

AI DEPENDENCY AND ITS IMPACT ON CRITICAL THINKING AND WRITING SKILLS IN THE CONTEXT OF GFL: A CROSS-NATIONAL PERSPECTIVE

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ABSTRACT

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The application of artificial intelligence (AI) in learning and writing German has been expanding rapidly. Although AI has been increasingly employed to assist in writing tasks, concerns have emerged regarding its potential impact on users' ability for critical thinking and writing independence. Moreover, examples of comparative research between educational and cultural context are limited. This research investigates learners', teachers' and lecturers' perceptions regarding the influence of AI dependency on critical thinking and German writing in Indonesia, Thailand, Algeria, and Germany. The research design is a cross-national descriptive survey, utilizing both qualitative and quantitative data. A web-based questionnaire consisting of closed- and open-ended questions was used for data collection. A total of 174 participants were recruited. Quantitative data were tested using non-parametric tests, and qualitative responses were thematically analyzed. The findings reveal significant differences in people's perceived reliance on AI across countries. Participants from Indonesia and Thailand reported higher AI use than those from Germany, while respondents from Algeria indicated a moderate level. For all countries, AI was perceived as helpful in increasing grammar precision and structuring ideas in German writing. Meanwhile, there were mixed opinions on critical thinking. Some participants felt that AI assisted in critical thinking, while others were concerned that frequent use reduced the ability to reason independently when writing. In conclusion, AI seems to play a significant complex role in the writing process. Although it can improve writing efficiency, care must be taken to ensure that critical thinking and writing skills are not weakened.

Keywords: Artificial intelligence (AI); AI dependency; critical thinking; German writing; cross-national perspective

1. INTRODUCTION

The development of technology has driven the integration of artificial intelligence (AI) in various parts of everyday life; education is no exception. Besides being used to develop videos (Kharis, 2024), AI tools, from grammar checkers to generative language models, have made their way into both university students' and academics' toolboxes at all levels of education, especially in the learning and writing of foreign languages (Alharbi, 2023; Benek, 2025; Pokrivcakova, 2019). Despite the benefits of integrating such technologies, there is growing concern about how they affect learning and cognitive skills development including critical thinking (George, 2023; Kharis et al., 2024; Sethy, 2012).

In the era of globalization, where the world is increasingly interconnected, one could argue that fluency in foreign languages such as German is considered an essential skill that people from around globe require for academic, professional, or intercultural communication with others (Oberste-Berghaus, 2024). Writing, as the most cognitively complex language skills, not only requires knowledge of specific grammatical and vocabulary items, but it also demands developed critical thinking abilities (Deane et al., 2008; Hestningsih, 2016; Kuek & Choul, 2010). Such thinking is necessary for generating original, coherent, and convincing writing, and it acts as one of the most basic cognitive skills. Thus, there is the need for education to focus on teaching critical thinking (Pandeeka & Maneekul, 2019). Critical thinking allows individuals to create valid arguments, build good evidence, recognize biases, and do a deep reflection (Gambrill, 2006; Hunter, 2014; Khalifa, 2024; Thayer-Bacon, 1998). Developing writing proficiency, in particular in a foreign language with its specific genre-related requirements, is a process of planning, drafting, revising, and integrating feedback (Deane et al., 2008; Duensing & Baumann, 2006; Rexhepi & Suka, 2025; Tatzl et al., 2012).

With the use of AI tools, questions have emerged regarding whether these tools are making it harder for students to think for themselves and improve their writing. While previous research has suggested that the use of AI can enhance writing efficiency (Ironsi & Ironsi, 2025; Rexhepi & Suka, 2025; Wale & Kassahun, 2024; Zhao, 2025), overdependence may impede learning activities which require analytic thought or creativity (Jayasuriya et al., 2025). In the case of learning foreign languages, reliance on AI, for example machine translation or grammar corrector tools, might prevent learners from internalizing rules associated with language and learning how to self-edit independently (Metwally et al., 2025; Ziar, 2025), as well as reducing their critical thinking ability. Furthermore, although AI can facilitate the efficient completion of tasks, it can also hinder the development of critical thinking skills in learners due to its tendency to replace rather than complement deep cognitive engagement (Jia & Tu, 2024).

German teachers and lecturers in Indonesia, Thailand, Algeria, and Germany are directly affected by this transformation. Observing their students' and fellow teachers' use of AI, they see first-hand the changing learning habits and the quality of student work. The available literature suggests that educators globally recognize the potential of AI but are very sensitive to issues such as academic integrity, plagiarism, and the acquisition of necessary student competencies (Kharis et al., 2024). A common worry is that students and even teachers will over-rely on AI, avoiding cognitive problems only to be confronted later with an inability to cultivate or exercise independent thinking and writing. However, the perspectives of teachers across countries may differ depending on their education system, learning culture, AI related policies and technological acceptance. For example, research in Southeast Asia and some African countries may stress AI's advantages but are often not centered on the linguistic or cognitive consequences of introducing AI from the perspective of German as Foreign Language (GfL) lecturers, teachers, learners. On the contrary, some researchers examine ethical considerations and AI in higher education (Li et al., 2024; Phosa, 2024), although without presenting a comparative perspective across regional spectra.

In this context, a significant research gap remains regarding the lack of comparative studies on how the views of German as a foreign language (GfL) lecturers, teachers, learners in Indonesia, Thailand, Algeria, and Germany differ concerning the extent to which AI-related teaching influences students' critical thinking and writing competence development. To account for both shared and locally situated perspectives, it is also essential to understand how instructors in these four countries think about and plan to address AI's impact on foreign language education.

Therefore, the present study attempts to explore and compare expectations of German language faculty in Indonesia, Thailand, Algeria, and Germany regarding reliance on AI. More specifically, the following research questions will be addressed:

1. How do German language learners, lecturers, teachers in Indonesia, Thailand, Algeria, and Germany perceive the impact of AI dependency on the development of critical thinking skills in German writing?
2. How do they perceive the impact of AI dependency on the mastery of German writing skills?

This study is expected to offer deeper insights into the pedagogical challenges faced by language educators and language learners in the AI era, particularly within multinational contexts. Theoretically, it contributes to the literature on the interaction between technology, cognition, and language development from culturally and educationally diverse practitioner perspectives. Practically, the results may provide useful guidance for educators to adapt their teaching strategies and policies in institutions as well as for curriculum developers on how AI can be integrated into a curriculum to not only mitigate its negative impact but also maximize its positive potential.

2. METHOD

This part presents the research methodology adopted in this study including research design, participants, instruments and questionnaire structure, data collection, and data analysis method. The application of the selected method will provide useful insights into the thoughts of German lecturers, teachers, students in Indonesia, Thailand, Algeria, and Germany about the influence of AI dependence on critical thinking and writing skills. Figure 1 illustrates the research process for this study, detailing how the process evolved from an initial mixed-methods design to the final stages of data analysis. It shows the combination of qualitative and quantitative methodologies throughout the four countries.

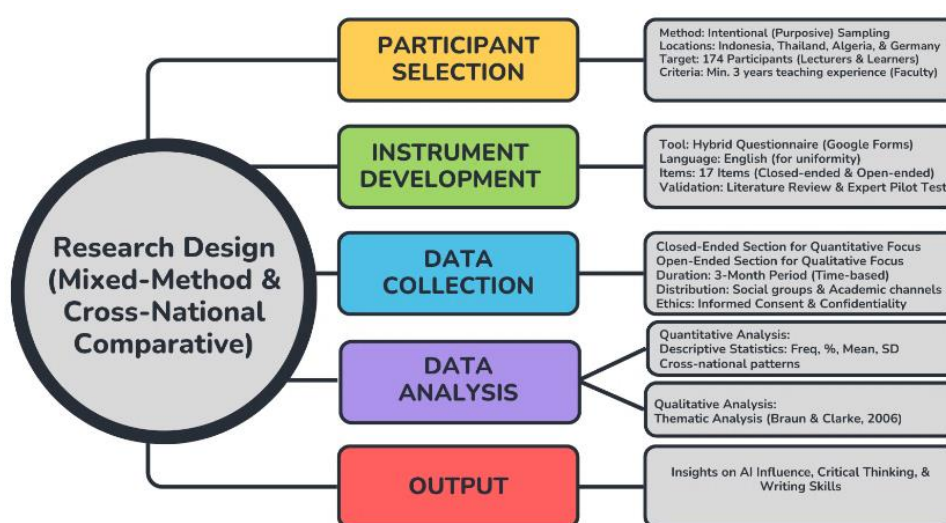


Figure 1: The research methodology

An explanation in detail of each stage in the flowchart is provided in the following sub-sections:

2.1 Research design and participants

This research takes a mixed-method design that triangulates both qualitative and quantitative data, with a cross-national comparative descriptive survey. The descriptive survey design allows data to be collected from a more diverse range of lecturers, teachers, and students across the four countries, providing a global perspective on current perceptions. This is further enhanced by the qualitative nature of open-ended questions. The cross-national comparative aspect allows us to gain insights into actual perception patterns.

A purposive sampling method was used in which subjects having a particular characteristic of interest to the study were deliberately sought in Indonesia, Thailand, Algeria, and Germany (Tongco, 2007). In this context, the participants were chosen as learners, teachers, and lecturers with some experience of GfL or as professionals who have experienced the use of AI-based tools in the context of GfL in their countries.

2.2 Participant characteristics

The inclusion criteria for participants are as follows:

- (1) currently active as a German language lecturer or learner in one of the four countries;
- (2) possessing a minimum of three years of teaching experience (teachers/lecturers); and
- (3) willingness to participate in this study.

The sample size is approximately 20 to 50 participants per country, totaling 174 participants. This range is intended to ensure a variety of perceptions.

2.3 Data collection instruments

The data were collected using a time-based data collection method. To ensure adequate participation it took place over a three-month period. The questionnaire was posted online to colleagues, social groups, and student networks through several academic channels. Informed consent was presented at the beginning of the questionnaire explaining the purpose of the study, protection for confidentiality, and voluntary basis for participation. Collected data were uploaded for secure storage.

Data was collected using a hybrid questionnaire; collected data was delivered in English for uniformity and ease of understanding for participants. The survey was run through the Google Forms platform and could be accessed via <https://forms.gle/VUuFtuwMNfMBg7Jz5>. It included 17 items (both close-ended and open-ended items) that were also modified to accommodate the international context.

- Closed-ended section: Intended to gather quantitative information regarding the frequency of AI use, the level of perceived reliance, and opinions about critical thinking skills and writing proficiency among students.
- Open-ended: Aimed to collect information on what participants think, feel and believe about AI. Four questions were open-ended, so that the respondents could give more extensive answers, as well as examples and express reflections and points of view.

The questionnaire was based on a thorough literature review. A pilot test with experts was also performed to check for clarity and relatedness of the items.

2.4 Data analysis techniques

Questionnaire responses were analyzed using mixed methods of descriptive statistics and qualitative data analysis, and a focus on cross-national comparative analysis.

- Items with closed response options: Frequencies, percentages, means and standard deviations were calculated for the individual descriptive categories in order to give a general impression of perception patterns within and across countries.
- Open-Ended Items: Responses were analyzed through thematic analysis to transform raw data into a more structured and organized format (Braun & Clarke, 2006; Squires, 2023). This was done in relation to the data from each country, followed by a thematic comparative analysis to identify commonalities, differences, and context-specific themes. Thematic analysis was supported by *julius.ai* to help organize records as well as analyze large datasets.

3. RESULT AND DISCUSSION

In all, 174 participants took part in this cross-national research. To increase transparency regarding the study's subjects, Table 1 provides a breakdown of the respondents, identifying the respondents by their positions and national origin.

Table 1: Distribution of participants by role and country of origin

Country of origin	Student	Teacher	Lecturer	Other	Total
Indonesia	30	7	20	1	58
Algeria	17	4	4	1	26
Thailand	46	0	11	0	57
Germany	6	4	10	2	22
Austria	2	0	1	0	3
Iran	0	0	1	0	1
Poland	0	1	0	0	1
Indonesia & Thailand	6	0	0	0	6
Total	107	16	47	4	174

The sample displays significant international diversity, with the largest groups hailing from Indonesia ($n = 58$), Thailand ($n = 57$), Algeria ($n = 26$) and Germany ($n = 22$). In terms of roles, the majority of participants are students ($n = 107$), followed by lecturers ($n = 47$) and teachers who represented a small number ($n = 16$). The "Other" category includes specialized roles such as researchers, administrative employees, writing pedagogy consultants, and third-space professionals. To ensure that participant counts are precise and do not overlap, this article groups those who take multiple roles (students and teachers as an example) into their main occupational categories or the highest level of professional title.

The discrepancy in numbers of respondents from each country may have occurred because some populations had easier access to the survey than others, for example. When the sample sizes are extremely

unbalanced, it is more difficult to compare the groups equally (Schulz & Grimes, 2002). Consequently, it is recommended to employ non-parametric tests—that are specifically designed for unbalanced data—allowing for reliable interpretation of results.

3.1 AI dependency on critical thinking skills

The following analysis explores how participants' perceptions of artificial intelligence interact with vary by geographic location. To illustrate these regional variations, Figure 2 presents the perceived dependence on AI tools, specifically focusing on countries with a representative sample size of five or more respondents ($n \geq 5$).

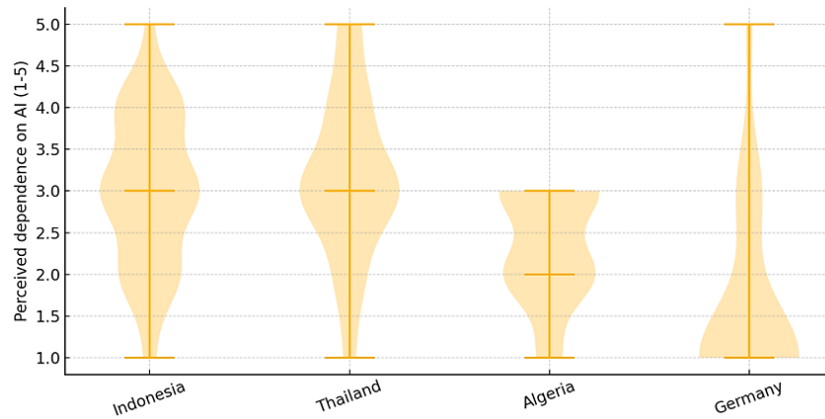


Figure 2: Perceived dependence on AI by country ($n \geq 5$)

Participants rated their critical thinking skills before and after the AI use on a 1–5 scale. A general trend was observed as the overall mean has shifted from around 3.3 before use to 3.7 after use. Still, the average was calculated descriptively, as the consistency of numbers was incomplete across the countries, as shown in Figure 3 below:

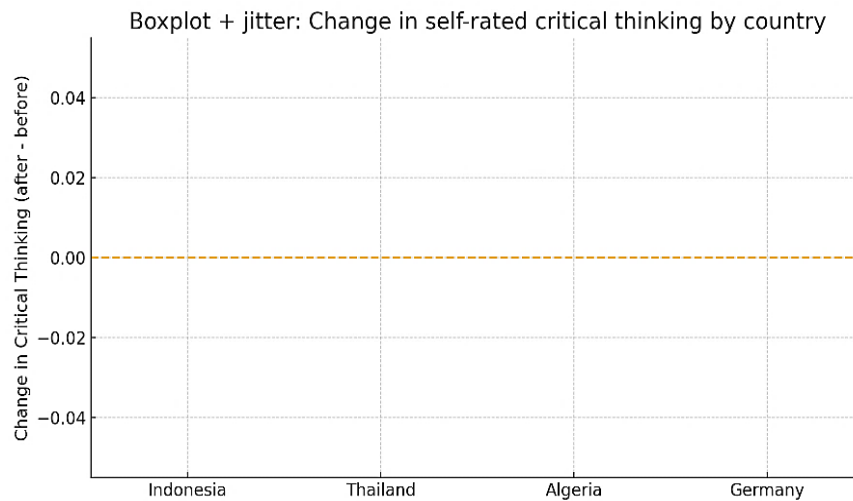


Figure 3: Boxplot and Jitter: Change in self-rated critical thinking by country

The box-and-jitter plot visualizes the change (after vs. before) per country. Most data points lie above zero, suggesting perceived improvement. The quantitative analysis is supported by a qualitative study as recurring themes such as “*helps to organize ideas*” and “*structuring arguments more logically*” appeared. Indeed, this is confirmed in other works, showing that machines can scaffold reasoning due to structural conceptual feedback (Kim et al., 2022; Li & Wilson, 2025).

Still, several respondents were skeptical about real cognitive improvements. Indeed, some comments were “*AI makes thinking easier, maybe too easy.*” This can be confirmed in works by Hacıoglu et al. (2025), claiming that automation destroys or limits human critical thinking and thus lacks the creativity to go in-depth rather than dealing with serious problems simplistically.

To comprehend the integration of AI into language learning, the participants were provided examples and suggestions of the use of AI tools to enhance their writing skills in German. This data were categorized in several ways, including technical assistance, cognitive support, and functional efficiency.

3.1.1 Linguistic scaffolding

The majority of students view AI positively in a learning context because, for example, it simplifies technical support in terms of the identification and correction of grammatical mistakes, verb conjugations, and noun declensions. AI was described by numerous students as a reliable means of checking their texts, particularly in the context of the complexities of the German language. As an example, one student pointed out that AI alters simplistic word choices to a wider range of more sophisticated vocabulary, making text more cohesive and natural. This demonstrates the role of AI in providing students with a form of “*linguistic scaffolding*.” Such automatic feedback empowers students to self-correct remaining grammatical mistakes (Boggs, 2019). For students learning German, AI is a text editing tool that guarantees a better level of precision.

3.1.2 Cognitive and emotional support

Many participants acknowledged that AI tools can assist with more than just correcting mistakes. Some respondents said “*when I am stuck with the developing of ideas*,” which means that they experienced “*cognitive block*” or “*writer’s block*,” where they struggle to continue their thinking processes. One unique finding relates to the use of AI on an emotional level: some participants said they were more comfortable asking the chatbot for help because “*it wouldn’t judge me*.”; some said they feel embarrassed asking teachers about questions pertaining to simple grammar rules. In this instance, AI provides a “low-stakes” environment and a space without a social judgement from their peers. In theory, this makes students feel comfortable enough to engage with the language, and therefore they will use the language more often. AI can also provide a stimulus for thought, as students struggle with how to begin a paragraph, as noted by Alzahrani (Alzahrani, 2025).

3.1.3 Functional efficiency in professional contexts

The data also indicates some levels of practicality and professionalism in the use of AI. Some respondents consider the use of DeepL or ChatGPT to draft formal emails, including job applications and other correspondence, as using AI to assist with making the language more “culturally appropriate” or professional. One even stated that AI recommended the use of more polite phrases, e.g. “*Ich bedaure sehr, dass...*” (I deeply regret that...) as opposed to the more direct, angry ones, e.g. “*Ich bin enttäuscht*” (I am disappointed). This illustrates the extent to which AI aids students in pragmatic expressions, which are typically more challenging for non-native speakers.

3.1.4 Critical awareness and human oversight

A number of participants reported AI to be of limited utility, for example, stating that AI makes mistakes, or generates responses that lack a human touch. One participant expressed feeling “disowned” of their text because of how AI modified it. These responses indicate that many participants engaged in “AI Literacy,” as they demonstrated a clear understanding of AI’s usefulness. Rather than using AI to simply copy and paste, many participants evaluated AI’s suggestions, incorporating only those suggestions that they found “appropriate” or “correct.” This sentiment illustrates the importance of a *human-in-the-loop* approach. However, perceived automation threat can drives people to prioritize creative skills over technical and social skills (Gamez-Djokic et al., 2025).

3.2 AI dependency on the mastery of writing skills

Respondents rated their perceived dependence on AI tools (1 = very low, 5 = very high) when writing in German. The mean and standard deviation for each major country are shown in Table 2 below:

Table 2: Statistical descriptive

Country	n	M	Median	SD
Indonesia	65	3.00	3	0.92
Thailand	55	3.16	3	1.00
Algeria	26	2.35	2	0.69
Germany	22	1.59	1	1.10

Perceived AI dependence also showed statistically significant variation across countries, Kruskal-Wallis $H = 38.84$, $p < .001$. Accordingly, Mann-Whitney U pairwise tests were calculated and adjusted for Bonferroni multi-comparison, showing largest contrasts:

- Thailand – Germany: $p = .000004$
- Indonesia – Germany: $p = .000005$
- Thailand – Algeria: $p = .0014$
- Algeria – Germany: $p = .0074$
- Indonesia – Algeria: $p = .0111$
- Indonesia – Thailand: not significant ($p = 1.00$)

Overall, participants from Indonesia and Thailand indeed showed larger levels of AI dependence than respondents from Germany while Algeria represented intermediate positions. This pattern is illustrated by the violin plot in Figure 1; respondents from Indonesia and Thailand predominantly cluster around scores 3–4, while for Germany, responses' main concentrations are at 1–2 scores. Indeed, previous quantitative studies confirmed that instructors in Southeast Asia tend to use AI pragmatically to improve their efficiency (Payadnya et al., 2025; Songsingchai, 2025; Wong & Looi, 2024), whereas German educators emphasize ethical caution and academic integrity (Schönegger & Wagner, 2019; Sira et al., 2025).

In contrast, participants consistently perceived improvement in their German writing proficiency after using AI. For the question “*How would you rate your German writing skills after using AI?*”, most respondents reported an improvement in their writing skills compared to before using AI. This shows that AI can be a useful tool for developing German writing skills, as shown in the Figure 4 below:

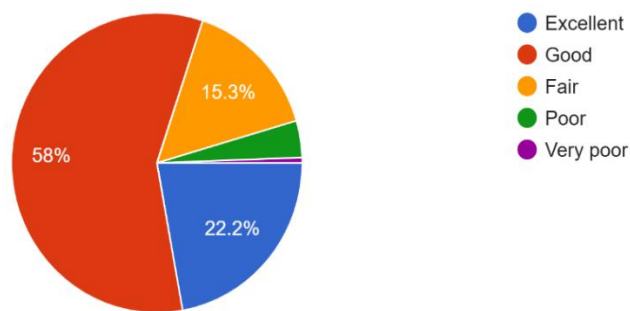


Figure 4: Writing skills in German following the use of AI

Descriptive comparison of before vs. after ratings revealed a noticeable increase (approx. 3.3 to 3.9 on a 5-point scale). Although not all respondents provided numeric data, the direction of change is clear and coherent with patterns in qualitative comments such as “*AI helps me choose correct words,*” “*fixes grammar,*” and “*makes my sentences more natural.*”

These improvements reflect linguistic enhancement rather than conceptual development—consistent with the concept that AI supports grammatical accuracy (Zhao, 2025) but may not strengthen originality or creativity. It was noted in the surveys that while there is a lot of positive feedback regarding AI-generated improvements in grammar, some participants also mentioned that they “accept” suggestions without giving it any thought. Therefore, the increase in writing skills is more likely to reflect the benefits of AI writing tools rather than actual gains in their linguistic competence. Hence, AI functions more as a language-form aid than a driver of higher-order thinking.

The data shows that AI tools assist more with language than with advanced thinking. While students appreciate the term enhancements for their German essays, these tools are actually a means of transportation helping students overcome obstacles to produce work that is good enough to be considered a university paper or formal email. However, a good understanding of language remains a requirement. One participant noted that the final result was “*much better,*” but the original concept was still the work of a human writer. This shows that AI is essentially useless for users who do not have basic ideas, because if they do not have basic ideas, then AI should be doing the work.

3.3 Participant-specific AI integration by categories

Beyond general trends, the data shows that different groups interact with AI in their own way. This section looks at the specific habits and concerns of lecturers, teachers, and students. Lecturers take a strategic approach, using AI mainly for academic copy editing, tone enhancement in written language, and streamlining formal letters. They usually take some prompts, such as pretending to be someone else and giving plenty of background, in order to treat AI as a “thinking partner” offering logical validation. There are still widespread questions about the legitimacy of academic work, plagiarism and data security of course. Meanwhile, teachers provide pragmatic pedagogical support, using AI to develop teaching materials and other administrative tasks quickly. Their prompting is functional and direct, mostly piecing together specific language levels. Although

they appreciate operational efficiency, they criticize over-reliance for making less room for embedded creativity and skills in independent writing.

At a lower level, students perceive AI as a kind of advanced personal tutor or specialized dictionary for language-related tasks. They focus on using it to get help with homework, translate words from their native language, and check their grammar on their own. Unlike the faculty members students use short, direct prompts to get what they need right away. Most are concerned with development, worrying that excessive dependence will erode opportunities for critical thinking and create a dependency that could be detrimental to their performance in standardized tests or thesis writing. Their concerns primarily relate to personal development; they worry that overreliance on artificial intelligence (AI) could reduce opportunities for critical thinking and foster a dependency that could hinder their performance on important exams or when writing their final papers.

3.4 Cross-national comparison

The cross-national pattern indicates certain contextual specifics in how AI is implemented in language learning and teaching. Germany and Southeast Asian countries like Thailand and Indonesia have distinct attitudes towards the practical application of AI technology. In Indonesia and Thailand many respondents frequently used and had good experiences in using AI tools as they perceive this technology as a useful way to boost productivity and aid learning. This indicates an instrumental adoption pattern where AI is used to improve learning and solve practical problems such as gaps in education. Recent studies show that many German Studies students use AI tools for writing at the University of Oran 2 (Chahrour, 2025) and at Ibn Khaldoun University (Seferti, 2025). Teachers also noticed that homework done with AI is much better than the work students do by themselves in class.

AI technology is currently under-development and not heavily practical in Germany. In contrast, in Southeast Asia, AI is seen as a resource and solution for problems (like gaps in education) which leads to a more positive sentiment towards using it. Meanwhile, Germany showed the lowest use of AI and a more critical opinion. This might be because of European policies that focus on ethics and democracy (Council of the European Union, 2025). These regulations are more focused on privacy and ethical concerns, effectively placing Southeast Asia in a more rule-less environment by comparison. Thus, Southeast Asia tends to use AI for less complex tasks as it makes their work easier. Generally, these findings show that we need to consider local contexts when using AI in education. Culture plays a very important role in how technology is accepted.

All the results demonstrate digital competence as being dependent on context. In Southeast Asia and Algeria, digital competence refers to working and overcoming resource constraints quickly. In contrast, digital competence in Germany focuses on the ability to think and act critically and ethically. Therefore, local policy and culture shape the context in which the risks and benefits of AI are viewed. In order to summarize and clarify these regional differences, Table 3 provides a structured overview of what each culture and regional framework considers to be the particular forms of AI applications and the distinct types of issues that arise in each country.

Table 3: Regional comparison of AI concerns and perspectives

National	Primary adoption pattern	Key concerns	Unique issue/ key quote
Indonesia	To work faster and help with study problems.	Students becoming too lazy to think or write by themselves.	<i>AI is good for the one who is already excellent on critical thinking. My concern is for the student that is not yet has this skill.</i>
Thailand	To make school tasks easier and save time.	Privacy, data safety, and students “stealing” ideas using AI.	<i>A friend has used my script and put it in ChatGPT, so they don't have to prepare anything while I stayed up all night doing research.</i>
Algeria	As a language helper to help with difficult German grammar.	The gap between perfect homework (made with AI) and poor work in class.	<i>Students view AI as more of a ‘language helper’ rather than a substitute for their own independent thinking.</i>
Germany	They have a more critical attitude due to strict rules and ethics.	Students handing in perfect-looking work without actually understanding it.	<i>Wasting my lifetime giving feedback to AI texts. Students create proposals that sound competent, but they have not really thought them through.</i>

3.5 Discussion in relation to previous research

The findings are consistent with the perspective on AI in education as a two-edged sword. On the one hand, for learners, AI is seen as a useful tool to improve grammatical accuracy, and to help organize their thoughts more effectively. This corresponds with the research of Kuddus (2022), and Zhao (2025), who have identified that AI became a strong enabler to leverage efficiency. A few other participants, however, were worried that the learners would become dependent on AI (Alkhalifah et al., 2024; Cave et al., 2019;

Frenkenberg & Hochman, 2025). Critical thinking, they claim, should remain under the control of the human majority. Moreover, cross-country dissimilarities from a cultural perspective complement prior work of Kharis et al. (2024). The findings demonstrate how cultural beliefs relating to AI and thinking, learning culture, and educational values of people affect their perceptions of AI. In places where AI is seen as a thinking partner, such as Indonesia and Thailand, it's more about efficiency and adapting learning to new tools. On the other hand, in Germany and other places where AI is thought of as a threat to critical thinking, the debates are more moralistic and about precision. Taken together, these contrasts illustrate the need for AI literacy frameworks that help students and teachers make sense of easily obtained technology in relation to autonomous critical reflection. This is well illustrated by the Algerian context ($M = 2.35$) where self-reported moderate dependence goes against the integration of AI in the daily life.

It was reported that 87.2% of German Studies students at Algerian universities use AI software in writing their academic works, and instructors perceived clear discrepancies of quality between homework completed using AI and unassisted classwork (Chahrour, 2025; Seferti, 2025). This discrepancy between perception and behavior indicates that normalization of AI can encourage students to underestimate their real use of such tools. Moreover, the current process of integration of AI into curricula in Algerian higher education to promote ethical sensibility and transversal competencies (Aboura, 2024) is a sign by institutions to address these challenges proactively.

3.6 Limitations and future directions

The significant limitation of the present study was the imbalance in sample size across countries, with most being Indonesian and Thai samples, that we might be overgeneralizing the results. With most participants coming from Thailand and Indonesia, the results lean towards the Southeast Asian context more than others. In the countries mentioned, the internet and mobile device accessibility is relatively good in the urban centers. However, we did not examine the socio-economic variations among the participants from different countries more closely. For instance, the experience with AI of a student in a rural area is likely to be very different from that of a student in an urban center. For more future studies, weighted sampling or stratified sampling could be employed, and/or multilevel modelling might be used to deal more accurately with the marked between-country variation (Asparouhov, 2006). More varied participants in future research would be necessary to gauge the impact of socio-economic factors on the integration of AI in language learning.

Another limitation is that the study is based on self-reported data, meaning that it only reflects the way people perceive their behavior and not how they actually behave. Further research could combine surveys with analyses of writing samples, or pair them with performance tasks to reinforce the findings. Additionally, there may be bias involved when utilizing self-reported data. Students from certain cultures might feel that AI tool use could be seen as "cheating" or could be looked down upon by teachers. For this reason, students may be less than fully honest about the extent to which they utilize the tools. Conversely, in cultures where technology is viewed as incredibly advanced, students may report that they use technology more than what is the case. This phenomenon, social desirability bias, means that students' reports reflect what they believe is expected, rather than what they actually perform. This is the rationale for combining surveys with actual classroom activities in future research.

It should be noted how broad the term 'AI' really is. In our research, we inquired about AI in the most general sense and did not specify various categories of tools. For example, using ChatGPT or Gemini to generate an essay is fundamentally different from using DeepL to translate, or using Duolingo to practice vocabulary. Each one of these tools influences how a student learns a language in a different way. If future researchers distinguish tools in this way, they will be able to provide educators with far better guidance on what type of technologies are beneficial for learning. Nevertheless, the research still makes a significant contribution to comparative research on AI in language learning settings. It suggests that the utility of AI is not only in cognitive, pedagogic terms but significantly in contextual terms. The results also show the necessity for educational frameworks to critically consider AI use instead of taking it for granted.

4. CONCLUSION

The findings of this study show that the function of AI in foreign-language writing is important, yet complex. Respondents feel that AI has clear benefits most notably in improving grammatical accuracy and communicating ideas more clearly. But they were divided over the deeper cognitive impacts of AI use. Some viewed AI as an operational invention that would enable them to save time and not as of threat, while others believed that the AI could restrict the chance to be creative and construct arguments in the target language. The cross-national differences suggest that cultural and educational settings impact how students view AI in learning tasks. In this regard, the relatively better acceptance of AI tools by students from Indonesia and

Thailand could be interpreted as an indicator that they are geographically further away than German-speaking countries and thus may perceive a greater demand for help in completing writing tasks in German. Some of them held positive views on AI as a “time-saving” tool which would enhance their effectiveness and reduce their language deficiency. Meanwhile, others were concerned that overdependence on AI might decrease the required mental effort for autonomous cognitive processes in reasoning and idea generation, the two major components of critical thinking in academic writing.

DECLARATION

1. Conflict of interest

The authors declare that they have no known competing personal relationships that could have appeared to influence the work reported in this paper.

2. Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used ChatGPT in order to build an outline of paper and improve the English grammar and phrasing; julius.ai to build figures of the data. After using these tools, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

3. Data availability statement

The data that support the findings of this study are available from the corresponding author, M. Kharis, upon reasonable request.

4. Ethics statement

The authors have obtained informed consent from all individuals included in this study.

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