ENGINEERING STUDENT PERCEPTIONS OF AI TECHNOLOGY IMPLEMENTATION IN ESP

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Abstract. In the last few years, traditional teaching and learning experiences have been fundamentally transformed by cutting-edge technology such as Artificial Intelligence (AI). While there has been a lot of discussion in the scientific literature regarding the adoption and use of AI tools in general foreign language learning contexts, there is a gap in research regarding these models' implementation in engineering education, particularly in English for Specific Purposes (ESP). The main aim of this article is to examine engineering students' opinions about using AI technology in the ESP course at the university and investigate whether it can enhance foreign language learning outcomes. To achieve the aim of the study, a survey was conducted at the Latvia University of Life Sciences and Technologies involving 137 engineering students representing different programs and various academic levels: undergraduate, postgraduate, and PhD. Having analysed the collected data, the authors of the present research found out that most engineering students actively use a wide range of AI tools in ESP and find them useful for various aspects of the foreign language learning process. The students also believe that AI tool incorporation enhances their learning outcomes and stress the importance of developing digital skills as the use of AI in education will inevitably grow in the future. Moreover, the students highlight the significance of using a critical approach to AI tool application in ESP and report that AI technology should be used responsibly to avoid issues like plagiarism and cheating, overreliance and laziness, lack of authenticity, originality, transparency, decreased quality of learning, negative impact on communication and interpersonal skills.

Keywords: engineering education, Artificial Intelligence (AI), English for Specific Purposes (ESP).

Introduction

"English has become an essential competence for any intellectual person to learn in order to communicate in the globalized world and to achieve success in various domains" [1]. English for Specific Purposes (ESP) is an approach to language teaching that "targets the current and/or future academic or occupational needs of learners, focuses on the necessary language, genres, and skills to address these needs, and assists learners in meeting these needs through the use of general and/or discipline-specific teaching materials and methods" [2]. In ESP, "language is learnt not for its own sake or for the sake of gaining a general education, but to smooth the path to entry or greater linguistic efficiency in academic, professional or workplace environments" [3].

This article highlights the importance of teaching the English language to engineering students at the tertiary level, with a particular focus on meeting their academic and professional needs. In ESP, engineering students should develop foreign language proficiency and transversal skills which are essential for both succeeding in the academic environment at the university and effectively performing job duties in English-speaking professional settings. Due to rapid global technological advancements and digitalisation processes in higher education institutions, it has become crucial to research AI technology implementation in ESP. The main aim of this article is to examine engineering students' opinions about using AI tools in the ESP course at the university and investigate whether it can enhance their foreign language learning outcomes.

ESP in Engineering Education

Within the academic context, the ESP course should be carefully designed to meet the academic standards and requirements of tertiary engineering education. Staying updated on emerging technologies is crucial for engineers and therefore often requires reading, understanding, interpreting, and evaluating professional and scientific literature such as academic research papers in English. Studies at university also involve taking part in lectures and seminars in English, explaining and comparing processes, presenting information in the foreign language, engaging in student exchange programs and studying abroad, communicating with foreign students, professionals, and lecturers, participating in conferences in an international academic environment, documenting project work and research findings, and publishing research reports.

Regarding the professional environments of the engineering domain, ESP should particularly focus on the specific English needs of students who choose to pursue an engineering career. Recognising the importance of the special needs of engineering students, most ESP practitioners agree that needs analysis plays a big role in designing ESP courses. "By understanding the specific English needs of engineering students, ESP course designers can develop more effective ESP courses" [4]. Needs analysis "can help teachers respond better to students' learning needs within their degree programs, which can improve their motivation to use English when discussing content-knowledge topics necessary for their academic and professional development" [5]. In line with this view, to help engineering students enhance their confidence in various engineering contexts, sustain employability, and achieve a prospective career, ESP teachers should concentrate on the development of future engineers' professional foreign language skills.

In addressing the professional needs of engineering students in ESP, it is essential to prioritise developing special technical vocabulary, learning domain-specific terminology, as well as translating industry-related texts [6]. Moreover, as the English language is constantly evolving, and driven by technological advancements, engineering students need to keep up with the latest terminology and concepts, including modern areas of engineering such as artificial intelligence, sustainability, green energy, climate change, etc. Engineering students also need to read and write various types of technical documents such as instructions, manuals, reports, notices, meeting minutes, cover letters, resumes, and fill forms about equipment.

However, ESP cannot be restricted solely to training in specialist terminology, translating an abundance of technical texts, reading and writing in English, the ESP course should prepare engineering graduates to communicate in the foreign language in complex engineering settings. A significant amount of research stresses the importance of intercultural and soft skills' development which is vital to be successful in the workplace. Engineering students need to build good interpersonal relations and collaborate effectively with colleagues, customers, subcontractors, suppliers, and counterparts across the world in the workplace, to build strong interpersonal relations [7-9]. Learning-to-learn skills, leadership skills, and IT skills are also viewed as vital soft skills to be developed in the ESP course for engineers [10].

Moreover, critical thinking is viewed as the most highly-ranked and vitally important in the engineering domain. Scientists [11-14] agree that critical thinking significantly contributes to engineering students' academic and professional success and critical thinking should be incorporated into any engineering curriculum as it enables students to:

- be autonomous,
- analyse problems from multiple perspectives,
- think creatively,
- critically assess various ideas and solutions,
- reason logically,
- solve problems,
- identify opportunities for improvement,
- articulate ideas clearly,
- construct persuasive arguments,
- engage in constructive dialogue with team members and stakeholders,
- critically evaluate the ethical implications of their work,
- reflect on their own work,
- consider the broader societal impacts of engineering practices,
- make responsible decisions that prioritise safety and sustainability,
- deal with increasingly rapid change and complexity in the world.

Consequently, critical thinking stands as a cornerstone of engineering education. To ensure engineering students' readiness for the complexities of their future careers, ESP should focus on the development of critical thinking skills.

The Potential of AI Tools in Language Learning

"Artificial intelligence (AI) is a branch of computer science that utilizes computer systems to perform tasks that typically require human intelligence. AI encompasses the ability of machines to understand, reason, learn, and interact with humans in a way that emulates human intelligence. It involves the development of algorithms, programs, and systems that can process information, make decisions and solve problems similar to how humans do" [15].

Research on technology-enhanced education [16-20] highlights the great potential of AI tools in language learning. Following is the summary of benefits for language learners:

- creative, interactive, and dynamic nature of AI tools in language learning,
- inclusive learning environments and personalised learning experiences tailored to the diverse preferences and needs of individual learners,
- positive influence on students' language learning experiences and increased motivation to learn the English language due to engaging and enjoyable activities,
- improved language proficiency,
- access to unlimited practice outside the classroom,
- personalised feedback, automatic speech recognition, and instant language assessment features: AI-based automatic speech recognition systems detect pronunciation errors, offer targeted feedback, and provide interactive pronunciation training, in this way assisting learners in developing accuracy and fluency, leading to improved oral communication skills,
- objective and efficient evaluation methods: AI systems can analyse learners' written compositions and provide immediate feedback on grammar, vocabulary usage, and overall coherence.

Materials and methods

When it comes to ESP courses for engineering students at the tertiary level, AI technology can be particularly useful. Various AI tools can be utilised to provide engineering students with meaningful foreign language experiences tailored to their professional and academic needs, as well as individual English proficiency levels. Following students' performance and progress, these tools use AI algorithms to adapt ESP content and tasks.

Using AI-powered language learning apps, students can choose topics related to different spheres of engineering: environmental engineering, computer science, civil engineering, mechanical engineering, etc., and take part in lessons focused on domain-specific terminology, technical vocabulary, and terminology. Also, there is a wide range of tasks enhancing the development of professional writing skills, the students can practice writing different types of technical and business documents in English and get instant feedback on grammar accuracy, vocabulary, punctuation, style, logical coherence and structure.

Using chatbots, virtual conversation partners, and AI collaborative platforms, students can practice real-life communication in engineering contexts, and complete exercises that simulate workplace interactions in authentic settings, such as problem-solving, case studies, video conferencing, participating in meetings, and negotiations, and giving presentations in English. Moreover, engineering students can work together on projects, sharing resources and providing feedback to each other. Working effectively in teams, brainstorming, exchanging ideas, explaining each other concepts, evaluating different perspectives and generating solutions to engineering problems, it is possible to learn soft skills and critical thinking skills that are vital in the workplace.

AI-powered academic research tools can assist in meeting the academic needs of engineering students in the ESP course as they can be used for finding resources and reading academic literature. Using these platforms, engineering students get access to academic research papers, journals, and conference proceedings and create organised collections of scientific papers relevant to specific areas of engineering. The students can obtain information about the latest developments in engineering, identify current research trends, and areas of active research, and critically evaluate whether a source is credible and authoritative using such AI features as author profile, citation analysis, and impact metrics. Furthermore, by exploring scientific articles, the students can learn about their structure and organisation, practice summarising, and paraphrasing, and gain valuable insights.

AI translation tools could be used to assist engineering students in facilitating understanding of complex engineering concepts in educational materials, technical specifications, manuals, and instructions, instantly providing accurate and contextually relevant translation and saving time. Moreover, AI translation tools can enhance communication between engineers speaking different languages and promote intercultural understanding by helping students engage with engineering literature and perspectives from around the world.

To sum up, AI tools implementation into the ESP curriculum presents a wide range of benefits by personalising and adapting content and tasks to the specific needs and individual proficiency levels of engineering students. Providing real-world language practice and feedback, AI tools can foster meaningful engagement and motivation among learners and it is possible to promote various skills necessary for success in professional and academic environments, including critical thinking, soft skills, and intercultural awareness.

To investigate perceptions of AI implementation in ESP, the researchers engaged engineering students of the Latvia University of Life Sciences and Technologies in the survey that they completed in January 2024. The study involved 137 respondents (n = 137) including 83 undergraduate engineering students of two programmes: Information Technologies for Sustainable Development, and Computer Control and Computer Science, 37 postgraduate engineering students of three programmes: Information Technologies, Forestry and Environmental, Water and Land Engineering, and 18 PhD engineering students of four programmes: Information Technologies, Agricultural Engineering, Environmental Engineering, and Food Science). See Fig. 1. which depicts the distribution of engineering students according to their level of study.
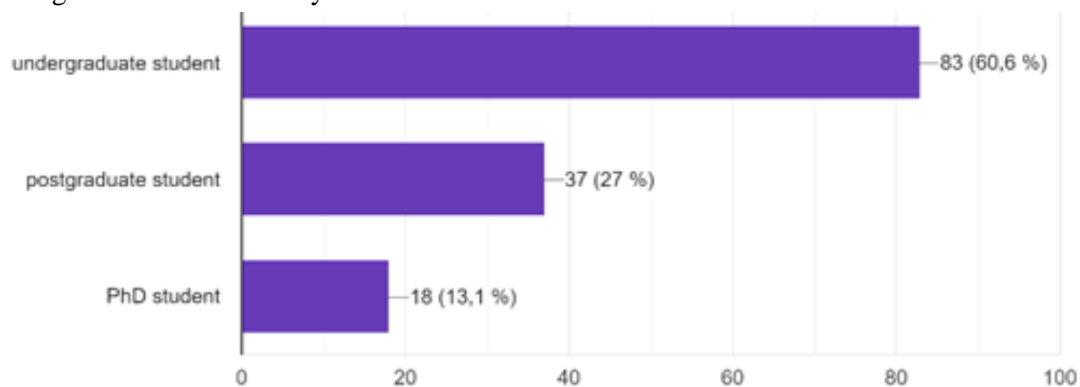

Fig. 1. **Distribution of engineering students according to their level of study**

The survey developed by the authors of this paper comprised six research questions.

Q1. Have you used any AI tools in your studies?
Q2. Why do you use AI tools in ESP?
Q3. Do you believe that the use of AI in your studies can enhance your learning outcomes?
Q4. How important is the ethical use of AI in studies?
Q5. What concerns do you associate with the unethical use of AI in your studies?
Q6. Do you believe that the use of AI in studies will become more prevalent in the future?

Results and discussion

Responses to the first research question "Have you experienced or used any AI tools or technologies in your studies?" gave the following result: most engineering students – 129 (90.5%) use AI tools in their studies, only 8 students (9.5%) do not use AI in their studies. See Fig. 2 below.

As we can see, AI solutions have become a part of students' life, since the overwhelming majority of respondents have already tried to integrate them in the learning process. It should be noted that the respondents represent the so-called Generation Z or "digital natives" whose life is completely merged with modern technologies, their everyday life is linked to the Internet, social networks, and smart devices. Therefore, the entry of AI technologies into the learning environment seems very natural to them. As society adapts to the advancement of technologies, academic staff members have to be aware that AI tools are an opportunity that should be used to the advantage of the learning process.
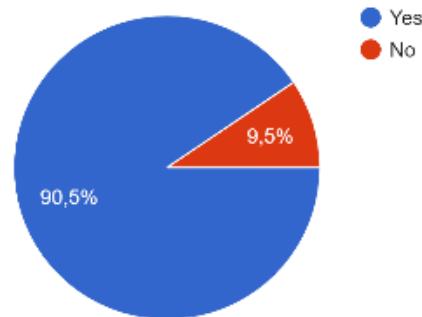
Fig. 2. **Engineering students' use of AI in studies**

The second research question was "Why do you use AI tools in ESP?". Table 1 below summarises the engineering students' responses grouping various AI tools according to their use in ESP.

Table 1

AI tools and their use in ESP

AI tool	Students using tool (%) $n = 137$	Purpose of usage in ESP course
Chat GPT	65.0	to have conversations and explore topics in engineering,
Microsoft Bing Copilot	9.5	to practice English speaking, listening, reading, writing skills, to identify and correct spelling and grammar mistakes,
Google AI	7.0	to learn new words, phrases, and technical terms,
iask.ai	10.0	to ask questions to clarify difficult concepts,
Google Bard	1.1	to request explanations,
Perplexity	9.0	to compose various types of text, e.g. technical documents, business correspondence, to use as a writing assistant, to generate ideas
DeepL	32.0	to translate complex engineering texts accurately,
Bing Translator	6.5	to get recommendations on the best translation option,
Alexa Translation	4.4	to find synonyms, opposite meaning of a word to edit translated parts,
Reverso Translation	3.6	to adapt the text to a formal or informal tone, to create glossaries, to paraphrase
Grammarly	24.8	to use as a writing assistant for paraphrasing, correcting grammar, spelling, and punctuation mistakes,
LanguageTool	8.0	to use clarity suggestions to make writing reader-friendly, to adjust tone, level of formality, and professional relevance
Canva.ai	13.1	to create posters and presentations, announcements, newsletters, etc.,
Midjourney	12.4	to generate and edit images and videos,
Lensgo.ai	8.8	to turn written descriptions into images,
DALL E	5.8	to collaborate with peers in projects
Adobe Firefly	4.4	
ChatPdf	27.7	to analyze PDFs for data extraction,
Grooper	16.0	for document classification, and content understanding,
Sharly	9.5	for summarising and paraphrasing lengthy texts such as research
Quillbot	8.8	articles in engineering
Otter.ai	24.8	to record audio during lectures/discussions and automatically generate real-time notes, to capture lecture slides, get transcripts and automated summaries
Mendeley	13.9	for academic writing, to cite references and research data
Decktopus	3.6	to create professional presentations
SmallTalk2me	2.9	to assess speaking performance: to analyse speech and get feedback on speech rate, pronunciation, vocabulary, grammar and overall confidence

From the table above, it is apparent that students use a wide range of various AI tools in ESP and find them helpful for various aspects of ESP. The results show that Chat GPT is the most often used tool, but students are also aware of such tools as DeepL, Garmmarly, ChatPdf, Otter.ai, and others.

The third research question was **"Do you believe that the use of AI in studies can enhance your learning outcomes?"** 90 students (65.7%) believe that the use of AI can enhance learning outcomes, 42 students (30.7%) are not sure about it, and 5 students (3.6%) think that the use of AI cannot enhance their learning outcomes. See Fig. 3.
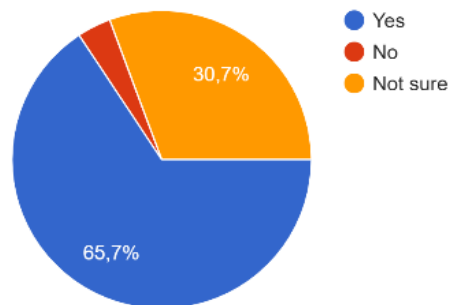
Fig. 3. **Engineering students' views on AI potential to enhance academic performance**

It seems that our life without artificial intelligence is no longer possible. However, the survey revealed that a part of students still think that AI cannot be of great help since the students' own contribution might be reduced and students' learning and creativity could suffer. In addition, the reliability of the AI-generated answers should be checked as sometimes they are biased or partly true.

The fourth research question was: **"How important is the ethical use of AI in studies?"** The responses to this question result in the following: 58 students (42.3%) think that the ethical use of AI in studies is rather important, 36 students (26.3%) believe it is very important, 24 students (17.5%) consider ethical use of AI as extremely important, 13 students (9.5%) think it is slightly important, and 6 (4.4%) express opinion that it is not important at all. See Fig.4 below.
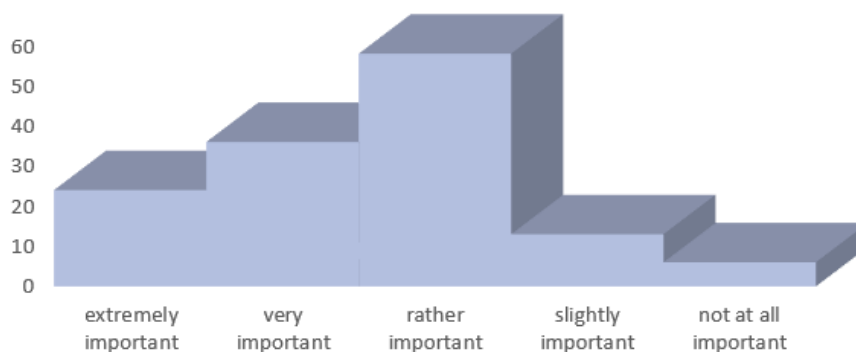

Fig. 4. **Engineering students' opinion on the importance of ethical AI use in studies**

This is a very important issue in the use of AI technologies. The unspecified use of artificial intelligence is actually a violation of academic integrity, just like plagiarism and cheating. Therefore, artificial intelligence tools should be used for learning purposes only. The study revealed that the majority of the respondents hold the view that there is an ethical aspect of AI tools and that students should not use them for the wrong things like getting work done instead of doing the work on their own. The public discussions in the media everywhere in the last year reflected the concern and anxiety of society about whether the new technologies will not replace the usual learning process. Many people believe that universities should regulate the use of artificial intelligence, but currently, it is not clear how to do it.

The fifth research question was "What concerns do you associate with unethical use of AI in your studies?" The students' responses were summarised and grouped into several categories. See Fig. 5 below. The majority of students 67 (48.9%) express concerns regarding plagiarism and cheating, which

means misrepresenting true skills and knowledge, not citing properly, not putting effort into original work, and as a result violating academic integrity. 38 students (27.7%) believe that unethical use of AI can lead to dependence on technology and laziness, which means that by over-relying on AI for learning, students are not able to develop creativity, critical thinking skills, and independent thought. 37 students (27%) have concerns about the authenticity and originality of work produced by AI, as students do not fully understand how AI works and how it generates content, and they are skeptical about the ability of AI to produce original work without human intervention. 23 students (16.8%) believe that AI-generated work lacks transparency, it "acts like a black box" and it is not known where the training data is taken from.

22 students (16%) believe that unethical use of AI tools can result in decreased quality of learning, which means not learning from the information provided by AI and merely copying it without thinking and understanding. 18 students (13%) state that it can harm communication and interpersonal skills between students and teachers due to overreliance on AI and lack of a human figure to go to for advice.

15 students (10.9%) believe that AI usage can raise trust issues, such as mistakes in AI-generated content, misleading information, and non-existing references. 11 students (8%) highlighted privacy and data security issues and expressed concerns about unauthorized access to personal information by AI systems and data misuse. 9 students (6.6%) expressed concerns that unethical use of AI can reduce the value of human input and expertise, prioritizing content generated by AI over human knowledge. Only 8 students (5.8%) stated they have no concerns or they do not know about it.
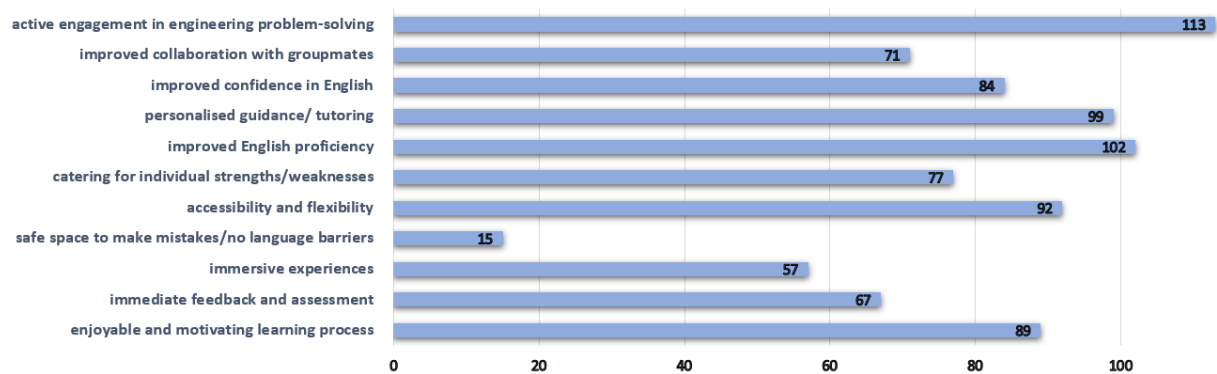

Fig. 5. **Concerns associated with unethical AI use**

The sixth research question was "Do you believe that the use of AI in studies will become more prevalent in the future?" 114 students (83.2%) believe that the use of AI in studies will become more prevalent in the future and therefore there is a need to develop digital skills, 21 students (15.3%) are not sure about it, 2 students (1.5%) believe that the use of AI in studies will not become more prevalent in the future. See Fig.6. below.
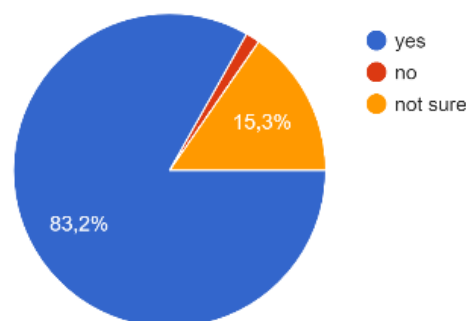

Fig. 6. **Engineering students' opinion on the potential of AI in the future**

According to the students' opinion, in the coming years, AI technologies will significantly transform society, the work environment and the learning process as a whole becoming an integral part of everyday life the same way as the Internet or mobile devices have become a part of our lives.

The results of the present study are confirmed by other scholars who have been recently exploring the usage of AI in a range of fields such as business (decision-making and AI-enabled automation) [21], healthcare (smart health, advice for public health and AI diagnosis) [22], and the gaming industry (designing game characters, plots, scenes and strategies) [23]. The researchers acknowledge that AI technology presents immense potential for a wide range of applications and agree that AI has created both opportunities and challenges which fall into such categories as ethics, harmful and inappropriate content, misuse, bias, overreliance, privacy and security. Additionally, the researchers anticipate that AI will continue to advance and soon will become unavoidable. Education should be transformed to teach necessary hard and soft skills to enable students to collaborate with AI technology in educational settings and in the workplace.

Conclusions

1. Teaching ESP to engineering students at the tertiary level should be focused on the academic and professional needs of learners. Engineering students should develop foreign language proficiency and transversal skills which are necessary to succeed in the academic environment at the university and to effectively perform job duties in an English-speaking professional context.
2. Current engineering curricula at the university can be complemented with AI technology as AI tools have a great potential to assist in efficiently acquiring the foreign language and enhancing learning outcomes in ESP.
3. Results of the study show that most engineering students (90.5%) use AI tools in their studies, they actively utilise a wide range of AI tools in ESP and find them useful in various aspects of the foreign language learning process. The majority of engineering students (65.7%) believe that AI tool incorporation in ESP enhances their learning outcomes.
4. It is crucial to adopt a critical approach to AI tool application in ESP and AI technology should be used responsibly to avoid issues like plagiarism and cheating, overreliance and laziness, lack of authenticity, originality, transparency, decreased quality of learning, negative impact on communication and interpersonal skills.
5. Developing digital skills is vital as the use of AI will inevitably grow in the future.
6. Further research is needed to clarify if student survey results correlate with teachers' opinions. Moreover, it is important to examine if the methodology would differ when teaching undergraduates, masters, and PhD students.

Author contributions

Both authors have contributed equally to the study and preparation of this publication. Authors have read and agreed to the published version of the manuscript.

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