The Role of Cutting-Edge Technology in Enhancing English Language Learning As Perceived By EFL Students in Palestinian Higher Education

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Abstract

This study investigated the perceptions of English language students regarding the role of cutting-edge technologies in their English language skills. The study participants were students enrolled in English language programs at various universities in the northern part of Palestine. The researcher developed a questionnaire to assess the impact of the latest technologies on English language skills. The researcher administered the questionnaire to a random sample of 150 students, with 110 valid responses analyzed using a descriptive approach. The findings revealed that the students' perceptions of the cutting-edge technology in enhancing English language learning in Palestinian Higher Education were high. As for the gender variable, there was no statistically significant difference in students' perceptions. The observed difference was slightly significant, even though female students scored marginally higher than male students. These results imply that perceived advantages of technology-enhanced English learning might not be influenced by gender. Regarding the place of residence, there were no statistically significant differences in students' perceptions of the impact of technology-enhanced English language learning, based on the results of the One-Way ANOVA. This shows that students in Palestine's urban, rural, and refugee camp environments generally view digital tools as equally helpful for advancing their English language proficiency. The study concludes with practical recommendations for educators and policymakers to enhance the integration of AI and digital tools in English language instruction.

Keywords: English Language Skills, EFL Students, Cutting-Edge Technologies, Palestinian Higher Education.

دور التكنولوجيا المتطورة في تعزيز تعلُّم اللغة الإنجليزية كما يراها طلبة اللغة الإنجليزية كلغة أجنبية في مؤسسات التعليم العالي الفلسطينية

ملخص

هدفت الدراسة الحالية إلى تحديد تصوّرات الطلبة حول دور التكنولوجيا المتطورة في تعزيز مهاراتهم في اللغة الإنجليزية؛ شارك في الدراسة عددا من طلبة اللغة الانجليزية من عدة جامعات في شمال فلسطينيين حيث قام الباحث بتطوير استبانه لتحديد دور التكنولوجيا المتطورة في تعزيز مهارات اللغة الانجليزية، إذ قام الباحث بتوزيع استبانة لتقييم دور التقنيات التكنولوجية الحديثة في مهاراتهم في اللغة الإنجليزية، حيث وزعت الاستبانة على عينة عشوائية تكونت من 150 طالبًا وطالبة، استعيدت منها 110، قام الباحث بتحليل البيانات باستخدام برنامج التحليل الاحصائي SPSS. مستخدما المنهج الوصفي لملاءمته أهداف الدراسة. وقد أظهرت النتائج الدور الإيجابي الذي تؤديه التكنولوجيا المتطورة في تعزيز تعلُّم اللغة الإنجليزية من وجهة نظر الطلبة. أما فيما يتصل بمتغير الجنس، فلم يكن هناك فروق ذات دلالة إحصائية في تصوّرات طلبة اللغة الإنجليزية حول دور التكنولوجيا المتطورة في تعزيز مهاراتهم في اللغة الإنجليزية. لكنّ هناك فروقا ذات دلالة إحصائية قليلة نسبيا لصالح الطالبات حيث كانت المتوسطات الحسابية أعلى بقليل من الطلاب الذكور . أما ما يتعلق بمتغير مكان السكن،فإنه لم تظهر النتائج فروقا ذات دلالة إحصائية في تصوّرات الطلبة حول دور التكنولوجيا المتطورة في تعزيز مهاراتهم في اللغة الإنجليزية؛ وذلك في ضوء نتائج تحليل التباين الأحادي (One-Way ANOVA) الذي أوضح أن الطلاب في البيئات الحضرية والريفية ومخيمات اللاجئين في فلسطين يرون على وجه العموم أن الأدوات التكنولوجية تُساعدهم على تحسين إتقانهم للغة الإنجليزية. أوصى الباحث عدة توصيات ذات بعد عملي للمعلمين وصانعي السياسات بضرورة تعزيز دمج الذكاء الاصطناعي والأدوات الرقمية المتطورة وتوظيفها في تعليم اللغة الإنجليزية.

الكلمات المفتاحية: مهارات اللغة الإنجليزية، طلبة اللغة الانجليزية كلغة اجنبية، التكنولوجيا المتطور، مؤسسات التعليم العالي.

Introduction

Nowadays, homes, shops, schools, and universities have a computerized system, if not an advanced system of data. Undoubtedly, these advancements in technological applications and innovative initiatives, which have taken place in the field of education, have not only affected language education but also the entire teaching and learning process. Generation Z (born roughly 1997-2012) and Generation Alpha (born 2013-2025) are distinct generations shaped by different technological and societal contexts. Gen Z grew up with the internet boom, while Gen Alpha is immersed in artificial intelligence and personalized technology from birth. Gen Z is known for being digital natives, resilient, and socially conscious, while Gen Alpha is globally connected, brand-conscious, and favors self-directed learning (Rose, 2024). Soon, this generation will be followed by Generation Alpha, who will manage their digital identities, make technology-based decisions, learn interactively, and exhibit shorter attention spans. Given that technology is deeply integrated into students' daily lives, the educational process, particularly the teaching of the English language, should be grounded in technological approaches, as their learning environments have become increasingly dependent on digital tools and platforms. In this sense, English language teachers encounter big barriers when teaching both generations as a result of the needs of their students' language realities (Su & Zou, 2022). Language educators should implement the latest technologies such as the Artificial Intelligence (AI) applications or Virtual Realities (VR) Labs so that they can 'keep up with their digitally informed students and engage them in learning a foreign language' (Klimova et al., 2023: 2). Teachers must look for the latest technologies and use them with these generations. Language teachers and educators are required to assess whether the selected technologies could add value and benefit to the students (Rafiana, 2024). Fulfilling these requirements requires professional competence because finding the best selected emerging technologies that add value to students requires professional competence and technical support. Not less than 65% of children who join school these days will be working in positions that do not yet exist. One cannot deny that educational institutions not only require language teachers to enhance their students' skills acquisition, but also, ask teachers to consolidate the 21st century skills of their students, such as soft skills, critical thinking, or collaboration skills. Having positive perceptions and motivation of teachers and students plays an integral role in the success of the integration of emerging technologies.

Based on the aforementioned reasons, the rationale for the present study is to investigate the role of cutting-edge technology in enhancing English language learning and whether such technologies have an influence on students' perceptions. Surveying

the literature related to the subject, a gap was found in the examination of the impact of technologies on students' perceptions of learning the English language. It remains uncertain whether studies in Palestine have specifically addressed the implementation of the latest technologies in relation to students' perceptions of learning the English language. Furthermore, the study aims to give pedagogical practical implications on how to make use of such new technologies in the field of the acquisition of English skills as an applied language.

Problem of the study

In recent years, English language learning has been influenced by the integration of several technologies such as learning management systems, AI-powered chatbots, and digital language applications. In Palestinian higher education institutions, these technologies are supporting the traditional chalkboard-based teaching and learning approaches. This shift is taking place in a challenging context where there are limitations in the infrastructure, digital literacy, and economic and political concerns. The success in the implementation of such technologies depends on students' perceptions and attitudes towards their use. Several studies in Palestine have been conducted on the students' perceptions towards technology (Hamdan et al., 2024). However, there is a lack of research studies in Palestine that deal with university students' perceptions towards the impact of the cutting-edge technologies on their English language learning experiences.

Questions of the study

The questions of this research are:

- How do English language students perceive the impact of implementing cutting-edge technologies in the service of English language learning?
- Are there statistically significant differences in students' perceptions of the use of cutting-edge technology for English language learning due to gender and place of residence variables?

Significance of the study

- It is hoped that the study can contribute to the theoretical framework in the field of students' perceptions of the impact of integrating cutting-edge technologies on learning EFL.
- The current study identifies the students' perceptions of the impact of integrating cutting-edge technologies in learning EFL as related to students' gender and place of residence.

- The study may help educators and policymakers to better understand students' perceptions toward the impact of integrating cutting-edge technologies on learning EFL.

Cutting-edge technologies

The latest technologies are the most up-to-date technologies. According to Emelogu et al. (2022), emerging or new technologies originated from the existing technologies developed by humans. Cutting-edge technologies are defined as those technologies that use the Internet to affect and develop communication, production, and research (Shah et al., 2022). Cutting-edge technologies or the emerging technologies, or communication technologies, are further categorized into hardware and software, or audiovisual and audio technologies that could be downloaded through the internet. These technologies include Artificial Intelligence (AI), Zoom, Augmented Reality (AR), Google class, big data, Moodle, machine learning, virtual reality (VR), Instagram, and ChatGPT. It is important to recognize that these technologies are important in education today as they give space for communication, and interaction virtually (Stahl & Eke, 2024) among students, teachers, technologists and curriculum designers. The emerging technologies provide language students with digital environments where they will be engaged and active; furthermore, teachers will implement digital tools to upload, download, and access content (Lee et al., 2024). These technologies bring the learning and teaching processes at hand, pushing teachers to dramatically shift their ways of teaching, being facilitators of their classes, and decentralizing the traditional role of teachers. On the other hand, students became autonomous in their learning. In fact, the emerging technologies changed the learning process to be more engaging and more active (Dai et al., 2023).

Effects of Technologies on Teaching English

Integrating modern technologies in teaching the English language has been found to have a positive impact on language education, particularly in developing the skills of the English language and meeting the needs of the current generations Z and Alpha (Taghizadeh & Yourdshahi, 2020). According to Asratie et al. (2023), virtual learning platforms enhance students' English language competence, communication with peers and teachers, and autonomous learning through technological tools (Bui, 2022). Social media has also been found to significantly influence students' motivation, vocabulary acquisition, and speaking skills in the English language learning (Lamb & Arisandy, 2020). Furthermore, implementing technology in teaching speaking skills has been found to improve fluency, accuracy, communication confidence, and rapport among students

(Abbasi et al., 2022). The findings of these studies collectively suggest that emerging technologies have a beneficial effect on the teaching of English. The literature on the impact of using emerging technologies on teaching the English language is limited, with a focus on higher education and adult students (Muñoz, 2022). Many studies have highlighted the diverse range of technologies being used in language learning and teaching, but do not specifically address the gap in the literature. Liza and Andriyanti (2020) emphasize the need for English teachers to develop technology literacy and a critical mindset, but did not provide specific guidance on how to do so. Therefore, there is a need for further research that explores the specific impact of emerging technologies on English language teaching, particularly in higher education, and provides practical guidance for teachers in this area. The present study investigated how students perceive the impact of using the latest technologies on learning the English language. In addition, the study investigated how gender and place of residence variables have significant differences on students' perceptions of the impact of the emerging technologies on English language learning in the Palestinian universities.

Method

Research design

The main objective of this study is to assess EFL students' perceptions of the impact of cutting-edge technologies on their English language learning. To fulfil these aims, the researcher used the descriptive approach by means of using quantitative data collection methods.

Sample

The researcher collected data from the English departments of three universities, including Al-Quds Open University, An-Najah National University, and Al-Istiqlal University. The archived data from the departments of registration include information about personal characteristics of the students (gender and place of residence). The researcher analyzed data obtained from 110 students enrolled in the first semester (2024/2025). The sample included English language majors who studied English at different universities in Palestine: 70 males (63.6 %) and 40 females (36.4 %), 28 (25.5%) live in the cities, 40 (36.4%) live in villages, and 42 (38.2%) live in refugee camps. Each student was handed a survey questionnaire (See Table 1 below).

Table 1: Distribution of the Sample According to the Independent Variables

Variable	Category	N	Percentage
Gender	Males	70	63.6%
	Females	40	36.4%
Place of residence	City	28	25.5%
	Village	40	36.4%
	Refugee camp	42	38.2%
Total		110	100%

Instrument

The questionnaire was developed based on several previous studies, including Shahid et al. (2023), Chocarro et al. (2023), and Klimova et al. (2023). Students were asked which technologies they commonly use when learning English. The questionnaire comprised 18 items developed based on the literature. These studies include: (Al-Mubireek, 2020; Castillo-Cuesta, 2020; Awabdeh & Albashtawi, 2023; Bellot, 2023; Klimova, et al., 2023; Chocarro et al., 2023; Namaziandost & Çakmak, 2020; Shahid et al., 2023; Klimova et al., 2023).

Validity

A panel of three experts in education and linguistics reviewed the items of the questionnaire. This procedure was undertaken to assess the items' clarity, relevance, and suitability for the study objectives. The reviewers suggested a number of corrections and improvements. For example, items 7, 11, and 15 were unclear and required revision, including word substitution and rephrasing. The researcher made the suggested revisions based on their feedback.

Reliability

To ensure the reliability of the study instrument, Cronbach's Alpha was used to measure the internal consistency of responses across the items of the scale. The Cronbach Alpha reliability coefficient was 0.96. This value indicates a very good level of internal consistency among the items of the questionnaire.

Students were asked to indicate their perceptions of the emerging technologies as strongly disagree (1), disagree (2), undecided (3), agree (4), and strongly agree (5) in response to each item.

Scaling

The following table is used to interpret the mean score of students' perceptions:

Table 2: Scale for Interpreting Students' Perceptions of the Role of Cutting-Edge Technology in English Language Learning

Mean Score	Interpretation
1.00 – 1.79	Very Low
1.80 – 2.59	Low
2.60 – 3.39	Moderate
3.40 – 4.19	High
4.20 – 5.00	Very High

Results and discussion

Results related to the first research question:

How do English language students perceive the impact of implementing cutting-edge technologies in the service of the English language learning? To answer this question, the researcher used means and standard deviations.

The following table summarizes the results of students' perceptions of the cutting-edge technology in English language learning.

Table 3: Means and Standard Deviations of EFL Students' Perceptions of the Role of Cutting-Edge Technologies on the English Language Learning

Rank	Item No.	Statement	Mean	SD	Level
1	4	Online instruction has helped me become a better speaker of the English language.	4.06	0.58	High
2	1	Online learning has helped me become a better reader of texts in the English language.	4.47	0.55	Very High
3	3	Using digital tools has helped me listen better in the English language.	4.23	0.61	Very High
4	10	I feel comfortable using technology to improve my English level.	4.19	0.75	High
5	2	Using applications such as ChatGPT has helped me become a better writer.	3.54	0.47	Moderate

Rank	Item No.	Statement	Mean	SD	Level
6	14	During online classes, teachers can keep a close eye on all student interactions.	3.53	0.46	Moderate
7	9	I feel comfortable with online resources to improve my English level.	3.93	0.61	High
8	17	I can use tech-based lessons to write well in English and access language learning platforms from anywhere at any time.	3.93	0.46	High
9	5	I can use social media to converse with native speakers of English.	4.22	0.60	Very High
10	6	I feel comfortable using technology to improve my English communication with native speakers.	3.86	0.57	High
11	7	Smart devices and AI help me better understand native speakers of English.	3.86	0.54	High
12	8	I feel that online immersion has contributed to my English language fluency.	3.83	0.49	High
13	15	Online resources provide flexibility when it comes to submitting English assignments.	3.70	0.68	High
14	11	Interactive features on platforms aid in learning.	4.07	0.54	High
15	13	Students who are not present can still receive feedback online.	3.55	0.48	Moderate
16	16	Technical expertise is needed to learn how to use the platform in supporting language learning.	3.43	0.79	Moderate
17	12	It is easy and quick to access content uploaded by teachers and students.	3.48	0.60	Moderate
18	18	Language tutorials available online help me become more familiar with native English pronunciation and expressions.	3.45	0.51	Moderate
		Total Score	3.90	0.27	High

The perceptions of students of how advanced technologies can improve their English language learning experiences in higher education are reflected in the results in Table 3. Overall, the findings clarify that the impact of digital tools and online platforms on English language skills was high (M = 3.90, SD = 0.27). This is consistent with recent research that suggests technology-enhanced learning environments offer individualised and flexible language acquisition pathways (Karimpour et al., 2025).

As can be noticed, the item "Online learning has helped me become a better reader of texts in the English language" scored the highest mean score (M = 4.47, SD = 0.55), indicating that online learning tools are especially useful for enhancing reading comprehension of learners. This is attributed to the availability of a variety of reading materials and flexible text-based assignments via online learning platforms. Similarly, item three states that ("Using digital tools has helped me listen better in English") scored a very high mean (M = 4.23, SD = 0.61), suggesting that technology tools integration greatly improves language listening skills. This is in line with earlier research showing how beneficial multimedia input, such as video and AI-assisted feedback, is for enhancing listening comprehension (Sahito et al., 2025). It is interesting to note that the writing skills had a more moderate mean (Item number 2, M = 3.54) than speaking skills, which also received a relatively high score (Item number 4, M = 4.06). This shows that even though writing programs and ChatGPT are regarded as helpful resources, students might still have trouble using these applications efficiently. Students' lack of confidence or adequate training in implementing AI tools for language tasks like writing skills may be the cause of this moderate response (Feng, 2025). The data also highlights the importance of feeling comfortable and confident when using technology. High levels of agreement regarding comfort using technology to support English language learning are evident in a number of items, for instance, items 10 and 7. These views are critical since it has been demonstrated that proficiency with digital tools is a major predictor of successful participation in online learning (Holm, 2025). Responses to items about teacher presence and interactivity such as item number 14, "During online classes, teachers can keep a close eye on all student interactions" had scored moderate means (M = 3.53) from a pedagogical point of view, suggesting that some students may still feel that there is a lack of monitoring and responsiveness from teachers in virtual environments. In addition, items concerning accessibility such as items number 12 and 18, and flexibility, such as item number 15, had moderate scores, indicating that although technology presents new opportunities, problems like internet dependability, technical difficulties, or a lack of digital literacy may limit students' ability to take full advantage of them.

A possible challenge is indicated by the item with the lowest mean score, item 16, M = 3.43, SD = 0.79, which is related to the requirement for technical expertise. This implies that, in order to guarantee fair access and usability — especially for students from less technologically equipped institutions — investments in technical support and training are essential.

Results related to the second question:

To answer the second question, 'Are there statistically significant differences in students' perceptions and use of cutting-edge technology for English language learning due to gender and place of residence variables?' To answer this question, a t-test was used to determine the first part of the second question related to the gender variable, and the results are shown in Table 4.

Table 4: Independent Samples t-Test Results due to the Gender Variable

	Variable	number	average	deviation	value(v)	Level of significance*
Total marks	Male	70	4.28	0.41	-1.012	0.31
	Female	40	4.31	0.40		

As stated in the table above, English learning scores of male and female students were compared using an independent-samples t-test. The findings showed that the p-value is greater than the significance level α = 0.05). This indicates that there was no statistically significant difference at (α= 0.05) with 0.31 in males and females in students' perceptions toward the use of cutting-edge technology in English language learning. The observed difference was not practically significant, despite the fact that female students scored marginally higher (M = 4.31, SD = 0.40) than male students (M = 4.28, SD = 0.41). These results imply that perceived advantages of technology-enhanced English learning might not be influenced by gender. Such result could be due to the institutional investments in ICT infrastructure and online learning platforms, particularly during and after the COVID-19 pandemic, which have played a significant role in digital access and literacy among Palestinian male and female students. Because of these initiatives, using digital tools for academic purposes has become common for both men and women, regardless of cultural norms. In addition, Palestinian women have demonstrated high levels of engagement and achievement in higher education, frequently surpassing male students in courses pertaining to English language. Regardless of gender, similar levels of engagement with and benefit from technology-enhanced learning resources are probably

a result of this balanced academic environment. In addition, English language skills are frequently connected to international advantages and career goals for both genders in Palestine, which creates a common incentive to make use of online resources such as language learning apps and AI-based materials. Any significant gender-based differences in the perceived efficacy of these technologies may be mitigated by this common motivation (Meghari, 2023).

For the second part of the second question, which is related to the place of residence variable, Table 5 shows the results of One-Way ANOVA.

Table 5: The Findings of One-Way ANOVA According to the Place of Residence Variable

Source of Variation	Sum of Squares	DF	Mean Square	F-value (q)	Sig.
Between Groups	0.039	2	0.0195	0.162	0.851
Within Groups	13.971	106	0.132		
Total	14.010	108			

According to One-Way ANOVA results, there were no significant differences in the perceptions of students regarding the impact of technology-enhanced English language learning based on the results related to place of residence. This shows that students in Palestine's urban, rural, and refugee camp environments generally view digital tools as equally helpful for advancing their English language proficiency.

The national and institutional efforts in Palestine over the past ten years have sought to bridge the digital divide brought on by geographic and socioeconomic diversity. Meghari (2023) confirms that Palestinian universities have been promoting online access and digital citizenship among students, regardless of their geographic location. Similarly, the Ministry of Education and Scientific Research has implemented mobile learning platforms and e-learning programs that serve students worldwide, particularly in reaction to the COVID-19 pandemic (MOEHE, 2021). Furthermore, some of the worldwide organizations, such as UNRWA and UNESCO, promoted educators to train for digital platforms and provided devices to support technology access programs in rural and camp areas (UNRWA, 2022). A more equitable educational experience across various living situations has probably been facilitated by the widespread push for digital inclusion. It is indicative of the increasing technological resilience of the Palestinian higher education system, where students' digital readiness and infrastructure have significantly improved in recent years (Qahman et al., 2025).

Implications for Practice

Based on the study results, many implications for practice in the field of teaching and learning the English language in Palestine could be suggested. First, the government should encourage all regions to have equal access to digital learning resources. Students in urban, rural, and camp areas all view technology as helpful, as evidenced by the lack of statistically significant differences based on place of residence. These results show that efforts to increase access to technology by the Ministry of Education (MoE) and institutions of higher education are having a good impact. In practice, this means that in order to keep this balance, institutions should keep funding digital equity initiatives and infrastructure, especially for under-resourced areas. Second, educational institutions should include AI-powered resources in courses, such as ChatGPT. Language teachers should think about formally incorporating AI writing assistants into writing tasks, assignments, and feedback cycles in English language courses, as students expressed a moderate level of agreement that apps like Chat GPT helped them become better writers. Third, the MoE should encourage language teachers to use multimedia to improve speaking and listening instruction. Students benefit greatly from audio-visual and interactive content, as evidenced by high ratings on speaking and listening skills items such as understanding native speakers and using digital tools. To support oral and auditory language acquisition, teachers should incorporate YouTube videos, podcasts, and AI voice tools into their lesson plans. Fourth, there should be gender sensitive support in a targeted way. Complex support is still advised even though gender differences were not statistically significant. For instance, more culturally aware digital spaces might be necessary for female students to participate fully, especially in traditional communities. E-learning settings that are gender-responsive can boost confidence and engagement. Fifth, the MoE should train educators on online tracking and engagement. Only a small percentage of students agreed that instructors successfully monitor interactions in online classes. This suggests that educators require professional development in digital pedagogy, which includes teaching them how to use interactive platform features, facilitate online discussions, and give immediate, tailored feedback. Lastly, the government should support teachers in designing educational resources that are culturally appropriate. Localized, culturally relevant digital content can boost engagement and lessen reliance on foreign-centered materials that might not accurately represent students' realities, especially in Palestine, where students face political, economic, and infrastructure obstacles.

Conclusion

Insightful information about how students in Palestinian higher education institutions view the use of cutting-edge technologies could be drawn from the above results, such as artificial intelligence (AI) tools, digital platforms, and multimedia resources, for English language instruction. The overall mean score of 3.90 indicates a high degree of agreement among students on the perceived advantages of technology in supporting their English proficiency. With resources like social media, smart devices, and online tutorials helping them learn the language, students expressed particularly high confidence in how online learning supports their speaking, listening, and reading abilities. The gender-specific t-test results revealed a slight difference in students' perceptions, but at the (α=0.05) level, this difference was statistically insignificant. This implies that the benefits of technology-enhanced language instruction are similar for male and female learners. A more equitable distribution of digital learning opportunities across Palestine's varied geographic and socioeconomic backgrounds is also demonstrated by the lack of significant differences found based on place of residence (rural, urban, or refugee camp). Although the majority of students were satisfied with the digital tools, the moderate answers to questions about technical knowledge and writing abilities point to persistent difficulties with digital literacy and the necessity of a systematic integration of ChatGPT and other AI-based writing tools.

These findings are especially important in the context of Palestine, where political and infrastructure limitations may restrict access to educational resources. They draw attention to how initiatives by ministries and universities to undergo digital transformation have helped level the playing field and made it possible for students from different communities to receive high-quality English language instruction. To guarantee that the full potential of educational technology is achieved, the data also highlighted the necessity of ongoing assistance in areas like infrastructure development, teacher training, and student digital readiness.

In conclusion, technology has proven to be a potent enabler in the Palestinian context—bridging gaps, improving access, and promoting language development—even though it cannot fully replace conventional approaches. Maintaining this momentum and ensuring that all students, irrespective of gender or place of residence, can flourish in digitally enhanced language learning environments requires strategic and inclusive policies.

- **Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

- **Data Availability Statement:** The raw data supporting the conclusions of this article will be made available by the authors on request.

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- **Conflicts of Interest**: The author declares no conflicts of interest.

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