Enhancing Writing Accuracy and Complexity through AI-Assisted Tools among Moroccan EFL University Learners

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Abstract

The present study investigates the effectiveness of the use of AI-powered tools, such as ChatGPT and Grammarly, in improving writing accuracy and complexity among Moroccan University English as a Foreign Language (EFL) learners. Since education in the 21st century has undergone radical and rapid changing landscape due to the advancement and integration of Artificial Intelligence (AI), there is a pressing need in examining its potential impact on language learning, particularly in enhancing the complexity and accuracy of the writing skill. Numerous studies were carried out on the impact of AI-powered tools on writing in general, but a few of them were conducted on the impact of these tools on particular writing subskills, like accuracy and complexity; hence this piece of research attempts to fill this gap. The study employs a quantitative design, administering a Likert-scale questionnaire to Moroccan University EFL learners to assess how their use of AI-powered tools influences writing accuracy and complexity. The findings revealed a positive impact on writing accuracy and complexity among Moroccan EFL learners, resulting in the production of complex syntactic structures and error-free constructions. This improvement primarily stems from the AI-powered tools' ability to provide personalized feedback and foster self-directed learning. Interestingly, the study also showed a strong positive correlation between accuracy and complexity, indicating that improvement in one aspect leads to improvement in the other. Such results serve as a trigger for decision-makers, including curriculum designers, to properly integrate AI in education for reinforcing writing instruction and support EFL learners in their language learning development.

1. INTRODUCTION

Artificial intelligence (AI henceforth) has significantly influenced societies, organizations, and individuals (Dwivedi et al., 2023). While it has enhanced living and working environment and become a part of daily life, scholars and practitioners have lately started to seriously discuss the new waves of generative AI tools, including ChatGPT and Grammarly, and their implications for teaching, learning, and assessment (Kohnke, 2023). They leverage advanced deep learning models to create content that closely resembles human output, spanning across audio, code, images, text, simulations, 3D objects, and videos, including new and unexpected outputs in response to varied and complex prompts (Lim et al., 2023). In this context, Huang

et al (2023) pointed out that students who receive personalized intervention, facilitated by AI-tools, have significantly higher learning performance than those who merely receive class tutoring.

The integration of AI-based tools in language learning environments offers numerous possibilities for fostering language skills, particularly writing (Rusmiyanto et al., 2023). In this context, there is a consensus among researchers that digital writing tools powered by AI can significantly enhance learners' written proficiency (Nobles & Paganucci, 2015; Dickson, 2017; Karyuatri, 2018). Lu (2019) indicated that EFL learners who utilize AI tools during writing receive ample feedback on grammar and language correction, aiding error identification and rectification. Zhoa (2023), on the other hand, observed that AI-powered tools assist in maintaining a continuous flow of English writing rather than getting stuck on one particular phrase or expression.

Bouchefra (2015) suggested that writing is a product-oriented approach whose primary concern is the final results and the accuracy of the grammatical sentences and the complexity of the syntactic structures. In this regard, new AI-assisted writing tools offer innovative approaches to tackle challenges related to writing accuracy and complexity (Jia et al., 2022 & Kohnke, 2023). They aid users in identifying and correcting grammatical and lexical errors, while also suggesting alternative sentence structures to enhance overall writing quality. With the rise of AI tools reshaping education and their capacity to bolster the writing proficiency of EFL learners through immediate feedback on grammar, sentence structure, and vocabulary, the relevance of instructors' feedback is diminished, marginalized, and ultimately rendered obsolete.

Given the limited research carried out on the impact of AI tools on enhancing writing among Moroccan University EFL learners, this paper seeks to explore the extent to which these tools influence writing, with a specific focus on accuracy and complexity skills. These two interdependent, but complementary, dimensions have always been regarded as being in trade-off as suggested by the Limited Attention Capacity (Skehan and Bui, 2018). By doing so, a comprehensive view will be drawn about and how the tools can solve the difficulties faced the Moroccan University EFL learners in writing, helping them in producing highly complex and error-free English constructions.

1.1. Accuracy And Complexity In L2 Writing

Writing, as a prominent language skill, plays a pivotal role in the language development of English language learners, enabling them to effectively communicate ideas, synthesize knowledge, advance arguments, evaluate perspectives, and clarify opinions (Zhou & Hiver, 2022). Alzahrani (2021) emphasized the role of writing in constructing coherent sentences and paragraphs to convey meaning and organize thoughts efficiently. A well-structured piece of writing, demonstrating proficiency in both lexis and grammar, tends to persuade readers more effectively than a poorly written paper on a given topic.

Researchers and educational practitioners have varied conceptualizations of proficiency in a second language (Housen et al., 2012, Bui & Skehan, 2014). They argue that L2 proficiency is not a singular construct but rather comprises multiple components. Three primary aspects have been proposed for measuring and defining such proficiency, namely, *complexity, accuracy*, and *fluency*, abbreviated as *CAF* for short (Housen et al., 2012). CAF has emerged as a

complementary dimension rather than a replacement for other established proficiency models, including the four language skills (Housen et al., 2012).

Complexity and accuracy are two crucial different, but complementary, aspects of second language acquisition. The former has to with the use of sophisticated and complex syntactic structures, using subordination and coordination (Skehan & Bui, 2018). Such complexity in using language can be manifested in terms of lexical diversity, lexical sophistication, and lexical density (Skehan & Bui, 2018). The latter, which is accuracy, refers to the ability of L2 learners in correctly following and using the rule system of the target language, exhibiting native-like constructions, and producing error-free sentences.

1.2. Artificial Intelligence

The term *Artificial Intelligence* was first coined by John McCarthy in 1956 to refer to the main types of thinking machines (McCarthy et al., 2006). It behaves as a rich system that incorporates intelligent programs that help humans to carry out a range of tasks (Song & Song, 2023). In education, AI has been recognized for its great potential for enhancing teaching methodologies for language instructors and facilitate language acquisition (Luckin et al., 2016; Zhang and Zou, 2020; Nazari et al., 2021; Sun et al., 2021; Xia et al., 2022). Additionally, many AI-based tools used in education have mainly, but not exclusively, digital writing assistants. Such tools have been widely proved for their capability in enhancing writing quality (Zheng & Warschauer, 2017).

AI-powered tools have a great impact and rapid influence on the writing skill of English as a Foreign Language. Learners, creating an environment where they can interact effectively, freely, and communicatively (Selim, 2023). Jia et al. (2022) emphasized that such tools significantly contribute to the writing development of EFL learners by facilitating dynamic interaction between the learner and the software, fostering more diverse, integrated, and intimate relationships. Among the renowned and extensively utilized AI-driven tools is ChatGPT, which has been empirically demonstrated to be beneficial in numerous language learning programs for enhancing learners' writing skills (Barrot, 2023). Leveraging its vast knowledge, ChatGPT constructs words and grammatically correct sentences, thereby assisting in the creation of well-structured written content. It comprehends human queries and effectively delivers pertinent responses. Additionally, according to Song and Song (2023), ChatGPT aids language learners in overcoming writing challenges related to organization, coherence, grammar, and vocabulary, offering alternative suggestions to rectify grammatical errors and enhance overall writing proficiency.

Many AI-based tools are used for enhancing writing accuracy and complexity among learners, including Grammarly and Wordtune. However, the majority of digital writing tools nowadays don't focus on generating content, but rather they focus on helping writers edit drafts from ungrammatical sentences and ill-formed ones (Winans, 2021). Grammarly, which is AI-powered tool, helps in providing prompt grammatical correction for any piece of writing.

Wordtune is another tool that facilitates learners with writing in the sense that it paraphrases their original texts for clarity and smoothness. When an EFL learner puts a set of English constructions into Wordtune, this tool rewrites the original sentences by undergoing word replacements and modifications (Zhao, 2022). Since most of the EFL learners use such tools for enhancement writing purposes, examining the degree to which such technologies positively

impact the quality of English writing has become a must for today's current research. All these AI tools, in addition to others, can be used to provide immediate and personalized feedback, tailored to different learning styles and various language levels. They can help in analyzing learners' writing, providing immediate, individualized, and adoptive feedback on grammar, organization, and content (Dwivedi et al. 2023).

Mushthoza et al. (2023) pointed out that AI tools can identify grammatical errors, propose alternative expressions or vocabulary options, and provide suggestions to enhance readability. In this regard, the integration of AI-driven writing tools holds promise in enhancing fluency, accuracy, and self-correction, offering potential solutions to the hurdles learners encounter in the writing skill (Al-Raimi et al., 2024). Specifically, such tools can significantly refine the precision of written compositions by identifying and rectifying errors in grammar, syntax, and vocabulary usage. Moreover, they contribute to the complexity of writing by suggesting nuanced language alternatives and advanced sentence structures, thereby enriching the overall quality of written expression (Mushthoza, 2023).

AI tools contribute to motivation and engagement among learners, incorporating gamification elements such as badges or rewards (Neji et al., 2023). The accessibility and availability of these tools are advantageous, enabling learners to practice writing at their convenience, aligning with their individual learning preferences. Furthermore, AI tools allow for the customization of the learning journey, addressing the specific needs and proficiency levels EFL learners. Huang et al (2023) showed through their study that AI-enabled personalized recommendations had a significant and positive effect on the online learning engagement of students with a moderate level of motivation. This personalized approach fosters a tailored and individualized learning environment, empowering learners to advance at their own pace and target particular areas for improvement in writing proficiency (Al-Raimi et al., 2024). In essence, AI technologies serve as a valuable asset for EFL learners, enriching their writing skills through tailored feedback, enhanced linguistic accuracy, motivation, and accessibility.

1.3. The Role of AI in Promoting Formative Feedback

Traditionally, students often lack the necessary formative feedback for various reasons (Molin et al., 2020). L2 writing instructors frequently find themselves unable to provide feedback to every student due to factors such as overcrowded classes or limited teaching resources. Consequently, L2 students must take on the responsibility of being intrinsically motivated and self-directed, actively engaging in deep and meaningful learning (Nazari et al., 2021). Grounded in the constructivist framework, deep and meaningful learning encompasses dynamic, constructive, self-regulated, purpose-driven, cooperative, and personal processes of acquiring knowledge and understanding, drawing from existing knowledge and situated within specific contexts (Jonassen et al., 2003). Therefore, AI tools serve as valuable resources upon which learners can depend for formative feedback and to facilitate meaningful learning experiences.

Formative feedback, as highlighted by Zimmerman et al. (2012), fosters engagement, knowledge construction, and autonomous learning. Consequently, it is considered a crucial component in enhancing writing skills and bolstering motivation in language learning contexts (Bakla, 2020; Liu et al., 2022; Zhang and Zou, 2023). In traditional teaching and learning methods, formative feedback played a fundamental role in guiding writing instruction, offering

valuable insights into areas needing improvement (Song & Song). Through the utilization of AI-supported language learning tools, learners actively engage and participate in dynamic interactions with AI, perceiving it as a knowledgeable and adaptable virtual peer that continuously provides guidance and suggestions to enhance their writing skills (Song & Song, 2023). Therefore, the personalized learning experience facilitated by AI-powered tools aligns closely with the fundamental principles of Vygotsky's constructivist theory. These tools enable L2 learners to progress at their own pace and convenience, receiving immediate and customized feedback, thus fostering a personalized learning journey (Huang A. Y. et al., 2023; Huang X. et al., 2023).

Given the role of both AI-driven tools and the constructs of Vygotsky theory in enhancing writing among EFL learners, the present study advances our understanding of the relationship between Moroccan university EFL learners and their use of these tools in ameliorating writing accuracy and complexity.

1.4. Research Problem and Research Gap

Writing is undoubtedly a complex process that requires not only mastery of the writing mechanisms, but also the grammatical rules and word choice. A great deal of research has shown that L2 learners generally tend to avoid writing due to many reasons, including limited vocabulary, unfamiliarity with grammar rules, lack of idiomatic expressions, and inadequate grasp of cultural differences between their mother tongue and their target language (Rozimela and Wahyuni, 2019). In the view of Belkhir and Benyelles (2017), Bouchefra (2015), Fazilatfar et al (2017), and Sasmita et al (2021), all these problems, in addition to others, are mainly attributed to the lack of practice which obstructs their progress in developing proficiency in their target language. Given that AI tools have revolutionized education for its potential effect on improving writing of EFL learners through providing immediate feedback on grammar, sentence structure, and vocabulary, the instructors' reactions become ignored, eliminated, and most importantly no longer needed.

Although many research studies were carried out on the impact of AI-driven tools on writing among EFL learners (Al-Raimi et al., 2024; Mahmoud, 2023; Gayed et., 2022, among others), they did not in fact investigate their perspectives especially in the Moroccan context regarding the adoption of AI. Also, a limited amount of research was investigated on its impact on particular language writing skills, such as accuracy and complexity, which, together, comprise proficiency in the second language. Hence, the present study aims to fill this gap, by undertaking an examination of how these tools enhance writing accuracy and complexity among Moroccan university EFL learners.

1.5. Studies on the Impact of the Use of AI-driven Tools on L2 Writing

Several studies have been conducted on the impact of the use of AI models in enhancing L2 writing among EFL learners. To start with, Al Mahmoud (2023) investigated the influence of *Wordtune* on improving writing skills among Saudi Arabian students, using a mixed method design whereby participants were divided into control and experimental groups. They both took pre/post-tests, analyzed by SPSS, to collect quantitative data while an evaluation of writing samples by two assessors was undergone to gather qualitative insights. The results revealed that the superiority of the experimental group who used Wordtune over the control one. Such tools greatly contributed to the enhancement of their writing abilities, regardless of their gender, allowing them to notably improve their language precision, lexical diversity, and

sentence complexity, thanks to the constructive feedback they receive. The study of Chang et al (2021) also supports the positive impact of AI tools in the rapid enhancement of students' English writing proficiency by using a mixed method teaching mode. Such a way does not only improve writing skills, but also leads to active engagement and deeper passion for writing among EFL learners.

Rahman and colleagues (2022) investigated the role of AI-driven tools on identifying grammatical errors among EFL learners. The results showed notable improvement in the writing of these learners who themselves showed positive attitudes towards the role of these tools in enhancing their writing capabilities. In the same line, Utami and Winarni (2023) carried out a case study focusing on three Indonesian EFL students, investigating how they utilized AI-supported language learning for academic research writing. By employing both quantitative measures via surveys and qualitative insights via interviews, the study uncovered that AI-based language learning tools had a beneficial impact on the students' academic research writing, fostering increased engagement in these activities.

Similarly, Fitria (2021) conducted a study examining how Grammarly, an AI-based language learning tool, impacted the writing proficiency of EFL students. Within the Grammarly environment, students received corrective feedback to refine and enhance their written work, leading them to exhibit accurate sentences. The study findings highlighted the substantial role of Grammarly in improving the writing skills of the learners. In another study, Yan (2023) conducted a study investigating the impact of ChatGPT on the English writing skills of EFL students. The study delved into students' responses and reflections regarding the utilization of this AI-supported tool for enhancing their academic writing abilities. Results underscored the significant role of the AI tool in improving writing proficiency and streamlining writing tasks. However, students also voiced concerns about potential drawbacks on their academic writing skills over time and emphasized the necessity for guidance on the tool's appropriate application in academic writing contexts.

Building on the insights gleaned from the aforementioned studies, the current investigation not only seeks to scrutinize how AI-driven tools influence the L2 writing of Moroccan university EFL learners but also aims to explore their attitudes and perspectives, with a specific focus on how these tools foster writing accuracy and complexity.

2. METHODOLOGY
2.1. Research Objectives, Questions, and Hypotheses

The present study aims to achieve the following research objectives:

RO1: To explore the impact of the use of AI-powered tools on enhancing writing accuracy and complexity among Moroccan university EFL learners.

RO2: To examine the relationship between writing accuracy and writing complexity due to the use of AI-powered tools by Moroccan university EFL learners.

The study under investigation aims to answer the following research questions:

RQ1: To what extent does the use of AI-powered tools enhance writing accuracy and complexity among Moroccan university EFL learners?

RQ2: What is the relationship, based on the use of AI-powered tools, between writing accuracy and writing complexity among Moroccan university EFL learners?

The research hypotheses emanating from the above research questions are:

RH1: The use of AI-powered tools significantly and positively enhances writing accuracy and complexity among Moroccan university EFL learners.

RH2: The use of AI-powered tools leads to a strong relationship between writing accuracy and writing complexity among Moroccan university EFL learners.

2.2. Research Design

The present study employed a quantitative research design. Data were collected through an online questionnaire based on the Likert-scale from Moroccan University EFL learners in order to measure their perspectives on the role of AI tools on improving their writing accuracy and complexity.

2.3. Participants

The questionnaire was administered online to English-majored students who were still pursuing their studies when the data was gathered. A total of 67 participants, 37 of whom were female participants (54.5%) and 30 were males (45.5%). Additionally, 9 (13.04%) participants ranged in age between 18-21, 37 (55.02%) between 22-25, 8 (11.09%) between 26-29, and 13 (19.04%) of those who were above 30 years old. Moreover, 26 (38.08%) of the participants were BA students, 36 (53.07%) were MA students, and only 5 (7.05%) were PhD students.

2.4. Research Instrument

Quantitative data were gathered through a questionnaire designed to investigate the impact of AI-driven tools on enhancing writing accuracy and complexity among Moroccan university EFL learners. The questionnaire comprised two parts. The first part focused on collecting demographic information about the participants, utilizing a Likert scale ranging from 2 to 5 points to assess factors such as gender, age, and academic level. In contrast, the second part consisted of a 5-point questionnaire aimed at evaluating the effects of these tools on participants' writing output. To streamline the data collection process, the questionnaire was created and distributed using Google Forms.

2.5. Reliability and Validity

To assess the reliability of the questionnaire items, the Cronbach alpha test was used. This test gauges the extent to which the questionnaire items evaluate the impact of AI-powered tools on enhancing writing complexity and accuracy among Moroccan university EFL learners. The results of the test indicated a level of internal consistency and reliability ranging from moderate to high, affirming the questionnaire's credibility and validity as a tool for investigating students' perspectives on the role of AI-driven tools in the writing process.

3. DATA ANALYSIS

The quantitative data collected from the questionnaire underwent coding based on established norms and were subsequently entered into the Statistical Package for Social Sciences (SPSS) for further analysis using various statistical tests. Descriptive statistical analyses, such as Mean, Standard Deviation, and Range, were utilized to examine the basic trends within the dataset.

Additionally, a series of correlational tests were conducted to explore the relationships between variables.

4. FINDINGS

This section presents the findings reached out of the data. It introduces them quantitatively, armed with statistical pieces of evidence.

4.1. Descriptive Trends in the Writing Skill among Moroccan University EFL Learners

Table 1 provides a comprehensive overview of Moroccan university EFL learners' attitudes toward the effectiveness of AI-powered tools in improving their writing skills. Overall, participants generally agreed that such tools significantly enhanced their writing skills (M=2.1045, SD=0.97132), indicating a perceived effectiveness. Moreover, the tools were seen to positively impact motivation levels and engagement among these EFL learners (Mean=2.3433), although there was some variability in opinions (SD=1.02325). Interestingly, the tools' ability to identify grammatical and spelling errors received the lowest mean score (1.7910) and the highest standard deviation (1.33186) among all categories, suggesting that learners, despite differing viewpoints, largely concurred on the tools' proficiency in error detection within written compositions.

Descriptive Statistics				
	Minimum	Maximum	Mean	S. D
Fostering Writing Skills	1,00	5,00	**2,1045**	**,97132**
Enhancing Motivation and Engagement	1,00	5,00	**2,3433**	**1,02325**
Identification of Grammatical and Spelling Errors	1,00	11,00	**1,7910**	**1,33186**
Enhancing Vocabulary Repertoire and Lexical Diversity	1,00	4,00	**1,9104**	**,71205**
Reducing Errors and Producing Error-free Construction	1,00	4,00	**1,8507**	**,70181**
Exhibiting Complex Sentences	1,00	4,00	**2,0149**	**,74859**
Promoting Self-Learning	1,00	5,00	**2,3881**	**,98404**

Table 1: Descriptive trends for writing skills

Note: 1=Strongly Agree, 2=Agree, 3=Neutral, 4=Disagree, 5=Strongly Disagree

According to the results, AI-driven tools were proved to be able to enhance vocabulary repertoire and lexical diversity in the writing productions (Mean= 1,9104) as long as more consistencies were witnessed among respondents' answers (SD=,71205). Regarding the help of such tools in reducing errors and producing error-free constructions, the Moroccan university EFL learners, based on relative consistency (SD=,70181), strongly agreed in their effectiveness in doing so (M= 1,8507). Similarly to motivation and engagement enhancements, AI-powered tools lead to the production of complex constructions (M=2,0149) with a moderate variability in their responses (,74859). Lastly, the mean being (2,3881) indicates that

respondents generally agreed in the promotion of self-learning due to the use of AI-powered tools.

4.2. The Correlation between the Identification of Errors and the Production of Grammatical Sentences

The present correlation test aims to examine the extent to which the identification of errors is related with the production of grammatically correct sentences.

Table 2 reveals that there is a strong positive relationship (,393**) between the identification of errors and the production of error-free sentences. This relationship is not only positive, but also highly statistically significant (p=0,001). This implies that AI-powered tools significantly and positively lead to the identification of errors among Moroccan University EFL learners, and hence push them to produce grammatically correct and spelling out error-free sentences in their written output.

Correlations				
			Identification of Errors	Reducing Errors and Producing Error-free constructions
Spearman's Rank Test	Identification of Grammatical and Spelling Errors	Coefficient	1, 000	**,393****
		Sig	.	**,001**
	Reducing Errors and Producing Error-Free Constructions	Coefficient	**,393****	1,000
		Sig	**,001**	.

Table 2: The relationship between the identification of errors and the production of error-free sentences

4.3. The Relationship between the Enhancement of Vocabulary Repertoire and Lexical Diversity and the Use of Complex Sentences

Table 3 illustrates Spearman's rank correlation coefficients between two variables: "Enhancing Vocabulary Repertoire and Lexical Diversity" and "Promoting Complexity of Sentences." It shows a positive but weak correlation (0,19) between the two variables. This weak correlation is also proved by the p-value being not statistically significant (p=0,19). This indicates that the enhancement of vocabulary repertoire and lexical diversity due to the use of AI-powered does not necessarily lead to the use of complex sentences in the written output.

Correlations				
			Enhancing vocabulary reportoire and Lexical Diversity	Promoting Complexity of Sentences
	Enhancing vocabulary repertoire and Lexical Diversity	Coefficient	1,000	**,193**
		Sig	.	**,117**
		Coefficient	**,193**	1,000

Spearman's Rank Test	Promoting Complexity of Sentences	Sig	,117	.

Table 3: The relationship between the enhancement of vocabulary repertoire and lexical diversity and the promotion of lexical diversity

4.4. The Relationship between Accuracy and Complexity among Moroccan University EFL Learners' Writing Productions

Table 4 presents the correlation coefficient test between the writing accuracy and writing complexity. A strong positive correlation (,193) between the two variables is observed, motivated by a highly statistically significant relationship (p=0,004). This suggests that there is an association line between writing accuracy and writing complexity due to the use of AI-powered tools in the sense that as the former increases, there is a corresponding increase in the latter.

Correlations				
			Writing Accuracy	Writing Complexity
Spearman's Rank Test	Writing Accuracy	Coefficient	1,000	,343**
		Sig	.	,004
	Writing Complexity	Coefficient	,343**	.
		Sig	,004	1,000

5. DISCUSSION

This study aimed to assess whether and to what extent AI-driven tools enhanced Moroccan EFL learners' writing outputs. The data was statistically analyzed using numerical evidence to either validate or refute the hypotheses posited earlier. In this section, the findings are discussed and interpreted in light of the reviewed literature to provide a comprehensive understanding of Moroccan university EFL learners' perceptions regarding the use of such tools.

The results yielded significant insights, revealing great enhancement in participants' writing productions due to the incorporation of AI-powered language learning. The areas of improvement were mainly reducing grammatical and spelling mistakes, exhibiting grammatically correct and complex sentences, raising the rate of motivation and engagement, and lastly promoting self-directed learning. These overall results are in line with, and support to a great extent Syahnaz and Fithriani's study (2023), which indicated positive attitudes towards the use of AI-powered tools, highlighting their abilities in improving content quality, minimizing grammatical errors, and enhancing linguistic competency. Comparatively to these findings, Farrokhnia et al. (2023) pointed out that excessive use of these tools and increased reliance on auto-correct and spell-check could decline creativity and critical thinking.

AI-driven tools facilitate error identification, thereby contributing to error reduction in writing. Tools like Grammarly, for instance, primarily focus on rectifying spelling and grammatical errors in written pieces. Through exposure to repeated and immediate corrections provided by various tools, learners gradually develop accuracy in the target language, producing

grammatically sound and well-structured constructions. This aligns with the findings of Song and Song (2023), who observed that such tools assist EFL learners in overcoming writing challenges related to cohesion, grammar, and vocabulary. Additionally, Mushthoza et al. (2023) and Fitria (2021) highlighted the ability of these tools to detect errors and propose alternative expressions and vocabulary options to enhance readability, clarity, and fluency. Furthermore, the close relationship between error identification and their correct usage in writing suggests that language learning progresses incrementally, with AI-driven tools serving both as error detectors and grammatical aids.

The findings support the assertion that the use of AI-powered tools increases engagement levels and motivation rates for writing. The adaptive and personalized feedback provided by these tools tends to capture the attention of Moroccan university EFL learners, keeping them engaged, motivated, and eager to interact with the tool. This personalized aspect of AI fosters language learning by offering tailored feedback and creating an individualized learning environment that addresses specific areas needing improvement in writing proficiency. Consistent with Bakla (2020), Liu et al. (2022), Zhang and Zou (2023), and Song and Song (2023), understandable formative feedback contributes to boosting motivation and engagement through active social interaction between learners and the software, with learners perceiving it as an adaptive virtual peer offering continuous guidance and suggestions for enhancing their writing skills. Moreover, in line with Chang et al (2021) and Utami and Winarni (2023), exposure to grammatically accurate sentences and appropriate word choices provided by AI tools reinforces the production of better-written texts, thereby enhancing learners' engagement in required writing tasks.

The utilization of AI-powered tools significantly enhances the lexical and syntactic repertoires of Moroccan university EFL learners, enabling them to construct complex and sophisticated sentences. Engaging with interactive AI tools, such as ChatGPT, facilitates rapid acquisition of lexical vocabulary and syntactic structures. Similar to the findings of Al Mahmoud (2023), these tools enable learners to use nouns, adjectives, and verbs with greater precision and appropriateness. Moreover, they not only assist in word ordering but also encourage learners to progress from forming simple sentences to crafting sentences characterized by phrasal and clausal complexity, incorporating conjunctions and embedded clauses. In a similar vein, Mushthoza (2023) affirmed that such tools significantly contribute to writing complexity by suggesting highly sophisticated sentence structures and nuanced language alternatives, thereby enriching the overall written output.

Self-directed learning is another characteristic that AI-powered tools can promote. While there was some variability among Moroccan university EFL learners regarding the tools' ability to foster self-learning, the overall consensus leaned towards agreement. Through the use of AI-assisted language tools, EFL learners can engage in learning at their own pace, time, and convenience, thanks to the formative, immediate, and personalized features of such tools. This aligns with the findings of Zimmerman (2012), Huang A. Y. et al. (2023), and Huang X. et al. (2023), who argued that the personalized language learning environment facilitated by assisted tools contributes to knowledge building and self-directed learning, both crucial elements of constructivist theory. Given the typical overcrowding of classes and the limited availability of tailored, corrective, and immediate feedback, learners often find the linguistic experience

provided by such tools more adaptable. They receive prompt feedback, enabling them to produce better-written texts. Furthermore, in line with Song and Song (2023) and Vygotsky's social constructivist theory, these tools effectively address writing issues, supporting learners in personalizing their writing activities and leading to the internalization of writing skills.

In conclusion, the findings strongly suggest that AI-driven tools have a significant impact on enhancing writing skills among Moroccan university EFL learners. These tools encourage learners to produce accurate and error-free constructions while also promoting the creation of highly sophisticated and syntactically complex sentences. Therefore, based on statistical evidence, the results validate the plausibility of the first hypothesis. Furthermore, the findings indicate a strong relationship between the use of these tools and the improvement of accuracy and complexity among learners, thus confirming the second hypothesis.

6. CONCLUSION

The present study aimed to investigate the impact of the use of AI-driven tools on enhancing writing accuracy and complexity among Moroccan University EFL learners. The findings reached showed significant advancement in students' writing productions following the integration AI tools. These advancements predominantly revolved around the mitigation of grammatical and orthographic inaccuracies, the production of grammatically sophisticated and intricate sentences, raising the level of motivation and engagement, and promoting autonomous learning.

Several limitations can be acknowledged when interpreting the results of this study. Firstly, the findings may not be generalizable due to the relatively small sample size (67), which may not adequately represent all Moroccan university EFL learners. Additionally, the absence of a control group limits the ability to make comparisons and draw definitive conclusions about the effectiveness of AI-driven tools. Conducting a study using an experimental research paradigm could provide more robust findings regarding differences between groups. Furthermore, the use of a cross-sectional design instead of a longitudinal one is another limitation, as it prevents the observation of changes over time, limiting the applicability of the results to the specific time frame in which the study was conducted.

The present study carries several pedagogical implications. Integrating AI-tools into classes is highly recommended as they align well with innovative approaches and pedagogical practices. These tools enable EFL learners to promptly identify their writing errors and effectively address them, thanks to the formative, tailored, and individualized feedback they provide. Given that these tools have demonstrated efficacy in enhancing engagement, motivation, and facilitating self-paced learning, teachers can leverage them to transition from a teacher-centered approach to a more learner-centered one. By encouraging active interaction with the software, learners are motivated to devote more effort to improving their writing skills and identifying areas for improvement.

Many potential future research directions arise from the present study. Firstly, given the moderate sample size used, it would be beneficial to increase the sample size to generate more generalized findings about the facilitative role of AI-driven tools in enhancing the writing skills of Moroccan University EFL learners. Additionally, future studies could extend the investigation over a longer period to examine the long-term influence of these writing-driven tools on writing development. Lastly, future research should consider employing an

experimental research design to explore the impact of AI-driven tools on actual writing samples, rather than solely focusing on the perceptions and perspectives of Moroccan University EFL learners. This would provide more concrete evidence of the effectiveness of these tools in improving writing skills.

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Appendix

You can get access to the questionnaire through the following link:

https://docs.google.com/forms/d/e/1FAIpQLSf2r25Z75ccXILGfbX3h6msyLBSHM_h6pcalMjYRcI4GJQYoQ/viewform?usp=sf_link.

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