools, Active Engagement, Adaptability, Monitoring, and Support System. The model is grounded in Activity Theory of technology use (Anthony, 2012), Rieber and Welliver's (1989) Micro Model of Technology Integration, and the Technology Acceptance Model (TAM). Therefore, From the exploratory model of ICT use for online learning illustrated in Figure 4, it is evident that the components of ICT use must operate in sync for effective learning to take place in an online learning environment.

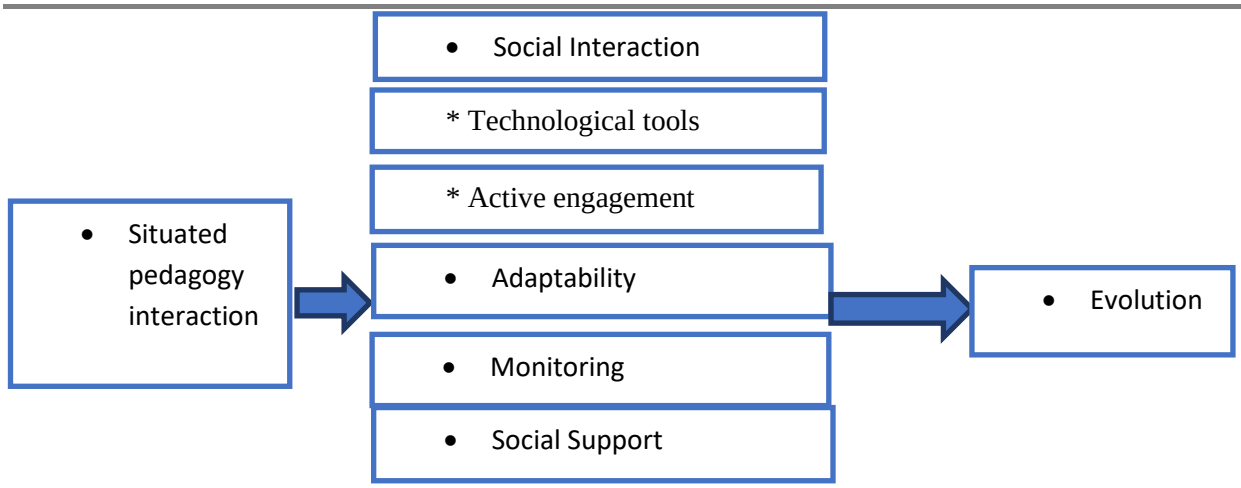


Figure 4: The proposed exploratory SSITAAMS model for online learning.

Each section of the proposed exploratory SSITAAMS model for online learning is briefly discussed below;

1. **Situated pedagogy** - emphasizes learning as a social and situated activity, where knowledge and understanding are constructed through active engagement within authentic contexts, focusing on the learners and faculty with, the main focus of ICT integration being the learner.
2. **Social interaction** - emphasizes the importance of connectedness and feeling of engagement by students, teachers and others in an online learning environment. It recognizes that learning is situated within specific social, cultural, and environmental contexts.
3. **Technological tools -** such as assessments, record keeping, report writing, and user information files that help to identify learning needs, monitor progress, and maintain student records. Others are tools that could assist the school teachers in monitoring and tracking students' interactions through the learning management system, e.g Moodle in LMS. These tools support teachers, students, institutions (universities) and e-learning designers / administrators in different forms.
4. **Active engagement - t**his emphasizes the innovative strategies adopted by the course teacher (his role) in promoting interaction among peer groups by creating suitable class environments and constructing strategic discussion tasks, and that of the students. It stresses the importance of acquiring knowledge and skill on the subject matter and cognitive development of the students. These require creating an interactive environment in both face-to-face and other online platforms such as Google Classroom settings, preparing online lecture materials as per certain rules, developing strategic discussion tasks for the students, facilitating student interaction, monitoring students' participation in the topic discussion, ensuring contribution from all students by adopting innovative and need-based strategies and evaluating the achievement of the course goals.
5. **Adaptability** - allows each student to optimize their learning experience and improve their academic performance. When learning is personalized, as in online learning, it allows students to access materials and activities tailored to their specific preferences and needs. Those who learn best through practice can benefit from interactive exercise and simulation, while those who prefer a more theoretical approach can access more detailed academic resources such as books, scientific articles, and technical papers.
6. **Modification** – this relates to significant redesign of learning tasks through the use of technology. It allows for tasks to be accomplished in ways that were previously inconceivable without technology. For instance, collaborative editing of documents in real-time using cloud-basic tools, or conducting virtual science experiments through simulations. Developing strategic discussion tasks for the students, facilitating students' interaction, monitoring students participation in the topic discussion, ensuring contribution from all students by adopting innovative and need based strategies and evaluating the achievement of the course goals.
7. **Support System** – This recognizes that effective learning cannot be delivered without a high level of collaboration across the departments, faculties and divisions within institutions. The model revealed the importance of teaching staff as well as administrative staff support for students in a holistic way. Engendering collaboration across teaching areas that enables academic activities to be integrated within

the classroom task thereby supporting students learning, with support staff working within "dedicated curriculum areas so they have much closer links with teaching staff" (Lecturer). Thus, this model emphasizes building a more collaborative approach to supporting students.

8. **Evolution** – The notion that technology can be a catalyst for pedagogical change with the teachers able to invent new learning experiences and use technology to its full affordance.

## CONCLUSIONS

This study emphasizes the critical role of perceptions regarding Information and Communication Technology (ICT) among administrators, teachers, and students in shaping online learning experiences. The findings indicate that both the availability of ICT and its ease of use positively influence its application, while challenges associated with ICT have a negative indirect effect on usage. This highlights the importance for educational stakeholders to consider these factors when designing and implementing online learning programs.

The implication of the proposed model and its dimensions supports the need to ensure availability of adequate ICT infrastructures and tools, provides training to ensure teachers competences and administrators practical skills needed for integration and use of ICT in online learning. The teachers, students as well as administrators' skills are needed in online learning as well as in classroom. Educators and policy makers ought to consider strategies that support online learning. The research is confined to a university context, the results diverge from a variety of studies which may limit the broader applicability of its conclusions. Future studies should aim to include a more diverse range of participants from various educational institutions state, federal, and private universities to enhance the validity of the findings. Additionally, exploring the distinct perspectives of students, teachers, and administrators based on their varied experiences could provide valuable insights into effective management strategies and policies that address the challenges encountered in utilizing ICT for online learning.

To further enrich this area of research, it would be beneficial to investigate how different educational environments influence ICT perceptions and usage. Engaging a wider demographic component can uncover unique challenges and solutions pertinent to each institution type. Furthermore, understanding the specific needs and experiences of each stakeholder group can inform tailored interventions that promote effective ICT integration in online learning settings. By addressing these gaps, future research can contribute to a more comprehensive understanding of ICT's role in enhancing educational outcomes across diverse contexts.

**Conflict of Interest:** The authors declare that they have no conflict of interest.

## ACKNOWLEDGEMENT

The authors are grateful to Tertiary Education Trust Fund (TET Fund) for the grant (TETFUND/TSU/2021-2022/IBR) allocated to this research.

**Institutional Review Board Statement**: Not applicable

**Author's Contributions:** Odaudu Sunday Adejo: Conceptualization, data collection, methodology, software, writing and editing. Oyeniyi Solomon: Data collection, software, editing and reviewing

**Data Availability Statement**: Data is contained within the article. For further questions, please contact the authors.

**Ethics Statement:** The study adhered to all necessary ethical considerations. In this regard, the Ethics Committee of the Taraba State University ensured confidentiality and anonymity of the respondents while also maintaining that none of the item on the administered scale posed a threat to the physical, psychological and social profiles of the respondents.

## REFERENCES

1. Adeleke, J. O., Olotu, K. A., & Adeniji, E. O. (2021). Teachers' awareness and competence as determinants of electronic examination adoption disposition in secondary schools, Ogun State. The

African Journal of Behavioral and Scale Development Research, 3 (1), 57 – 64.
2. Adeosun, O. (2010). Quality basic education development in Nigeria: Imperative for use of ICT. Journal of International Cooperation in Education, 13(2), 193-211.
3. Akinbobola, A. O., Inyang, G. B., & Ushie, B. C (2007). Effective utilization of Information and Communication Technology (ICT) for boosting research in science education: Implications for the challenges of globalization. Eureka International Journal of Education Studies, 1 (2), 66 – 76.
4. Allen, I.., and Seaman, J. (2014). Grade change: Tracking online education in the United States. Retrieved from www.onlinelearningsurvey.com/reports/gradechange.pdf
5. Al-ruz, J. A. and Khasawneh, S. (2011). Jordanian preservice teachers' and technology integration: A human resource development approach, Educational Technology and Society, 14, 77-87.
6. Anthony, A. B. (2012). Activity theory as a framework for investigating district-classroom systems interactions and their influences on technology integration, Journal of Research and Technology Education, 44 (4). 335 – 356. Retrieved from iste.org/jrte
7. Appana, S. (2008). A review of benefits and klimitations of online learning in the context of the student, the instructor, and the tenured faculty. International journal on E-Learning, 7 (1), 5 - 22
8. Asabere, N., Togo, G., Acakpovi, A. (2017). AIDS: An ICT model for integrating teaching, learning and research in technical university education in Ghana. International Journal of Education and Development using Information and Communication Technology. 13 (3), 162 – 183. https://files.eric.ed.gov/fulltext/EJ1166618.pdf
9. Ayawanle, M.A., Ntshangase, S. D., Adelana, O. P., Afolabi, K. W., & Olatunbosun, S. O. (2024). Navigating the future: Exploring in-service teachers' preparedness for artificial intelligence integration in South African schools, Elsevier Computer and Education: Artificial Intelligence, 7, 1-17. https://doi.org/10.1016/j.caeai.2024.100330
10. Basar, Z. M., Mansor, A. N., Jamaludin, K. A., & Alias, B. S. (2021). The effectiveness and challenges of online learning for secondary schools' students – A case study. Asian Journal of University Education, 17(3), 119 – 129 https://files.eric.ed.gov/fulltext/EJ1309475.pdf
11. Chai, C. S., Koh, J. H. L., & Tsai, C. C. (2013). A review of technological pedagogical content knowledge. Journal of Educational Technology & Society, 16(2), 31–51.
12. Cheng, M. W., & Yim, I. H. (2024). Examining the use of ChatGPT in public universities in Hong Kong: A case study of restricted access areas. Discover Education, 3(1), 1–10. https://doi.org/10.1007/s44217-023-00081-8
13. Chiu, T. K. F. (2021). Applying the self-determination theory in online student engagement in online learning during the COVID-19 pandemic. Journal of Research on Technology in Education, 54 (51), 514 – 530. https://doi.org/10.1080/15391523.2021.1891998
14. Curtis, D., & Lawson, M. (2001). Exploring collaborative online learning. Journal of Asynchronous Learning Networks, 5(1), 21-34.
15. Craig, A., Coldwell Neilson, J. Goold, A., and Beekhuyzen, J. (2012). A review of e-learning technologies: Opportunities for teaching and learning. In CSEDU 2012 – 4th International Conference on Computer supported Education, (INSTICC), Porto, Portugal, pp. 29 – 41.
16. Dearing, J. W., & Cox, J. G. (2018). Diffusion of innovations theory, principles, and practice. Health Affairs, 37, 183–190. [CrossRef]
17. DiPietro, G., Biagi, F., Costa, P., Karpinski, Z., & Mazza, J. (2020). The likely impact of COVID-19 on education: Reflections based on the existing literature and recent international datasets. JRC Technical Report. European Union
18. Erdogdu, F., & Erdogdu, E. (2015). The impact of access to ICT, student background and school/home environment on academic success of students in turkey: An international comparative analysis. Computers & Education, 82, 26−49. https://doi.org/10.1016/j . compedu.2014.10.023
19. Eze, N. U., Obichukwu, P. U., & Kesharwani, S. (2021). Perceived Usefulness, Perceived Ease of Use in ICT Support and Use for Teachers, IETE Journal of Education, DOI: 10.1080/09747338.2021.1908177
20. Federal Republic of Nigeria (2001). Nigeria national policy for information technology (IT). Abuja. www.nitda.gov.ng/nigeriaitpolicy.pdf
21. Fu, J. S. (2013). ICT in Education: A Critical Literature Review and Its Implications. International Journal of Education and Development using Information and Communication Technology, 9 (1),

112 – 125. https://files.eric.ed.gov/fulltext/EJ1182651.pdf
22. Gallick, S. (1998). Technology in higher education: Opportunities and threats. (ERIC Document Reproduction Service No. ED415929)
23. Ghavifekr, S. & Rosdy, W.A.W. (2015). Teaching and learning with technology: Effectiveness of ICT integration in schools. International Journal of Research in Education and Science, 1(2),175-191. https://files.eric.ed.gov/fulltext/EJ1105224.pdf
**24.** Ghavifekr, S., Kunjappan, T., Ramasamy, L., & Anthony, A. (2016). Teaching and learning with ICT tools; issues and challenges from teachers' perceptions. Malaysian Online Journal of Educational Technology, 4(2), 38 – 57. https://files.eric.ed.gov/fulltext/EJ1096028.pdf
25. Gherhes, V., Stoian, C. E., Farcasiu, M. A. & Stanici, M. (2021). E-learning vs. face-to-face learning: Analyzing students' preferences and behaviors. Sustainability. 13(8), 4381 https://doi.org/10.3390/su13084381
26. Gunzo, F. T. (2020). Teachers' perceptions, experiences and challenges related to using ICTs in teaching Social Sciences in marginalized classrooms in the Eastern Cape Province, South Africa. Published Ph.D. thesis, Rhodes University. https://core.ac.uk/download/pdf/323918016.pdf
27. Hartnett, M. K. (2015). Influences that undermine learners' perceptions of autonomy, competence and relatedness in an online context. Australasian Journal of Educational Technology, 31(1),86–99. https://doi.org/10.14742/ajet.
28. Huang, C-H. (2021). Using PLS-SEM Model to explore the influencing factors of learning satisfaction in blended learning. Education Science, 11, 249
29. Ikegbusi, N. G. (2021). Teacher's level of exposure to ICT as a pedagogical tool for teaching JSS English Language in Anambra State. In H.I. Tijani and A. Tobalse (Eds.) Pedagogy: Teaching and learning in Contemporary Nigeria – A Fischrift in Honour of Professor Abdallah Uba Adamu. Pp. 256 – 270. Houston: Africa Diaspora Press
30. Iyekekpolor, O. & Iyekekpolor, S. A. O. (2016). Comparative survey of the availability, accessibility and utilization of instructional media in tertiary institutions in Taraba State of Nigeria. Journal of Science, Technology, Mathematics and Entrepreneurial Education, 1 (1), 122 – 130.
31. Juhanak, L. Zounek, J., Zaleska, O. B., & Vickova, K. (2018). The Relationship between Students' ICT Use and Their School Performance: Evidence from PISA 2015 in the Czech Republic, Orbis Scolae, 12(2), 37 – 64. https://karolinum.cz/data/clanek/6483/OS_12_2_0037.pdf
32. Khan, M. A., Vivek, . Nabi, M. K., Khojah, M., & Tahir, M. (2021). Students' perception towards E-learning during COVID-19 pandemic in India: An empirical study. Sustainability, 13 (57), 1 – 14. Doi: 10.3390/su13010057
33. Kulkal, A., and Nayak, A. (2017). A study on perception of teachers and students towards online classes in Dakshina Kannada and Udupi District, Asian Association of Open Universities Journal. https://www.emerald.com/insight/2414-6994.htm pp 162 - 183
34. Majumdar, S. (n.d). Modelling ICT development in education. Retrieved from https://unevoc.unesco.org/fileadmin/up/modelling_ict.pdf
35. Maphalala, M. C. & Mpofu, N. (2018). Exploring E-learning experiences of academic staff at a South African University, Progrssio, 40 (1), 1 -18. Doi: 10.25159/0256-8853/4710.
36. Mishra, P., & Koehler, M. J. (2006). Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge. Teachers College Record, 108(6), 1017-1054.
37. Mugo, D. G., Njagi, K., Chemwei, B., & Motanya, J. O. (2017). The technology acceptance model (TAM) and its application to the utilization of mobile learning technologies, British Journal of Mathematics & Computer Science, 20(4), 1 – 8. DOI: 10.9734/BJMCS/2017/29015
38. Murphy, R., Gallagher, L., Krumm, A., Mislevy, J., & Hafter, A. (2014). Research on the use of Khan Academy in Schools. Menlo Park, CA: SRI Education.
39. Nasution, A. K. P., Nasution, M. K., Batubara, M. H. (2020). Learning during COVID-19 pandemic: A systematic literature review. International Journal of Evaluation and Research in Education, 11 (2), 639 – 648. DOI: 10.11591/ijere.v11i2.21917
40. Noor, N. M., Mahbob, M. H., & Salleh, M. A. M. (2024). Usefulness and ease of use of E-leaning towards the effectiveness of training and development programme for Civil servants. Journal of Electrical Systems, 20(5s), 1646 – 1652
41. Neyland, E. (2011) integrating online learning in NSW secondary schools: Three schools perspectives

on ICT adoption, Australian Journal of Educational Technology, 27(1), 152 – 173
42. Ryan, R. M., & Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective. Definitions, theory, practices, and future directions. Contemporary Educational Psychology, 61, 101860. Doi.org/10.1016/j.cedpsych.2020.101860
43. Scherer, R. & Hatlevik, O. E. (2017). "Sore eyes and distracted" or "excited and confident"? – The role of perceived negative consequences of using ICT for perceived usefulness and self- efficacy, Computers & Education, 115, 188 – 200. https://doi.org/10.1016/j.compedu.2017.08.003.
44. Squire, K. D. (2022). From virtual to participatory learning with technology during COVID-19, E-Learning and Digital Media, 19(1), 55 – 77. https://journals.sagepub.com/doi/pdf/10.1177/20427530211022926
45. Stosic, L., Dermendzhieva S., & Tomczyk, L. (2020). Information and communication technologies as a source of education, World Journal on Educational Technology: Current Issues. 12(2), 128-135. https://doi.org/10.18844/wjet.v12i2.4815
46. Tezci, E. (2011). Factors that influence preservice teachers' ICT usage in education. European Journal of Teacher Education, 34, 483-499.
47. UNESCO. (2014). Information and communication technology (ICT) in education in Asia: A comparative analysis of ICT integration and e-readiness in schools across Asia. Montreal: UNESCO Institute for Statistics. Retrieved from http://www.uis.unesco.org/Communication/Documents/ICT-asia-en.pdf
48. UNESCO. (2020). COVID-19 educational disruption and response. UNESCO https://en.unesco.org/covid19 /education response.
49. UNESCO IIEP (2023, 22 March). Information and communication technology (ICT) in education. Retrieved from https://learningportal.iiep.unesco.org/en/issue-briefs/improve-learning/information-and-communication-technology-ict-in-education
50. Vargas-Montoya, L., Gimenez, G., & Fernandez-Gutierrez, M. (2023). ICT use for learning and students' outcomes: Does the country development level matter? Socio-Economic Planning Sciences, 87, 1 -13. https://doi.org/10.1016/j.seps.2023.101550
51. Venkatesh, V & Davis, F. D. A. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. Management Science, 46, 186 – 204 (CrossRef).
52. Waluyo, U., Sudirman, & Hakim, M. (2022). University students Readiness to adapt to the change of learning platform during campus closure. Technique Social Science Journal, 29, 172 – 180.
53. Williams, T., Layne, M., and Ice, P. (2014). Online Faculty perception on effective faculty mentoring: A Qualitative Study. Online Journal of Distance and online Learning, 17 (2). Retrieved from https://www.westga.edu/~distance/ojdla/summer172/Williams_Layne_Ice172.html
54. Wu, B. & Chen, X. (2017). Continuance intention to use MOOCs: Integrating the technology acceptance model (TAM) and task technology fit (TTF) model. Computer Human Behavior, 67, 221 – 232. CrossREf.
55. Yee, R. C. S. (2011). Perceptions of online learning in An Australian University: Malaysain Students Perspectives. A published Ph.D. Thesis of Queensland University of Technology.
56. Yesilyurt, E. & Vezne, R. (2023). Digital literacy, technological literacy, and internet literacy as predictors of attitude toward applying computer-supported education, Education and Information Technologies, 28, 9885 – 9911. https://doi.org/10.1007/s10639-022-11311-1