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# Exploring the Interplay of E-Readiness, Technical Skills, and Digital Resources on Digital Literacy of Business Students: A Two-Stage PLS-ANN Approach

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**Abstract**

**Background:** Digital literacy has emerged as a key skill for success in today's quickly evolving digital world, especially in the field of business education, where students must be able to use digital tools and technologies effectively in order to succeed in both their academic and professional endeavours.

**Objectives:** This study intends to explore the relationship between digital literacy and e-readiness among Pokhara University's Bachelor of Business Administration (BBA) and Master of Business Administration (MBA) students. It focuses on the ways that institutional support, technical proficiency, and access to digital resources affect the development of digital literacy skills.

**Methods:** A causal-comparative research design was used to examine the impact of e-readiness, technical skills, and digital resource access on digital literacy among 360 BBA and MBA students at Pokhara University. Data were analyzed using Structural Equation Modeling (SEM) via Smart PLS and Artificial Neural Networks (ANN), with SEM identifying significant relationships and ANN assessing the predictive importance of each factor.

**Results:** SEM revealed that e-readiness, technical skills, and resource access significantly affect digital literacy, with technical skills being the strongest predictor. ANN confirmed the critical role of e-readiness and supportive learning environments, with digital resource availability being the least influential.

**Conclusion:** The findings emphasize the need for integrating technical skills training and improving resource accessibility into curricula to enhance digital literacy. Supportive environments and technical competencies are essential for students' digital proficiency.

**Keywords:** ANN, digital literacy, digital resources, e-readiness, PLS-SEM
**JEL Classification:** D83, I23, L86, O33

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## Introduction

Digital literacy has become an essential skill in today's ever-changing digital world, particularly in business. Proficiency in digital tool use is critical, as diverse enterprises increasingly rely on digital technology for communication, data analysis, and decision-making (Phuapan et al., 2016). Business students, particularly those pursuing Bachelor of Business Administration (BBA) and Master of Business Administration (MBA) degrees, must have strong digital literacy abilities in order to succeed academically and professionally (Vodă et al., 2022). The capacity to communicate with emerging technologies and efficiently use digital platforms is critical for navigating the current corporate environment. Students who lack these abilities may struggle to compete in an increasingly digital job world (Geylani, 2021). Digital literacy is the capacity to acquire, assess, and effectively use information via digital technology. It entails more than just fundamental computer abilities, including the ability to connect with digital platforms, operate software, communicate in virtual spaces, and critically evaluate the veracity of online information (Reddy et al., 2021). However, the development of digital literacy varies across students and is impacted by a number of factors, including access to technology, individual technical abilities, and the availability of a conducive learning environment (Tian & Park, 2022). These variables combine to generate the idea of e-readiness, which refers to a person's or institution's readiness to engage with digital technology. E-readiness is defined as having access to digital resources such as the internet, being technically proficient in utilizing digital tools, and living in an environment that promotes digital learning (Mosa et al., 2016).

Business students at Pokhara University are required to study and develop their digital literacy in order to meet the demands of modern education and careers. However, inequalities in e-readiness may impede students from efficiently gaining these skills (McGuinness & Fulton, 2019). E-readiness varies with access to digital resources, specific talents, and the amount of assistance given by the institution. Students without dependable internet connection, new digital technologies, or sufficient technical competence may struggle to participate in online platforms, placing them at a disadvantage compared to classmates with better resources (Chau et al., 2021). Furthermore, students' views about technology might influence their propensity to utilize digital technologies, which affects their digital literacy development. This variance in e-readiness can result in unequal digital literacy results, compromising academic achievement and professional readiness (Wang et al., 2024). Despite the importance of digital literacy in business education, there has been little study into the link between e-readiness and digital literacy among Nepalese business students. Most previous research focuses on industrialized nations with more extensive access to digital infrastructure and technology (Joshi et al., 2019). In Nepal, where digital infrastructure is still developing and access to technology is uneven, the influence of e-readiness on students' capacity to achieve digital literacy is understudied. This disparity underscores the need for further research into how e-readiness influences digital literacy growth among Pokhara University's BBA and MBA students.

This is especially relevant in Nepal, where access to digital resources might be limited. Business students at Pokhara University must have good digital literacy abilities to thrive in today's business environment (Adhikari, 2023). However, variations in e-readiness can cause considerable variances in students' capacity to learn these abilities. Students with greater access to technology, stronger technical skills, and institutional assistance are more likely to attain higher levels of digital literacy (Eunice & Christopher, 2021). Those without these resources, on the other hand, may lag behind, restricting their academic and professional success in a global market that places a higher priority on digital abilities. If these gaps are not addressed, students may face uneven chances, both academically and professionally (Cortés et al., 2019).

This study examines the association between e-readiness and digital literacy among Pokhara University's

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BBA and MBA students. It will concentrate on critical aspects of e-readiness, such as access to digital resources, technical abilities, and institutional support, and how these elements affect digital literacy growth. Furthermore, the study will look at students' attitudes about technology and how their willingness to use digital tools influences their literacy. The findings seek to provide insights into how e-readiness impacts digital literacy outcomes and to make suggestions for enhancing digital preparation among business students. The major objective of this study is to examine the impact of various aspects of e-readiness on the digital literacy of BBA and MBA students at Pokhara University.

## Review of Literature

### E-Readiness and Digital Literacy

E-readiness is the ability of individuals or institutions to adapt and successfully employ digital technology (Ghosh Roy & Upadhyay, 2017). In higher education, e-readiness is critical in molding students' abilities to interact with digital learning tools and acquire digital competencies (Kim et al., 2019). According to research, students who are more e-ready—that is, those who have access to dependable digital resources, possess technical abilities, and are in supportive learning environments—had greater levels of digital literacy. For Pokhara University BBA and MBA students, e-readiness is an important component in their capacity to learn digital literacy. Institutions with more access to technology and effective support systems create stronger digital abilities in their students, whereas those without these resources may struggle to appropriately prepare students for the digital economy. Based on these, the following hypothesis is developed.

H1: There is a significant positive impact of E-readiness on digital literacy among BBA and MBA students at Pokhara University.

### Digital Resources Availability and Digital Literacy

Access to digital resources, such as high-speed internet, online databases, and digital learning platforms, is an important aspect of e-readiness. According to research, pupils who have regular access to these tools are more likely to develop excellent digital literacy abilities (Reyaz Ahmad Bhat, 2023). These resources allow students to learn independently, collaborate online, and use digital technologies for academic performance and future professional chances (Şumuer, 2017). For BBA and MBA students at Pokhara University, the availability and quality of digital resources can have a significant influence on their capacity to develop digital literacy. This study will explore how access to these resources influences students' digital literacy. Based on these, the following hypothesis is developed.

*H2: There is a significant positive impact of digital resource availability on digital literacy among BBA and MBA students at Pokhara University.*

### Technical Skills and Digital Literacy

Technical skills are the ability to use digital tools and platforms, which are required for students to effectively engage in online learning settings. According to research, kids with excellent technical abilities are better able to gain advanced digital literacy (Ferrer et al., 2020). For business students, these abilities include the ability to use data analysis software, online financial tools, and productivity applications—all of which are necessary for professional advancement (Jou & Wang 2013). At Pokhara University, business students with superior technical abilities are likely to have higher levels of digital literacy, since these skills enable them to navigate and use various digital platforms successfully. On the basis of these, the following hypothesis is developed.

*H3: There is a significant positive impact of technical skills on digital literacy among BBA and MBA students at Pokhara University.*

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### Supportive Learning Environment and Digital Literacy

A supportive learning environment is another important aspect in the development of digital literacy. This involves access to institutional resources including digital literacy training, academic advice, and peer cooperation (Chiu & Sun, 2022). According to research, students who get continuous institutional assistance are more likely to engage with digital technology and learn the abilities required to become digitally literate (Nkomo et al., 2021). A conducive learning environment at Pokhara University might considerably improve business students' capacity to connect with digital technologies and promote digital literacy. On the basis of these, the following hypothesis is developed.

*H4: There is a significant positive impact of a supportive learning environment on digital literacy among BBA and MBA students at Pokhara University.*

### Attitudes Towards Technology and Digital Literacy

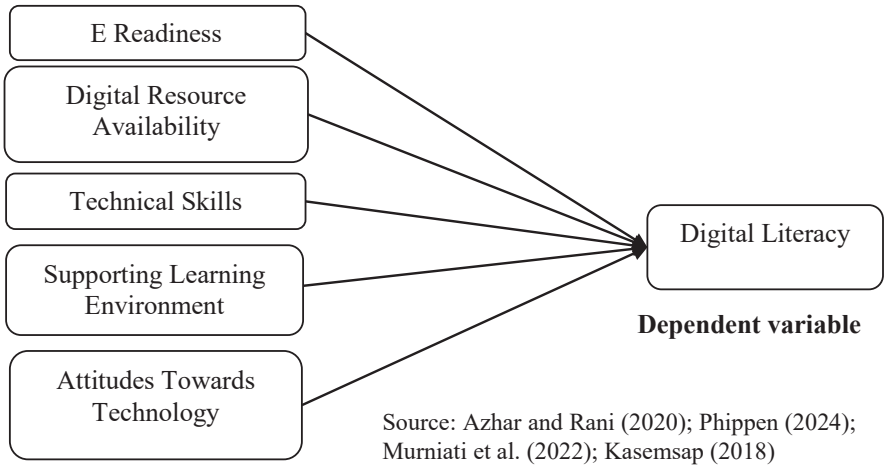
Students' attitudes toward technology influence how they engage with digital technologies. According to research, pupils with favourable attitudes toward technology are more likely to use digital platforms and develop excellent digital literacy abilities (Ardies et al., 2015). Students that have a negative attitude toward technology, on the other hand, may be less likely to use digital technologies, thereby impeding their digital literacy growth (Muis et al., 2015). Students at Pokhara University with more favourable views about technology are projected to have greater levels of digital literacy because they are more likely to accept and participate in digital learning platforms. On the basis of these, the following hypothesis is developed.

*H5: There is a significant positive impact of attitudes towards technology on digital literacy among BBA and MBA students at Pokhara University.*

E-readiness, which includes access to digital resources, technical skills, and supportive learning settings, is critical for improving digital literacy among Pokhara University's BBA and MBA students. Access to these tools, as well as students' technical abilities and attitudes towards technology, have a substantial influence on their capacity to interact with digital platforms. A helpful learning environment helps them improve their digital skills. The conceptual framework below depicts these interactions with digital literacy.

**Figure 1**

*Conceptual framework of exploring the interplay of E-Readiness, Technical Skills, and Digital Resources on Digital Literacy of Business Students*




Source: Azhar and Rani (2020); Phippen (2024); Murniati et al. (2022); Kasemsap (2018)

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## Materials and Methods

This study employed a causal-comparative research design to investigate the interplay of e-readiness, technical skills, and digital resources on digital literacy among business students at the School of Business, Pokhara University. This design was selected to establish relationships between the independent variables (e-readiness, technical skills, and digital resources) and the dependent variable (digital literacy) without manipulating the independent variables, allowing for the examination of naturally occurring differences in these constructs among students. A purposive sampling method was utilized to select a sample of 360 students from the BBA and MBA programs at Pokhara University. This technique was thought to be appropriate since it targeted individuals with relevant understanding and experience in digital learning environments, resulting in enough statistical power for the study.

Data collection was conducted through a structured questionnaire divided into two parts: the first part gathers demographic information, while the second part employs a five-point Likert scale to assess the constructs of e-readiness, digital resource availability, technical skills, supporting learning environment, attitudes towards technology, and digital literacy. The Likert scale items for each construct were sourced from established literature to ensure validity and reliability. Specifically, e-readiness was measured using items adapted from Khulwa and Luthfia (2023), Azhar and Rani (2020), Kim et al. (2019), and Ghosh Roy and Upadhyay (2017). Digital resource availability was assessed based on statements from Reyaz Ahmad Bhat (2023) and Şumuer (2017). Technical skills were drawn from Murniati et al. (2022), Ferrer et al. (2020), and Jou and Wang (2013), while the supporting learning environment was measured using items adapted from Chiu and Sun (2022), Nkomo et al. (2021), and Kasemsap (2018). Attitudes towards technology were informed by Ardies et al. (2015) and Muis et al. (2015). Finally, digital literacy was adapted from Phippen (2024), Alom and R (2024), and Kartanegara et al. (2024). The operationalization of variables is presented in the appendix.

The data was evaluated using a mix of Structural Equation Modeling (SEM) using Smart PLS 3.0 software, and Artificial Neural Networks using SPSS 26 software. SEM was chosen because of its capacity to handle complicated interactions between numerous variables while also providing a full assessment of the measurement model's validity and reliability. Key metrics such as factor loadings, Cronbach's alpha, composite reliability, and average variance extracted (AVE) were used to confirm the constructs' reliability and validity. The relevant features revealed using SEM-PLS path analysis were then used as input neurons in the ANN model, which was chosen because of its robustness to non-normal data distribution, non-linear correlations, and noise. The ANN model employed a feed-forward-backward-propagation algorithm with multilayer perceptrons and sigmoid activation functions. A ten-fold cross-validation process was conducted to validate the model's performance. The Root Mean Square Error (RMSE) for training and testing confirmed model fit, and sensitivity analysis revealed key predictors of the outcome variables. Ethical considerations were followed throughout the study, including obtaining informed consent from participants, ensuring confidentiality of their responses, and emphasizing that participation was voluntary.

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## Results and Discussion

### Demographic Profile

The demographic profile of the students at the School of Business, Pokhara University is presented in Table 1

**Table 1**

*Demographic profile*

| Characteristics | Sub categories | Frequency | Percent |
|---|---|---|---|
| Age | Under 20 years | 85 | 23.6 |
| | Between 20-25 years | 79 | 21.9 |
| | Between 25-30 years | 95 | 26.4 |
| | Above 30 years | 101 | 28.1 |
| Gender | Male | 242 | 67.2 |
| | Female | 118 | 32.8 |
| Program of Study | BBA | 187 | 51.9 |
| | MBA | 173 | 48.1 |
| Own Digital Device | Yes | 185 | 51.4 |
| | No | 175 | 48.6 |
| High-Speed Internet Access | Always | 80 | 22.2 |
| | Frequently | 77 | 21.4 |
| | Sometimes | 72 | 20 |
| | Rarely | 131 | 36.4 |
| Hours Using Digital Tools | Less than 5 hours | 95 | 26.4 |
| | 5-10 hours | 84 | 23.3 |
| | 11-15 hours | 92 | 25.6 |
| | More than 15 hours | 89 | 24.7 |
| Location of Residence | Urban area | 126 | 35 |
| | Suburban area | 128 | 35.6 |
| | Rural area | 106 | 29.4 |
| Primary Internet Source | Home Wi-Fi | 58 | 16.1 |
| | Mobile data | 79 | 21.9 |
| | University Wi-Fi | 58 | 16.1 |
| | Public internet (e.g., cafés, libraries) | 83 | 23.1 |
| | No regular access | 82 | 22.8 |
| Hours Using social media for Academic Purposes | Less than 1 hour | 86 | 23.9 |
| | 1-3 hours | 86 | 23.9 |
| | 4-6 hours | 83 | 23.1 |
| | More than 6 hours | 105 | 29.2 |

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| | | | |
|---|---|---|---|
| Confidence in Troubleshooting | Very confident | 87 | 24.2 |
| | Somewhat confident | 91 | 25.3 |
| | Not very confident | 84 | 23.3 |
| | Not confident at all | 98 | 27.2 |
| Formal Training in Digital Literacy | Yes | 185 | 51.4 |
| | No | 175 | 48.6 |
| Frequency of Online Learning Platform Use | Daily | 64 | 17.8 |
| | Several times a week | 65 | 18.1 |
| | Once a week | 81 | 22.5 |
| | Less than once a week | 150 | 41.7 |
| Prior Work Experience | Yes, full-time work | 100 | 27.8 |
| | Yes, part-time work | 88 | 24.4 |
| | Yes, internship | 80 | 22.2 |
| | No work experiences | 92 | 25.6 |
| Overall Digital Literacy Skills | Excellent | 79 | 21.9 |
| | Good | 64 | 17.8 |
| | Average | 77 | 21.4 |
| | Below average | 68 | 18.9 |
| | Poor | 72 | 20 |

*Source: Survey, 2024.*

Table 1 presents the demographic profile of 360 students from the School of Business, Pokhara University. The age distribution shows that most students are above 30 years old (28.1%), followed by those aged 25-30 (26.4%). The sample consists of 67.2% male and 32.8% female students. Regarding academic programs, 51.9% are enrolled in BBA and 48.1% in MBA. About half of the students (51.4%) own a digital device, while 48.6% do not, and only 22.2% always have high-speed internet access meaning that they have constant uninterrupted high speed internet facilities. Students use digital tools for varying amounts of time, with 26.4% using them for less than 5 hours daily. The majority of students reside in suburban (35.6%) and urban (35%) areas, and 23.1% primarily use public internet for connectivity. Academic social media use is divided almost evenly, with 29.2% using it for more than 6 hours daily. Confidence in troubleshooting varies, with 27.2% not confident at all. A slight majority (51.4%) received formal digital literacy training. Online learning platform use is infrequent, with 41.7% using them less than once a week. Finally, 27.8% have full-time work experience, while 25.6% report no work experience. Digital literacy skills range, with 21.9% rating themselves as excellent, and 20% considering their skills poor.

**Common Method Bias**

The study used Harman's single-factor test, a popular diagnostic technique for common method bias (CMB) identification, to assess the possible presence of CMB because both predictor and outcome variables were gathered using a single instrument (Podsakoff et al., 2003). According to the statistical analysis, a single factor only accounts for 28.63% of the variance, far less than the generally recognized 50% criterion. Podsakoff et al. (2003) state that the probability of common method bias is decreased when one factor does not account for more than 50% of the variance. This result supports the validity of the instrument employed in the study by indicating that CMB does not provide a substantial problem.

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**Assessment of Measurement Model**

**Table 2**

*Measurement model of exploring the interplay of E-Readiness, Technical Skills, and Digital Resources on Digital Literacy of Business Students*

| Constructs | Indicator | Factor Loading | Cronbach Alpha | Composite Reliability (CR) | Average Variance Explained (AVE) |
|---|---|---|---|---|---|
| E Readiness | ER1 | 0.615 | 0.738 | 0.826 | 0.519 |
| | ER2 | 0.695 | | | |
| | ER3 | 0.686 | | | |
| | ER4 | 0.747 | | | |
| | ER5 | 0.744 | | | |
| Digital Resource Availability | DRA1 | 0.579 | 0.726 | 0.819 | 0.508 |
| | DRA2 | 0.782 | | | |
| | DRA3 | 0.554 | | | |
| | DRA4 | 0.713 | | | |
| | DRA5 | 0.799 | | | |
| Technical Skills | TS1 | 0.655 | 0.749 | 0.833 | 0.53 |
| | TS2 | 0.684 | | | |
| | TS3 | 0.69 | | | |
| | TS4 | 0.721 | | | |
| | TS5 | 0.78 | | | |
| Supporting Learning Environment | SLE1 | 0.691 | 0.766 | 0.842 | 0.518 |
| | SLE2 | 0.685 | | | |
| | SLE3 | 0.779 | | | |
| | SLE4 | 0.757 | | | |
| | SLE5 | 0.679 | | | |
| Attitudes Towards Technology | ATT1 | 0.59 | 0.711 | 0.81 | 0.523 |
| | ATT2 | 0.63 | | | |
| | ATT3 | 0.781 | | | |
| | ATT4 | 0.642 | | | |
| | ATT5 | 0.74 | | | |
| Digital Literacy | DL1 | 0.713 | 0.784 | 0.852 | 0.537 |
| | DL2 | 0.63 | | | |
| | DL3 | 0.799 | | | |
| | DL4 | 0.761 | | | |
| | DL5 | 0.749 | | | |

*Source: Survey, 2024 and authors' calculation.*

The measurement model results presented in Table 2 demonstrate that the constructs used in the study exhibit acceptable reliability and validity. The E-Readiness construct had factor loadings ranging from 0.615 to 0.747, with a Cronbach's alpha of 0.738, a composite reliability (CR) of 0.826, and an average variance extracted (AVE) of 0.519, indicating satisfactory internal consistency and convergent validity.

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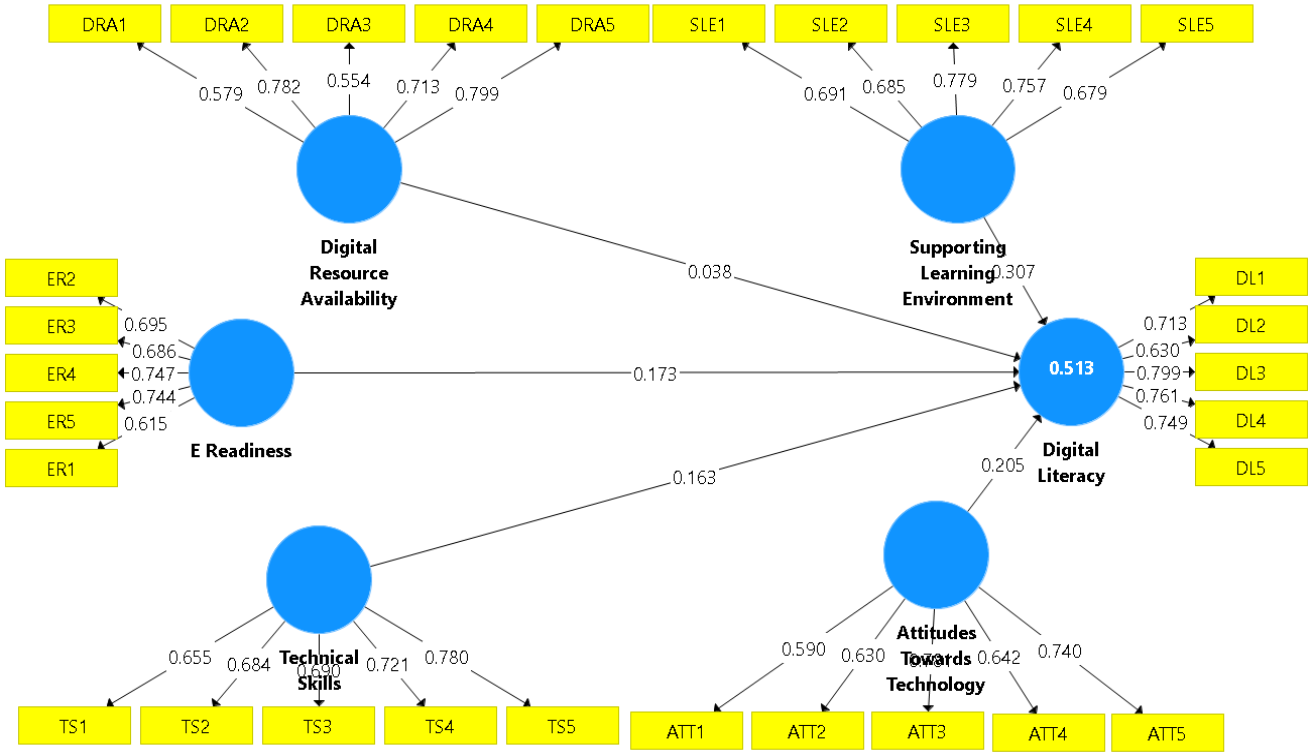
For Digital Resource Availability, factor loadings ranged from 0.554 to 0.799, with a Cronbach's alpha of 0.726, CR of 0.819, and an AVE of 0.508. Technical Skills construct showed factor loadings between 0.655 and 0.780, with a Cronbach's alpha of 0.749, CR of 0.833, and an AVE of 0.530, confirming good reliability and validity. The Supporting Learning Environment construct had factor loadings ranging from 0.679 to 0.779, a Cronbach's alpha of 0.766, CR of 0.842, and an AVE of 0.518, demonstrating strong internal consistency. The Attitudes Towards Technology construct exhibited factor loadings between 0.590 and 0.781, with a Cronbach's alpha of 0.711, CR of 0.810, and an AVE of 0.523, indicating acceptable reliability. Finally, the Digital Literacy construct had factor loadings between 0.630 and 0.799, with a Cronbach's alpha of 0.784, CR of 0.852, and an AVE of 0.537, confirming high internal consistency and strong convergent validity. Overall, these results suggest that the constructs in the study are both reliable and valid based on the values of factor loadings, Cronbach's alpha, CR, and AVE (Cheung et al., 2023).

**Figure 2**

*Measurement model of exploring the interplay of E-Readiness, Technical Skills, and Digital Resources on Digital Literacy of Business Students*



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**Discriminant Validity**

**Table 3**

*Fornell Larcker Criteria*

| | ATT | DL | DRA | ER | SLE | TS |
|---|---|---|---|---|---|---|
| ATT | 0.681 | | | | | |
| DL | 0.545 | 0.733 | | | | |
| DRA | 0.467 | 0.505 | 0.693 | | | |
| ER | 0.371 | 0.515 | 0.608 | 0.699 | | |
| SLE | 0.564 | 0.642 | 0.528 | 0.517 | 0.719 | |
| TS | 0.521 | 0.59 | 0.634 | 0.516 | 0.673 | 0.707 |

*Source: Survey, 2024 and authors' calculation.*

Note: ER= E Readiness, DRA= Digital Resource Availability, TS= Technical Skills,

SLE= Supporting Learning Environment, ATT= Attitudes Towards Technology, DL= Digital Literacy

**Table 4**

*Heterotrait-Monotrait Ratio*

| | ATT | DL | DRA | ER | SLE | TS |
|---|---|---|---|---|---|---|
| ATT | | | | | | |
| DL | 0.706 | | | | | |
| DRA | 0.651 | 0.648 | | | | |
| ER | 0.5 | 0.664 | 0.813 | | | |
| SLE | 0.733 | 0.807 | 0.679 | 0.677 | | |
| TS | 0.71 | 0.766 | 0.652 | 0.693 | 0.69 | |

*Source: Survey, 2024 and authors' calculation.*

Note: ER= E Readiness, DRA= Digital Resource Availability, TS= Technical Skills,

SLE= Supporting Learning Environment, ATT= Attitudes Towards Technology, DL= Digital Literacy

Discriminant validity was assessed using the Fornell-Larcker criterion and the Heterotrait-Monotrait (HTMT) ratio. According to the Fornell-Larcker criterion in Table 3, the square root of the average variance extracted (AVE) for each construct exceeds its correlations with other constructs, supporting discriminant validity. For instance, Digital Literacy (DL) has an AVE of 0.733, which is higher than its correlations with Attitudes Towards Technology (ATT) (0.545) and Technical Skills (TS) (0.59). Likewise, E-Readiness (ER) has a square root AVE of 0.699, which is greater than its correlations with Digital Resource Availability (DRA) (0.608) and Supporting Learning Environment (SLE) (0.517). The HTMT ratio, shown in Table 4, provides further confirmation, with most values below the 0.85 threshold. For example, the HTMT between ATT and DL is 0.706, and between DRA and TS, it is 0.652, both below the cutoff. The HTMT ratio between SLE and TS is 0.69, also well within acceptable limits, affirming the distinctiveness of these constructs. These results collectively support the discriminant validity of the constructs, indicating that they are appropriately distinct for interpretation within the study (Cheung et al., 2023).

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**Assessment of Structural Model**

**Table 5**

*Predictive Relevance and VIF*

| Construct | $f^2$ | VIF | R2 | mn |
|---|---|---|---|---|
| Attitudes Towards Technology | 0.054 | 1.589 | | |
| Digital Resource Availability | 0.021 | 2.097 | | |
| E Readiness | 0.035 | 1.743 | | |
| Supporting Learning Environment | 0.088 | 2.187 | | |
| Technical Skills | 0.023 | 2.339 | | |
| Digital Literacy | | | 0.513 | 0.506 |

*Source: Survey, 2024 and authors' calculation.*

Table 5 summarizes the predictive relevance and multicollinearity (VIF) for each construct related to Digital Literacy. The effect sizes ( ) show that Supporting Learning Environment has the largest impact ( =0.088), while Digital Resource Availability has the smallest ( =0.021). The VIF values, all below 5, indicate acceptable levels of multicollinearity, with Technical Skills having the highest VIF (2.339) and Attitudes Towards Technology the lowest (1.589). Digital Literacy's of 0.513 indicates that the model explains 51.3% of its variance, with an adjusted of 0.506, supporting the model's explanatory strength while adjusting for the number of predictors.

**Table 6**

*Path analysis results of exploring the interplay of E-Readiness, Technical Skills, and Digital Resources on Digital Literacy of Business Students*

| Hypothesis | Path | T Statistics | P Values | Decision |
|---|---|---|---|---|
| H1 | E readiness -> Digital Literacy | 4.543 | 0 | Accepted |
| H2 | Digital Resource Availability -> Digital Literacy | 0.713 | 0.476 | Rejected |
| H3 | Technical Skills -> Digital Literacy | 3.184 | 0.001 | Accepted |
| H4 | Supporting Learning Environment -> Digital Literacy | 4.945 | 0 | Accepted |
| H5 | Attitude towards Technology -> Digital Literacy | 2.884 | 0.004 | Accepted |

*Source: Survey, 2024 and authors' calculation*

The structural model results in Table 6, derived using bootstrapping with 5000 samples, provide robust insights into the relationships between e-readiness, technical skills, digital resource availability, supportive learning environments, attitudes towards technology, and digital literacy among business students (Wong, 2013). The use of bootstrapping ensures stability and reliability of the parameter estimates by generating confidence intervals and reducing the impact of sampling variability, particularly in cases where the data may not strictly adhere to parametric assumptions. This methodological rigour strengthens the validity of the inferred relationships within the model. Hypothesis H1, which posits a positive relationship between E-Readiness and Digital Literacy, was supported ($T = 4.543$, $p < 0.001$), confirming that students well-prepared with digital tools exhibit higher digital literacy. However, H2, exploring the impact of Digital Resource Availability on digital literacy, was rejected ($T = 0.713$, $p = 0.476$), indicating that access to resources alone does not significantly influence digital literacy. H3, which tested the effect of Technical Skills on digital literacy, was accepted ($T = 3.184$, $p = 0.001$), highlighting the importance of technical proficiency in fostering digital competencies. H4, which examined the role of a Supporting Learning Environment, also showed a significant positive impact ($T = 4.945$, $p < 0.001$), emphasizing that institutional support and guidance enhance digital literacy. Lastly,

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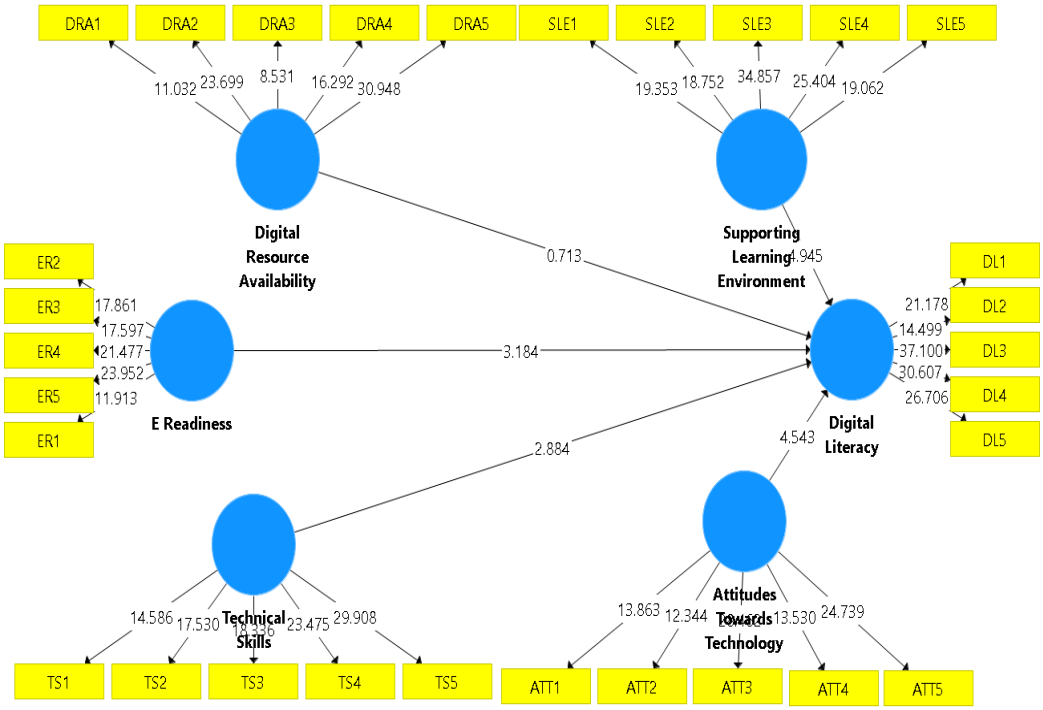
H5, which looked at Attitudes Towards Technology, was accepted (T = 2.884, p = 0.004), showing that students with favourable attitudes towards digital tools are more likely to improve their digital literacy. These findings suggest that while digital resources alone are insufficient, factors like readiness, skills, supportive environments, and positive attitudes are key drivers of digital literacy. The diagrammatic representation of path analysis is shown in figure 3.

**Figure 3**

*Path analysis results of exploring the interplay of E-Readiness, Technical Skills, and Digital Resources on Digital Literacy of Business Students*




**Artificial Neural Network (ANN)**

**Figure 4**

*Artificial Neural Network Diagram*

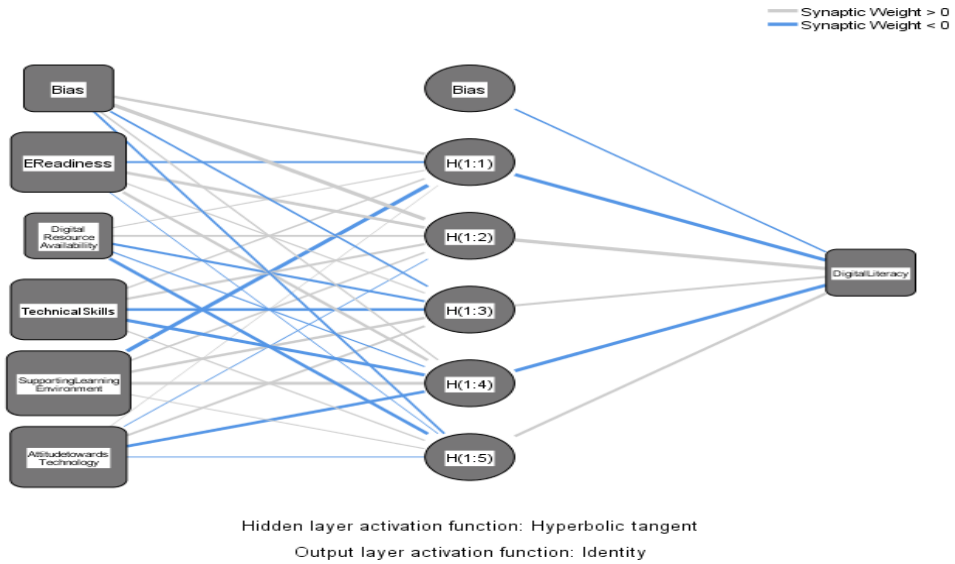


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**Table 7**

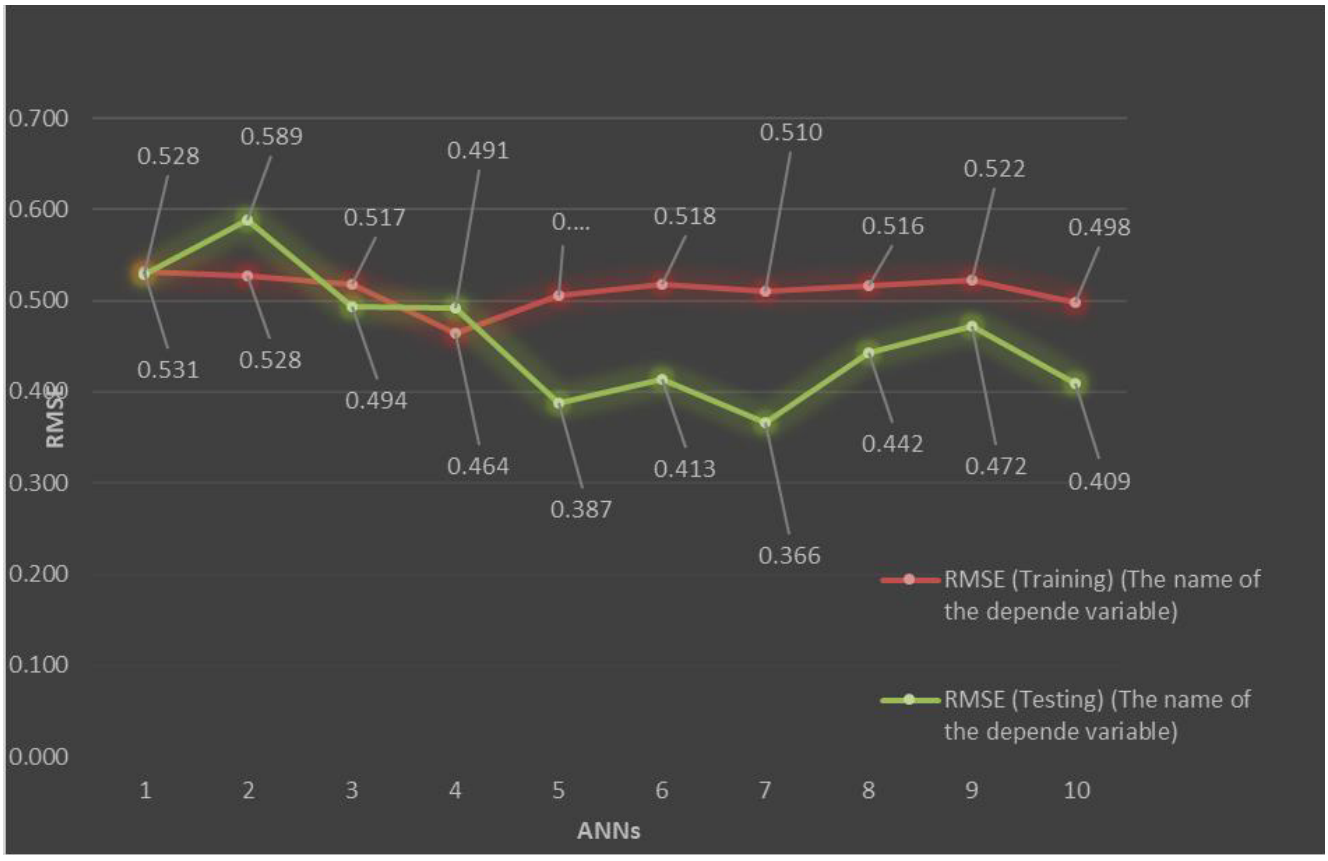
*RMSE Value*

| | Training | | | Testing | | |
|---|---|---|---|---|---|---|
| N | SSE | RMSE | N | SSE | RMSE | Total Samples |
| 320 | 90.303 | 0.5312 | 40 | 11.142 | 0.5278 | 360 |
| 325 | 90.49 | 0.5277 | 35 | 12.136 | 0.5888 | 360 |
| 324 | 86.661 | 0.5172 | 36 | 8.772 | 0.4936 | 360 |
| 321 | 69.212 | 0.4643 | 39 | 9.413 | 0.4913 | 360 |
| 315 | 80.671 | 0.5061 | 45 | 6.747 | 0.3872 | 360 |
| 326 | 87.628 | 0.5185 | 34 | 5.813 | 0.4135 | 360 |
| 320 | 83.132 | 0.5097 | 40 | 5.356 | 0.3659 | 360 |
| 324 | 86.228 | 0.5159 | 36 | 7.043 | 0.4423 | 360 |
| 316 | 86.166 | 0.5222 | 44 | 9.818 | 0.4724 | 360 |
| 323 | 80 | 0.4977 | 37 | 6.193 | 0.4091 | 360 |
| Mean | 84.049 | 0.5110 | Mean | 8.243 | 0.4592 | |
| S.D. | 6.309 | 0.0192 | S.D. | 2.353 | 0.0689 | |

*Source: Survey, 2024 and authors' calculation.*

**Figure 5**

*RMSE diagram*



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The Artificial Neural Network (ANN) diagram (Figure 4) illustrates the architecture used to model the significant factors identified from the SEM-PLS path analysis. Input neurons were fed into the ANN, which utilized a feed-forward-backward-propagation (FFBP) algorithm, allowing for error correction during training by adjusting weights through backward error propagation. The model employed multilayer perceptrons and sigmoid activation functions to capture both linear and non-linear relationships. A ten-fold cross-validation process was used to prevent overfitting, with RMSE values calculated for both the training and testing datasets across ten different neural networks (NN I to NN X). Table 7 presents the Root Mean Square Error (RMSE) values, which indicate how well the model fits the data. The RMSE values for training ranged from 0.4643 to 0.5312, with a mean of 0.5110, while the testing RMSE values ranged from 0.3659 to 0.5888, with a mean of 0.4592. These relatively low values suggest strong model performance, with minimal errors in both the training and testing phases. The RMSE diagram (Figure 5) visually represents the error distribution, showing a consistent decrease in prediction error across the iterations, thus confirming the robustness of the ANN model.

**Table 8**

*Sensitivity Analysis*

| Neural Network | E-readiness | Digital Resource Availability | Technical Skill | Supportive Learning Environment | Attitude toward Technology |
|---|---|---|---|---|---|
| NN(I) | 1 | 0.055 | 0.442 | 0.467 | 0.685 |
| NN(II) | 0.782 | 0.561 | 0.759 | 1 | 0.958 |
| NN(III) | 0.682 | 0.134 | 0.561 | 1 | 0.842 |
| NN(IV) | 0.868 | 0.319 | 0.626 | 1 | 0.835 |
| NN(V) | 0.718 | 0.237 | 0.505 | 1 | 0.689 |
| NN(VI) | 0.497 | 0.433 | 0.891 | 1 | 0.549 |
| NN(VII) | 0.394 | 0.19 | 0.367 | 1 | 0.484 |
| NN(VIII) | 0.356 | 0.136 | 0.561 | 1 | 0.587 |
| NN(IX) | 0.872 | 0.276 | 0.29 | 1 | 0.228 |
| NN(X) | 0.873 | 0.474 | 0.882 | 1 | 0.891 |
| Percentage (%) | 70.40% | 28.20% | 58.80% | 94.70% | 67.50% |

*Source: Survey, 2024 and authors' calculation.*

The sensitivity analysis (Table 8) was conducted to evaluate the predictive importance of each input neuron in the ANN model. This analysis revealed that E-readiness and Supportive Learning Environment were the most influential factors in predicting outcomes, with normalized importance values of 70.40% and 94.70%, respectively. Attitude towards Technology and Technical Skills also demonstrated significant predictive power, with normalized importance values of 67.50% and 58.80%. However, Digital Resource Availability showed the least importance, with a normalized value of 28.20%, indicating that it plays a lesser role in influencing the predictions of digital readiness and literacy. The sensitivity analysis highlights the varying impact of different factors, with the Supportive Learning Environment emerging as the most critical predictor. Overall, the analysis provides insight into the relative contribution of each factor, helping to prioritize areas for improvement in digital literacy and readiness programs.

The findings from the two-stage analysis, combining both PLS-SEM and ANN models, provide significant insights into the factors influencing digital literacy among business students at Pokhara University. The PLS-SEM results revealed that e-readiness, technical skills, supportive learning environments, and

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attitudes toward technology have significant direct effects on digital literacy. This is consistent with previous studies that underscore the importance of student preparedness in digital environments. For instance, Adhikari (2023) emphasized that students equipped with digital platforms and devices are better positioned to utilize these resources effectively, which aligns with the significance of e-readiness in this study. The role of e-readiness is further supported by Chau et al. (2021), who highlighted that digital tools alone are not sufficient without the readiness to engage with them effectively. The ANN model's sensitivity analysis provided a more granular view, identifying e-readiness and supportive learning environments as the most critical predictors, with normalized importance values of 70.40% and 94.70%, respectively. These results support the assertion by Eunice and Christopher (2021) that a supportive environment—characterized by institutional and peer support—significantly enhances digital competency. Chiu and Sun (2022) also argue that peer collaboration and faculty guidance are vital in cultivating digital literacy, which corresponds to the ANN findings showing the high importance of supportive learning environments.

The findings also reaffirm the importance of technical skills in enhancing digital literacy. As evidenced by the PLS-SEM results and consistent with Jou and Wang (2013), students with higher technical competence are more proficient in using digital platforms, which in turn enhances their digital literacy. This relationship is also emphasized by Geylani (2021), who demonstrated that a lack of technical proficiency could hinder the effective use of digital resources, even if they are available. This highlights the critical role of technical skills training in ensuring students maximize the benefits of digital tools. Interestingly, while digital resource availability was initially hypothesized to play a significant role in enhancing digital literacy, the ANN results show that it had the least influence, with a normalized importance value of only 28.20%. This finding aligns with research by Wang et al. (2024), who argued that the mere presence of resources does not equate to digital literacy without the necessary skills to utilize them. Similarly, Mosa et al. (2016) contend that access to digital tools can be underutilized if users lack the competence to operate them effectively.

Another important dimension is the attitude toward technology, which both the PLS-SEM and ANN models identified as a significant predictor of digital literacy. Students with positive attitudes toward adopting new technologies demonstrated higher levels of digital proficiency, confirming findings from Khulwa and Luthfia (2023) and Ardies et al. (2015). These studies emphasized that attitudes toward technology shape how students engage with digital tools, with more positive attitudes driving greater engagement and higher literacy. The combined PLS-SEM and ANN analysis thus provides a comprehensive understanding of the factors affecting digital literacy. While both models reinforce the importance of e-readiness, technical skills, and supportive environments, the ANN model goes further by quantifying the relative importance of these factors. The in-depth understanding gained from this approach highlights areas where educational institutions can intervene to enhance digital literacy. Specifically, promoting supportive learning environments and improving technical skills training emerge as priority areas for intervention, as these have the most significant impact on students' digital proficiency. The role of attitudes toward technology also suggests that promoting a culture of openness to new technologies within academic institutions can further enhance digital literacy.

## Conclusion and Suggestions

This study integrates PLS-SEM and ANN models to offer valuable insights into the factors influencing digital literacy among business students at Pokhara University, highlighting the significance of e-readiness, technical skills, supportive learning environments, and positive attitudes toward technology. While digital resource availability alone proves insufficient, its combination with technical proficiency and institutional support fosters a more effective digital learning environment. These findings have practical implications for educational institutions aiming to enhance digital literacy by integrating technical

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skills training, fostering supportive learning environments, and cultivating positive attitudes toward technology through workshops, certifications, and mentorship programs. However, the study's focus on students from a single institution limits the generalizability of its findings, and its cross-sectional design precludes tracking changes over time. Future research should expand to multiple universities and disciplines, adopt longitudinal approaches, and examine contextual factors such as socioeconomic background to provide a more comprehensive understanding of digital literacy development. By addressing these dimensions, educational institutions can better equip students to thrive in digitally-driven academic and professional environments.

**Author(s) contribution**

Bibek Karmacharya conceived the study, developed the framework and hypotheses, conducted data collection and analysis, interpreted results, authored the manuscript, guiding critical methodological decisions, addressing the comments of reviewers, and finalizing the manuscript.

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## Appendix

### Operationalization of variables

| Constructs_Indicator | Statements | Source | |
|---|---|---|---|
| E Readiness | ER1 | I have reliable digital tools for learning. | Khulwa & Luthfia (2023); Azhar & Rani (2020); Kim et al. (2019); Ghosh Roy & Upadhyay (2017) |
| | ER2 | I am comfortable using online platforms. | |
| | ER3 | I can navigate digital environments easily. | |
| | ER4 | I am familiar with digital communication tools. | |
| | ER5 | I adapt quickly to new technologies. | |
| Digital Resource Availability | DRA1 | I have internet access for my studies. | Reyaz Ahmad Bhat. (2023); Şumuer (2017) |
| | DRA2 | My school provides adequate digital resources. | |
| | DRA3 | I can access online libraries easily. | |
| | DRA4 | I have the necessary hardware for my studies. | |
| | DRA5 | I know about available online resources. | |
| Technical Skills | TS1 | I can use productivity software (e.g., Word, Excel). | Murniati et al. (2022); Ferrer et al. (2020); Jou & Wang (2013) |
| | TS2 | I can create and manage digital content. | |
| | TS3 | I can analyze data with digital tools. | |
| | TS4 | I troubleshoot basic technical issues. | |
| | TS5 | I know advanced features of digital tools. | |
| Supporting Learning Environment | SLE1 | Instructors encourage using digital tools. | Chiu & Sun (2022); Nkomo et al. (2021); Kasemsap (2018) |
| | SLE2 | Peers support me with digital platforms. | |
| | SLE3 | My school offers digital literacy training. | |
| | SLE4 | Faculty support my digital skills development. | |
| | SLE5 | Workshops are available to improve my skills. | |

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| | | | |
|---|---|---|---|
| Attitudes Towards Technology | ATT1 | I enjoy learning new digital technologies. | Ardies et al. (2015); Muis et al. (2015) |
| | ATT2 | Digital skills are essential for my career. | |
| | ATT3 | I am motivated to improve my digital literacy. | |
| | ATT4 | I see technology as a valuable resource. | |
| | ATT5 | I am open to new digital tools. | |
| Digital Literacy | DL1 | I can find and evaluate information online. | Phippen (2024); Alom & R (2024); Kartanegara et al. (2024) |
| | DL2 | I feel confident using productivity software. | |
| | DL3 | I can create digital content (e.g., presentations). | |
| | DL4 | I can analyze data with digital tools. | |
| | DL5 | I use social media for professional networking. | |