Enhancing EFL writing skills for adult Deaf and hard of hearing individuals

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The paper examines how Deaf and hard of hearing (D/HH) learners use information technology to develop English as a Foreign Language (EFL) writing skills. Conducted during two EU-funded summer schools, one in Italy and one in Poland, the research explores how internet tools like Google Translate, ChatGPT, and online dictionaries affect writing quality and confidence among 18 adult D/HH participants. The findings indicate that participants perceived these tools as improving vocabulary, grammar, coherence, and writing confidence. Moreover, the study highlights the creative strategies D/HH learners use to overcome linguistic challenges, such as employing simple and direct language, imaginative storytelling, and using visual imagery. Participants demonstrated resourcefulness in conveying complex ideas despite limitations in vocabulary and grammar, even when writing without technology. With the aid of internet tools, these strategies were further enhanced, helping to improve the clarity and structure of their texts. However, the research acknowledges limitations of relying heavily on technology, as it may limit opportunities for independent language growth. The study emphasizes the need for a balanced approach that integrates both technology and traditional methods to foster comprehensive EFL skill development.

KEYWORDS

Deaf and hard of hearing (DHH), writing strategies, artificial intelligence (AI), English as a Foreign Language (EFL), technology in the classroom, writing errors, learning English, writing skills

1 Introduction

In today's digital age, information technology has become an essential component of education, offering both opportunities and challenges, especially for learners with special educational needs. This paper explores the effects of using information technology on the writing skills of Deaf and hard of hearing (D/HH) individuals learning English as a Foreign Language (EFL). It focuses on how internet tools influence the quality of writing and the confidence of D/HH learners, as well as the potential drawbacks of relying on such tools.

Research indicates that hearing impairment may significantly impact language development (Krakowiak, 2012; Malik, 2019), including challenges with reading (Dłużniewska, 2021) and writing (Antia et al., 2005; Andrews et al., 2011; Kontra and Csizer, 2020). Phonological awareness is often reduced in D/HH learners, leading to difficulties in spelling, reading, and writing (Mather et al., 2009). On the other hand, there is a body of research confirming good language (and sometimes also speech) competencies of DHH individuals (Domagała-Zyśk and Podlewska, 2021, 2024; Nunn et al., 2022; Lewandowska, 2024).

Writing in a foreign language is important, as it is an essential aspect of language acquisition, fostering both cognitive and academic development. Writing in a foreign language is one of the four essential skills, alongside listening, speaking, and reading, acquired by language learners. In the mid-20th century, writing was considered secondary to speaking (de Saussure, 1961; Bloomfield, 1933). However, scholars such as Ong (1982) began studying the transition from oral to written culture, demonstrating that literacy is just as important as speaking proficiency. Today, the importance of effective writing is widely recognized. Mastery of written communication, both in one's native language and in foreign languages, is essential for active participation in social, academic, and professional life. In the era of social media, writing has become even more crucial, particularly for D/HH individuals, who, through writing proficiency, can communicate with the world (Mayer and Trezek, 2019). Moreover, writing has been shown to positively impact cognitive development (Kellogg, 2008; Arnold et al., 2017; Łompieś, 2015; Haider, 2016; Mayer and Trezek, 2019; Nückles et al., 2020).

While some research highlights how D/HH learners can achieve comparable writing levels to their hearing peers (Antia et al., 2005; Kluwin, 1993; Gärdenfors, 2023), there is limited research on how these learners engage with EFL writing specifically. This study seeks to address this gap by examining how adult D/HH learners use internet tools to improve their EFL writing skills. The goal is to understand the challenges they face, the strategies they employ, and the overall impact of these tools on their writing proficiency.

2 Research study

2.1 Research objectives and questions

The study aimed to investigate how information technology affects the development of EFL writing skills among adult D/HH individuals. The primary research questions were:

1. Which internet tools are most frequently used by D/HH learners to improve their EFL writing?
2. How does the use of these tools affect their confidence in writing?
3. How does the use of these tools impact the overall quality of their writing?

2.2 Tools

Participants were asked to complete a questionnaire that gathered data on the internet tools they used, such as search engines, online dictionaries, thesauruses, grammar checkers, ChatGPT, Google Translate, and DeepL. The questionnaire assessed participants' confidence in their writing abilities with and without technology and asked for a comparison of their writing experiences. Participants were also asked to write short compositions in English, one without using their smartphones and one using their smartphones.

2.3 Procedure

The study was conducted during two separate summer schools held in July 2024, one in Siena, Italy, and the other in Motycz Leśny, Poland. Both summer schools were part of the European Union projects: LangSkills (organized by various institutions, including the Catholic University of Lublin, Masaryk University Brno, Siena School of Liberal Arts), and the SUITA Association.

During the summer school in Siena, participants visited the Pinacoteca Nazionale, where they were instructed to take photographs of objects that interested them. Upon returning, they were asked to write short compositions (5–10 sentences) based on the photographed objects without using smartphones. Afterward, they rewrote the same compositions using smartphones. A similar procedure was followed during the summer school in Motycz Leśny, with the photographs taken in the training center and surrounding garden.

2.4 Participants

Eighteen participants from Poland, Italy, Sweden, Georgia, and the Czech Republic took part in the study, comprising 6 Deaf and 12 Hard of hearing individuals aged 19 to 34. They were university students and young working adults. The group's diversity provided a comprehensive basis for analyzing the impact of internet tools on D/HH learners' EFL writing skills.

3 Results

3.1 Statistical analysis of questionnaire results

The study employed a questionnaire designed to assess the impact of internet tools on the writing process of D/HH participants. The questionnaire collected demographic information, including the participants' ages and hearing status (Deaf or hard of hearing). It also explored the internet tools used by participants to enhance their compositions, asking them to select all applicable tools from a list that included search engines, online dictionaries, thesauruses, grammar checkers, ChatGPT, and Google Translator, with an option to specify other tools used. Participants were then asked to evaluate their experience with these tools, rating the ease of finding useful information and the helpfulness of the tools in improving their writing on a five-point scale. The questionnaire also included a comparison of the participants' confidence levels in their compositions written without and with the help of the internet, using a similar five-point scale. Finally, participants were prompted to describe the most significant difference they noticed between their two stories, providing qualitative insights.

Participants generally found it easy to locate useful information online, with 65% describing the process as "Very Easy" or "Easy," and only a small fraction (15%) finding it "Difficult" or "Very Difficult."

Moreover, 75% of respondents rated the internet tools as either "Very Helpful" or "Helpful," with none considering them "Not Helpful at All." These results indicate that internet tools are not only accessible but also perceived as highly effective in aiding language comprehension and production, aligning with studies like those by Abdoulaye and Ziyad (2020), which highlight the critical role of educational technology in supporting language learning for D/HH students.

Confidence levels among participants showed a notable increase when using the internet. With internet access, 70% felt "Very Confident" or "Confident," compared to only 40% without it. Conversely, the percentage of participants who felt "Not Confident" or "Not Confident at All" dropped from 35% without internet to just 10% with it. This boost in confidence suggests that internet tools not only support the technical aspects of writing but also empower learners by providing them with resources that make language tasks more manageable.

Qualitative improvements in writing were also noted, with participants reporting enhanced vocabulary (60%), better grammar (55%), increased confidence in writing (50%), and improved structure and coherence in their texts (45%) when using internet tools. These findings support the idea that technology can significantly improve the quality of language output, which is consistent with broader research on the impact of technology on education.

These findings reflect participants' perceptions, not direct measures of improvement, as the study relied on self-reported data. Also, when analyzing the results by hearing status and age, some limitations arise due to the small sample size.

Hard of hearing participants more frequently used search engines, online dictionaries, and ChatGPT, and found it easier to access useful information, and Deaf participants showed a preference for grammar checkers. These observations cannot be deemed statistically significant. Similarly, age-related differences, such as younger participants favoring more interactive tools like ChatGPT, while older participants leaned toward established tools like Google Translator, require further investigation with larger participant pools. These findings should be considered as signals for future research rather than conclusive evidence, highlighting the need for tailored educational approaches based on individual characteristics like age and hearing status.

Furthermore, it is essential to consider the potential limitations of relying heavily on these tools. As highlighted by Kaliknazarova (2023), while internet tools like automatic grammar checkers can improve accuracy, they may also hinder the development of independent language skills if overused. This suggests that while these tools are indispensable for fostering writing proficiency among D/HH students, they should be balanced with traditional teaching methods to ensure sustained language growth and autonomy.

In conclusion, the findings of this study emphasize the critical role of internet tools in enhancing the EFL writing skills of D/HH learners. The effective use of tools such as Google Translator, search engines, and ChatGPT has been shown to improve vocabulary, grammar, and overall writing coherence, while also boosting confidence. These outcomes underscore the necessity of integrating technology into language learning for D/HH, as also suggested by Abdoulaye and Ziyad (2020). However, as noted by Kaliknazarova (2023), it is crucial to balance the use of these tools with traditional methods to foster independent language skills. Future research should continue to explore how these tools can be further refined and tailored to meet the diverse needs of learners in these communities.

3.2 Written compositions: a comparative analysis

This section provides an analysis of the written compositions produced by participants both without and with the use of internet tools. Fifteen composition pairs were analyzed. The analysis focuses on the strategies that students used in their texts when writing without technological support, communicating effectively despite linguistic challenges. However, only 15 pairs of written compositions were included in the analysis. The composition labeled as 16a was written in Georgian, a case that is described in more detail later in the article. Additionally, the texts from participants 17 and 18 were produced in only one version each, therefore they were excluded from the analysis.

Table 1 shows the comparison between error patterns in versions a and b of the 15 texts.

3.2.1 Communication strategies and creativity in texts without technology

When analyzing the texts written without the aid of technology (Version a) it is evident that the D/HH participants demonstrated noteworthy creativity and communication skills. Despite the presence of linguistic errors, they were able to express their ideas clearly and engage the reader through various storytelling strategies. This is a significant success, as it shows their ability to navigate the complexities of a foreign language without technological assistance. These strategies resonate with the findings of Kołodziejczyk (2021), who explores communication strategies used by D/HH children that enable them to communicate effectively despite linguistic challenges. While Kołodziejczyk's research focuses on spoken language, similar strategies are also employed by D/HH individuals in written language.

Here are examples of strategies used by the participants:

1. Simplicity and Directness: Many participants used simple and direct language to convey their stories. In Text 1a, the participant successfully creates a scene with:

"*One day bed dragon scared small city. The dragon lived the mountains. No nobody arrive to the dragon.*"

While there are grammatical mistakes, the message is clear: a dragon is threatening a small city. The participant effectively employs basic language to build suspense and engage the reader.

2. Imaginative Storytelling: Despite language barriers, participants were able to craft imaginative and engaging narratives. In Text 5a, the participant tells a quirky story with a humorous twist:

"*Once I wean't outsaid and soe a single pice of bread an old taier and some big bosches. Then I did nothing with data informaision and wean't back in said.*"

TABLE 1 Error patterns.

Text pair	Errors without technology (Version a)	Errors with technology (Version b)
1	9 spelling errors, 4 grammatical errors, incomplete sentences	3 spelling errors, 1 grammatical error, smoother narrative
2	7 grammatical errors, 5 spelling errors, awkward phrasing	4 grammatical errors, better structure, 2 spelling errors
3	6 grammatical errors, 3 spelling errors, coherence issues	2 grammatical errors, no spelling errors, better coherence
4	8 grammatical errors, awkward phrasing, inconsistent tenses	4 grammatical errors, improved coherence and sentence flow
5	11 spelling errors, 5 grammatical errors, disjointed narrative	3 spelling errors, more fluid and coherent structure
6	5 grammatical errors, inconsistent tense usage	2 grammatical errors, improved narrative flow
7	6 spelling errors, 5 grammatical errors, awkward sentence structures	3 spelling errors, improved readability and structure
8	7 grammatical errors, lack of narrative coherence	3 grammatical errors, improved structure and readability
9	4 grammatical errors, incomplete sentences	2 grammatical errors, smoother flow
10	5 grammatical errors, incomplete ideas, awkward sentence transitions	2 grammatical errors, improved transitions and coherence
11	6 grammatical errors, disjointed sentence flow	2 grammatical errors, smoother narrative
12	7 grammatical errors, incomplete phrasing	3 grammatical errors, better sentence structure and readability
13	5 grammatical errors, awkward sentence flow	2 grammatical errors, improved coherence and flow
14	4 grammatical errors, awkward phrasing	2 grammatical errors, smoother narrative
15	6 grammatical errors, spelling inconsistencies	3 grammatical errors, improved sentence fluidity

The participant's creativity shines through, transforming a simple observation into an amusing anecdote. Even with spelling errors, the story's charm and originality are evident.

3. Use of Vivid Imagery: Many participants successfully used descriptive language to create vivid mental images. In Text 6a, the participant wrote:

"*He then saw many red and round fruits hanging on the trees, waiting to be taken.*"

This sentence effectively creates a visual of "*red and round fruits*" demonstrating the participant's ability to paint a clear picture, even without perfect grammar.

4. Narrative Progression: The participants showed a strong grasp of how to structure a narrative with a beginning, middle, and end. In Text 7a, the participant describes a woman's adventure with clear, simple language:

"*A woman, her name is Flowerangel. She work on long road and see the book. the book is strange for me but she try to take it and open book.*"

Despite grammatical errors, the participant establishes the protagonist, the conflict, and the start of the adventure. The story progresses logically, showing a grasp of narrative structure.

5. Expressing Emotions: Participants were able to use their writing to express emotions, creating a connection with the reader. In Text 14a, the participant wrote about Mary's empathy for a poor fisherman:

"*She wish him more luck in life and feeling really sad about him, so she pray for him.*"

The participant effectively communicates Mary's sadness and her desire to help, drawing the reader into the emotional core of the story.

6. Creativity in Language Use: Some participants employed creative language strategies to convey their ideas. In Text 15a, the participant wrote:

"*Yellow flowers shiver a bit, moved by wind dot there be sat on another sort of flowers, pink ones.*"

Though phrasing is awkward, the image of "yellow flowers shivering in the wind" is poetic, showing the participant's creative approach to describing nature.

7. Exploration of Complex Ideas: Some participants tackled deeper, more philosophical themes. In Text 3a, the participant reflected on the story of Lucifer, saying:

"*Not many people know his name origin Lux means light just like we do not know the background of people we thought we knew.*"

Despite grammatical errors, the participant explores a complex idea about human nature and symbolism, showing their ability to engage with profound concepts.

3.2.2 Linguistic issues analysis and text quality comparison

When comparing the texts written without technology (Version a) and those written with the help of internet tools (Version b), it is evident that technology use enhanced clarity, coherence, and accuracy. However, even in Version a, the participants demonstrated a strong ability to communicate their ideas despite errors. Below is a breakdown of the errors and improvements observed across all 15 text pairs.

The linguistic issues identified in the study fall into several key categories: spelling errors, grammatical inconsistencies, word order problems, vocabulary limitations, and narrative coherence issues. The shift from Version a to Version b demonstrates clear improvements in these areas. Below, there are examples from different texts to highlight specific types of errors and strategies for improvement.

1. Spelling Errors

Spelling was a particularly prevalent issue in Version a texts. D/HH learners often struggle with spelling. The use of internet tools in Version b allowed participants to correct these mistakes.

Example from Text 5:

- Version a:

"*Once I wean't outsaid and soe a single pice of bread.*"

- Version b:

"*Once I went outside and saw a single piece of bread.*"

All misspellings were corrected in Version b, improving clarity.

Example from Text 1:

- Version a:

"The witch said to take her cote and they went to dragon and give red ring."

- Version b:

"The witch said to take her coat and go to the dragon to give it the red ring."

All misspellings were corrected in Version b, improving clarity.

2. Grammatical Inconsistencies

Grammatical errors were frequent in Version a, particularly in terms of verb tenses, subject-verb agreement, and article usage.

Example from Text 2:

- Version a:

"At night, a magical book in a library. When someone find it on the library, it will sall a paining show gold and colors a person."

- Version b:

"At night, there is a magical book in the library. When someone finds it, the painting shows golden colors and a person."

Version b adds a missing verb, corrects subject-verb agreement, and refines phrasing.

Example from Text 3:

- Version a:

"He was the closest angel to god until he had decided to throw rocks at humans and became the face of the devils we know of today."

- Version b:

"Lucifer was the closest angel to God until he made the choice to harm humans by throwing rocks at them, becoming the embodiment of evil we know today."

Version b enhances clarity and coherence by addressing tense inconsistency ("had decided" and "became"), refining the subject's description, and improving phrasing. The awkward expression "the face of the devils we know of today" is replaced with "the embodiment of evil," creating a more polished and precise sentence. These changes improve readability and make the narrative flow more naturally.

3. Word Order Problems

D/HH learners also frequently struggled with word order.

Example from Text 1:

- Version a:

"No nobody arrive to the dragon."

- Version b:

"Nobody arrived at the dragon."

Version b smooths transitions and ensures correct tense usage.

Example from Text 6:

- Version a:

"The man follow it through the woods, the fields and finally he find the apple trees."

- Version b:

"The man followed the sound through the woods and fields, finally finding the apple trees."

Version b smooths transitions and ensures correct tense usage.

4. Vocabulary Limitations

In Version a, many participants demonstrated limited vocabulary, relying on simple or repetitive words. Internet tools in Version b helped participants expand their lexical choices, leading to more varied and precise language.

Example from Text 6:

- Version a:

"He saw many red and round fruits hanging on the trees."

- Version b:

"He noticed the bright red apples hanging from the trees, ripe and ready to be picked."

Version b enriches description, making it more vivid.

Example from Text 9:

- Version a:

"There were very long stairs, and a painting of a woman and people under her coat."

- Version b:

"The long spiral stairs led to a painting of the Virgin Mary, with people seeking shelter under her protective cloak."

Version b enriches description, making it more vivid.

5. Narrative Coherence and Structure

Many participants had difficulty maintaining coherent and well-structured narratives in Version a, particularly when dealing with longer texts or more complex ideas. With the help of technology, their texts became more logically organized and cohesive.

Example from Text 10:

- Version a:

"The princess fight the monster. The monster become small. The princess keep it like a bird."

- Version b:

"The princess bravely fought the monster, and to her surprise, it began to shrink. She decided to keep the tiny creature, which was no bigger than a bird."

Version b improves flow and expands on the narrative.

Example from Text 15:

- Version A:

"Yellow flowers shiver a bit, moved by wind dot there be sat on another sort of flowers, pink ones."

- Version B:

"Yellow flowers swayed gently in the breeze, their bright color contrasting with the soft pink blooms beside them."

Version b improves flow and expands on the narrative.

Additionally, one participant (texts 16a and 16b) took a unique approach when completing the task without the use of technology. Instead of writing in English, she created a drawing accompanied by a few sentences in her native language, Georgian. When the task was repeated with the aid of technology, she utilized Google Translator to translate these sentences into English.

While this approach highlights the flexibility and adaptability of technology in supporting language learning, particularly for DHH individuals, it also raises some concerns. On the one hand, the participant's use of a visual medium combined with her native language illustrates a creative strategy to overcome the initial barrier of writing in a foreign language. By leveraging translation

tools like Google Translator, she was able to produce an English text that effectively communicated her original ideas, allowing her to engage with the language in a way that felt accessible and manageable.

On the other hand, it is noteworthy that without the use of technology, the participant did not even attempt to write a word in English, potentially indicating a sense of defeat or lack of motivation. This could be concerning, as it suggests that the availability of technology might sometimes reduce the incentive to actively engage with the language learning process. If students rely too heavily on tools like Google Translator for translation, they may miss opportunities to practice and develop their own language skills, potentially leading to a decrease in motivation to learn and improve in the long term.

This example underscores the dual-edged nature of technology in education. While it provides powerful support and can make learning more accessible (cf. Domagała-Zyśk, 2013b), it is crucial to ensure that it complements rather than replaces the active learning process. Educators should be mindful of balancing the use of technology with traditional language learning methods to foster both confidence and independence in students' EFL writing skills.

Generally, the comparison between Version a and Version b texts highlights the critical role that internet tools play in enhancing the writing quality of D/HH learners. While Version a texts contained more spelling and grammatical errors, the participants still demonstrated creativity, strong narrative structures, and the ability to communicate their ideas effectively.

With the help of technology in Version b, participants were able to reduce linguistic errors and improve the clarity and coherence of their texts. Spelling errors were significantly reduced, grammatical consistency was improved, and overall narrative flow became smoother and more engaging. However, even without technology, the participants' ability to tell compelling stories, express emotions, and convey complex ideas reflects their strong language-learning potential and resourcefulness. These successes underscore the importance of combining traditional language instruction with technological tools to support comprehensive language development for D/HH EFL learners.

These findings suggest that technology plays a crucial role in enhancing the writing skills of D/HH individuals learning EFL, providing support that leads to improvements in vocabulary, grammar, coherence, and overall writing quality.

4 Discussion and conclusion

The findings from these two EU-funded projects provide valuable insights into the role of information technology in enhancing the EFL writing skills of D/HH students. The studies conducted during the summer schools in Siena and Motycz Leśny have shown that the integration of internet tools into the writing process significantly improves the quality of written compositions. These tools not only aid in vocabulary enrichment and grammatical accuracy but also contribute to greater coherence and confidence in writing.

The analysis of the compositions without technology revealed a spectrum of writing abilities among the participants. Those with higher proficiency demonstrated a strong command of

English, utilizing complex sentence structures, rich vocabulary, and sophisticated narrative techniques. Their texts reflect the benefits of prior exposure to English, likely through diverse learning experiences and consistent practice. On the other hand, the compositions from participants with lower proficiency levels, although marked by grammatical and structural errors, displayed creative and communicative strategies that allowed them to convey their ideas effectively. These texts, while less polished, underscore the importance of continued support and targeted interventions to further develop their language skills.

The introduction of technology into the writing process yielded noticeable improvements across all levels of proficiency. The use of tools like Google Translator, ChatGPT, DeepL, and grammar checkers enabled participants to refine their language use, correct errors, and enhance the overall quality of their writing. The technology also provided a means for participants to engage more deeply with the writing process, encouraging experimentation with language and fostering greater confidence in their abilities.

The differences observed between D/HH participants, as well as across age groups, highlight the need for tailored educational approaches that account for individual preferences and learning styles. Younger participants' inclination toward interactive, AI-driven tools like DeepL or ChatGPT, compared to older participants' preference for more traditional resources like Google Translator, suggests that educational interventions should be adaptable and responsive to these varying needs.

These findings align closely with the work of Domagała-Zyśk, who emphasizes the importance of considering both the linguistic challenges and the cognitive abilities of D/HH learners in EFL education. As Domagała-Zyśk (2013a) notes, writing produced by individuals with hearing impairments often reveals language difficulties experienced by the authors, yet these difficulties do not necessarily correlate with lower cognitive abilities. Instead, the focus should be on evaluating the communicative success of the written discourse and the degree to which students achieve the intended communicative function of the language, rather than merely the grammatical form.

Domagała-Zyśk's (2013a) work also suggests that despite the linguistic challenges Deaf and Hard of hearing students face—such as difficulties with complex syntactic structures, verb forms, and functional words—their cognitive potential can be fully realized through individualized teaching approaches. This is particularly relevant when considering the integration of internet tools into EFL instruction. These tools, when used appropriately, can support students in overcoming specific linguistic barriers while fostering their overall communicative competence.

Moreover, the study underscores the importance of balancing the use of technology with traditional teaching methods. While internet tools offer significant benefits, there is a risk of over-reliance, which could hinder the development of independent language skills. As noted in previous research, such as that by Kaliknazarova (2023), the automatic correction of grammar by these tools can sometimes limit students' opportunities to learn from their mistakes. The Siena Motycz Leśny study further supports this caution, advocating for a balanced approach that incorporates technology as a complement to, rather than a replacement for, foundational language learning practices.

In conclusion, the integration of information technology into EFL instruction for DHH students is both beneficial and essential. These tools provide critical support in overcoming the unique challenges faced by these learners, helping to enhance their writing skills and build their confidence. However, the effectiveness of these tools varies based on individual factors such as age, hearing status, and personal preferences, indicating that a one-size-fits-all approach is insufficient. Future research and educational practices should continue to explore and develop more personalized, adaptable resources that address the specific needs of DHH learners, ensuring that all students can achieve their full potential in language learning.

Domagała-Zyśk's (2013a,b) findings emphasize that educators must focus on the communicative success of DHH students rather than solely on their grammatical accuracy. This approach allows for a more nuanced understanding of their language abilities and acknowledges the complexity of their learning processes. The projects discussed in this study illustrate the potential of technology to assist in this endeavor, offering tools that help bridge the gap between linguistic challenges and cognitive potential. As such, continued exploration and refinement of these tools will be crucial in advancing the field of EFL education for DHH students.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

Ethical approval was not required for the studies involving humans as it involved no invasive procedures, medical interventions, or the collection of sensitive personal data. The research was conducted during educational summer schools where participants voluntarily engaged in language learning activities using publicly available internet tools. All data were anonymized, and participants provided informed consent to participate in the study and for their data to be used for research purposes. The study adhered to general ethical guidelines for educational research, ensuring the well-being and privacy of all participants. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

MC: Writing – original draft.

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declare that generative AI was used in the creation of this manuscript. Generative AI was used to correct texts

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