# *AI-Enhanced Transformative Approach to ESP in Engineering Education*

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The Barcelona Conference on Education 2024
Official Conference Proceedings

**Abstract**
Transformative learning is an underlying theory in various aspects of contemporary language pedagogy, the field of teaching English for specific purposes (ESP) is no exception. When applied to the ESP curriculum, transformative learning can have significant pedagogical implications and it can be beneficial for engineering students, as it follows their specific needs. Due to digitalization processes in higher education institutions, it has become crucial to study the current dimensions of transformative learning in ESP in engineering education and whether its implications support new forms of learning such as AI-powered tools. The main aim of the present research is to examine student opinions about the incorporation of AI technology in the ESP course and assess if AI technology can facilitate transformation. The article overviews the theory of transformative learning, discusses transformative goals, gives examples of how transformative learning can be enhanced through AI technology, and investigates engineering students' opinions about AI technology implementation. The results of the study were obtained in a survey, involving 137 undergraduate and postgraduate engineering students of different engineering programs at Latvia University of Life Sciences and Technologies. The data obtained indicate a strong overall approval of AI integration into the ESP course and reveal the potential of AI to foster transformation. The findings of this research can be used by ESP teachers to revise methods and content promoting transformative learning outcomes.

Keywords: Engineering Education, Transformative Learning, English for Specific Purposes (ESP), Artificial Intelligence (AI)

## Introduction

Transformative learning is a theory about how adult people learn and how they make sense of their life experiences. This theory was introduced by the American sociologist Jack Mezirow in 1978 and since then it has gained great popularity in the fields of pedagogy and research. Transformative learning theory focuses on 'personal transformation', suggesting that learning experiences can dramatically change a learner's way of thinking, and cause a shift in perception and reconsidering of beliefs, values, and assumptions. Transformation is "about change, dramatic, fundamental change in the way we see ourselves, and the world in which we live" (Merriam, 2004, p. 60).

In transformative learning, students take an active role in their learning process, they take control of it, and become more self-directed and autonomous. The learners undergo a complicated process of conscious change reassessing beliefs, values, and assumptions, engaging in critical discussions, collaborating with peers, critically analyzing different perspectives, and evaluating their experience by reflecting individually and with other learners (Cranton, 2016; Mezirow & Taylor, 2009).

The goal of adult education which the teacher must address, in Mezirow's view, is 'the process of helping learners become more aware of the context of their problematic understandings and beliefs, more critically reflective on their assumptions and those of others, more fully and freely engaged in discourse, and more effective in taking action on their reflective judgments (Mezirow, 2000).

The role of the teacher in transformative learning is to:

- provide a supportive and inclusive environment and facilitate the learning process;
- involve learners in experiential learning;
- provide learners with activities in which they are transformed through their collaboration;
- encourage critical discussions to examine information from different perspectives to form new insights;
- involve the learners in active and reflective learning experiences;
- encourage trying new roles and behaviors;
- encourage articulating arguments and supporting them with appropriate evidence;
- encourage the learners to analyze experience by reflecting, evaluating, and reassessing it individually and together with their groupmates;
- encourage the integration of newly found perspectives and behaviors into daily life, testing their validity. (Adria, 2009; Alhadeff-Jones, 2012; Apte, 2009; Sinkus, 2019)

Thus, transformative learning focuses on how adults can undergo personal transformation through education. The idea is that learning isn't just about gaining knowledge; it's about fundamentally changing the way students think and see the world. It's especially relevant in ESP, where the goal is not only to teach language but to foster critical and reflective thinking and professional communication skills in a specialized field like engineering.

This article focuses on how AI technology implementation in ESP can promote transformative learning in engineering education. The main aim of the present research is to examine student opinions about the incorporation of AI technology in the ESP course and assess if AI technology can facilitate transformation.

**Facilitating Transformative Learning in the ESP Course for Engineering Students Through AI Tools**

The use of AI as a tool and assistance is growing and requires engineers to enhance their digital skills including data and AI competencies, therefore higher education institutions should complement current engineering curricula with these competencies (Schleiss, 2022). Research has shown that AI technology represents a significant advance in teaching methods and can be successfully implemented in foreign language learning, including ESP for engineering students (Patty, 2024; Rahimi & Fathi, 2022). ESP instructors are now incorporating AI technologies to create immersive language learning environments that actively engage learners and facilitate language learning processes (Alqahtani, 2018; Shadiev et al., 2023).

In the last few years, a wide variety of AI tools for foreign language learning have appeared, including AI-generated content, chatbots, machine translation, speech recognition, etc. AI technologies can enhance the development of linguistic knowledge, and improve students' reading, listening, speaking, and writing skills (OECD, 2024). AI tools can help learners boost vocabulary and grammar knowledge (Utami et al., 2023). Moreover, they can tailor English learning activities to the specific needs of students and enhance the learning experience by producing tasks for different proficiency levels or purposes and enabling personalized communicative learning processes (Chun et al., 2016; Shatri, 2020).

As discussed in the introduction section, one of the goals of transformative learning is creating opportunities for active and experiential learning, as engineering students learn best through the practical application of the foreign language in dealing with real-life engineering problems.

Integration of AI tools into the ESP course curriculum allows engineering students to engage actively in authentic engineering tasks and apply theoretical knowledge to experience real-world engineering situations. Students can take part in such hands-on activities as engineering discussions, case studies, simulations, and conducting research. These practical tasks engage students in interacting with AI technology, developing their critical thinking and problem-solving skills, enhancing their understanding of engineering concepts, and promoting English language proficiency.

Language learning applications powered by AI such as LanguaTalk, TalkPal, Babbel, and Mondly can be used in ESP to meet engineering students' professional needs and individual language proficiency levels and provide them with meaningful foreign language experiences. Utilizing AI language learning apps in ESP can provide numerous benefits for developing engineering students' English skills including:

- a variety of engineering field-related topics, e.g. environmental engineering, computer science, civil engineering, etc.;
- developing professional vocabulary through modules focused on engineering terminology;
- practicing English communication skills and doing exercises that simulate professional communication scenarios in authentic settings, e.g. writing professional emails, participating in meetings, and giving presentations;
- developing professional writing skills, practicing writing technical documents in English, reports, and getting instant feedback on grammar accuracy, vocabulary, punctuation, and style;

- providing interactive speaking practice tasks doing which students can practice pronunciation and fluency in a relevant engineering context;
- progress tracking features for monitoring language use and receiving feedback and guidance.

Incorporating AI tools in ESP enables learners to actively engage in English language learning through participation in real-world engineering contexts. This meaningful experience not only facilitates the skills vital for engineering students' professional success but also fosters transformative learning.

Another goal of transformative learning is to provide opportunities for reflective thinking. Active participation of students in the self-evaluation of their learning and the development of reflective thinking are the key features of successful learning (Kavaliauskiene et al., 2012). Critical reflection in ESP involves becoming more autonomous and independent, organizing and planning meaningful language learning, setting and adjusting language learning goals, tracking progress, monitoring language learning motivation, choosing the most appropriate learning strategies, recording and analyzing learning experiences, identifying challenges and mistakes, evaluating learning and making further improvements in the language learning process.

AI technology offers a variety of opportunities to support students' reflective thinking. It can provide prompts to encourage deeper reflection on learning experiences and help students reassess their assumptions about learning the foreign language and incorporating innovative solutions into the ESP course. Engaging in reflective practices in the ESP course, learners can explore ways AI can be used to enhance their foreign language proficiency and engineering skills, this helps students better understand and adapt to new ways of learning and become more effective communicators in their domain.

Prompted by AI tools such as Reflectly, Journey.ai, Reflect.ai, and Daylio students can get instant feedback on their foreign language performance and professional communication skills, enhancing their reflective thinking and self-assessment. Such feedback provided by AI might relate to:

- the appropriateness of technical vocabulary and terminology used;
- the effectiveness of presentations, meetings, and negotiations in an engineering context;
- the clarity of technical writing, considering organization, use of grammar, technical vocabulary, coherence, and cohesion;
- cultural understanding, the appropriateness of language use in intercultural communication in various engineering contexts with engineers from other countries.

Thus, AI tools can be very useful in ESP as they present a range of opportunities for enhancing reflective practice and in this way fostering transformative learning. Utilizing AI technology students can analyze and evaluate their English use in various engineering contexts independently and together with other learners, developing a deeper understanding of the significant role of the foreign language in their engineering career.

Another essential goal of transformative learning is to promote student collaboration and encourage critical discussions. This process allows learners to explore and exchange different perspectives and validate their ideas through dialogue and debate, thus fostering new insights and a deeper learning experience.

Research has shown that AI technology enhances student real-time communication and collaboration, fosters teamwork and creativity, facilitates team building, coordinates various team activities, manages tasks and task interdependence, supports decision-making, monitors performance, and even acts as an emotion regulator for a team in resolving conflicts (Khakurel & Blomqvist, 2022).

Participating in teamwork with other engineers involves the assessment of beliefs, feelings, and values and therefore can lead to learner transformation. Working together on engineering tasks, students can engage actively in meaningful discussions and collaborative problem-solving in this way developing their English language skills and enhancing their understanding of engineering concepts.

Chatbots such as Chat GPT, Discourse, Replika, or Tandem involve engineering students in collaboration in ESP in the following ways:

- offering multiple interactive features and engaging students in discussions and exchanging diverse perspectives on various engineering topics, e.g emerging technologies in engineering (renewable energy systems, artificial intelligence, nanotechnology, etc.) and their potential applications; ethical issues and challenges in engineering, sustainability issues (green technologies, strategies for mitigating environmental impacts, etc.);
- serving as a virtual assistant, guiding group discussions, facilitating efficient collaboration, task allocation, and helping students with problem-solving;
- providing feedback on how to improve communication in professional settings;
- enhancing student understanding of complex concepts in the engineering domain and offering language learning support by providing explanations, clarification, examples, and practice exercises related to English grammar and professional vocabulary;
- helping to overcome language barriers.

Thus, AI tools can promote collaboration in ESP and in this way facilitate engineering students' transformative learning. AI tools can engage them in discussions, and problem-solving activities that require the use of English to analyze engineering concepts or collaboratively solve real-life engineering problems.

To sum up, complementing the ESP course with AI tools can foster transformative learning as students encounter opportunities presented by technology. Through experiential learning, reflective thinking and collaboration students experience deeper and more impactful learning and develop the skills, attitudes, and values necessary to become successful engineers and proficient English communicators.

**Investigating Student Opinion on AI Tools' Application in the ESP Course**

To investigate engineering students' views on technology implementation in the ESP course, and to assess its potential for transformative learning, AI tools were integrated into the syllabus of the ESP course to complement traditional teaching methods. The course syllabus was structured into two parts: 80% traditional face-to-face learning and 20 % individual work using AI tools. The topics of the ESP course were introduced and discussed during in-person seminars. To consolidate this newly acquired knowledge, students used AI to engage in open-ended conversations on industry-related topics and practiced new vocabulary with a chatbot.

The students chose an AI tool from those available to them, in most cases they selected ChatGPT, Perplexity, Midjourney, TalkPal, or Smalltalk2me.

A survey was conducted with 137 respondents comprising 83 undergraduate students of such engineering programs as Information Technologies for Sustainable Development, Computer Control and Computer Science; 37 postgraduate students specializing in Information Technologies, Environmental, Water and Land Engineering, Forest Science, and 18 PhD students of such programs as Information Technologies, Agricultural Engineering, Environmental Engineering, Food Science.

As seen in Figure 1, the results of the survey show a very positive attitude of students toward AI integration into the ESP course. The most common advantages highlighted by the students were active and experiential learning, valued by 113 students 82.5 % (113 students), motivating learning process, valued by 74.5 % (102 students), supportive and inclusive learning environment, valued by 72.3% (99 students). Other advantages were engagement in collaborative problem-solving, appreciated by 67.2 % (92 students), the opportunity to discuss engineering problems critically, appreciated by 65% (89 students), and the development of reflective thinking, appreciated by 61.3% (84 students). Also, students appreciated promoting English language proficiency, supported by 56.2 % (77 students) and developing autonomy and independence, supported by 51.8% (71 students). Improved confidence in English was acknowledged by 48.9% (67 students) and 41.6% (57 students) acknowledged an opportunity to solve real-life engineering problems.

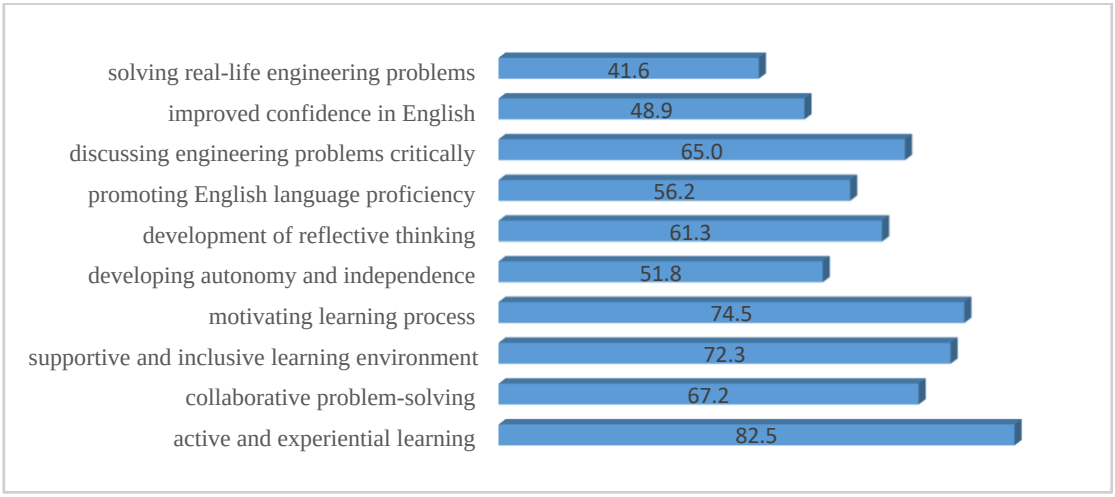


Figure 1: The Advantages of AI Technology Application in the ESP Course According to Engineering Students

These findings highlight the potential of AI to foster transformation. The identified attributes—active engagement in experiential learning, enhanced motivation, inclusive learning, critical and reflective thinking, development of autonomy and independence, and collaborative problem-solving are crucial in modern education. These attributes align with the core principles of transformative learning and serve as indicators of transformation. Therefore, it can be concluded that the application of AI technology in the ESP course promoted transformative learning.

## Conclusion

Implementing transformative learning into the ESP curriculum can have significant implications for the education of engineering students as it presents opportunities for continuous intellectual growth and self-improvement, the development of autonomy, self-directedness, and critical and reflective thinking. Student engagement in experiential, critically thoughtful, reflective and collaborative language learning experiences transforms the way they learn from a passive accumulation of information to its active usage in problem-solving in academic and professional contexts.

The use of AI in language learning is not just a trend, it is an innovation with the transformative potential to enhance educational experiences. AI-powered tools and traditional language learning techniques are not mutually exclusive, they act as complementary. Combining the advantages of traditional teaching methods with AI technology enables ESP teachers to create a more flexible, personalized, and inclusive language learning environment for their students, which leads to improved learning outcomes and helps students for professional success in an increasingly technology-driven world.

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