



**RESEARCH PAPER**

**Impact of Digital Technology on the Academic Writing Skills of Undergraduate ESL Learners in a Pakistani University Context**

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**ABSTRACT**

This study aims at investigating the impact of digital technology on the Academic Writing of undergraduate English as a Second Language (ESL) learners at Sukkur IBA University, Pakistan. It employs Van Dijk, 2005's Resources and Appropriation Theory (RAT) that investigates access to digital tools, their appropriation (integration and use) during the writing process and the resulting outcomes on Academic Writing of undergraduate ESL learners in Sukkur IBA University. This study was conducted through a quantitative approach. The data was collected through a survey from 109 undergraduate ESL learners through a convenient sampling. The findings of the study reveal that ESL learners had appropriate access to digital tools and they used and integrated them on regular basis for planning, drafting, revising and improving their writing. It indicates that digital tools assisted them in improving and enhancing their accuracy, coherence, vocabulary, motivation and confidence during the Academic writing. The findings also indicate that the access to digital tools is important, but the effective appropriation and strategic usage are the primary components of improved writing outcomes. On the whole, this study suggests that proper digital literacy training and well-organized teaching strategies are vital for the appropriate use of digital tools in ESL classrooms in general and Sukkur IBA University, Pakistan in particular.

**KEYWORDS** Digital tools, Academic writing, Resources and Appropriation Theory

**Introduction**

Digital technologies are the part and parcel of teaching and learning in the modern era, especially for the English as a Second Language (ESL) learners. It is very much helpful and useful for learning all the skills of learning English language. As far as English Academic Writing is concerned, it is noticed as the most difficult language learning skill among ESL learners as it requires them to combine all the components of Academic Writing like vocabulary, sentence structures, punctuation, coherence, etc. so that it can be understandable to the target audience. In this regard, digital tools like AI-assisted chatbots like ChatGPT, Google Gemini, etc., digital dictionaries, collaborative platforms, apps and software have paved way for ESL learners towards English language learning, especially writing. These digital tools give immediate feedback, help in improving vocabulary, sentence structure, punctuation, overall grammar and allow learners to revise and improve their work more efficiently.

Digital tools can greatly improve ESL learners' writing skills and their performance. In this regard, AI-assisted writing platforms support ESL learners to identify and correct the grammatical errors, enhance new vocabulary, and structure the writing tasks more effectively (Alharbi, 2023; Dong & Chen, 2023). Likewise, collaborative platforms and online immediate feedback systems encourage peer communication and offer reflection opportunities, improve coherence and expression development in writing (Wang & Chen,

2022). Such digital tools also enhance and promote language learners' confidence, motivation, and engagement towards writing assignments (Sun & Chen, 2021).

As far as Pakistani context is concerned, educational institutions, especially universities are increasingly adopting such digital tools to increase and improve learners' experiences in all domains including ESL learning. At Sukkur IBA University, ESL learners also widely use digital tools like online dictionaries, AI editors, apps and document-sharing platforms for their academic writing tasks. In spite of growing use and integration of technology in their written texts, research with respect to the impact of digital tools on writing outcomes in the context of Pakistan is quite limited because most of the research studies focus on ESL learners' perceptions towards the use of digital tools rather than systematically investigating their impact on writing performance (Khan & Shah, 2021). To address this gap, this study especially applies the Resources and Appropriation Theory (RAT) given by Van Dijk (2005) as a theoretical framework. This theoretical framework in terms of language focuses that learning outcomes are not only influenced by access and availability of resources, but also appropriate integration and use of these resources into their language learning tasks. Hence, in ESL learning, especially writing, digital tools trigger as valuable resources which learners can integrate and use to plan, draft, revise and improve their texts. Therefore, by investigating both access and appropriation of digital tools, RAT provides an authentic theoretical framework to investigate how the effective integration and use of digital tools affect the writing outcomes, including accuracy, coherence, vocabulary, motivation and confidence.

## **Literature Review**

Digital technology has introduced and offered novel and innovative ways of teaching and learning strategies for teachers and learners respectively in the modern era. They use different digital tools to fulfil their required tasks. As most digital tools were not actually generated for educational purposes, education experts have adapted them in helping academic learning, especially in developing writing skills of the learners (Burden & Atkinson, 2008)). Similarly, these tools offer vast opportunities to ESL (English as a Second Language) learners to learn new vocabulary, improve sentence structures, organize coherent ideas, and generate well-organized texts academically. Garlinska et al. (2023) have called several digital platforms such as online workshops, virtual classroom, and cloud-based writing tools as the revolutionizing tools in the field of writing instruction because of their multiple functionalities such as collaborative editing, plagiarism checks and real-time feedback. Such platforms promote peer review and feedback mechanisms that fosters a collaborative learning environment (Umamah & Cahyono, 2022).

Moreover, there has been an increasing research these tools are so important these days that they also enhance the motivation and engagement of learners by helping them in customized and personalized learning as they can progress their activities at their own pace and time, and can monitor their academic writing progress and development over the period of time (Sebba et al., 2007). Though some researchers have shown doubts on digital tools in terms of effectiveness in education (Oppenheimer, 2023), their access and variety have proved their usefulness, especially in terms of promoting independent and self-controlled academic learning in different situations.

However, this digitization of writing instruction has invited some challenges too. these digital tools may not work effectively with traditional teacher-centered approaches that may limit digital literacy of teachers in using and integrating them in their teaching. According to Duncan and Joyner (2022), teachers must consider these challenges to address the digital, privacy, equity and the potential for students' distraction. for In order to address such issues pre-service and in-service training programs are required to increase and improve the digital literacy and pedagogical skills of teachers. Hence, digital tools can greatly support academic writing skills of ESL learners if they are used and integrated

strategically in their lessons by fostering their critical thinking, creativity, and scholarly skills in order to understand their growing importance in higher education.

There has been an increasing research debate on the impact of digitization on students' writing skills. Many research studies highlighted the positive impact of digitization (Wagner et al. 2022; Gayed et al. (2022), however, others indicate the negatives outcomes of digitization on students' writing skills (Iskender, 2023; Johnke et. al., 2023). The tools which brought the positive impact include Grammarly, Wordtune, Quillbolt, and Jenni (Marzuki, et. al. 2023), since they help students to identify and amend their grammatical and syntactical errors. GPT-3 is also considered an excellent tool for learners for enhancing their writing ideas and style (Mhlanga, 2023). On the other hand, it is stated that that digital tools lead students to heavily rely on digitization rather than using their own critical skills (Iskender, 2023).

Moreover, education in Pakistan has shifted from traditional teacher-centered approaches to more learner-focused methods that integrate digital technologies. Early efforts focused on Computer-Assisted Language Learning (CALL), where students practiced language skills through desktop programs (Rehman, 2014). Though basic, these initiatives marked a step toward modernizing English language teaching. The growth of the internet and increased computer access expanded Technology-Enhanced Language Learning (TELL) as universities began to use online resources such as digital dictionaries, grammar tutorials, and writing aids (Mahboob, 2011). Initial adoption was limited by funding, infrastructure and teacher training, yet educators recognized the potential of technology to engage learners more effectively than rote methods.

Writing skills are quite critical in the digital era as professional, academic, and online interaction depends on clear and persuasive writing. Hence, writing in the modern era demands blogging, content creation, and multimodality that require critical thinking and ethical reasoning to depict true and well-organized arguments (Rohman, 2020; Davies & Howard, 2016). Digital tools also offer language learners the vast opportunities to enhance their writing skills through video tutorials, peer review feedback and other collaborative apps. Nevertheless, a number of Pakistani university learners face challenges to achieve proficiency in their argument expressions, academic writing, and coherence that affect their overall academic performance and global competitiveness (Ahmed & Siddiqui, 2020; Khan et al., 2021).

Moreover, digital tools can address language learning issues by giving quick and immediate feedback, providing collaborative writing platforms and giving exposure to authentic target audiences through blogs, chatbots and discussion boards (Khan & Khan, 2019). Research evidence reveals that language learners using these kinds of tools exhibit great confidence, high-quality writing and understanding towards writing skills as a process rather than mere a product (Ahmed & Waqar, 2020). However, effective and useful integration of technology in terms of writing requires careful and thorough planning, modern teacher training, and complete institutional support. When integration of technology in language learning is implemented effectively, ESL learning, especially writing proficiency in the context of Pakistan can be very much useful for language learners. In other words, the usefulness of these digital tools is not understood by their availability (Resources) only, but the way they are effectively determined by the learners' skills (knowledge), their strategic use and integration (Appropriation) into the learning outcomes.

The access and appropriate integration of technology in education, especially language learning is very challenging for ESL learners because of socio-economic and educational inequalities. In this regard, Resources and Appropriation Theory (RAT), presented by Van Dijk (2005), suggests a strong research framework to understand such access and appropriation disparities related to digital technology. RAT suggests that

categorical inequalities like education, income and social position, determine the distribution of resources that are essential to access and use digital technology, which resultantly influences appropriation and learning outcomes. This process creates feedback loops that reinforce existing inequalities and highlights that digital engagement is socially embedded rather than merely a matter of connectivity (Van Dijk, 2005, 2006, 2020).

This theoretical framework aligns with deeper digital disparity which emphasizes that inequalities revolve around access, skills, usage, and outcomes (Hargittai, 2002; Warschauer, 2003). In the context of Pakistan, ESL learners with similar levels of effort can attain different writing outcomes which indicates it is not just access, but strategic appropriation of digital tools supported by skills and motivation produces excellent outcomes. Hence, motivation also plays a vital role as ESL learners, who perceive clear benefits from digital engagement, are expected to explore rich resources and develop effective digital competencies. Scheerder, Van Deursen, and Van Dijk (2017) confirms that skills and usage inequalities are the major factors of digital engagement outcomes that validates RAT's sequential framework. Studies in non-Western contexts, like Mexico and Thailand, have also applied RAT to determine the way socio-economic status, institutional support and cultural norms affect digital appropriation similar to the context of Pakistan where these factors shape ESL learners' engagement with digital tools.

RAT centrally conceptualizes on sequential digital access that consists of four dimensions: motivational, material, skills and usage access. Motivational access refers to learners' interest, attitudes and willingness to engage with digital tools. Material access relates to the availability of digital devices, internet connection and infrastructure. Skills access refers to informational, operational and strategic competencies needed for appropriate use of technology. While, Usage access includes the diversity, frequency and purpose of the digital tools engagement. The shortcomings in the earlier stages hinder the progress in the later stages that explain the reason of improvements in physical (material) access alone do not guarantee the useful outcomes (Van Dijk, 2005, 2006). In the context of ESL learning in Pakistan, Motivational access differs with respect to the learners' confidence in English language. Material access is influenced by socio-economic and regional inequalities where learners in urban private schools, colleges and universities generally have better digital resources than those of rural ones. Skills access is generated by appropriate exposure to digital literacy for operating and searching ESL learning resources, whereas Usage access reflects the frequency and purpose of engagement with digital tools for ESL learning outcomes. Empirical studies have supported and extended RAT in multiple contexts. Van Deursen (2011) and Van Dijk (2014) indicated that with significant material access, learners vary in their skills to use digital tools effectively which indicates that appropriate digital skills play a major role in attaining meaningful engagement with the digital tools. Similarly, Helsper (2012) focused on the "Third-level Digital Divide" which emphasized on outcomes derived from digital engagement including social, professional and academic benefits. In the context of Pakistan, ESL learners, who have ample digital access and appropriate (integrate and use) digital tools, like AI-assisted chatbots, grammar checkers, digital dictionaries, language learning apps, websites, tutorial videos, etc. strategically tend to attain better ESL writing outcomes as compared to those with limited digital access and appropriation. This study; therefore, adopts the Resources and Appropriation Theory (RAT) as a theoretical framework in order to investigate the influence of digital tools' access and their appropriate use and integration on the writing tasks of ESL learners in the context of Pakistan, especially in Sukkur IBA University.

In spite of vast availability of digital tools, there still exists a significant gap in understanding the true relationship between access, usage and impact of digital tools with respect to the improving of Academic Writing skills among ESL learners in Pakistan. Although previous research studies used the potential digital tools frameworks, especially Technological Acceptance Model (TAM) with respect to ESL writing, this study is quite unique and important in a way that it applied Resources and Appropriation Theory (RAT)

Van Dijk, 2005 by combining its three components: the resources, appropriation and outcomes of digital tools on academic writing, particularly in Pakistan. Therefore, this study aims to investigate the impact of digital tools on the academic writing through the lens of Resources and Appropriation Theory (RAT) with the purpose to investigate the outcomes of digital tools on the academic writing of ESL learners at Sukkur IBA University, Pakistan.

## Material and Methods

This study was conducted with the quantitative approach. It was conducted with undergraduate ESL learners at Sukkur IBA University, Pakistan. For the data collection, a survey was designed to investigate undergraduate ESL learners' digital access, appropriation of digital tools and their writing outcomes. For the validity of the survey items, it was reviewed by the experts in English language. Afterwards, it was sent to the undergraduate ESL learners for data collection. The participants of the study were selected through a convenient sampling. This sampling method was employed because the participants were easily accessible and already using digital tools for English language learning. It was also feasible to collect the required data efficiently within limited time and resources. The data was collected through a Google Form which was sent to the participants through a link on their Whatsapp numbers. It was sent to 150 undergraduate ESL learners; however, 109 participants provided the data. The survey comprised of 28 items across three constructs: Resources (6 items) that measured ESL learners' access to digital tools; Appropriation (10 items) that covered how ESL learners actively used and integrated these tools into their writing processes, and Outcomes (12 items) that assessed the perceived impact of digital tool usage on the writing performance of undergraduate ESL learners. All items were rated on a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The data analysis was conducted using SPSS version 26 that includes reliability analysis to ensure internal consistency of the constructs, descriptive statistics to summarize undergraduate ESL learners' responses, Pearson correlation to determine the relationships among Resources, Appropriation and Outcomes, and a multiple regression analysis to investigate the influence of digital tools' access and their appropriation on writing outcomes. This approach provided a comprehensive evaluation of the intersection between digital tools' access, usage and writing performance of undergraduate ESL learners in the context of Pakistan.

## Theoretical Framework

The Resources and Appropriation Theory (RAT), presented by Jan van Dijk, (2005) explains how digital resources and their appropriation interact to affect learning outcomes. This theory comprises of four connected constructs: *categorical inequalities*: age, gender and social class, *resources*: material (devices, internet), skills (digital competencies) and motivation (interest and willingness), *appropriation* (integration and use of digital tools) and *learning outcomes*. The resources (material, skills and motivation) are accessed through four types of digital access: material, skills, motivational and usage, which collectively determine how learners appropriate (integrate and use) digital tools for learning. Hence, effective appropriation (integration and use) of digital tools leads to learning outcomes. In short, this framework emphasizes that resources alone are insufficient; meaningful learning outcomes depend on sequential digital access and their strategic appropriation. This study has the limitation of this framework in a sense that it covered only three main constructs of RAT: Resources, Appropriation and Outcomes as the aim was to investigate the impact of digital tools access and their effective use on the Academic writing skills. Hence, the first component, categorical inequalities was not included because this study was not conducted to compare undergraduate ESL learners based on demographic or social group differences.

## Results and Discussion

**Table 1**  
**Cronbach's Alpha Reliability for RAT Constructs**

Sr. No	Construct	No. of Items	Cronbach's Alpha
1	Resources (Digital Tools Access)	6	0.78
2	Appropriation (Integration and Use)	10	0.84
3	Outcomes (Impact on Writing Skills)	12	0.88
	Overall Survey Reliability	28	0.86

The internal consistency of the survey instrument was examined using Cronbach's alpha ( $\alpha$ ). Table 1 shows that all constructs revealed excellent reliability that exceeded from the accepted .70 Cronbach's alpha value. In this regard, the Resources (Digital Access) construct consisted of 06 items that generated .78 Cronbach's alpha value and it indicates the strong reliability in measuring ESL learners' access to digital tools. The Appropriation (Integration and Use Usage) construct consisted of 10 items that indicates ESL learners' digital competency and integration of digital tools into their writing tasks and it produced .84 alpha value reflects very high internal consistency. Likewise, the Outcomes (Impact on Writing Skills) construct consisted of 12 items that produced the reliability .88 alpha value, which confirms that the items consistently measured the perceived effects of digital technologies on ESL learners' writing skills.

Overall, the complete survey consisted of 28 items that produced .86 Cronbach's alpha value, which reveals that the instrument as a whole was highly reliable and suitable for measuring the three components of the RAT theoretical framework: Resources, Appropriation, and Outcomes in the context of ESL learners' digital writing practices in the context of Pakistan.

**Table 2**  
**Descriptive Analysis for Resources (Digital Tools Access)**

Item	Description	N (Valid)	Range	Mean	Mode	SD	Variance
Q1	Access to Digital Tools	109	3	4.12	4	0.71	0.50
Q2	Access to Apps, AI Tools, etc.	109	3	4.08	4	0.74	0.55
Q3	Ease of Interface and Usability	109	4	3.96	4	0.79	0.62
Q4	Internet Connectivity	109	4	4.01	4	0.83	0.69
Q5	Digital Skills and Knowledge	109	3	3.89	4	0.76	0.58
Q6	Motivation to Use Digital Tools	109	3	4.15	4	0.69	0.48
<b>Overall Resources</b>	<b>Composite Score</b>	<b>109</b>	<b>2</b>	<b>4.03</b>	<b>4</b>	<b>0.59</b>	<b>0.35</b>

The descriptive results in Table 2 reveals that ESL learners generally had good digital tools access (resources) for academic writing. The overall mean score ( $M = 4.03$ ,  $SD = 0.59$ ) indicates the most participants agreed that digital tools were available to them. The mode value of 4 suggests that Agree was the most common response for all items. In addition, the low variance in responses reveals that ESL learners shared similar views that confirmed the reliability of the Resources construct within the Resources and Appropriation Theory framework.

**Table 3**  
**Descriptive Analysis for Appropriation (Integration and Use of Digital Tools)**

Item	Description	N (Valid)	Range	Mean	Mode	SD	Variance
Q7	Digital Tools Use Across Writing Stages	109	3	4.05	4	0.73	0.53
Q8	Use of Multiple Tools	109	3	3.98	4	0.77	0.59
Q9	Digital Dictionaries	109	3	4.21	4	0.68	0.46
Q10	AI Writing Assistants	109	4	4.02	4	0.81	0.66
Q11	Grammar and Spell Checkers	109	3	4.18	4	0.66	0.44
Q12	Collaborative Writing Tools	109	4	3.72	4	0.85	0.72

Q13	Paraphrasing Tools	109	3	3.91	4	0.79	0.62
Q14	Combining Different Tools	109	3	4.06	4	0.72	0.52
Q15	Video Tutorials	109	4	3.84	4	0.82	0.67
Q16	Digital Feedback Submission	109	3	4.09	4	0.70	0.49
<b>Overall Appropriation</b>	<b>Composite Score</b>	<b>109</b>	<b>2</b>	<b>4.01</b>	<b>4</b>	<b>0.57</b>	<b>0.32</b>

The results in Table 3 reveal that ESL learners actively used digital tools during different stages of academic writing. The overall composite mean score ( $M = 4.01$ ,  $SD = 0.57$ ) indicates common agreement that digital tools were well integrated into their writing practices. The mode value of 4 across all items suggests that Agree was the most common response. Low variance values show consistent responses among learners that support the Appropriation component of Resources and Appropriation Theory.

**Table 4**  
**Descriptive Analysis for Outcomes (Impact of Digital Tools on Writing Skills)**

Item	Description	N (Valid)	Range	Mean	Mode	SD	Variance
Q17	Writing Process Improvement	109	3	4.11	4	0.71	0.50
Q18	Sentence Clarity	109	3	4.06	4	0.73	0.53
Q19	Punctuation & Connectors	109	3	3.97	4	0.76	0.58
Q20	Vocabulary Enhancement	109	3	4.19	4	0.65	0.42
Q21	Organization & Coherence	109	3	4.02	4	0.72	0.52
Q22	Writing Tasks effectively and Quickly	109	4	3.94	4	0.78	0.61
Q23	Academic Performance	109	4	3.88	4	0.81	0.66
Q24	Motivation	109	3	4.17	4	0.67	0.45
Q25	Anxiety Reduction	109	4	3.85	4	0.80	0.64
Q26	Confidence	109	3	4.09	4	0.70	0.49
Q27	Satisfaction	109	3	4.14	4	0.69	0.48
Q28	Learning Opportunities	109	3	4.22	4	0.63	0.40
<b>Overall Outcomes</b>	<b>Composite Score</b>	<b>109</b>	<b>2</b>	<b>4.05</b>	<b>4</b>	<b>0.56</b>	<b>0.31</b>

The descriptive results in Table 4 reveal that digital technology had a positive impact on ESL learners' academic writing skills. The overall composite mean score ( $M = 4.05$ ,  $SD = 0.56$ ) suggests that most learners agreed that digital tools improved different aspects of writing. The mode value of 4 across all items confirms that Agree was the most common response. Low variance values indicate consistency in learners' understanding. These findings support the Outcomes component of Resources and Appropriation Theory which indicate that effective access and use of digital tools lead to improved writing skills among learners.

**Table 5**  
**Pearson Correlations among RAT Constructs**

Sr. No	Variables	Resources	Appropriation	Outcomes
1	Resources	1		
2	Appropriation	.62**	1	
3	Outcomes	.55**	.71**	1

Note:  $p < .01$

Pearson correlation analysis was made to determine the relationships among ESL learners' access to digital resources, appropriation of digital tools and their writing outcomes. As shown in Table 5, all constructs were positively correlated significantly. Particularly, Resources and their Appropriation reveal a strong positive relationship with  $r = .62$ ,  $p < .01$ ) which indicate that ESL learners with greater access to digital tools also tend to use and integrate them more effectively in their writing tasks. The strongest correlation was noticed between Appropriation and Outcomes with  $r = .71$ ,  $p < .01$  that indicate that strategic use and integration of digital tools has a substantial impact on learners' writing performance. Resources and Outcomes were also positively correlated with  $r = .55$ ,  $p < .01$  which further highlighted the importance of digital access in helping writing development.

These findings reveal the significance of not only having access to digital tools, but also developing their effective use and integration to improve ESL writing outcomes.

**Table 6**  
**Regression Analysis Predicting Writing Outcomes**

Predictor	Standardized $\beta$	t	p
Resources	0.27	3.52	< .01
Appropriation	0.68	8.94	< .001

Note. Dependent variable: Writing Outcomes.

Multiple regression analysis was also conducted to investigate the predictive impact of resources (digital access) and appropriation (skills and usage) on writing outcomes (Performance/result). The results depicted in Table 6 show that appropriation of digital tools was the strongest predictor of writing performance ( $\beta = .68$ ,  $t = 8.94$ ,  $p < .001$ ), followed by access to resources ( $\beta = .27$ ,  $t = 3.52$ ,  $p < .01$ ). These results indicate that the access to digital tools is important, but the effective appropriation and strategic usage are the primary components of improved writing outcomes.

Hence, these findings provide the strong empirical support for the Resources and Appropriation Theory (RAT) which indicates that ESL learners' access to digital tools alone is insufficient, but the effective appropriation and strategic usage of digital tools by ESL learners are key components for enhanced academic writing skills.

## Discussion

The findings of the study indicate that digital technology has a significant and positive impact on the writing skills of undergraduate ESL learners in Sukkur IBA University, Pakistan. The finding regarding the first research question, the types of digital tools access for the improvement of the academic writing skills, indicates that undergraduate ESL learners had access to different digital tools, like laptops, smartphones, reliable internet connection for getting access to online language learning resources, apps and AI-assisted chatbots like ChatGPT, Google Gemini, etc. for drafting, editing and improving their written texts. Hence, the access to such digital tools play significant role in improving undergraduate ESL learners' academic writing skills at Sukkur IBA University.

The finding with respect to the second research question, the extent to which ESL learners at Sukkur IBA University use and integrate the digital tools for the improvement of their writing skills, reveals that ESL learners extensively and actively use and integrate digital tools at different stages of the writing process like planning, drafting, revising and improving. Hence, their frequent use and support of AI-assisted tools, grammar checkers and digital dictionaries show the high level of involvement in improving the accuracy, clarity, coherence and overall the quality of their written texts.

In connection to the third research question, the impact of the digital tools on the writing skills of ESL learners, the finding indicates that the digital tools significantly improved writing outcomes that include grammar accuracy, vocabulary development, coherence, organization, and confidence.

These findings with respect to the previous researches related to digital technology suggest that digital tools not only improve the linguistic abilities, but also enhance ESL learners' engagement and motivation towards academic writing.

The findings of the study are:

- The undergraduate ESL learners at Sukkur IBA University, Pakistan reported high levels of digital access, active appropriation of digital tools and positive writing outcomes.

- All constructs were significantly and positively correlated with the appropriation of digital tools that reveals the strongest relationship with their writing outcomes.
- Regression analysis also indicates that undergraduate ESL learners' appropriation of the digital tools is the most influential component of their writing performance, followed by their access to the resources (digital tools).
- The study also reveals that undergraduate ESL learners' effective use and integration of digital tools, rather than only their availability, is critical for improving their ESL writing skills.

## **Conclusion**

The findings of this study identified the transformative influence of digital technology on the undergraduate ESL learners' writing at Sukkur IBA University, Pakistan. The learners indicated the high access to digital tools and actively used and integrated them into planning, drafting, revising, and peer feedback processes of their Academic Writing. The appropriation of digital tools of undergraduate ESL learners was strongly associated with the measurable improvements in the accuracy, coherence, vocabulary, grammar and their overall writing confidence. The regression analysis also revealed that the appropriation of digital tools was the strongest factor of writing outcomes which emphasizes that digital tools access alone is insufficient without their strategic use and integration in the overall writing process. Hence, these results pave the way for the importance of structured training and pedagogical guidance to maximize the digital tool usage and integration in the academic writing. Overall, this study provides empirical evidence that supports the integration of technology into ESL learning in order to improve ESL learners' writing proficiency, especially in the Pakistani context.

## **Recommendations**

Based on the conclusion above, this study has emerged several recommendations for teachers, students policymakers, and for educational institutions. First, it is recommended that some extensive professional training courses should be offered for both stakeholders (teachers and students) to ensure the effective and ethical use of digital tools that may restrain them to have an over-dependence of the tools. Since the success of digital writing instruction depends heavily on the thoughtful implementation of digital writing tools as per the learners' needs. Second, educational institutions should adopt a hybrid learning approach where students should effectively use digital writing collaborative tools and automated writing evaluation systems. provide students a platform to use digital tools for enhancing their writing skills. At the same time, teachers should be mindful of the risk of over-dependence on automated correction tools as Lekamge and Smith (2025) found that prolonged dependence on the digital writing tools can undermine the longterm language proficiency and consequently can lower down students' writing confidence. Third. Educational institutions should ensure the ways for equitable access to the digital infrastructure so that all students should equally benefit from technology. Fourth, all stakeholders should should promote digital peer collaboration using tools such as blogs, padlet, Google docs, etc. Last, curriculum designers should integrate some digital writing activities in the curriculum with certain classroom learning objectives and outcomes.

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