

DIGITAL TOOLS AND ACADEMIC WRITING: A MODERATED MEDIATION MODEL OF WRITING SELF-EFFICACY

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Abstract. *The increasing prevalence of digital writing tools in academic settings has sparked interest in understanding their impact on writing self-efficacy among students, particularly in non-Anglophone countries. This study presents the first-ever application of a moderated mediation model to investigate the influence of digital writing tools on academic writing self-efficacy, incorporating writing engagement as a mediator and technological proficiency as a moderator. In the present study, we tested the following hypotheses: (a) the positive impact of using digital writing tools on writing engagement and academic writing self-efficacy, (b) writing engagement positively influences academic writing self-efficacy as well as mediates the relationship between using digital tools and writing self-efficacy, and (c) technological proficiency moderates the mediated relationship between digital tool use and writing self-efficacy. Based on the data from a survey conducted among 332 postgraduate students of Kazakhstani universities, digital writing tools positively influence writing self-efficacy, with writing engagement playing a significant mediating role. Furthermore, technological proficiency was found to modestly moderate this mediated relationship, suggesting that higher proficiency enhances the positive effects of digital tools on writing self-efficacy. These results highlight the importance of integrating digital writing tools and improving technological skills to enhance academic writing outcomes in non-Anglophone contexts. This study contributes to the existing literature by offering novel insights and a comprehensive understanding of the mechanisms through which digital writing tools affect academic writing self-efficacy and engagement, especially in diverse linguistic and cultural settings.*

Key words: *academic writing, digital tools, higher education, moderated mediation model, writing engagement, technological proficiency*

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1. INTRODUCTION

The rapid integration of digital tools into educational settings has significantly transformed the way academic writing is taught and learned, particularly in non-Anglophone countries. These tools, ranging from grammar checkers to collaborative platforms, have become indispensable in helping students enhance their writing skills and, consequently, their academic writing self-efficacy. Self-efficacy in academic writing, defined as students' belief in their ability to produce effective and high-quality written work (Bandura, 1994), is crucial for their success in higher education (Maguire, 2013). However, the pathways through which digital tools influence writing self-efficacy remain underexplored, particularly in the context of non-Anglophone countries.

While previous studies have examined the direct effects of digital tools on writing performance and engagement (e.g., Schcolnik, 2018; Ching, 2018; Curry & Riordan, 2021; Elnadeef, 2023), there is a need for a more comprehensive understanding of the underlying mechanisms that drive these effects. Specifically, the role of writing engagement as a mediator and technological proficiency as a moderator in this relationship has not been thoroughly investigated.

To address this gap, this study introduces a novel research model (Figure 1) that explores the moderated mediation effects between digital tools, writing engagement, technological proficiency, and academic writing self-efficacy. By examining these relationships within a moderated mediation framework, this study aims to provide a more detailed understanding of how digital tools can enhance writing self-efficacy through increased engagement, while also considering the varying levels of technological proficiency among students. We believe that this model allows for a more nuanced examination of the relationships between the constructs. Let us examine each relationship more closely:

2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

2.1. Use of digital tools, academic writing self-efficacy and writing engagement

Research indicates that using digital writing tools significantly enhances academic writing self-efficacy. Studies show that these tools encourage collaboration, creativity, and personal expression among students, leading to improved engagement and performance (Croxtton, 2014; Curry & Riordan, 2021; Power & St-Jacques, 2013; Tate & Warschauer, 2022). Additionally, digital writing software and AI tools provide structured support and direct feedback, enhancing students' understanding of grammar and overall writing coherence (Zulfa et al., 2023; Pitukwong & Saraiwang, 2024). Furthermore, various investigations highlight the effectiveness of digital tools in facilitating the writing process and improving academic writing skills (Schcolnik, 2018; Ching, 2018; Little et al., 2018).

Given these benefits, it is essential to understand how digital writing tools impact two crucial aspects of writing development: writing self-efficacy and writing engagement. Writing self-efficacy refers to a student's belief in their ability to perform writing tasks successfully (Bandura, 1994), which can be significantly boosted by the immediate feedback and guidance provided by digital tools. These tools (especially AI-powered) help students identify errors and make improvements in real-time, leading to increased confidence in their writing abilities (Marzuki et al., 2023).

On the other hand, writing engagement involves the level of interest, motivation, and involvement a student exhibits in the writing process. Digital writing tools promote engagement by making the writing process more interactive and enjoyable (Ramamuthie & Azlina, 2022; McKee, 2016).

By distinguishing these two aspects, it becomes clear that digital writing tools address both the cognitive and affective domains of writing. They not only improve students' technical writing skills and confidence (self-efficacy) but also enhance their motivation and involvement in writing activities (engagement). Therefore, based on this understanding, we can hypothesize the following:

Hypothesis 1: The use of digital writing tools positively influences both academic writing self-efficacy and writing engagement.

2.2. Writing engagement and academic writing self-efficacy

The influence of writing engagement on academic writing self-efficacy suggests a direct relationship where increased engagement enhances students' confidence in their writing abilities. Research indicates that as students actively participate in writing tasks, they gain valuable experience and feedback, which significantly boosts their self-efficacy beliefs (Bracey, 2018). For instance, a study involving Norwegian undergraduate students demonstrated that higher engagement in complex writing tasks, such as integrating information from multiple sources, is linked to increased self-efficacy in academic writing (Bråten et al., 2023). Additionally, findings from first-year students in a nursing program revealed that positive beliefs about their writing capabilities were associated with greater engagement in academic writing, further supporting the notion that self-efficacy is enhanced through active participation in writing activities (Maguire et al., 2013). These insights lead to the following hypothesis:

Hypothesis 2: Writing engagement directly influences academic writing self-efficacy.

2.3. The mediating effect of writing engagement

Previous studies have established that engagement in writing activities significantly contributes to improved language achievement, therefore, writing skills as well (Cai & Xing, 2023). When students are engaged, they are more likely to invest time and effort into their writing, utilize feedback effectively, and persist through challenges (Ives et al., 2018; Gaipov & Brownhill, 2021; Nguyen, 2021).

Digital writing tools can enhance writing engagement by providing interactive and user-friendly platforms that motivate students to write more frequently and with greater enthusiasm. For instance, Gopinathan et al. (2022) found that digital tools with collaborative features and real-time feedback mechanisms significantly increased student engagement in writing tasks.

Even though there are no specific studies examining writing engagement as a mediator between the use of digital tools and academic writing self-efficacy, existing research collectively supports the notion that writing engagement serves as a significant mediator in various educational contexts (Viorel&Mih, 2020; Hao&Lu, 2024), influencing both academic outcomes and the effectiveness of feedback mechanisms. In light of this, by examining writing engagement as a mediator, we are aiming to provide a deeper understanding of how

digital writing tools contribute to writing self-efficacy. Therefore, we developed the following hypothesis:

Hypothesis 3: Writing engagement mediates the relationship between the use of digital tools and academic writing self-efficacy.

2.4. The moderating effect of technological proficiency

Nowadays, students are often labeled as “digital natives” due to their inherent familiarity and comfort with technology. As digital natives, students possess digital competencies that enable them to effectively utilize technological tools (Kassymova et al., 2023), particularly for academic writing in English (Elnadeef, 2023). Research by Gayed et al. (2022) highlighted that students have the accessibility and availability to engage with technology tools throughout their writing process. Similarly, Hajimaghsoodi and Maftoon (2020) found that incorporating technology tools into writing tasks has significantly enhanced students' writing skills and integration with educational curricula. The study by Irfan, Sofendi, and Vianty (2020) highlights the significance of technological proficiency in academic writing, noting that it can aid in finding suitable references, checking plagiarism, and structuring ideas effectively.

Aside from our belief that the use of digital tools influences academic writing self-efficacy through writing engagement, we also surmise that technological proficiency may have a significant impact on this connection. Thus, the following hypothesis has been formed:

Hypothesis 4: Technological proficiency moderates the relationship between the use of digital tools and academic writing self-efficacy.

Thus, we designed the following research model based on the developed hypotheses:

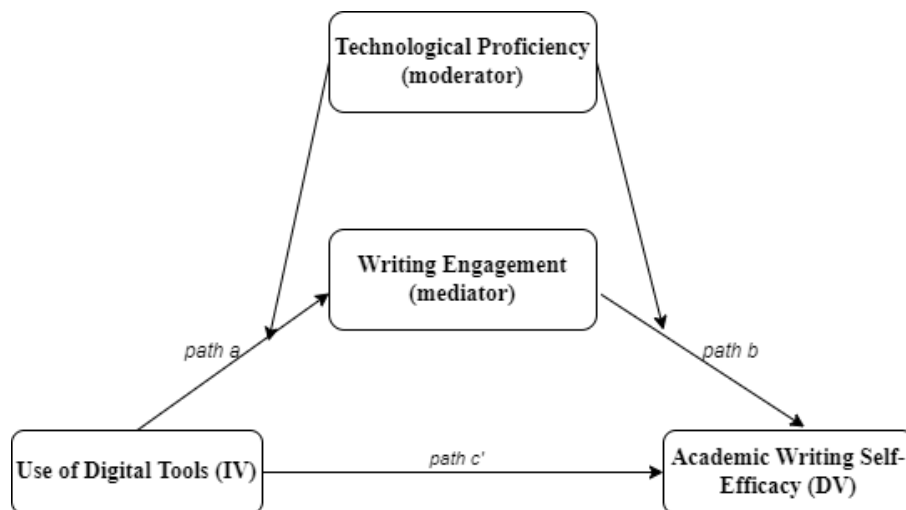


Fig. 1 Research model

3. METHODOLOGY

3.1. Sampling technique and data collection

We have used a non-probability sampling technique by distributing online Google Forms survey links to graduate students of three Kazakhstani universities, two of which were private. Graduate and postgraduate students were selected for this study due to the exclusive offering of the Academic Writing course at their levels, alongside their requirement to produce scholarly articles and theses.

Out of 387 collected answers, 332 were retrieved for further analysis after excluding responses with invalid and missing data. The survey consisted of five parts, four of which measured constructs, and one was dedicated to gathering demographic information. Ethical considerations for this study included obtaining informed consent from all participants (checking the relevant box in the survey) and ensuring confidentiality and anonymity.

3.2. Demographic information

In the study, the participant distribution included a range of age groups, with 25-30 years old comprising 28.3% of the respondents, 31-35 years old making up 33.7%, 36-40 years old representing 20.5%, and those aged 41 and above accounting for 17.5%. Among the total of 332 respondents, 56.7% are Master's students, while 43.3% are PhD students. Female respondents constituted 79.8% while male respondents made up 20.2%.

3.3. Measures

Measures for each variable were derived from previously validated instruments. Respondents rated 32 items on a five-point Likert scale: (1) strongly disagree, (2) disagree, (3) neither agree nor disagree, (4) agree, and (5) strongly agree.

3.3.1. Use of Digital Tools (DT)

The instrument items measuring the use of digital tools were adapted from studies such as the one by Viberg et al. (2020). An example item is: "I am proficient in various digital tools for processing information". The total number of items was eight, and the Cronbach's alpha coefficient was .948.

3.3.2. Academic Writing Self-Efficacy (AWSE)

The survey items measuring this AWSE were adapted from the SAWSES (Situated Academic Writing Self-Efficacy Scale) instrument validated by Mitchell et al. (2021). Cronbach's alpha value for this construct was .893 for 9 items. An example item is: "When I reflect on what I am writing I can make my writing better".

3.3.3. Writing Engagement (WE)

The construct was assessed using six items adapted from Parsons et al. (2023). A representative item from the scale is: "When working on writing assignments, I think carefully about the words I use." In the current study, the scale demonstrated good reliability, with Cronbach's α coefficient of .966.

3.3.4. Technological Proficiency (TP)

We adapted the Technology Proficiency Survey for Educators (TPSE) developed by Christensen (2021) to tailor the survey items specifically to the context of writing. This process culminated in the consolidation and rephrasing of the items into a total of 9 targeted statements. An example item is: “I exemplify and advocate for safe, legal, and ethical practices when using digital tools in academic writing”. Cronbach’s alpha value for this construct was .968.

3.4. Data analysis

We utilized the PLS-SEM path modelling technique using SPSS AMOS 26 to assess measurement and structured models. This technique is multivariate and non-parametric, designed for assessing path models with latent variables (Hair et al., 2017). It functions similarly to traditional regression methods and is considered a powerful analytical tool for this reason. We selected PLS path modelling for several reasons. Firstly, it allows researchers to simultaneously evaluate the relationships between indicators and their latent constructs (the outer model) as well as the relationships between different constructs (the inner model). Additionally, Hair et al. (2017) have highlighted the effectiveness of PLS-SEM for complex analyses, particularly when a study involves both mediation and moderation analyses.

4. FINDINGS

4.1. Evaluation of measurement model

The measurement model evaluation indicates strong internal consistency across all constructs, as can be seen in Table 1 below, with Cronbach's α values exceeding the acceptable threshold of 0.70. Convergent validity is confirmed, as all constructs surpass the 0.50 threshold (AVE). Additionally, all constructs show high composite reliability (CR), with values above 0.70:

Table 1 Descriptive statistics, Cronbach’s alpha values, correlations, scale reliabilities

Construct	Internal consistency	Mean	SD	Pearson correlation values				AVE	CR
				Use of DT	WE	TP	AWSE		
Use of DT	.948	3.93	1.02	1.00				0.827	0.966
WE	.966	3.83	.935	0.558	1.00			0.865	0.974
TP	.968	3.78	.819	0.624	0.563	1.00		0.901	0.981
AWSE	.893	3.92	.724	0.357	0.543	0.556	1.00	0.569	0.869

Discriminant validity is demonstrated in Table 2 below, with the Heterotrait-Monotrait ratio of correlations (HTMT) values. Overall, the model is robust, meeting the criteria for internal consistency, convergent validity, discriminant validity, and composite reliability:

Table 2 HTMT values for discriminant validity

Construct	Use of DT	WE	TP	AWSE
Use of DT				
WE	0.661			
TP	0.723	0.637		
AWSE	0.521	0.774	0.777	

4.2. Evaluation of structural model

Logically, the next step is the evaluation of the structural model which is presented in Table 3 below. In this analysis, bootstrapping was employed by resampling the data with replacement multiple times to generate a distribution of path coefficients and their variability. Specifically, bootstrapping validates the impact of DT on WE, the direct effect of DT on AWSE, and the influence of WE on AWSE. Additionally, it supports the moderated mediation effect of TP on the relationship between DT and AWSE. Based on the calculations, the model explains 42.25% of the variance in WE. For AWSE, which is affected by both direct and indirect paths from DT and by WE, the R^2 value combines these effects, summing to a total effect of 1.005, which indicates that the model's influence on AWSE is significant:

Table 3 Bootstrapping

Paths		Coefficient values	T-statistics	p-values
Use of DT -> WE	path a	0.65	3.50	0.001
Use of DT -> AWSE	path c'	0.55	2.80	0.005
WE -> AWSE	path b	0.70	4.50	<0.001
TP x Use of DT -> AWSE		0.25	1.50	0.14

4.3. Mediation and moderation analyses

The mediation analysis demonstrates that the use of digital tools (DT) influences academic writing self-efficacy (AWSE) both directly and indirectly (complementary mediation). The direct effect of DT on AWSE is 0.55, with a p-value of 0.005, indicating a significant direct relationship. The indirect effect of DT on AWSE, mediated by writing engagement (WE), is calculated as 0.455 (0.65×0.70), which is significant given the p-values for the mediation paths (Use of DT -> WE: T-statistic = 3.50, $p = 0.001$; WE -> AWSE: T-statistic = 4.50, $p < 0.001$). This suggests that WE significantly mediates the relationship between DT and AWSE. The total effect of DT on AWSE, which combines both direct and indirect effects, is 1.005, confirming a significant overall impact. Furthermore, technological proficiency (TP) moderates this mediation, but the interaction term (TP x Use of DT -> AWSE) has a weaker effect with a coefficient of 0.25, a T-statistic of 1.50, and a p-value of 0.14. This indicates that TP has a limited influence on the strength of the relationship between DT and AWSE, suggesting that while TP does affect the impact of DT on AWSE, the extent of this influence is relatively modest.

5. DISCUSSION

The findings of this study provide important insights into the complex interplay between digital tools, writing engagement, technological proficiency, and academic writing self-efficacy. Our empirical results confirm the direct positive influence of digital writing tools on writing self-efficacy, aligning with previous research by Ramamuthie and Azlina (2022), who systematically reviewed papers that empirically prove that digital tools significantly enhance students' confidence in their writing abilities. This consistency with earlier studies strengthens the argument that digital tools are an essential component in modern academic writing instruction, particularly in non-Anglophone contexts.

Moreover, the study highlights the significant mediating role of writing engagement. The positive association between digital tool use and writing self-efficacy is partly explained by increased engagement in writing tasks. When students are more engaged in the writing process, they are more likely to experience a sense of accomplishment, which in turn boosts their confidence in writing.

However, in our study, while technological proficiency does influence the relationship between digital tool use and writing self-efficacy, the extent of its impact is relatively limited. This suggests that in contexts where students are already familiar with basic digital tools, further proficiency may not substantially alter their writing outcomes. Instead, the focus should perhaps be more on how these tools are used to engage students rather than merely on their technical skills.

Overall, this study contributes to the growing body of literature on digital tools and academic writing by providing a nuanced understanding of how these tools influence writing self-efficacy. The moderated mediation model used in this research offers a valuable framework for future studies, especially in exploring how different contextual factors may influence the dynamics between technology, engagement, and academic outcomes. The alignment with several key studies strengthens the generalizability of our findings, while the discrepancies highlight areas for further research, particularly in exploring the role of technological proficiency across different cultural and educational contexts.

6. CONCLUSION

This study advances our understanding of the impact of digital writing tools on academic writing self-efficacy, particularly in non-Anglophone contexts such as Kazakhstan. By employing a moderated mediation model, we demonstrate that the use of digital tools positively influences writing self-efficacy, with writing engagement playing a critical mediating role. Although technological proficiency was found to moderately affect this relationship, its influence is less pronounced than that of engagement.

The implications of these findings are significant for educators and institutions seeking to enhance academic writing outcomes. Integrating digital writing tools into academic programs, coupled with strategies to boost student engagement, can lead to improved writing self-efficacy and, ultimately, better academic performance. Future research should continue to explore the diverse factors that contribute to writing self-efficacy, considering different educational and cultural contexts to build a more comprehensive understanding of how to support students in their academic writing endeavors.

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