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DIGITAL LITERACY AND INCLUSIVE GROWTH: EXAMINING DIGITAL EMPOWERMENT OF FEMALE STUDENTS IN LAHORE

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ABSTRACT

The digital economy has created various entrepreneurship opportunities for women in Pakistan. E-commerce platforms and online marketplaces have enabled women to start their own businesses, reach a larger customer base, and overcome traditional gender-based constraints. The ability to operate businesses from home has also provided flexibility, allowing women to balance their work and family responsibilities. The primary objective is to explore the digital empowerment status of female students in Lahore. This study utilizes a modified scale for the dependent variable, focusing on the dimensions of digital awareness, legal understanding, and economic aspects of digital empowerment. To investigate digital empowerment, the questionnaire is distributed to gather data from 390 female students of both public and private universities in Lahore, Pakistan. Data is analyzed using Smart-PLS 4 and SPSS, while graphical analysis is done through R studio. Frequency, mean, standard deviation, and percentage of variables are calculated for data analysis. Confirmatory factor analysis CFA is used to evaluate the hypotheses. The results reveal that the majority of the 65.3% of respondents have a medium level of digital empowerment. Income has a positive and significant impact on digital empowerment. Digital literacy skills, digital training, and internet skills have positive and significant impact on digital empowerment. Independent variables are considered as important factors in promoting digital empowerment among female students. Institutions and discipline negatively and significantly influence digital empowerment. Additionally, the study examines female students' access to a digital device and their internet usage behavior. Results show that 25.9% of respondents do not have access to the device at home. This research endeavors to pave the way for policy formulation aimed at empowering young female students with essential digital literacy skills that align with international standards.

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INTRODUCTION

The world is becoming digital as technology develops in every industry, including engineering, trade, domestic life, economics, and accounting. Technology in education plays an exclusive role. Digital empowerment refers to a person's capacity to use technology, whereas empowerment is defined as the development of the knowledge and skills that are essential for people to manage their own learning activities. Technology has improved learning in the modern era of the Industrial Revolution from a variety of angles, including the development of the most up-to-date and skilled curriculum, the improvement of student data management, and the enhancement of student safety. To create a positive learning atmosphere and increase productivity, there are entrance and testing procedures, instructor evaluations, and online training programs. One of the most significant approaches for encouraging innovation, dynamism, and development in the world economy is to increase the economic power of women (Pacheco and Coello-Montecel, 2023).

People need to have digital literacy skills to take part in digital economies and societies, it enables them to get an advantage from digital goods, services, and information. It is important to equip the population with fundamental digital skills and digital literacy to ensure that no one is left behind in the development of the digital economy. Digital literacy is the skill of using search engines, apps, and other digital tools to find, evaluate, and obtain information. It is clear that having a strong understanding of technology will affect many facets of daily life. Students may be motivated to learn for lifelong learning and become more interested in the process of developing their academic skills if they have access to digital technology (Meherali et al., 2021). Digital literacy also has an impact on social empowerment since it enables people to stay connected and educated about societal issues. Nowadays, digital technology has added a new aspect to information, which becoming a prime commodity. Furthermore, network connections have aided in quick communication between people across the world, which seems to be happening in real-time. Hans (2018) investigated the ways and means of digitally empowering marginalized individuals who live in socio-economic illiteracy and suffer from information poverty. It brings attention to the use of basic smart technologies and skill-based activities and projects that provide powerful entry routes for learners. Successful adoption of these projects will increase competitiveness, and the paper predicts digital empowerment as a way towards inclusive growth.

Inclusive growth aims to ensure that the benefits of development are shared equitably among all segments of the population. The digital sector plays a significant role in facilitating inclusive growth by providing opportunities for digital empowerment. The growth of the digital sector has

strengthened inclusive growth by breaking down barriers and enabling the exchange of information and resources across different economies. Digitization of data and the process of digitalization have been key drivers in this regard. By bringing digitized data and information onto a single platform, digitalization promotes the sharing and accessibility of resources, knowledge, and opportunities. It enables individuals and communities to connect, collaborate, and engage in activities that were previously limited by physical boundaries (Keshava and Gupta, 2018). Empowering women is essential to promoting sustainable development and inclusive growth. However, women in Pakistan encounter significant obstacles in their pursuit of empowerment. Women's empowerment is positively correlated with factors including age, work position, and access to financial services, highlighting the role that women play in promoting inclusive growth. On the other hand, barriers like unpaid domestic labor and a fear of violence impede advancement. In order to advance women's empowerment and larger initiatives for inclusive growth and development in Pakistan, it is imperative that these obstacles be removed (Batool and Afzal, 2022).

Equal access to information and communication technologies (ICTs) by the whole population of any nation on earth is one of the primary drivers for the achievement of the Millennium Development Goals (MDGs). Universal service and universal access have become significant measures that governments are employing to reduce the digital gap between people around the globe. In order to increase communication, the term "universal access" signifies access to suitable ICTs within a certain range. It appears that various nations define the idea somewhat differently. For instance, the government of Botswana explains free access as having a cell phone available in each community for more than 500 persons. As was already said, governments increasingly see public access and public service as essential elements in reaching the MDGs (Mutula, 2008; Khan et al., 2023; Imran et al., 2023). The "digital divide" poses the biggest problem, though with difficulty, notably in the emerging world and in African nations. Different experts have characterized the "digital divide" in different ways. For instance, Spectar (2000) explains the "digital divide" as the uneven access of individuals or groups of individuals within a nation or across nations to ICTs like computers, the internet, phones, cable, and other internet-related technologies. However, in a world that is becoming more linked, this definition neglects to address questions of usage and access quality.

Moreover, the digital economy has created various entrepreneurship opportunities for women in Pakistan. E-commerce platforms and online marketplaces have enabled women to start their own businesses, reach a larger customer base, and overcome traditional gender-based constraints. The ability to operate businesses from home has also provided flexibility, allowing women to balance their work and family responsibilities. Therefore, investing in the education and training of women in computer technologies is vital to bridge the existing digital divide and promote their active participation in the digital economy. By providing equal access to ICTs and empowering women with the necessary skills, Pakistan can accelerate its economic growth and achieve greater gender equality in the digital era. The main objective of this study is to measure the level of digital empowerment of female students in Lahore, Pakistan.

Role of Digital Competence in Empowering Female Students

Pacheco and Coello-Montecel (2023) explored digital competencies and their effects on job performance. Digital competence and job performance are predictor and outcome variables, respectively, and psychological empowerment is introduced as a mediating factor. The findings were estimated by applying structural equation modeling (SEM). The result showed that digital competence has a favorable impact on psychological empowerment, psychological empowerment raises job performance, and digital competence raises employees' job performance.

Anzak and Sultana (2020) explored the effectiveness of digital literacy among women in Islamabad and Rawalpindi, Pakistan. Using a qualitative research design, they analyzed how women engaged in producing, gathering, and connecting through electronic technology economically and socially. They analyzed different activities through electronic devices, such as calls and messaging, shopping, and entertainment. Results showed that social networking is the most significant activity done through digital literacy. The findings of the study highlighted the importance of equal access to Information and Communication Technologies (ICTs) in promoting economic growth.

Abbas et al. (2019) explored the impact of technological competencies on the efficacy of university students. The goal of the study is to investigate the impact of technological competence on education, abilities to communicate, ability to research, and attitude of the students and the hurdle to learning technological competence in university. A mixed quantitative and qualitative research approach is used. The study results showed that most of the respondent has a high level of competence. There is a statistically negative relationship between digital competence and the educational performance of the students. There is a strong positive relationship between technological competence and exchanging information abilities and attitudes of the students.

Surian and Sciandra (2019) investigated the reliability of the Internet skill scale as determined by a sample poll of Italian Internet users. This study tests internet skill scale reliability and fit on the Italian population survey by looking at Cronbach's alphas and CFA. The results showed that there is a discriminant concern for the scales. Further, they conducted a $\chi 2$ difference test for the overall scales. The results showed that the overall scales model is a stable solution for the Italian population. Litt (2013) discovered strong evidence that education level and internet proficiency are positively correlated, whereas mixed (positive and negative) correlations between age and internet skills are found. The data is analyzed through percentages. Litt (2013) found an appositive link between technology-related abilities and content-related skills, as well as how these skills have changed through time in terms of both age and educational dynamics.

Suwana (2017) explored how media literacy could empower women of Indonesian. Media literacy includes a number of digital production skills like the capacity to create, evaluate, contribute, and consume digital content. The study used qualitative methods. The results showed that digital media literacy is reduced because of inadequate education, a lack of opportunity, and the patriarchal society in Indonesia.

Role of Digital Access in Digital Empowerment of Female Students

Reddick et al. (2020) explored the digital divide in Texas. The study concentrates on the five key economic items that drive broadband adoption. The study shows evidence that four of the items (geographical gap, profit-based differences, technology cost, and socioeconomic factors) influence the digital divide. Kirti and Mandal (2017) explored a new dimension of media i.e. the internet and cell phone that transformed media cultures around the world. Digital empowerment is calculated with reference to psychological, legal,

economic, and technical competencies. The study concluded that under psychological, legal, and economic aspects, all items are positive. Under the technical competency aspect, some item numbers are positive and some are negative.

Mumporeze and Prieler (2017) explored the gender digital gap in Rwanda. The results showed that despite significant efforts by the government, there is still a gender digital divide in Rwanda. Yu et al. (2016) analyzed the level of the digital divide in adults. People with less reliable internet access are those who are economically, socio-culturally, or physically disadvantaged. Access to technological resources positively predicts SNS usage. This study examined internet access and SNS adoption using secondary data analyses. Findings showed that most of the respondents do not have internet access. Moreover, results showed that economic and health conditions are not reliable indicators of elderly individual's SNS usage.

Role of Social Economic Factor in Digital Empowerment of Female Students

By using multivariate regression analysis, Mubarak et al. (2020) confirmed that there is a significant correlation between ICT and socio-economic indices. This study showed a strong positive correlation between income and education and levels of ICT penetration. It is possible to say that the rate of GDP per capita is related to the rate of ICT penetration. The research conducted by Batool et al. (2021b) was also unique in terms of the socio-economics dimension.

Hufad et al. (2019) analysis showed that the behavior in women's internet literacy in rural areas does not always belong to a low category. Digital access has a significant effect on daily activities. Through percentage analysis, the study found that most women do not get a higher education instead, they learn from the current technological development e.g. smartphones and computers with internet access. A study conducted by Batool et al. (2021a) in the area of Southern Punjab concluded that digital literacy will enhance female's decision-making ability and make them aware of their equal opportunities in jobs that will lead to growth.

Akhter (2003) analyzed the digital divide and purchase intention. Study reported that men are more likely to use the internet as compared to women; younger people than older people, more educated people compared to less educated people, and wealthier people compared to less wealthy people. Using multiple regression analysis, results showed that age, income, and education have a significant impact on the chance of purchasing over the Internet and can be used to target consumers and create public policies to bridge the digital divide

This study contributes to extending the literature by identifying socio-economic factors such as age, income, place of residence, and culture that have been ignored in the context of digital empowerment in existing literature (De and Singh, 2017). The present study assesses digital empowerment with digital awareness: Awareness regarding understanding the potential opportunities created by the use of new technologies, and economic and legal aspects. Moreover, it is noted that existing literature mostly studied in foreign contexts such as India, Nigeria, and China conducted research on digital empowerment (De and Singh, 2017; Sun et al., 2018). Very few studies have been conducted on the digital empowerment of female university students in Pakistan (Anzak and Sultana, 2020). Still, there is a huge gap that has to be filled.

METHODOLOGY

The main variables investigated in this research are digital empowerment, digital literacy, internet skills, and accessibility of the internet. Digital empowerment is measured by digital awareness, and legal and economic aspects of digital awareness. Multiple measures are used to assess each of the constructs through an online survey process. After a preparatory review of the survey instrument (including literature review and in-person survey pilot testing), a structural equation model is used to analyze data.

Questionnaire Design

Digital empowerment, digital skills, and internet accessibility are measured using the same scales. However, one variable (internet skills) has a different scale than the other. Scale items are derived and adapted from the previous research that described the variables used to measure the constructs (Olibie et al., 2010; De and Singh, 2017; Alam and Salahuddin, 2015; Vodă et al., 2022). All variables are measured as reflective first-order constructs. To prevent overlap between variables the measurement items are carefully selected and refined. For general informational purposes, arrange of descriptive data is collected.

Sample Description

A sample consists of 390 students from 6 Universities (03 public & 03 private). A multistep stratified sampling method is adopted for the selection of universities and students.

In the first step, 6 universities (03 public universities and 03 private universities) located in Lahore city of Pakistan were selected by using a random sampling technique. The list of universities is obtained from the website of the Higher Education Commission. In the second step, two faculties (0 belongs to Arts/Social Sciences and 1 belongs to Sciences/Technology) are chosen from each university by using a simple random sampling technique. In the last step, 390 students from the Public and Private sectors are selected by a simple random sampling technique. In this way, 65 university students are selected from each sampled university. The total sample belonging to public and private universities is 390. After the pilot research, the reliability of the questionnaire is verified by a reliability test and Croanbach's alpha coefficient (α= 0.87) which is suitable to use for data collection of the study. The sample process for the online survey targeted female students in the universities of Lahore. Data is gathered by using an online questionnaire created through Google Forms. Questionnaires were sent electronically to the eligible respondents in order to increase the response rate. In two months, from April to May, 390 responses were received.

RESULTS AND DISCUSSION

Demographic Variables

Respondents are asked about their family information such as income, family type, and parent's occupation. They are asked to provide their age, education level, source of education finance, and information related to digital device access, access to the internet, and usage behavior. Moreover, they are enquired to provide information about their institution and discipline.

Table 1 shows the frequency and percentage of demographic variables that indicate the personal information of 390 respondents. Figure 1 describes the Device Access, figure 2 access to the internet, Figure 3 represents the purpose of internet usage, Figure 4 describes access per work, and in Figure 5 level of digital empowerment is described.

Computer (desktop and laptop) at home: Results show that 25.9 % of respondent do not have access to devices at home. While 48%, 14.9%,

6.7%, and 1.5% of respondents have access to the device. The result shows that there is an access gap among respondents.

Table 1. Demographic information of respondent.

Variable name	Frequency	Percentage
Age in groups		
18-24	223	55.5
25-31	110	27.4
32-38	34	8.5
39-45	23	5.7
Qualification		
Intermediate	58	14.4
BS Hons	192	47.8
Ms	105	26.1
Ph.D	35	8.7
Source of finance		
Support by parents	240	59.7
Student grant	28	7.0
Employment during the semester	62	15.4
Employment during the semester break	26	6.5
Scholarship	34	8.5
Family type		
Joint	264	65.7
Nuclear	126	31.3
Fathers' occupation		
Government service	113	28.1
Business	154	38.3
Labor	52	12.9
Farming	71	17.7
Mothers' occupation		
Government service	43	10.7
Business	12	3.0
Labor	18	4.5
Housewife	317	78.9

Source: Author's own calculation.

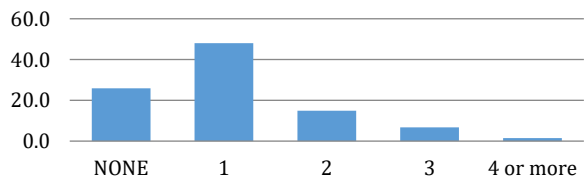

Figure 1. Device access.

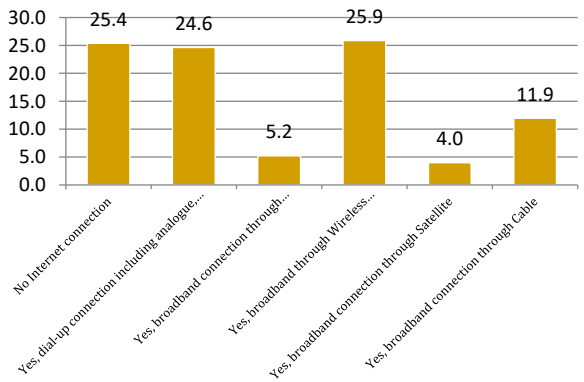

Figure 2. Access to the Internet.

Household access to the Internet: An increasing number of people are using the Internet for their daily needs and it has become part of their daily lives. 25.5% of respondents do not have access to the internet at home. 25.9% and 24.4% of female respondents have internet access through a wireless broadband connection and a dial-up connection.

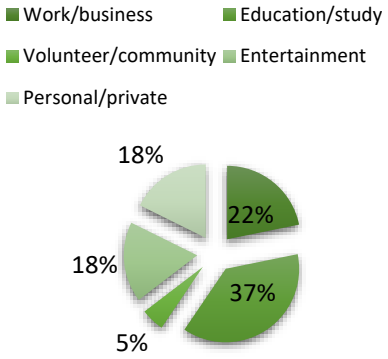

Figure 3: Purpose of usage

Purpose of Internet Access: In terms of the purpose of Internet access, female students access the internet for education/study purposes (36.6% high category), for work/business (21.1%), and for entertainment and personal/private (17.2%, 17.2%). For volunteer/community purposes they access the internet (5.0% with very low category).

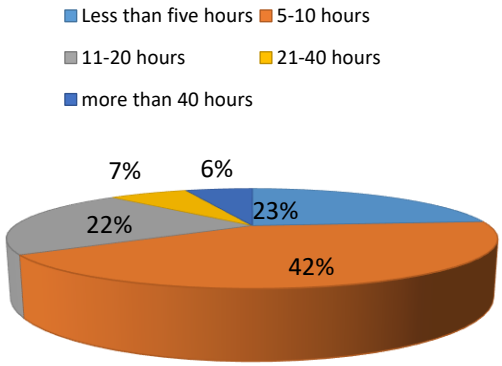

Figure 4: Internet Access per week

Duration of Internet access per week: The majority of the students have access to the internet on average 5-10 hours per week, less than 5 hours per week, and 11-20 hours per week (41%, 22.9%, and 21.1%). The proportion of people using the internet for 21-40 hours per week and more than 40 hours per week falls within the low category (below 6%).

Level of Digital Empowerment of Student

The objective of this study is to measure the level of digital empowerment of female students of Lahore. The results reveal that the majority of the 255(65.3%) respondents have a medium level of digital empowerment. Out of two dimensions 204 and 201 respondents reported belonging to the medium level of digital empowerment (52.3%) and (49.9%) while for one dimension 188 respondents reported a high level of digital empowerment (48.2%).

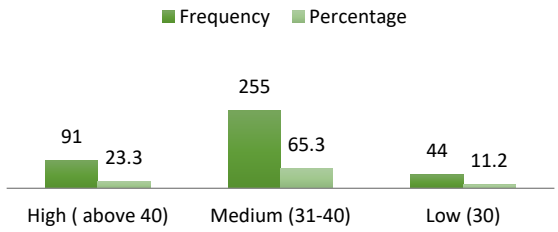

Figure 5. Level of digital empowerment.

Table 2. Level of digital awareness of female students.

Sr No.	Digital Awareness dimension of digital empowerment	Respondent (N=390)	
		Frequency	Percentage
1	High (above 24)	126	32.3
2	Medium (23-17)	237	60.7
3	Low (17)	27	6.9
	Mean	21.9	
	Std. Deviation	3.3	

Source: Author's own calculation.

Table 2 shows that 237 (60.7%) students belong to the medium level of digital awareness dimension of digital empowerment. The remaining 126(32.3%) and 27(6.9%) respondents have a high and low levels of digital awareness.

Table 3. Level of legal dimension of digital empowerment of female students.

Sr No.	The legal dimension of digital empowerment	Respondent (N=390)	
		Frequency	Percentage
1	High (above 11)	169	43.3
2	Medium (8-11)	199	51.1
3	Low (Below 7)	22	5.6
	Mean	10.9	
	Std. Deviation	2.14	

Table 3 shows that 199 (51.1%) students belong to the medium level of the legal dimension of digital empowerment. The remaining 169(43.3%) and 22(5.6%) students have low and high levels of awareness related to the legal dimension of digital empowerment. The result indicates that students have a medium level of awareness related to the complexities of the legal system and technology-related crimes.

Table 4. Level of economic dimension of digital empowerment of students.

Sr No.	The economic dimension of digital empowerment	Respondent (N=390)	
		Frequency	Percentage
1	High (above 19)	117	30
2	Medium (13-19)	250	64.5
3	Low (13)	23	5.8
	Mean	17.6	
	Std. Deviation	3.1	

Source: Author's own calculation.

In case of students' level of the economic dimension of digital empowerment, it could be noted from Table 4 that 250(64.5%) students have a medium level of the economic dimension of digital empowerment. 117(30%) and 23(5.8%) students have a high and low levels of the economic dimension of digital empowerment.

Measurement Model

The model used in this study is in Figure 6; the R square value is 41%. The measurement model concerns the relation between observed and latent variables. In research independent variable and dependent variable are composites of multiple responses to questionnaire items (Hair et al., 2019). Measurement models are hypotheses about the relation between a set of observed variables. Questionnaire items are created to measure data.

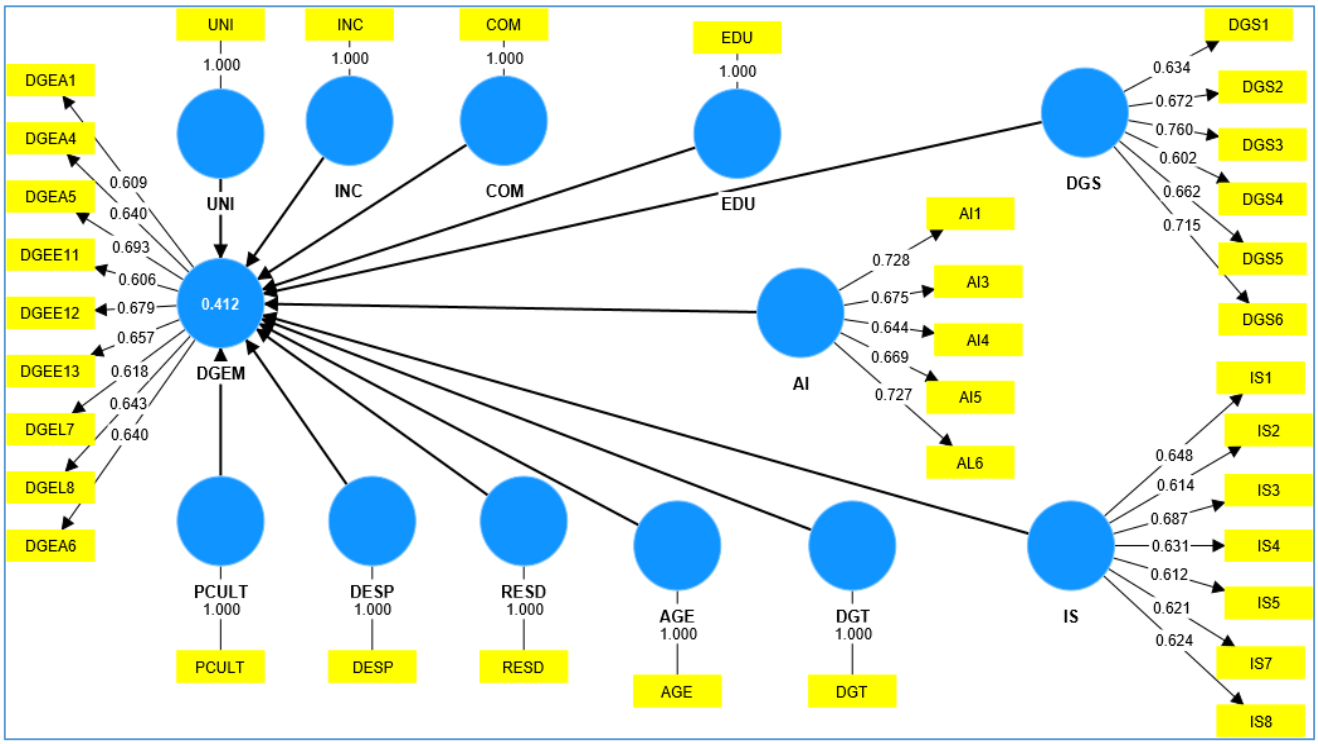

Figure 6. Measurement model.

Analytical Process

The validity and reliability of the construct are confirmed by confirmatory factor analysis (CFA). The outer loading of the construct is measured. Based on suggestion any item lower than 0.7 is considered for elimination if indicator removal improves the internal consistency reliability. Two items had loading less than 0.4 other five items had loading less than 0.7 but greater than 0.4. Removing those indicators improves the internal consistency reliability. Cronbach's alpha, composite reliability, and average variance extracted (AVE) are computed in Table 5 to evaluate the internal consistency, construct reliability, and convergent validity. All constructs demonstrate a high degree of internal consistency, construct reliability, and convergent validity. Results show that the AVE value of DGEM and IA is greater than 0.5 while the value of DGS (0.40) and IS (0.41) is slightly less than 0.5 (Pahlevan et al., 2022). The scale of DGEM consists of fourteen components in the subcategory of digital awareness (6 items), legal (3 items), and economical (5 items) out of which five items are dropped due to low outer loading. According to Hair et al. (2017), indicators with a non-significant weight should certainly be removed. The indicator should be removed if has a significant loading of 0.50 or below. The outer loading of each construct is examined. The internal consistencies of reflective measures have Cronbach's alphas greater than 0.6 and composite reliabilities greater than 0.70 and average variance greater than 0.4.to evaluate discriminate validity.

Table 5. Reliability and validity indices of measurement model.

Construct	Measurement item	Factor loading	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
IA	IA1	0.728	0.734	0.733	0.819	0.53
	IA3	0.675				
	IA4	0.645				
	IA5	0.669				
	IA6	0.727				
DGEM	DGEA1	0.61	0.823	0.823	0.864	0.51
	DGEA4	0.64				
	DGEA5	0.693				
	DGEA6	0.641				
	DGEE11	0.606				
	DGEE12	0.678				
	DGEE13	0.656				
	DGEL7	0.618				
	DGEL8	0.643				
DGS	DGS1	0.634	0.759	0.759	0.825	0.41
	DGS2	0.672				
	DGS3	0.76				
	DGS4	0.602				
	DGS5	0.662				
	DGS6	0.715				
IS	IS1	0.648	0.759	0.764	0.825	0.40
	IS2	0.614				
	IS3	0.687				
	IS4	0.631				
	IS5	0.612				
	IS7	0.621				
	IS8	0.624				

Source: Author's own calculations.

Table 6. Summary of discriminant validity (HTMT) in measurement model.

Heterotrait-Monotrait Ratio (HTMT)													
	AGE	IA	DA	DGEM	DGS	DGT	EDU	INC	IS	PCULT	RESD	UNI	DESP
AGE													
IA	0.052												
DA	0.134	0.286											
DGEM	0.054	0.518	0.102										
DGS	0.084	0.677	0.302	0.71									
DGT	0.027	0.212	0.163	0.189	0.441								
EDU	0.353	0.041	0.141	0.067	0.143	0.162							
INC	0.119	0.115	0.246	0.137	0.075	0.125	0.177						
IS	0.061	0.564	0.249	0.441	0.532	0.382	0.092	0.112					
PCULT	0.052	0.078	0.15	0.099	0.077	0.053	0.146	0.026	0.054				
RESD	0.099	0.14	0.019	0.114	0.099	0.051	0.078	0.066	0.037	0.12			
UNI	0.114	0.106	0.062	0.051	0.151	0.159	0.046	0.015	0.313	0.059	0.094		
DESP	0.083	0.118	0.065	0.077	0.152	0.071	0.1	0.099	0.113	0.07	0.104	0.119	

Source: Author's own calculations.

After examining appropriate HTMT ratios, discriminate validity is confirmed. Values of the HTMT matrix are less than 0.8. According to Fornell and Larcker, (1981), each construct's square root of AVE is greater than its association with other variables as shown in Table A1. Table 6 shows the results regarding discriminant validity. The findings show that all diagonal values are greater than other values. This study used the HTMT proportion of relationships to evaluate the discriminant validity. The greatest HTMT value is 0.71 which is lower than 0.85. The value is greater than the correlation values in both columns and rows. The remaining factors are observed in the same way. The result indicates that discriminant validity is well established.

Through saturated and estimated models, values of overall model fit have been examined. The values of both saturated and estimated model values are closely linked to the predicted values. As a result, both SRMR and NFI values supported the statistically tested model. Table A2 in Appendix displays values of saturated and estimated models.

According to Hair et al. (2010). Multi-collinearity refers to how much the other variables in the analysis are correlated. High multi-collinearity can influence the overall results. The presence of multi-collinearity in this study was checked using the value of the variance inflation factor (VIF). Table A3 in the appendix shows the value of VIF. There is no issue of multi-collinearity as the value of VIF is about two or below.

Preliminary Results

Figure 7 shows the normality of the data. It is evident that data is approximately normally distributed as few peaks are above the boundary.

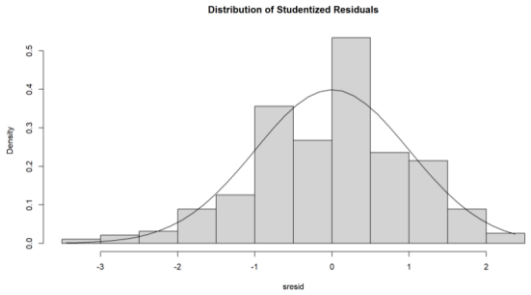

Figure 7. Normality graph.

Figure 8 shows the QQ plot (quantile-quantile plot), which shows the normality as well as outliers in the data. It shows that observations 106 and 269 are outliers, which does not bother our results.

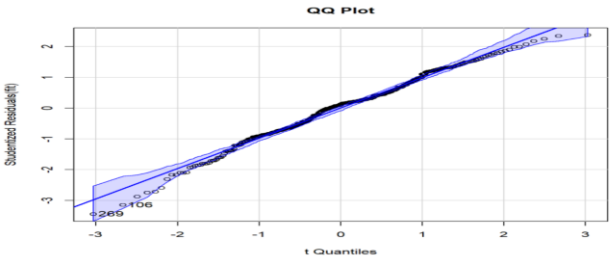

Figure 8. QQ plot.

Figure 9 shows the high leverage of each independent variable with respect dependent variable. The leverage plot in Figure shows the outliers in each variable.

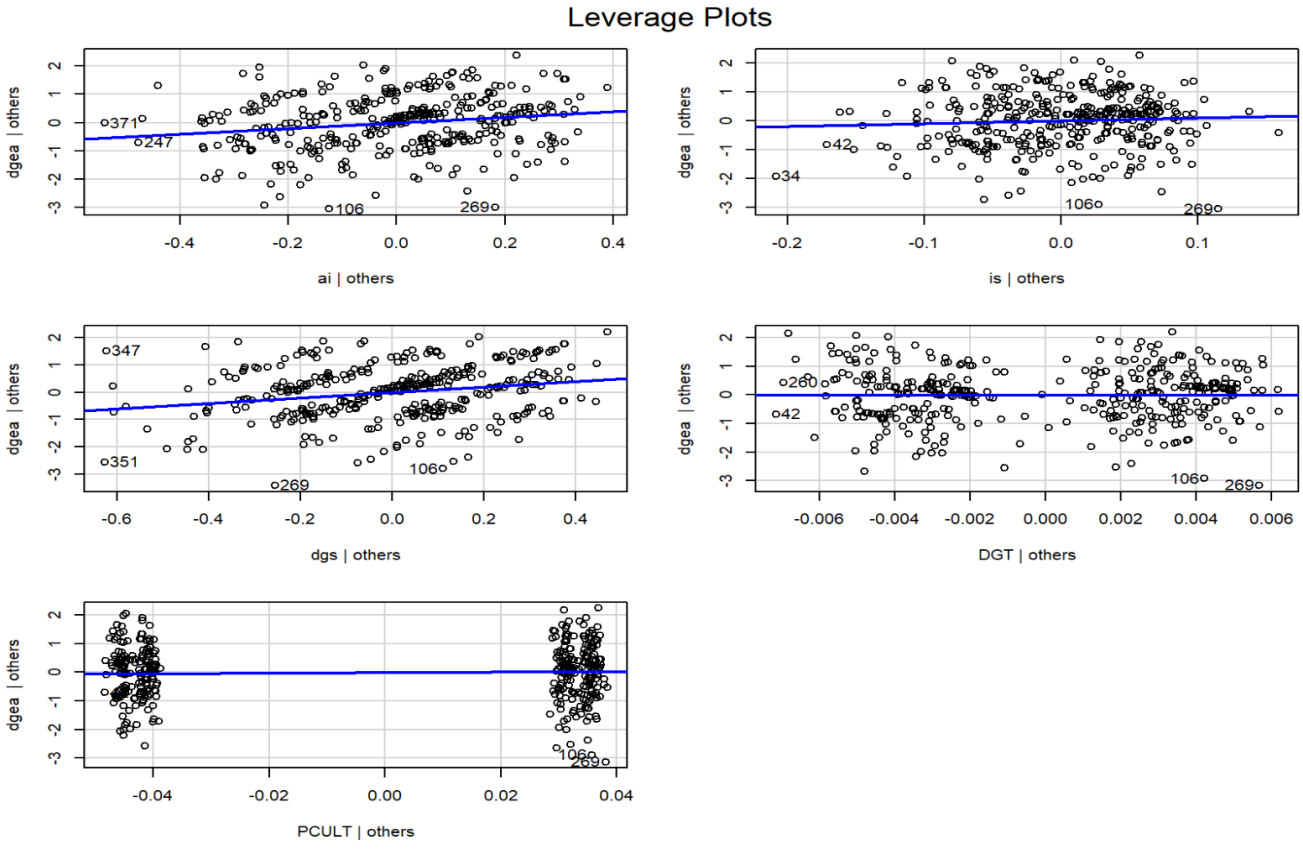

Figure 9. Leverage plot.

Figure 10 shows the influence of each observation on the dependent variable. It shows that 34, 269, 347, and 389 have high influence.

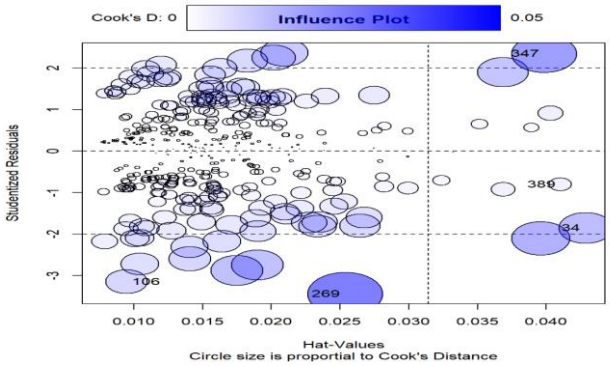

Figure 10. Influence plot.

We have checked the heteroscedasticity graphically with the help of spread spread-level plot. Figure 11 shows that there is no heteroskedasticity as the purple line is not so far from the blue (critical line).

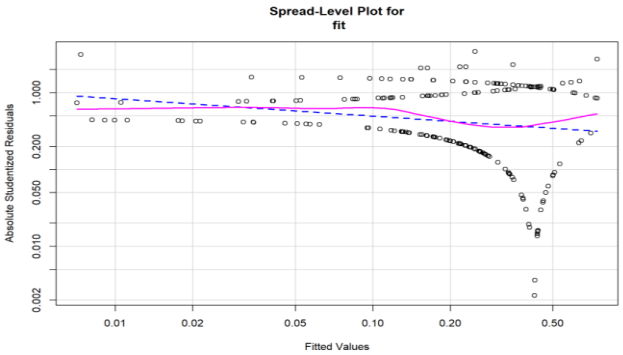

Figure 11. Spread level plot.

Figure 12 shows the linearity of the data. As blue (critical) line follows the purple line suggesting the linearity of variables, except for the affordability of the internet (AI) and digital literacy skills (DGS).

Finally, we also conducted an advance multicollinearity test graphically. Figure 13 shows that there is no multicollinearity between variables.

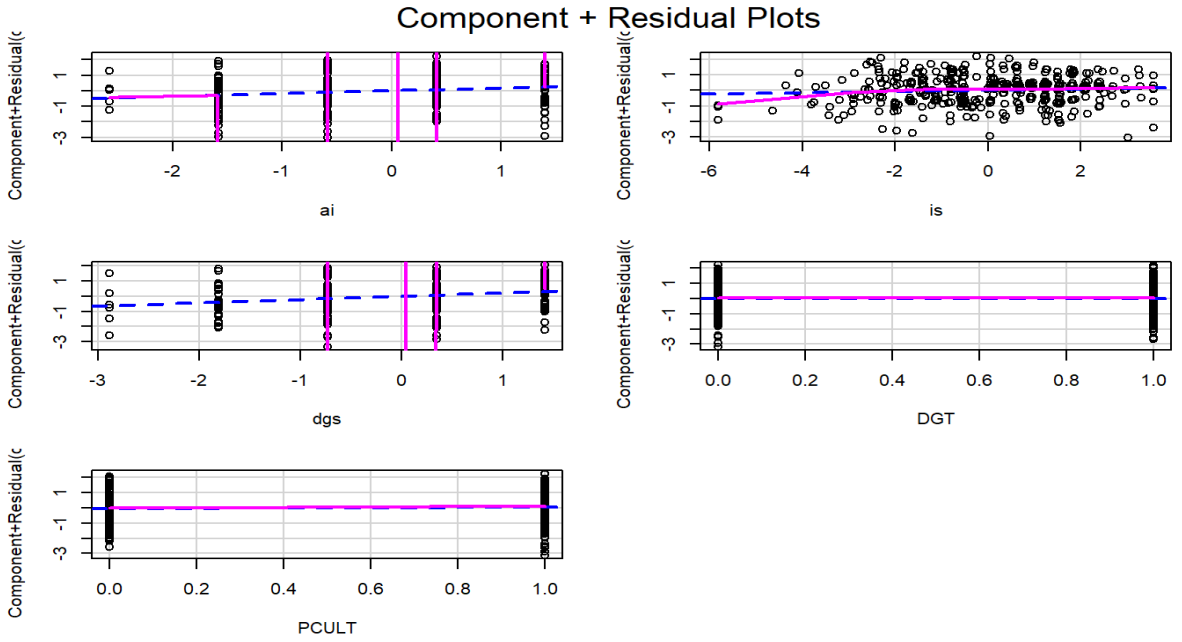

Figure 12. Component + residual plots.

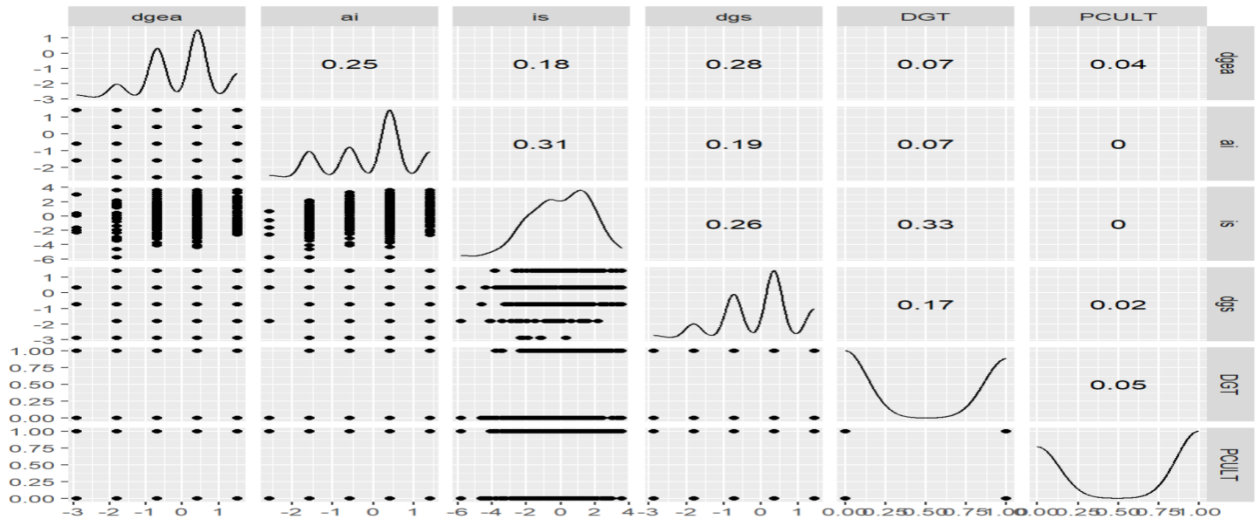

Figure 13. Pairwise correlation plots.

Table 7 shows path coefficient results using PLS-SEM. Results of IA and DGEM (β = 0.12, t= 2.45, p= 0.014) show that internet access is significant and positively affects digital empowerment. DA and DGEM (β = -0.017, t= 2.19, p= 0.02) sows device access is significant and negatively affects digital empowerment. A decrease in device access affects digital empowerment. DGS and DGEM (β = 0.48, t= 8.78, p= 0.00) show that digital literacy skills are significant and positively affect digital empowerment. Figure 14 shows relationship between dependent and independent variable. DGT and DGEM (β = 0.19, t= 2.26, p= 0.02) show that digital training positively and significantly affects digital empowerment.INC and DGEM (β = 0.12, t= 3.17, p= 0.002) show that income has positive and significant effect on digital empowerment. IS and DGEM (β = 0.21, t= 3.8, p= 0.000) show that internet skills positively affect digital empowerment.

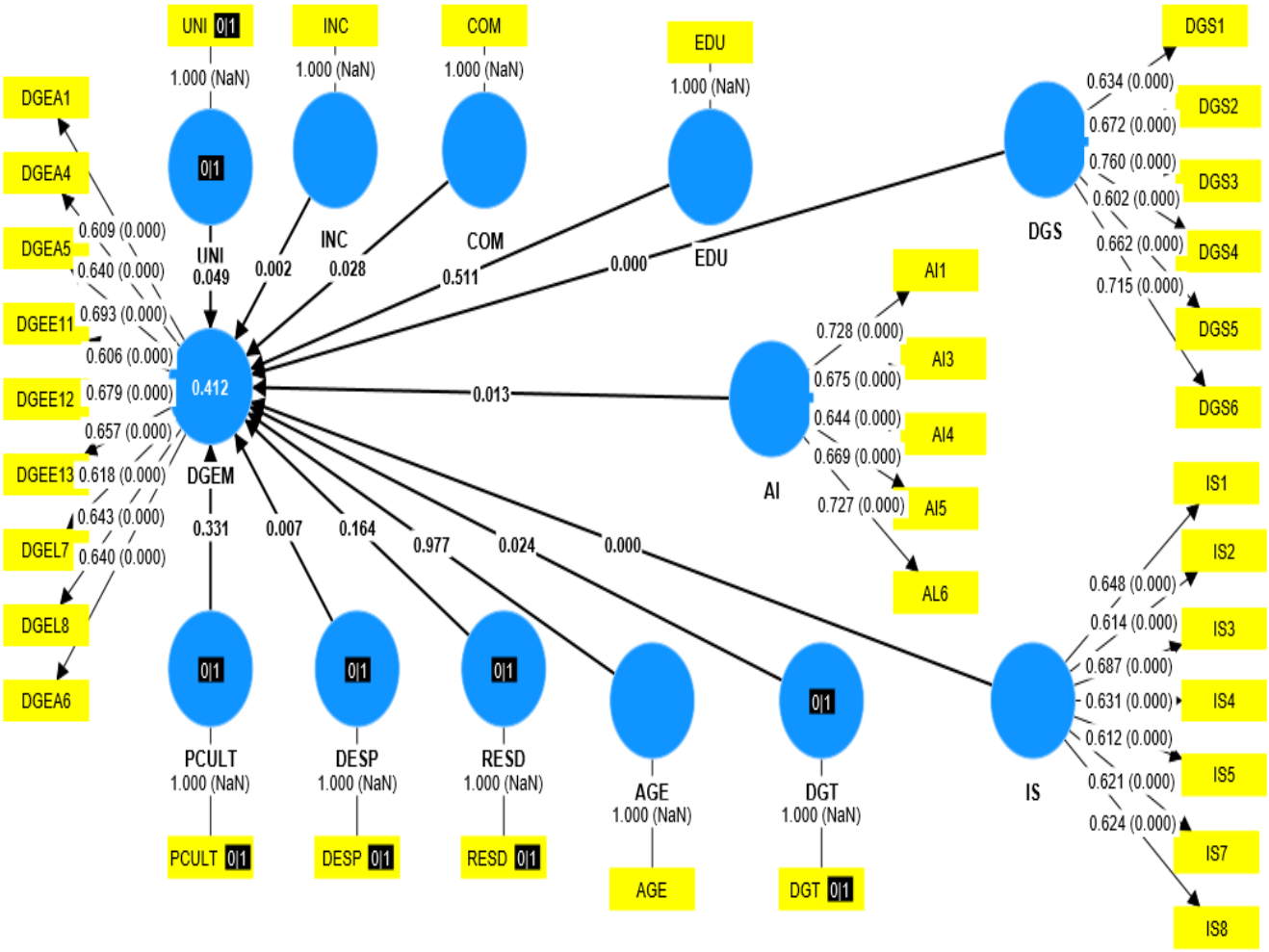

Figure 14. SEM analysis.

Table 7. Path coefficient.

Hypothesis testing	Path coefficient	t-statistics	p-values	Result
AGE -> DGEM	-0.002	0.029	0.977	Rejected
I A-> DGEM	0.127	2.488	0.013**	Accepted
DA-> DGEM	-0.107	2.198	0.028**	Accepted
DGS -> DGEM	0.488	8.758	0.00**	Accepted
DGT -> DGEM	0.192	2.261	0.024**	Accepted
EDU -> DGEM	-0.033	0.657	0.511	Rejected
INC -> DGEM	0.125	3.099	0.002**	Accepted
IS -> DGEM	0.212	3.977	0.000**	Accepted
PCULT -> DGEM	0.081	0.972	0.331	Rejected
RESD -> DGEM	0.12	1.391	0.164	Rejected
UNI -> DGEM	-0.156	1.971	0.049**	Accepted
DESP -> DGEM	-0.217	2.699	0.007**	Accepted

Source: Author's own calculation

Results of Age (β =-0.001, p =0.9), family type (β = 0.02, p= 0.7), prevailing culture (β = 0.07, p= 0.3), place of residence (β = 0.12, p= 0.16) and education level (β =-0.03, p= 0.5) of the respondent are not statistically significant with digital empowerment.

Discussion

All direct relationships are evaluated using a bias-corrected bootstrapping technique with 390 respondents as shown in figure 14. Tests are two-tailed and any variable with a p-value of less than .05 is said to be statistically significant. The finding of the study shows that independent variables have contributed to the effect of the dependent variable.

The second hypothesis states that internet affordability influences the digital empowerment of female students. The results of the study indicate that internet accessibility is significant and positively related to digital empowerment (β = 0.12, t= 2.45, p= 0.014). Therefore, with the finding of SEM, it is testified that the second hypothesis has been accepted. Internet accessibility plays an important role in shaping the digital empowerment of students, particularly female students. Access to the internet not only connects people globally but also provides access to a vast array of educational materials, online courses, research databases, and opportunities for collaboration. Results are quite consistent with Van Deursen and Van Dijk (2011).

This study indicates that a huge part of the population is excluded from actual and effective internet use due to a lack of internet access.So, for a person to be digitally empowered, having access to affordable internet plays a part in closing the digital divide gap. Table 8 shows all the hypotheses of this study. According to Odongo and Rono (2017), internet access and digital empowerment have a positive link, as widespread access to affordable internet services plays a crucial role in promoting economic development and empowering individuals and communities. The Internet provides a platform for entrepreneurship and business development. With online connectivity, businesses can reach global markets, explore e-commerce opportunities, and tap into a vast customer base. It also promotes financial inclusion and social empowerment, contributing to a more equitable and prosperous society.

The third hypothesis states that access to digital devices influences digital empowerment.

Digital device accessibility is significant and negatively related to digital empowerment (β = -0.017, t= 2.19, p= 0.02). Thus, Hypothesis 3 is accepted. As the access to devices decreases digital adoption also decreases. The results of the study are quite consistent with Kirti and Mandal (2017). According to this study, in order to close the digital gap population needs to have more access to digital devices because it is digital access that separates society.

De and Singh (2017) explained that digital device access and digital empowerment are two interconnected concepts that are crucial for fostering inclusive education and leveling the playing field in today's technology-driven world. It is essential that students have access to devices both at home and in educational institutions. Unequal access to digital devices can create a digital divide, where some students are left at a disadvantage due to limited or no access to technology. Bridging this gap is crucial to ensure that all students have equal opportunities to learn and thrive in the digital age.

The fourth hypothesis states that digital literacy skills are essential for the digital empowerment of female students

Digital skills are positively and statistically significantly associated with digital empowerment (β = 0.48, t= 8.78, p= 0.00). So, with the finding of SEM results, it is certified that Hypothesis 4 has been accepted. The positive and significant association reveals that; people having digital literacy skills are more empowered. Results are consistent with Iyengar et al. (2017). The study suggests that female students need to have digital skills in order to be empowered online. Digital literacy skills are the first step toward digital empowerment. The positive relation reveals that; digital literacy skills are important inputs, that could assist people in achieving digital empowerment. Njenga (2018) argues that digital literacy plays a crucial role in driving economic development in the digital age. Digital literacy enhances an individual's employability by equipping them with the skills and knowledge required in the modern workforce. It enables entrepreneurs to start and grow businesses online, reducing the barriers to entry and expanding market reach.

The fifth hypothesis states that digital training courses affect the digital empowerment of female students.

The ability of students to use technology is positively and significantly impacted by digital training programs (β = 0.19, t= 2.26, p= 0.024). Thus,the the fifth hypothesis is also accepted. Respondent reported that digital training courses are effective in increasing their digital empowerment. The Results of the study are consistent with Vodă et al. (2022). The study states that students who declared no digital education have lower electronic adoption, while for those who mentioned high digital education, the highest adoption noticed. Digital courses are effective ways to improve digital skills.

The seventh hypothesis states that income level influences the digital empowerment of female students.

Respondent reported that Income is positively and significantly related to digital empowerment. So, hypothesis 7 is accepted as well. As the income level increases access to digital devices and the internet increases which helps empower female students. Results are consistent with Akhter (2003). Our results suggest that people with high income as compared to less income use more the internet and have access to the internet which makes them digitally empowered. According to Parks et al. (2022), income has a significant impact on digital empowerment. Digital empowerment allows individuals to diversify their sources of income. For example, someone with a full-time job may also engage in part-time freelance work or sell products online, reducing financial risk and increasing overall income.

The eighth hypothesis states that internet skills influence the digital empowerment of female students.

Internet skills are positively and statistically significantly associated with digital empowerment (β = 0.21, t= 3.8, p= 0.000). So, hypothesis 8 is accepted. Individuals with higher internet skills are able to utilize the internet more effectively compared to those with lower or no internet skills. Alam and Salahuddin (2015) studied that there is a positive link between digital empowerment and internet skills. People with higher internet skills can use the internet more than people with low skills or lack of skills. Ponte (2012) explained that internet skills are a fundamental component of digital empowerment. It enables individuals to effectively search for and access information online. This access empowers them to stay informed, conduct research, and make informed decisions in various aspects of life, from education to health to personal finance.

The eleventh hypothesis states that institution plays an important role in the digital empowerment of female students.

The institution is negatively and significantly related to digital empowerment (β = -0.15, t= 1.97, p= 0.04). It means student's digital empowerment is influenced by their institute. So, Hypothesis 11 is accepted. According to Akkoyunlu et al. (2010), education institution plays an important part in educating young people for life in fast fast-evolving digital world of today.

Table 8. Summary.

Hypotheses	Decision	
H_1: The age of the female student influences digital empowerment.	Negative	Rejected
H_2: Internet affordability influences the digital empowerment of female students.	Positive	Accepted
H_3: Access to devices influences the digital empowerment of female students.	Negative	Accepted
H_4: Digital literacy skills are necessary for the digital empowerment of female students.	Positive	Accepted
H_5: Digital training affects the digital empowerment of female students.	Positive	Accepted
H_6: Level of education influences the digital empowerment of students.	Negative	Rejected
H_7: Income level influences the digital empowerment of female students.	Positive	Accepted
H_8: Internet skills influence the digital empowerment of female students.	Positive	Accepted
H_9: Prevailing culture affects female internet and technology usage which influences their digital empowerment.	Positive	Rejected
H_{10}: Place of residence (village/city) influences the gender digital divide.	Positive	Rejected
H_{11}: Institution plays an important role in the digital empowerment of female students.	Negative	Accepted
H_{12}: Digital empowerment of female students is influenced by their discipline.	Negative	Accepted

Reference: From Table 7.

The results concluded that students of both (public and private) sectors have different opinions about their digital empowerment. Moreover, Zhao et al. (2008) explained that private and public universities can have a negative impact on digital empowerment. Private universities usually have higher tuition fees compared to public institutions, making education less accessible to students from lower-income backgrounds. This financial barrier can restrict the opportunity for digital empowerment, as not all students can afford the necessary devices, software, or internet connectivity to fully engage in online learning and digital tools.

The twelfth hypothesis states that the digital empowerment of female students is influenced by their discipline.

Discipline is negatively and significantly related to digital empowerment ($\beta = -0.21$, $t= 2.69$, $p= 0.007$). this hypothesis is also accepted. Results show that science and technology students are more empowered than social sciences students. According to Voda et al. (2022), respondent's digital empowerment gets influenced by their discipline. Students who belong to the science and technology discipline get more influenced as compared to social sciences students. By increasing women's access to technical skills, knowledge, and decision-making, we can bridge the digital divide and achieve gender equality.

CONCLUSIONS

Digital technology has significantly changed people's lives over time by permeating every aspect of their lives, communities, and societies. Young people today who are born in the digital age are constantly surrounded by a world where electronic devices like computers, smartphones, social media, and online communities play a significant role in how they communicate, learn, and work to advance their political, social, economic, and digital well-being. The results of the study show that internet accessibility, Digital literacy skills, digital training courses, and Internet skills are positively and significantly related to digital empowerment. Digital device accessibility is negatively and significantly related to digital empowerment. Income is positively and significantly related to digital empowerment. Institution and Disciplines negatively and significantly influence digital empowerment. Age, prevailing culture, residence, and education are insignificant suggesting no effect on the digital empowerment of the respondent. It is clear that improving digital literacy among women is vital for them to fully benefit from these technologies.

There are several policy implications that originate on the basis of the results of the study. (i) This study suggests to the Government of Pakistan (GoP) to acknowledge the expansion of the IT and telecommunications industries as a crucial lever for the mid- to long-term progress of the nation. The goal of the government should be to increase the availability, affordability, and universality of IT services to enhance social, economic, and overall quality of life. (ii) Private and public universities need to prioritize investing in digital infrastructure and resources; and offer scholarships or financial aid packages to ensure greater accessibility for students. (iii) Finally, this study suggests policymakers to boost international cooperation in the areas of ICT access and women's and girls' active participation in the digital society. Launch initiative projects to provide network accessibility at educational institutes across Pakistan. The study indicates that efforts must be made to provide skills.

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APPENDIX

Table A1. Discriminant reliability and validity.

Fornell-Lacker criterion												
	AGE	IA	COM	DGEM	DGS	DGT	EDU	INC	IS	PCULT	RESD	UNI	DESP
AGE	1												
IA	0.043	0.689											
COM	0.134	0.248	1										
DGEM	0.05	0.432	0.093	0.643									
DGS	0.053	0.516	0.264	0.565	0.676								
DGT	0.027	0.178	0.163	0.172	0.388	1							
EDU	0.353	0.024	0.141	0.053	0.106	0.162	1						
INC	0.119	0.105	0.246	0.124	0.063	0.125	0.177	1					
IS	0.038	0.42	0.214	0.373	0.402	0.323	0.073	-0.038	0.634				
PCULT	0.052	0.006	-0.15	0.089	0.051	0.053	0.146	-0.026	0.008	1			
RESD	0.099	0.13	0.019	0.097	0.065	-0.051	0.078	-0.066	-0.014	0.12	1		
UNI	-0.114	0.063	0.062	-0.005	0.106	0.159	-0.046	-0.015	0.26	-0.059	-0.094	1	
DESP	-0.083	0.07	0.065	-0.053	0.098	-0.071	-0.1	-0.099	0.063	-0.07	0.104	0.119	1

Source: Author's own calculation.

Table A2. Model Fit.

	Saturated model	Estimated model
SRMR	0.065	0.068
d_ULS	2.987	3.261
d_G	0.629	0.641
Chi-square	1401.067	1427.276
NFI	0.657	0.651

Source: Author's own calculation.

Table A3. Collinearity.

Variable	VIF	Variable	VIF
AGE	1	DGS4	1.317
IA1	1.43	DGS5	1.348
IA3	1.416	DGS6	1.61
IA4	1.491	DGT	1
IA5	1.159	INC	1
IA6	1.374	IS1	1.243
COM	1	IS2	1.479
DGEA1	1.363	IS3	1.373
DGEA4	1.421	IS4	1.362
DGEA5	1.625	IS5	1.289
DGEA6	1.481	IS7	1.416
DGEE11	1.379	IS8	1.53
DGEE12	1.62	PCULT	1
DGEE13	1.567	RESD	1
DGEL7	1.436	EDU	1
DGEL8	1.513	UNI	1
DGS1	1.318	DESP	1
DGS2	1.431		
DGS3	1.681		

Source: Author's own calculation.