



Digital Tool Use and Perceived 21st-Century Skill Development Among University Students in South Punjab, Pakistan



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Abstract

The paper has analyzed the correlation between the use of digital tools and perceived acquisition of 21st-century skills among university students in South Punjab, Pakistan. A total of 400 students were sampled at four public universities: The Islamia University of Bahawalpur, Bahauddin Zakariya University, Rahim Yar Khan University, and the University of Education, Multan. The sample was institutionally balanced (100 students in each university) and gender balanced (200 males and 200 females). The questionnaire contained 39 items on digital-tool-use and 40 items on perceived skill-development (perceived effectiveness, academic and learning impact, personality and soft-skill development). Items of digital-tool-use were reverse-scored such that the higher the score, the more often the item was used. Descriptive statistics, reliability analysis, Pearson correlations, independent samples t tests, one-way ANOVA, and multiple regression were used. Both scales were highly reliable, with $\alpha = .91$ in digital-tool use and $.89$ in perceived skill development. Perceived effectiveness and skill development were moderately high and digital-tool use was high. WhatsApp was used as a learning tool, Google Chrome, YouTube as a learning tool, ChatGPT, Meta AI/Gemini, and MS Office were most frequently used, and JSTOR, open educational resources, Mendeley, Zotero, and Coursera/edX were least frequently used. There was a positive and significant relationship between the use of digital-tools and all perceived domains of skill-development. Digital-tool use was confirmed as a positive predictor by regression analysis following the control of demographic, academic, departmental and institutional variables.

Key Words

Digital Tools, 21st-century Skills, Higher Education, Pakistan, University Students, Digital Literacy

Introduction

Digital technologies have become central to information searching, academic communication, assignment preparation, content creation, and collaborative learning in higher education. The digital tools utilized by university students have multiplied and include: search engines, social media, learning management systems, online meeting platforms, generative artificial intelligence, cloud storage and productivity applications. Such tools are able to

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facilitate access, flexibility, feedback, interaction, and independent learning, which are significant aspects of modern higher education (Means et al., 2010, Tinmaz et al., 2022).

The learning potential of digital tools, however, lies in how students integrate the use of the tools. Having access to technology does not necessarily result in more in-depth learning, critical thinking, group work, or better grades. Digital resources can more effectively be used in learning when they are incorporated into meaningful academic tasks, meaningful pedagogy and when they offer students the opportunity to create, evaluate and communicate knowledge (Mishra & Koehler, 2006). In this regard, the digital tools are to be both analyzed as technologies and as learning aids that develop the academic practices of the students and their perceived proficiency growth.

In Pakistan, the higher education sector has undergone a fast development in the utilization of digital resources particularly following the rise in online and blended learning practices. Research in the Pakistani higher education has indicated that information and communication technologies have the potential to improve the teaching and learning process, but the success of applying technology hinges on institutional preparedness, access quality, student preparedness, and pedagogical integration (Ahmad et al., 2024; Shaikh & Khoja, 2011). Other studies also indicate that students tend to utilize all means that can be readily accessed (smartphones, social media, and general-purpose programs) more than formal research databases or specialized scholarly applications (Dahraj et al., 2020).

The current research pays attention to the perceived development of 21st-century skills. These are the abilities that are typically linked with communication, collaboration, critical thinking, creativity, digital literacy, adaptability, self-directed learning, and responsible information usage. Since the study was based on a self-report survey, it investigated the perceptions of students towards the use of digital tools in facilitating these skills instead of measuring the actual performance-based outcome of these skills. This framing is suitable to comprehend the experience of digital learning of students in their daily activities at the university.

The following research questions were used to lead the study: (1) How often university students use various types of digital tools? (2) How does use of digital-tools relate to perceived effectiveness, academic, and learning impacts, and personality and soft-skill development of students? (3) Are there differences in digital-tool use perceptions and skill development between genders, between levels of academic and between institutions? (4) What are the most predictive digital-tool areas of perceived 21st-century skill development?

Literature Review

In research on digital learning, it is always stressed that technology is only educationally significant when related to the learning goals and the active participation. According to Means et al. (2010) online and blended learning environments can enhance student learning provided that they entail proper instructional design and effective learner engagement. Likewise, Tinmaz et al. (2022) defined digital literacy as a multidimensional concept that incorporates locating, assessing, generating, and sharing information using digital platforms. These viewpoints imply that the effect of digital tools should be investigated not just in terms of access and frequency.

The Technological Pedagogical Content Knowledge framework offers a convenient description of the way in which digital tools aid in the process of learning. Mishra and Koehler (2006) believed that the integration of technology is best achieved when it is correlated with the pedagogy and disciplinary content. In this view, the use of tools like Google Docs, MS Office, Google drive, learning management systems and presentation software can help develop the skills when they are applied in activities that involve the use of students to write, design, arrange, collaborate and communicate academic work. Another theory relates to connectivism learning theory which

emphasizes on networked learning, where students learn by engaging with digital information sources, fellow students, educators, and online communities (Siemens, 2005).

The studies on the use of technology further reveal that perceived usefulness and ease of use influence the use of digital systems by the students in their learning processes. The unified theory of acceptance and use of technology is a concept that states that the performance expectancy, effort expectancy, social influence, and facilitating conditions affect the behavioral intention and actual use (Venkatesh et al., 2012). Students in universities will thus tend to employ the tools that they deem convenient, available, and helpful in accomplishing academic assignments. This contributes to the common use of general-purpose platforms as opposed to special scholarly tools.

Similar studies by Pakistani higher education have demonstrated that the digital learning resources can help facilitate learning opportunities, yet the trend of utilization is uneven among students and institutions. Shaikh and Khoja (2011) stressed the importance of ICT in developing Pakistani higher education, and Ahmad et al. (2024) noted the persistence of the necessity of institutional and pedagogical preparedness. Dahraj et al. (2020) have discovered that the use of the available digital tools to learn language and academic support is common among undergraduate students in Pakistan. Ahmad et al. (2023) also added that the regular use of technology does not necessarily guarantee a high level of digital literacy, which explains the need to build the skills of using digital tools critically and academically in students.

The recent interest in generative artificial intelligence has introduced a new layer of the discussion of digitally tools use. ChatGPT, Gemini, and Meta AI tools are gaining popularity among the students as they can quickly ask academic questions, write, generate ideas, and solve problems. Their academic merit hinges on the capabilities of students to check facts, utilize prompts in a responsible manner, prevent instances of academic dishonesty, and combine artificial intelligence assistance and critical thinking. This is why universities should be knowledgeable of evidences regarding the current utilization of digital tools by students as well as the relationship between perceived learning and skill development with this utilization.

Methodology

Research Design

The research design employed a cross-sectional survey, which was quantitative. This design was appropriate since the aim was to test patterns of digital-tool use, student attitudes towards digital resources, and the statistical associations between tool use and student perceptions of developing skills in the 21st century at a single point in time.

Population and Sampling Procedure

Students in institutions of higher learning that belong to the public sector in South Punjab, Pakistan, formed the population of the study. The total sample size was 400 university students whereby a quota sampling method was adopted. It was represented by four public universities and an equal institutional quota of 100 students in each university was maintained: The Islamia University of Bahawalpur, Bahauddin Zakariya University, Rahim Yar Khan University, and the University of Education, Multan. The gender distribution was also even 200 males and 200 females. The student sample comprised five disciplinary groupings to represent academic diversity of Education, Business Administration/Management Sciences, Basic Sciences, Computer Sciences and Social Sciences.

Participants

The last sample was comprised of 400 students. The number of male students was 200 and the number of female students was 200. In terms of residential background, there were 252 students who belonged to urban areas and 148 students who belonged to rural areas. On the academic level, 252 students were pursuing undergraduate studies and 148 were pursuing postgraduate studies. The four public universities provided 100 students to the study each.

Table 1

Participant Characteristics (N = 400)

Characteristic	Category	n	%
Gender	Male	200	50
Gender	Female	200	50
Residential status	Urban	252	63
Residential status	Rural	148	37
Academic level	Undergraduate	252	63
Academic level	Postgraduate	148	37
Department	Education	84	21
Department	Business Administration/Management Sciences	83	20.8
Department	Basic Sciences	80	20
Department	Computer Sciences	79	19.8
Department	Social Sciences	74	18.5
Institution	The Islamia University of Bahawalpur (IUB)	100	25
Institution	Bahauddin Zakariya University (BZU)	100	25
Institution	Rahim Yar Khan University (RYK)	100	25
Institution	University of Education, Multan	100	25

Note: Percentages are based on the final analytic sample of 400 students.

Instrument and Scoring

The questionnaire was divided into two big sections. The initial part was the frequency of digital-tool use assessed with 39 items on browsers and search tools, generative AI tools, language-support tools, communication platforms, content-creation tools, cloud-storage tools, classroom platforms, reference-management tools, learning management systems, educational applications, language applications, and educational games. The original frequency response scale was between 1 = regularly and 5 = never. To analyze and interpret, these items were reverse-scored such that higher values reflected more usage.

The second part involved a five-point agreement scale (strongly disagree, strongly agree) to measure the perception of digital resources among the students. There were 6 items that assessed perceived effectiveness of digital resources, 21 items that assessed academic and learning impact and 13 items that assessed personality and soft-skill impact. The mean perceived score of skill-development was calculated as an average of the 34 academic/learning and personality/soft-skill measures. All composite scales were on a mean scale to ensure that obtained results could be interpreted using a 1-to-5 scale.

Data Analysis

Descriptive statistics, internal-consistency reliability estimates, Pearson product-moment correlations, independent-samples t tests, one-way analysis of variance, and multiple regression analysis were used to analyze data. The main scales were the ones that had their reliability measured using Cronbachs alpha. The differences

were studied in terms of gender, academic level and institution. The determination of whether overall digital-tool use and distinct digital-tool domains predicted perceived skill development, after adjusting for demographic, academic, departmental, and institutional factors was carried out using regression models. The level of statistical significance was determined at 0.05.

Results

Reliability and Descriptive Statistics

The main scales demonstrated acceptable to strong internal consistency. The overall digital-tool-use scale showed excellent reliability ($\alpha = .91$). The perceived-effectiveness scale showed acceptable reliability ($\alpha = .71$), while the academic and learning impact scale showed good reliability ($\alpha = .85$). The personality and soft-skill impact scale also demonstrated acceptable-to-good reliability ($\alpha = .78$), and the overall perceived skill-development scale showed strong reliability ($\alpha = .89$). Students reported moderately high use of digital tools and high agreement that digital resources supported their learning and skill development.

Table 2

Reliability and Descriptive Statistics for the Main Scales

Scale	Items	M	SD	Cronbach's alpha
Digital tool use (overall)	39	3.1	0.64	0.91
Perceived effectiveness of digital tools	6	4.28	0.52	0.71
Academic and learning impact	21	4.13	0.47	0.85
Personality and soft-skill impact	13	4.2	0.44	0.78
Overall perceived skill development	34	4.15	0.42	0.89

Note: All scores are reported as mean scores on a 1-to-5 metric. Digital-tool-use items were reverse-scored so that higher values indicate more frequent use.

Most-Used and Least-Used Digital Tools

Individual-item means showed that students used general-purpose communication, browsing, video-learning, AI, and productivity tools most frequently. WhatsApp for learning, Google Chrome, YouTube for learning, ChatGPT, Meta AI/Gemini, and MS Office appeared among the highest-ranked tools. In contrast, JSTOR, open educational resources, Mendeley, Zotero, Coursera/edX, and EndNote were among the lowest-ranked tools. This pattern indicates that students' everyday digital learning practices are strongly oriented toward accessible and task-focused tools, while specialist scholarly search and reference-management tools are used less frequently.

Table 3

Most-used and Least-used Digital Tools

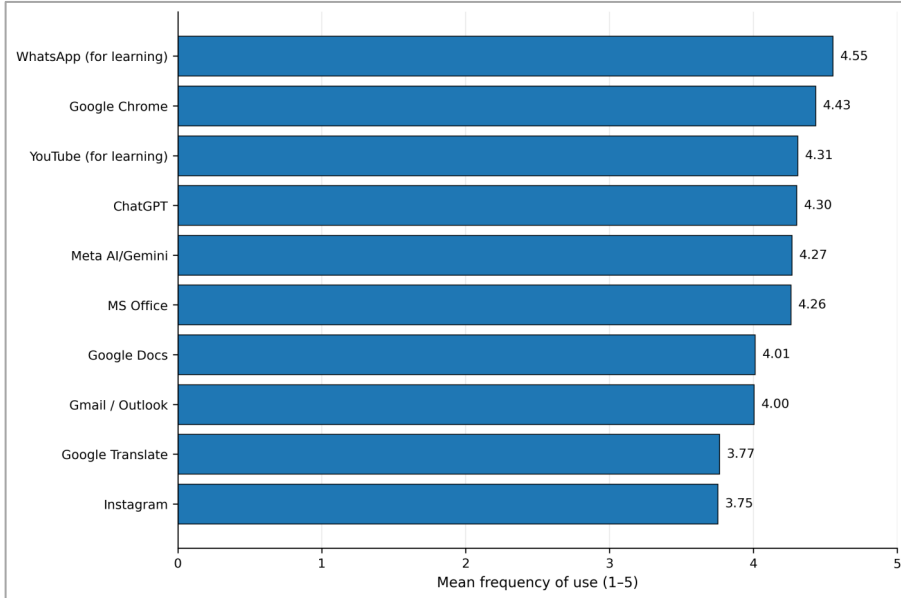
Most-used tools	M	Least-used tools	M
WhatsApp (for learning)	4.55	JSTOR	1.75
Google Chrome	4.43	Open educational resources (OERs)	1.76
YouTube (for learning)	4.31	Mendeley	1.89
ChatGPT	4.3	Zotero	1.93
Meta AI/Gemini	4.27	Coursera / edX	2.17
MS Office	4.26	EndNote	2.19
Google Docs	4.01	Dropbox	2.2
Gmail / Outlook	4	IELTS / Duolingo	2.36
Google Translate	3.77	Skype	2.44

Instagram	3.75	Google Classroom	2.48
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Note: Means are based on the reverse-scored 1-to-5 frequency scale, where higher values indicate more frequent use.

Figure 1

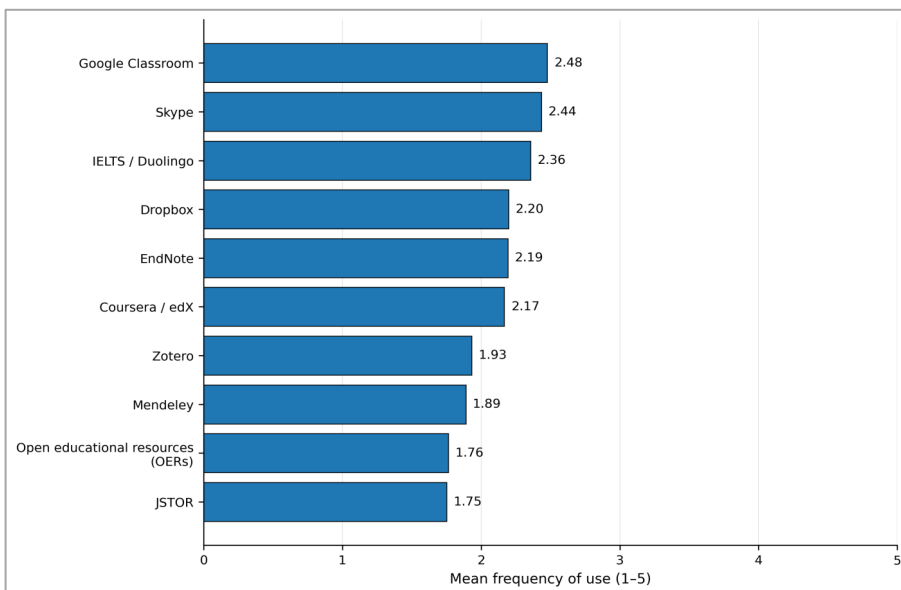
Ten Most Frequently used Digital Tools



Note: Means are based on the reverse-scored 1-to-5 frequency scale

Figure 2

Ten Least Frequently used Digital Tools



Note: Lower scores indicate less frequent use after reverse scoring

Digital-Tool-Use Domains

When individual tools were grouped into broader domains, communication and collaboration tools had the highest mean score, followed by personal learning and productivity tools, content creation and management tools, other learning tools, content and course-access tools, and reference-management tools. The domain results show that students used digital technologies most often for communication, participation, productivity, and academic task completion.

Table 4

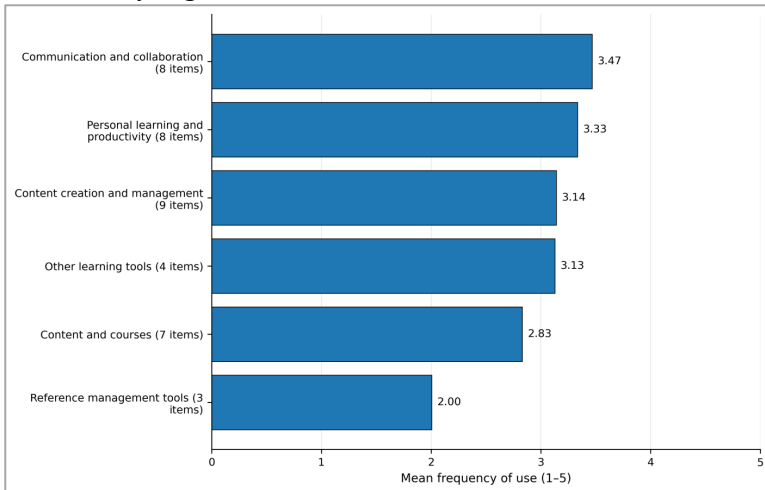
Descriptive Statistics for Digital-tool-use Domains

Domain	Items	M	SD
Communication and collaboration	8	3.47	0.76
Personal learning and productivity	8	3.33	0.65
Content creation and management	9	3.14	0.88
Other learning tools	4	3.13	1.06
Content and courses	7	2.83	0.89
Reference management tools	3	2	1.12

Note: Domain scores are mean scores based on reverse-scored digital-tool-use items.

Figure 3

Mean Use by Digital-tool Domain



Note: Higher values indicate more frequent use.

Correlational Findings

Pearson correlations showed that overall digital-tool use was positively associated with all major perception outcomes. More frequent digital-tool use was associated with higher perceived effectiveness ($r = .123, p = .014$), academic and learning impact ($r = .122, p = .015$), personality and soft-skill impact ($r = .133, p = .008$), and overall perceived skill development ($r = .136, p = .006$). These results show a consistent positive pattern across the core outcomes.

Table 5

Correlations among the Core Study Variables

Variable	1	2	3	4	5
1. Digital tool use	-				
2. Perceived effectiveness	0.123*	-			

3. Academic and learning impact	0.122*	0.648**	-		
4. Personality and soft-skill impact	0.133**	0.589**	0.682**	-	
5. Overall skill development	0.136**	0.678**	0.957**	0.866**	-

Note: * $p < .05$. ** $p < .01$.

Regression Models

A multiple regression model was estimated to examine whether overall digital-tool use predicted perceived skill development after demographic, academic, departmental, and institutional controls were entered. The model was statistically significant, $F(12, 387) = 7.04$, $p < .001$, adjusted $R^2 = .154$. Overall digital-tool use remained a significant positive predictor ($B = 0.109$, $SE = 0.031$, $\beta = .165$, $p < .001$). Postgraduate students also reported higher perceived skill development than undergraduate students. Institution-level coefficients indicated that BZU had a comparatively lower mean score than the University of Education reference group, while IUB and RYK did not differ significantly from the reference group after controls were included.

Table 6

Multiple Regression Predicting Overall Perceived Skill Development

Predictor	B	SE	t	p	95% CI LL	95% CI UL
Digital tool use	0.11	0.03	3.53	< .001	0.05	0.17
Male (vs. female)	0	0.04	0.03	0.97	-0.08	0.08
Urban (vs. rural)	0.06	0.04	1.42	0.16	-0.02	0.14
MS/MPhil (vs. BS/BSc)	0.13	0.05	2.82	0.01	0.04	0.21
PhD (vs. BS/BSc)	-0.01	0.15	-0.09	0.93	-0.31	0.29
IUB (vs. University of Education)	0.01	0.06	0.09	0.93	-0.11	0.12
BZU (vs. University of Education)	-0.36	0.06	-6.38	< .001	-0.47	-0.25
RYK (vs. University of Education)	-0.1	0.06	-1.74	0.08	-0.21	0.01

Note: Reference groups were female, rural, BS/BSc, Education, and University of Education, Multan. Department controls were included in the model but are not displayed in the table. Model statistics: adjusted $R^2 = .154$, $F(12, 387) = 7.04$, $p < .001$; standardized β for digital-tool use = .165.

A second regression model replaced the overall digital-tool-use score with the six digital-tool-use domains. This model was also statistically significant, $F(17, 382) = 5.26$, $p < .001$, adjusted $R^2 = .154$. Among the six domains, content creation and management tools were the only domain with a unique positive contribution to perceived skill development ($B = 0.073$, $SE = 0.033$, $p = .028$). Variance inflation factors for the six tool domains were below 2.16, indicating that multicollinearity was not a concern. The result suggests that students perceive the strongest developmental value in tools used to produce, organize, manage, and submit academic work.

Table 7

Regression Model with Digital-tool Domains as Predictors

Tool domain	B	SE	t	p	95% CI LL	95% CI UL
Personal learning and productivity	0.01	0.04	0.27	0.79	-0.06	0.09
Content and courses	0	0.03	0.13	0.9	-0.06	0.07
Communication and collaboration	0.03	0.03	0.95	0.34	-0.04	0.1
Content creation and management	0.07	0.03	2.2	0.03	0.01	0.14
Reference management tools	-0.03	0.02	-1.3	0.2	-0.07	0.02
Other learning tools	0.02	0.02	0.75	0.45	-0.03	0.06

Note: The model also included gender, residential background, academic qualification, department, and institution as controls. Model statistics: adjusted $R^2 = .154$, $F(17, 382) = 5.26$, $p < .001$.

Group Differences

Academic-level comparisons showed that postgraduate students reported significantly higher perceived effectiveness, academic and learning impact, and overall perceived skill development than undergraduate students. The difference in digital-tool-use frequency was not statistically significant, indicating that undergraduate and postgraduate students used digital tools at broadly similar levels, while postgraduate students perceived somewhat stronger learning and skill-development benefits.

Table 8

Academic-level Differences in Key Study Outcomes

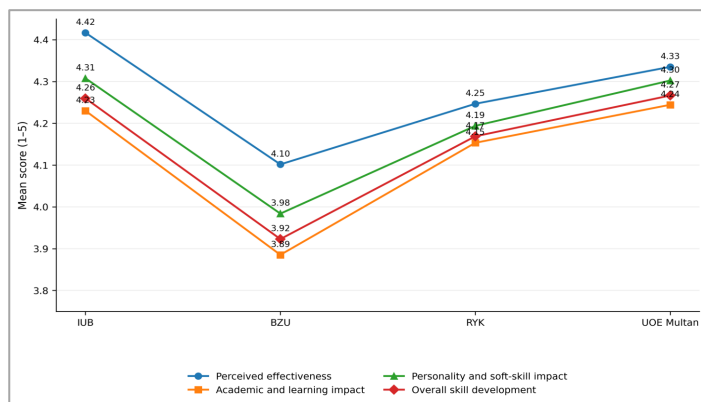
Outcome	UG M	UG SD	PG M	PG SD	t	p	Cohen's d
Digital tool use	3.08	0.64	3.14	0.63	-0.81	0.42	0.08
Perceived effectiveness	4.23	0.55	4.36	0.45	-2.5	0.01	0.25
Academic and learning impact	4.08	0.5	4.21	0.39	-2.69	0.01	0.26
Personality and soft-skill impact	4.18	0.46	4.24	0.41	-1.37	0.17	0.14
Overall skill development	4.12	0.45	4.22	0.36	-2.4	0.02	0.23

Note: UG = undergraduate students; PG = postgraduate students. Positive Cohen's d values indicate higher postgraduate means.

Gender comparisons showed no statistically significant differences in overall perceived skill development (male M = 4.156, female M = 4.153, p = .953) or overall digital-tool use (male M = 3.136, female M = 3.070, p = .301). Institutional comparisons showed significant differences in perceived effectiveness, academic and learning impact, personality and soft-skill impact, and overall perceived skill development. For overall perceived skill development, the ANOVA result was $F(3, 396) = 16.19, p < .001, \eta^2 = .109$. Post hoc comparisons indicated that BZU reported a comparatively lower overall skill-development mean than IUB, RYK, and the University of Education, while the latter three universities did not differ significantly from one another.

Figure 4

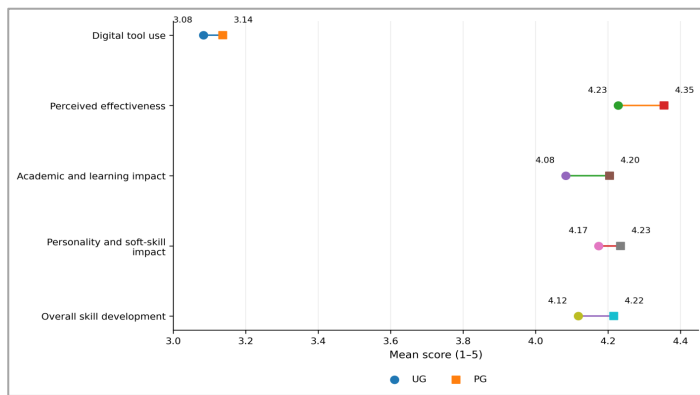
Key Outcome Means by University



Note: Scores are mean values on a 1-to-5 scale

Figure 5

Outcome Means by Academic Level



Note: Postgraduate students reported higher perceived effectiveness and overall skill development.

Discussion

The findings provide clear empirical support for a positive relationship between digital-tool use and perceived 21st-century skill development among university students in South Punjab. Students who reported more frequent use of digital tools also reported higher perceived effectiveness, stronger academic and learning impact, stronger personality and soft-skill impact, and stronger overall perceived skill development. Although the correlations were moderate in practical magnitude, their consistency across all major outcomes strengthens the interpretation that digital tools form an important part of students' academic learning experiences.

The most commonly used tools were practical and available, as well as directly related to the daily academic work: WhatsApp, Google Chrome, YouTube, ChatGPT, Meta AI/Gemini, MS Office, Google Docs, Gmail/Outlook, Google Translate, and Instagram. This means that digital learning activities of students are influenced by tools that facilitate the process of communication, rapid access to information, content creation and accomplishment of academic tasks. Contrarily, those databases and reference-management tools were less commonly utilized, which might imply universities need to offer a stricter guidance on academic search, the utilization of scholarly databases, and reference-management workflows.

This is further reinforced by the regression results. When the content creation and management tools were the only unique positive predictor of perceived skill development when all the tool-use domains were considered together. This finding indicates that the tools that assist students to write, edit, organize, design, store, submit, and share academic work have the greatest developmental value to them. These tools are directly related to the active learning process but not to the passive exposure to the information, which is in line with the belief that meaningful integration of technology requires meaningful academic application.

Another significant inference is the high ranking of generative AI tools among the most commonly used tools. The ChatGPT and the AI/Gemini ranked in the top list, which proves that AI-assisted study practices already become a part of the academic routine of students. This result has implications on higher education. Instead of viewing AI as a threat, universities can create a set of transparent academic guidelines and learning tasks that will guide students on how to use AI to act ethically, fact-check AI-based information, generate better prompts, reference sources in the most adequate way, and retain independent academic judgment.

Comparisons between groups revealed that postgraduate students found greater learning and skill-development advantages in using digital tools, compared to undergraduate students, although there were no significant differences in the overall frequency of tool-use between the two groups. This can be an indication of the increased level of academic and research-based postgraduate study where the student is likely to have to be more strategic in the use of digital tools. There were also institutional differences such as the significance of university level digital environment of learning, practice of teachers, student support, and access to academic technologies.

Conclusion and Implications

The conclusion of the research is as follows: digital tools have a positive relationship with the perceived academic learning and development of 21st century skills in the context of the public university in South Punjab. High perceived effectiveness and skill-development benefits were reported by students and frequent use of digital-tools was a positive predictor of perceived overall skill development following adjustment of demographic, academic, departmental and institutional factors. The results demonstrate the importance of communication, productivity, content creation, and management of academic tasks tools.

Higher education institutions can have various implications of the results. First, digital literacy should be enhanced in universities beyond simple access and academic applications of technology, including academic searching and source assessment, reference management, digital collaboration and responsible use of AI. Second, educators ought to incorporate digital technology into significant scholarly activities in such a way that students apply technology in the creation, analysis, organization and communication of knowledge. Third, universities are encouraged to offer specific support to underutilized academic resources like JSTOR, OER repositories, Mendeley, Zotero, EndNote and Coursera/edX since they have the potential to enhance the research and independent learning capabilities of students when properly utilized. Fourth, digital support should be standardized within institutions to ensure that students enjoy similar opportunities to enjoy digital learning resources.

Scope and Future Research

The researchers conducted the study on the self-reported use and perceived improvement in skills of the students in the use of digital-tools in four state-owned universities in South Punjab. Future research can build on this work by including survey results with performance-based indicators of digital literacy, critical thinking, communication, collaboration, and academic production. Longitudinal studies can also be used to investigate the impact of the long-term use of particular digital tools in developing skills. Qualitative research may also seek to understand the reasons behind student preference of some tools, how they apply generative AI to academic tasks, and how they can be better assisted to use scholarly and reference-management tools.

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