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Teaching and Learning in Higher Education with Generative AI

Interdisciplinary Case Studies from Engineering, Management, Linguistics, and Psychology

IDA SKUBIS, JOLANTA WODARSKA, KRZYSZTOF WODARSKI, AND TERESA SÁNCHEZ-GUTIÉRREZ

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This interdisciplinary book demonstrates how generative artificial intelligence (GenAI) changes higher education across diverse academic fields, including philology, management, engineering, and psychology. Drawing on empirical case studies, surveys, and experiments, this book combines theoretical and practical perspectives to explore AI's impact on learning and cognitive development. Each chapter offers discipline-specific analysis of how GenAI reshapes pedagogy – supporting multilingual education, enhancing reflective thinking, fostering self-regulated learning, and encouraging ethical awareness. By comparing case studies from varied academic and cultural contexts, this book highlights the opportunities and challenges of AI adoption, emphasizing responsible, creative, and critically informed approaches to academic innovation. It will appeal to researchers of AI in Higher Education across disciplines. Key features:

- Explains how GenAI transforms higher education across a variety of disciplines, from logistics to psychology.
- Includes practical and theoretical insights into AI's role in reshaping pedagogy, fostering critical thinking, and supporting multilingual education.
- Provides a global perspective on the opportunities and challenges of AI adoption through diverse case studies and empirical research.

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Contents

Introduction

Generative artificial intelligence (GenAI), particularly large language models such as ChatGPT, Claude, and Gemini, is now being widely used in higher education settings. Researchers and educators are examining how these tools affect teaching practices, student learning behavior, and disciplinary expectations (Pérez et al., 2025; Testa et al., 2025). The use of GenAI in academic environments is no longer limited to isolated disciplines. It has become a topic of interest across fields including language education, management, engineering, and psychology.

At the same time, higher education discussions increasingly emphasize how people interact with GenAI systems through prompts and how these systems respond under ethical and policy constraints. Research based on prompt-response analysis demonstrates that GenAI tools can be both academically useful and operationally limited when users ask for sensitive, controversial, or potentially harmful information (Skubis et al., 2024). In particular, the analysis of human–ChatGPT interaction shows that model outputs are shaped not only by user intent but also by safety rules and embedded ethical boundaries, which can lead to refusals, partial answers, or responses that redirect the user toward broader societal, legal, or ethical dimensions rather than explicit details (Skubis et al., 2024). These dynamics are relevant in higher education because they affect what students can realistically obtain from GenAI tools, how they learn to formulate prompts, and how they interpret the reliability and completeness of AI-generated content. This dynamic resembles adoption processes in other AI domains, where decision-makers tend to focus on perceived usefulness, operational efficiency, and risks before integrating AI tools into real practice (Skubis, 2025a).

Recent comparative research further refines this perspective by demonstrating that different generations of large language models respond to controversial prompts in systematically different ways. A comparative analysis of ChatGPT 3.5 and GPT-4.0 shows that while both models emphasize ethical considerations and compliance with usage policies, they differ in their prompt sensitivity, linguistic flexibility, and response strategies (Skubis et al., 2025). ChatGPT 3.5 tends to adopt a more conservative and avoidance-oriented stance, frequently declining to engage with sensitive content, whereas GPT-4.0 displays a more nuanced contextual understanding and

greater willingness to engage, albeit sometimes at the cost of reduced factual accuracy. Research on AI highlights that algorithmic decision-making can optimize workflows and strategic planning, yet still requires clear human oversight due to limitations in emotional intelligence, ethical reasoning, and accountability (Skubis, 2025b, 2025c). These findings highlight that GenAI use in education is not static but depends on the specific model, its training, and its ethical alignment mechanisms.

This book presents case studies from several disciplines to document how students and teachers engage with GenAI in practical settings. These studies are based on empirical methods such as surveys, experimental tasks, and classroom observation. The aim is to document how GenAI tools are being applied, what expectations students and teachers hold, and what types of cognitive and pedagogical effects are being reported.

In language learning and teaching, the research on GenAI is largely concentrated on English as a Foreign Language (EFL) contexts and higher education. It demonstrates that GenAI tools can support personalized learning, enhance writing development, foster learner motivation, and streamline teachers' workload through automated feedback, material generation, and assessment support (Law, 2024).

Castany (2025) examined translation classes where AI-generated outputs are compared with human translations to highlight both strengths and errors. These comparisons help students recognize dialectal variation and explore questions of stylistic consistency and lexical accuracy.

Recent systematic evidence reinforces these trends. Li et al. (2025), in a two-year review of 144 empirical studies published between 2023 and 2024, found that research on GenAI in language education has expanded exponentially, changing from exploratory work to more robust, data-driven investigations. Their analysis shows that higher education and EFL contexts continue to dominate the field, with writing, particularly AI-supported drafting and feedback, emerging as the most extensively studied skill. Mixed-methods research has become increasingly common, reflecting a growing interest in understanding how GenAI affects learners' cognitive, affective, and behavioral dimensions.

Recent studies show that GenAI is beginning to influence both the content and format of teaching in management and business education. Csaszar et al. (2025) argue that AI's ability to match or exceed student performance in analytical tasks is pushing business schools toward a strategic rethinking of their pedagogical models, marking a possible "third epoch" of management education. At the student level, Nawaz and Ong (2025) found that postgraduate business learners are not only using GenAI for literature synthesis, academic writing, and research planning but also warn of risks such as diminished critical thinking and ethical uncertainties. In a more applied

context, Meepung (2025) developed and tested a creative learning model integrated with GenAI, demonstrating improvements in innovation-related skills, including creativity, design thinking, problem-solving, and digital literacy among undergraduate students in business and information technology.

In the context of logistics and production engineering education, Reider and Lang (2025) present a system architecture that enables students and practitioners to use GenAI for simulation modeling tasks that would traditionally require deep domain expertise. Their framework combines natural language input with structured modeling tools, allowing users to describe scenarios in plain language, which are then converted into simulation models. This setup lowers technical barriers, making it useful for educational settings where students can experiment with factory planning and logistics without needing advanced simulation skills.

Halliday et al. (2025) conducted a scoping review to explore how GenAI can be incorporated into assessment practices in tertiary psychology education. The review identified three main opportunities: using GenAI as a personal tutor, designing authentic assessment tasks involving GenAI, and asking students to critique AI-generated outputs to build digital literacy and ethical awareness. While only a few studies currently address this topic, the findings suggest that GenAI, if used thoughtfully, can support pedagogical goals without compromising accreditation standards. The authors emphasize the need for evidence-based assessment models that reflect the growing presence of AI in professional psychological practice.

The contributions in this book provide comparative perspectives across different academic cultures and disciplines. By focusing on specific use cases, the chapters avoid abstract claims and instead concentrate on the actual conditions under which GenAI tools are used. The topics range from student attitudes and ethical concerns to writing support, reflective learning, and disciplinary norms. Studies have shown that there is no uniform way in which students adopt GenAI tools, differences appear across subject areas, course levels, and institutional policies (Chamorro-Mera, 2025; Hayes et al., 2025).

Rather than presenting GenAI as either a threat or a solution, this volume collects findings from varied teaching contexts. It offers empirical documentation and structured analysis of GenAI use, emphasizing academic practice over theoretical speculation. Readers will find that the chapters address both the everyday uses of AI tools in higher education and the long-term questions related to educational responsibility, student learning habits, and disciplinary change.

This volume is organized into four chapters that collectively examine the use of GenAI in higher education from interdisciplinary, empirical, and pedagogical perspectives.

Chapter 1 focuses on language education, specifically on German as a Foreign Language, by examining the role of GenAI in addressing German

pluricentrism. It analyzes students' awareness of linguistic varieties and evaluates ChatGPT's capacity to recognize and generate diverse language forms, illustrating how AI tools can support multilingual competence, intercultural awareness, and applications relevant to international business and communication.

Chapter 2 presents the results of a survey conducted among students of STEM disciplines, such as logistics, production engineering, biomedical engineering, and social sciences, such as management and project management. In particular, this chapter shows the results of research relating to students' affective and motivational attitudes toward GenAI in the learning process and to the frequency, scope, and methods of using GenAI tools by students in the learning process, depending on their demographic and educational characteristics. In addition, the relationships between students' attitudes and their intention to continue using GenAI in the learning process and their willingness to recommend it to other students are presented. The results of research on students' perceptions of the impact of GenAI on learning effectiveness, productivity, creativity, and the development of educational and professional competences, while being aware of its limitations and potential risks, were also presented.

Chapter 3 expands on this analysis, focusing on critical thinking skills in the context of AI-assisted learning. Based on an experiment conducted with a group of students majoring in Project Management, this chapter answers two questions:

- Does the use of AI in a long-term teaching project strengthen or weaken students' reflective thinking?
- Does the condition of limited AI use allow for a beneficial balance between technological support and students' intellectual autonomy?

Chapter 4 addresses psychology education and explores students' attitudes, perceptions, and self-regulated learning practices in relation to GenAI. Using the Technology Acceptance Model, the Unified Theory of Acceptance and Use of Technology, and Self-Regulated Learning frameworks, the chapter analyzes ethical reflection, metacognitive awareness, and cognitive engagement as key dimensions of responsible and effective AI-supported learning.

Finally, the concluding chapter synthesizes findings across all empirical studies, providing an integrated overview of how GenAI is being incorporated into higher education. It identifies recurring patterns, disciplinary variations, and shared challenges while reflecting on ethical considerations, cognitive development, and ongoing pedagogical transformation. The chapter concludes by offering evidence-based recommendations for the responsible, reflective, and innovative use of GenAI in academic contexts.

1 Generative AI and German pluricentrism

ChatGPT and advancing language education

According to Statista, approximately 130 million people worldwide speak German as either a first or second language, around 15.4 million people are learning German as a foreign language (GFL), and about 7.5 million people belong to a German-speaking minority. In the USA, 45 million people claim German-speaking heritage, including 1.4 million native German speakers.[1]

For years, Poland has been at the top with 1.95 million learners according to data from 2020.[2] According to Statista, in 2022, more than 846,000 middle school students in Poland were studying GFL. In contrast, the number of elementary school pupils learning German was significantly lower, with nearly 77,000 students enrolled.[3] The results of the study "Deutsch als Fremdsprache in der Welt", presented in Berlin by the German Foreign Ministry in cooperation with Deutsche Welle (DW), the Goethe Institute, the German Academic Exchange Service (Deutscher Akademischer Austauschdienst – DAAD), and the Central Agency for Schools Abroad (Zentralstelle für das Auslandsschulwesen – ZfA) have proved that this number has decreased by 15% since 2015. Despite this declining trend, the German language remains one of the most popular foreign languages in the world.

In German-speaking countries, there are different variants of the language, as German is a pluricentric language. A pluricentric language has

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at least two national varieties (Skubis, 2016a, 2020). Ammon (1995) states that every language can be considered pluricentric if it has several standard variants that are used in different countries, although they do not necessarily need to have the status of an official language.

German is the only national official language in Germany and Austria, whereas in Switzerland it functions alongside French, Italian, and Romansh. On the one hand, there is standard grammar, orthography, and vocabulary, but on the other hand, there are linguistic differences depending on the region in which it is used (Russ, 1994).

Duden (2011) defines the standard variety as "a generally binding language form that stands above dialects, local colloquial languages, and group languages, and can be used in both spoken and written forms". The standard is represented by individuals with established cultural roles within a society.

Ammon (1995) identifies three full centers and four semi-centers of the German language. The full centers are Germany, Austria, and the German-speaking part of Switzerland, each having a linguistic code (also called the linguistic codex or simply codex): the linguistic code is the norm-setting body of a standard variety, usually the easiest to identify, easier than model texts, the corrective behavior of norm authorities, or the judgments of language experts (Retti, 1999).

For each full center of German, the following codes exist (Ammon, 1995):

- The 12-volume Duden series for Germany;
- Österreichisches Wörterbuch für Österreich;
- Unser Wortschatz: Schweizer Wörterbuch der deutschen Sprache für die deutschsprachige Schweiz.

In contrast to full centers, semi-centers do not have codices. In this paper, we deal with full centers, which can be also called national norms or national varieties. The semi-centers of the German language include Luxembourg (where German is a national official language alongside French and Luxembourgish), Liechtenstein (where German is the only national official language), South Tyrol (where German is a regional official language in the province of Bolzano-South Tyrol alongside Italian and, in some areas, Ladin), and the German-speaking community in eastern Belgium (where German is a regional official language in the area of the German-speaking community) (Ammon et al., 2004).

The full centers determine the varieties of the German language, meaning that German has three varieties:

- German variety;
- Austrian variety;
- Swiss variety.

It should also be noted that the spoken standard differs from the written standard in all full- and semi-centers.

National and regional variants play an important role in the process of learning a foreign language. Students should be sensitized to the different variants because, as users of the language, they will often have to deal with various varieties. If they only acquire one variety, they will likely experience a shock abroad. This situation is also illustrated by the words of Ehnert et al. (2000):

> Somewhere in the world they are taught, they learn a German that does not exist. When they come to Austria, Germany, or Switzerland, depending on where they land, they believe they have arrived in a country where the German they thought they knew is not spoken.

The above-mentioned quote reflects the learner's encounter with reality. Skubis (2020, 2022a) emphasizes that the German language should be understood not only as the standard language in foreign language teaching but also as a language with all its national and regional variants. Therefore, teachers should prepare their students for real communication in the real world.

This chapter investigates the role of pluricentrism in DaF education and highlights the need for increased focus on national varieties within language instruction. Through an empirical study comparing the knowledge of German language students and the artificial intelligence (AI) model GPT-5 in recognizing and identifying German national varieties, this research aims to showcase the existing knowledge gap and propose ways to enrich language education. By doing so, the study highlights the importance of exposing students to the full spectrum of German linguistic diversity to foster better comprehension and adaptability in authentic language environments.

Moreover, in the field of management, effective multilingual communication is a key factor in global business success. AI-driven tools such as GPT-5 can be applied to international management, assisting in overcoming language barriers, optimizing translation accuracy in corporate settings, and facilitating intercultural communication. Businesses operating across multiple linguistic regions must ensure consistency in messaging and terminology, which AI can support by providing real-time, region-specific language adaptation.

1.1 CHATGPT AND ITS CHARACTERISTICS

Recent advancements in AI, particularly in natural language processing (NLP), have reshaped human-computer interaction (Botha & Pieterse, 2020; Clayton, 2023; Wołk et al., 2021, 2022). ChatGPT, developed by OpenAI, is a notable example of these advancements, representing a significant step forward in conversational AI. Built on the Generative Pre-trained Transformer (GPT) architecture, ChatGPT uses deep learning models that understand and generate human-like text responses based on user input. OpenAI's training approach combines unsupervised pre-training with supervised fine-tuning, optimizing the model for coherence and relevance in output (Radford & Narasimhan, 2018; Radford et al., 2019; Roumeliotis & Tselikas, 2023). This has led to broad applications in sectors ranging from customer service automation to healthcare (Brynjolfsson et al., 2023; Guo et al., 2023).

OpenAI's best practices for prompt engineering, the process of crafting specific inputs to guide ChatGPT's responses, include using clear instructions, providing examples, and specifying desired formats (Skubis & Kołodziejczyk, 2024; White et al., 2023). Despite its capabilities, ChatGPT also faces challenges, such as mathematical errors, common-sense reasoning issues, and hallucinations – instances where the model generates unsubstantiated content (Bang et al., 2023). These weaknesses highlight the need for ongoing evaluation frameworks and improvements.

From a disciplinary perspective, linguistic applications of AI can be regarded as comparatively low risk for users when contrasted with AI systems deployed in fields such as robotics, autonomous vehicles, or electronics, where software failures may directly endanger human life and health. In language-related AI, typical errors, such as grammatical inaccuracies, imperfect translations, or pragmatic mismatches, remain correctable by human users and do not usually lead to irreversible physical harm. Consequently, linguistics emerges as a relatively safe domain for empirical AI research, provided that human oversight, data protection, and ethical standards are maintained (Skubis, 2020).

Ethical concerns around ChatGPT's deployment are extensive, particularly regarding safety, responsibility, and potential misuse in sectors like academia, where it could enable plagiarism (Skubis, 2021, 2024a; Zhou et al., 2022). In terms of bias, ChatGPT's training data can inadvertently encode social and linguistic biases, leading to potential unfairness and underrepresentation for specific groups (Zhuo et al., 2023).

To mitigate these concerns, Zhuo et al. (2023) emphasize the need for diverse training data and regular updates. Key ethical categories – bias,

robustness, reliability, and toxicity –form the basis for assessing generative AI models like ChatGPT. For instance, robustness requires models to maintain performance under varied inputs, while reliability ensures that the outputs are accurate and current. Transparency, especially in informing users when they are interacting with AI, is also a priority under the EU's AI Act (The European Union, (2024), Artificial Intelligence Act (AI Act). Hacker et al., 2023; Skubis, 2024b).

Regulatory frameworks like the AI Act and GDPR, along with proposals from scholars like The AI Act, categorize general-purpose AI models like ChatGPT as limited-risk AI systems but mandate transparency, especially when users engage with these systems in ways that could lead to misinterpretation or undue influence. These regulatory recommendations also include clarifying roles between AI developers, deployers, and users to ensure shared accountability across the AI lifecycle. In terms of teaching and learning, ChatGPT can be a useful source of information, and in this chapter, we are going to check its ability to deal with German national varieties which are a big obstacle for language learners.

1.2 GERMAN LANGUAGE IN THE CONTEXT OF DAF LESSONS

The consideration of national and other (supra-regional and dialectal) variants is an important aspect of teaching. Language plays a central role in individual, regional, and national identification processes, i.e. language is not just a means of communication, its spectrum is much broader. This is also an important argument in favor of GFL (German as a Foreign Language – DaF in German) lessons but also in GSL (German as a Second Language – DaZ in German).

Pluricentrism is an important aspect of foreign language teaching, but it is still very much neglected and the teaching of German varieties is limited to a few well-known words from the Austrian variety, such as *Paradeiser (A) – Tomaten (D); Erdäpfel (A) – Kartoffeln (D); Obers (A) – Sahne (D); Jänner – Januar; Feber (A) – Februar (D); heuer (A) – dieses Jahr (D); Trafik (A) – Kiosk (D)* (Skubis, 2016b). Standard Swiss German is usually omitted. The concept of German pluricentrism in GFL lessons has been investigated by researchers such as de Cilia (2006), Ransmayr (2006), Hägi (2007), Radzik (2012, 2013), Jarząbek (2013), Skubis (2020), and Utri (2013). The study shows that some approaches to integrating German diversity into GFL lessons and textbooks point to national differences. Nevertheless, the number of these approaches is still insufficient (Skubis, 2022a).