LEVERAGING AI FOR PERSONALIZED INSTRUCTION IN HIGHER EDUCATION: INITIAL FINDINGS FROM THE LEADER AI PROJECT

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Abstract

This paper presents preliminary findings of the LEADER AI, an Erasmus+ project aimed at equipping Higher Education Institutions (HEIs) with guidelines and resources for leveraging AI-based and data-driven tools for personalized instruction. Drawing upon a multifaceted research approach, this study conducted desk research across four diverse countries (Greece, Malta, Italy, and Denmark), as well as focus group and survey research in Greece. Both research tools were designed to elucidate the affordances and challenges associated with the adoption of AI-based and data-driven tools. Results provide valuable perspectives on the opportunities, barriers, and ethical considerations inherent in employing AI-based solutions for personalized instruction in HEIs.

Introduction

The LEADER AI project aims to build the capacity of Higher Education Institutions (HEIs) to personalize digital learning through AI-based tools and data-driven decision making, in order to respond to students' needs, strengths, and skills, through the proper exploitation of advanced technologies. The project's specific objectives are: a) raise awareness about the role of Learning Analytics (LA) and Artificial Intelligence (AI) for personalisation of learning in HE, considering ethical issues; b) develop hands-on resources for the adoption of AI-based and data visualization tools for personalized learning in HE; c) build the digital and pedagogical competences of HE faculty and staff in customizing their teaching using AI-based and data visualization tools; and d) improve the supply of high quality digital learning opportunities in HE. LEADER AI will develop a toolkit with practical guidelines, scenario-based training, and a MOOC with digital resources on how HEIs can use AI-based and data-driven tools and approaches for personalized instruction. As part of the development of the toolkit, the consortium has conducted desk and field research in Cyprus, Greece, Romania, and Portugal. This paper presents the Greek National Report and explores the current state of AI integration in higher education, by employing desk research, focus groups, and questionnaires to uncover the benefits and challenges of AI-driven personalized learning. The paper is organized as follows: the initial section provides a theoretical overview of AI and LA in educational contexts; subsequently, the methodology employed in this research is delineated, leading into the presentation of findings; and finally, the last section deliberates upon these results, drawing conclusions concerning the application of AI and LAs in Higher Education in Greece.

Theoretical Background

Despite the growing realization of the potential for AI in education (AIED), influenced by educational evidence-based policy (OECD, 2021), it has arguably only now transitioned from experiment to practice in educational settings. Moreover, AI is subject of an extensive public discourse, especially after the introduction of ChatGPT and DALL-E, which have both captured our imagination and shocked in equal measure, requiring education to respond to generative AI's growing capabilities. The uptake of these tools has given rise to a debate in education about readiness, ethics, trust, impact, and added value of AI, as well as the need for governance, regulation, research, and training to cope with the speed and scale at which AI is transforming teaching and learning (Bond et al., 2023). As Bond et al. (2023) summarizes in their meta-systematic review of AI in Higher Education, the evolution of AIED can be traced back several decades, exhibiting a rich history of intertwining educational theory and emergent technology. As the field matured through the 1990s and into the 2000s, research explored various facets of AIED such as intelligent tutoring systems, adaptive learning environments, and supporting collaborative learning environments.

After the 2010s, the synergies between AI tools and educational practices have further intensified, boosted by advancements in machine learning, natural language processing, and cognitive computing. During this period, researchers explored chatbots for student engagement, automated grading, and feedback, predictive analytics for student success, and various adaptive platforms for personalized learning, facing various challenges and dilemmas, like the ethical use of AI. In order to gain further understanding of the applications of AI in higher education, and to provide guidance to the field, Zawacki-Richter et al. (2019) developed a typology (Figure 1), classifying research into four broad areas: 1) profiling and prediction; 2) intelligent tutoring systems; 3) assessment and evaluation; and 4) adaptive systems and personalisation.

"Personalisation" is conceptualized as a process where students consciously assume responsibility for their learning process, self-assessing and reorganizing their learning paths and as such, personalized learning is conceived as an individual, student-focused learning, where students become central agents of their learning process (Tsai et al., 2020).

Figure 1

AIED Typology (Zawacki-Richter et al., 2019)

Profiling & Prediction	Intelligent Tutoring Systems	Assessment & Evaluation	Adaptive Systems & Personalization
-Admission decisions & course scheduling -Drop-out & retention -Student models & academic achievement	-Teaching course content -Diagnosing strengths & automated feedback -Curating learning materials based on student needs -Facilitating collaboration between learners -Teacher's perspective	-Automated grading -Feedback -Evaluation of student understanding, engagement & academic integrity -Evaluation of teaching	-Teaching course content -Recommending personalised content -Supporting teachers in learning and teaching design -Using academic data to monitor & guide students -Representation of knowledge

Personalized Learning (PL) is basically the process of modifying teaching and learning based on the learners' profile, in advance, or as the learning process unfolds "a range of learning experiences, instructional approaches, and academic support strategies intended to address the specific learning needs, interests, aspirations, or cultural backgrounds of individual students" (Holmes et al., 2018, p. 15). For example, PL is linked with supervised learning that focuses on students' learning habits and adaptation to new ones (Topîrceanu & Grosseck, 2017), use of adaptive learning environments (Renz et al., 2020), the creation and/or adaption of individualized learning plans for students (Bucea-Manea-Țoniş et al., 2022), the provision of recommendations based on students' psychological profile (Brdnik et al., 2022), and the adaptation of chatbots to the users' language level (Belda-Medina & Calvo-Ferrer, 2022).

When automated technology is used, technology is responsible for the adaptation, where participants' activity and interactions are available through Learning Management System (LMS). Keller et al. (2019) suggested that individually tailored learning outcomes can be achieved through LA that provide students with performance feedback and learning recommendations by uncovering patterns in their individual learning behaviors. With a specific focus on LA in HE and its link to study success, LA are defined as "the use, assessment, elicitation and analysis of static and dynamic information about learners and learning environments, for the near real-time modeling, prediction and optimisation of learning processes, and learning environments, as well as for educational decision-making" (Ifenthaler, 2015, p. 447).

Research Methodology

To address the project objectives, we adopted a mixed-method research to elucidate the affordances and challenges of AI-based and data-driven tools for personalized instruction. Initially, desk research across four countries (Greece, Malta, Italy, and

Denmark) was conducted to understand the current landscape of AI in HEIs and provide answers to the following research questions:

- *What methodologies are followed to investigate the application of PL with AI and data-driven technologies?*
- *What types of AI and data-driven technologies are used and in what way, to implement PL?*
- *Which benefits and challenges of PL with AI and data-driven technologies were reported?*

The desk research focused on research papers published from 2018-2023 in the SCOPUS, EBSCO, Semantic Scholar, and Google Scholar databases. Desk research studies were predominantly from Greece (6), followed by Italy (2), Malta (2), and Denmark (2). Additionally, the research methodology incorporated a focus group session with semi-structured questions involving eight Higher Education staff members and a questionnaire distributed to 50 respondents affiliated with Greek HEIs (teaching and research staff, e-Learning experts, instructional designers, leaders), with 86% of them having a PhD degree.

Results

What methodologies are followed to investigate the application of PL with AI and data-driven technologies?

In the desk research, most studies utilized student-provided information, either directly (e.g., registration), or indirectly (e.g., Moodle). Montebello (2021) employed implicit and explicit data, including browsing history and learning analytics within the platform. Gkontzis et al. (2018) analyzed data from the Hellenic Open University's Moodle, encompassing essays, e-quizzes, and forum threads. Iatrellis et al. (2021) and Agrusti et al. (2020) sourced data from university databases, Carannante et al. (2021) measured students' activity, while Moşteanu (2022) employed qualitative interviews.

Focus group answers revealed a moderated familiarity with concepts like PL, LA, and AI, and a lack of empirical interventions in Greek HEIs, while current practices focus on e-quizzes, course monitoring and use of selective-release criteria with platforms like Moodle. Concerns regarding institutional guidance, potential behavior control, and documented learning benefits emerged, as well. Finally, participants recognized the potential value of educational data, mostly in terms of monitoring rather than personalizing e-courses.

Survey respondents demonstrated a strong familiarity with the terms "personalized learning" and "educational data" and moderate familiarity with "learning analytics" and "artificial intelligence" (Figure 2). Reasons of the low usage (Figure 3) is the lack of university support (33/50, 66%), lack of training (33/50, 66%), lack of university policy (25/50, 52%), lack of adequate infrastructure (23/50, 46%), lack of time (18/50, 36%) and lack of skills (17/50, 34%). Also, 3/50 (6%) of the respondents stated that they use these technologies as a university policy, 29/50 (58%) as beneficial for their students, and 26/50 (52%) for pedagogical purposes. Moreover, they stated that they are using PL and LA for self-assessment, supervised learning, statistical analysis, chatbots, research, and predictive analytics.

Figure 2

Levels of Familiarity with PL, LA, AI and Educational Data

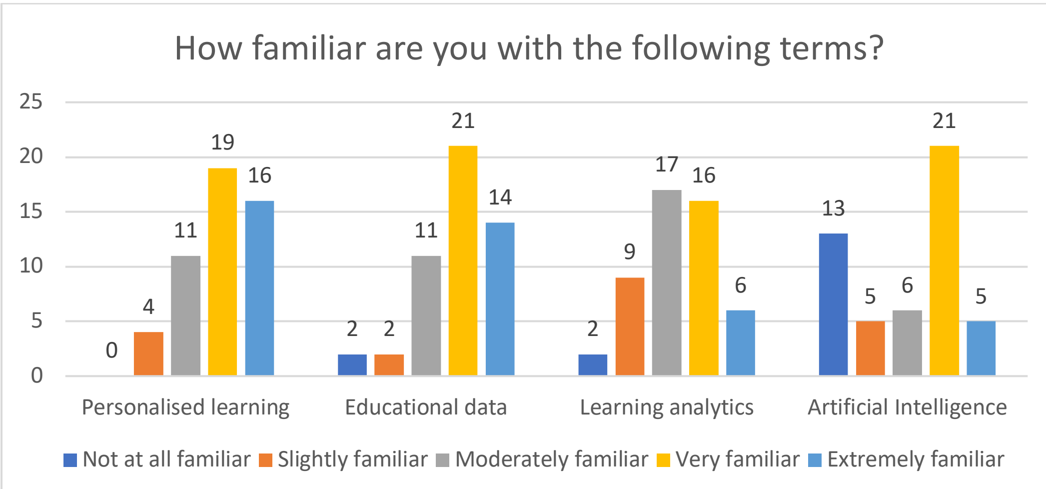
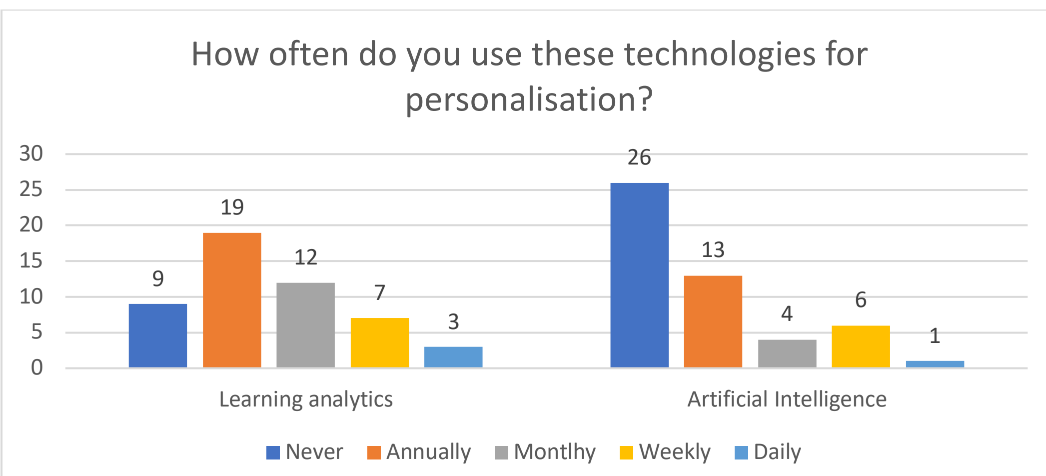


Figure 3

Use of PL and LA for Personalization



What types of AI and data-driven technologies are used and in what way, to implement PL?

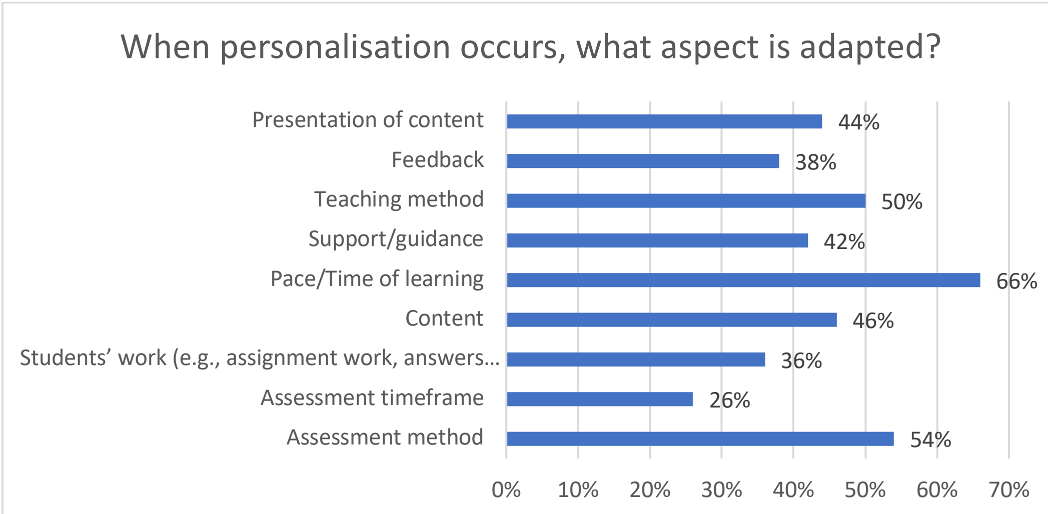
In the desk research, Gkontzis et al. (2018) reported Moodle's Learning Analytics Dashboards for performance visualization. Algayres & Triantafyllou (2020) proposed a personalized adaptive learning model and Iatrellis et al., (2021) used supervised learning. Carannante et al. (2021) employed PLS Path Modeling to analyze the relationship among performance, engagement, and learning. The study by Montebello (2021) focused on a PL environment through the integration of AI machine learning to address e-learning issues such as isolation, motivation, and self-determination. Agrusti et al. (2020) explored dropout prediction using different sets of features related to academic and administrative data.

Participants in the focus group recognised the potential benefits of LA for self-improvement and reflective practices and recommended utilizing log data from LMS and virtual environments, acknowledging their significance. On the other hand, participants stated that actual utilization of these technologies for personalization still remains low due to skepticism and concerns about data privacy and students' discomfort. Participants envisioned AI applications such as automated responses and feedback, yet raised concerns over their credibility and ethical implications, emphasizing the need for responsible implementation. Ethical considerations, technological readiness, and the necessity for practical training were not reported as crucial aspects. Moreover, the need for transparent guidelines for the integration of AI and LA in education were reported as essential for ensuring ethical and effective implementation.

Survey results showed that decision-making is mainly a teacher-driven approach (28/50, 56%) mainly informed by performance metrics (38/50, 76%), data patterns (24/50, 48%) and educational goals (20/50, 40%). Respondents stated that adaptations could occur in the whole course (20/50, 40%), before the instruction (14/50, 28%) and during instruction (15/50, 30%), with adjustments to pace, assessment methods, teaching strategies, content delivery, support and feedback mechanisms (Figure 4).

Figure 4

Types of Course Adaptation



Which are the benefits and challenges of PL with AI and data-driven technologies?

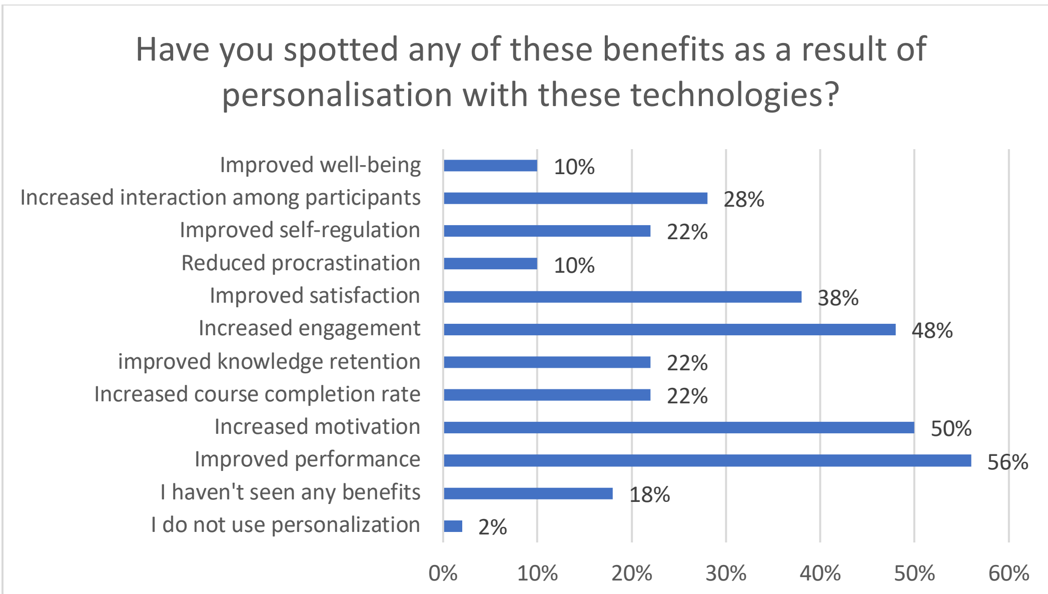
Moşteanu (2022) highlighted the potential of AI and machine learning in various educational aspects, such as admission processes, attendance monitoring, personalized learning, and assisting in evaluation processes. Gkontzis et al. (2018) noted that student participation indicators correlate with educational progress and higher grades, aiding tutors in understanding student characteristics affecting academic achievement. Demetriadis et al. (2018) emphasized benefits like increased online engagement, motivation, innovative pedagogical approaches, and reduced dropout rates through LA. Montebello (2021) suggested compatibility of AI, social networks, and learners' portfolios in enhancing online education. Carannante et al. (2021) highlighted the importance of user actions, frequency, and time spent, as indicators of engagement and study organization. Time-based indicators improved performance measurement, but models combining administrative and academic career features yielded better results than those using administrative features alone.

The results from the focus group pertaining to the benefits and challenges of PL with AI and data-driven technologies revealed a nuanced landscape. While participants highlighted the potential benefits of PL for self-improvement and reflective practices, concerns were raised regarding credibility, ethical implications, and the need for responsible implementation. Machine learning algorithms were identified as promising tools for predictive modeling in student evaluations, although challenges such as data privacy and student discomfort persisted.

Various benefits were reported from the survey, including enhanced academic performance, motivation, engagement, and satisfaction, alongside increased interaction, completion rates, knowledge retention, and self-regulation (Figure 5). Finally, in the open question about challenges of personalization, respondents mentioned increased workload, human isolation, incorrect or irrelevant data, and the lack of technical support, policies, training and infrastructure.

Figure 5

Perceived benefits of personalization



Conclusions

This study aimed to investigate the adoption of LA, AI, data-driven technologies and PL in HEIs in Greece, as part of a transnational research in the framework of the LEADER AI project, conducting desk research as well as focus group and survey research. Results revealed a diverse landscape of methodologies, technologies, and outcomes.

Desk research indicates various methodologies employed, primarily centered around leveraging student-provided information and traditional research techniques rather than direct integration of AI and LA into PL environments. While AI and data-driven technologies are recognized for their potential benefits, such as higher retention rates and enhanced assessment, their integration into PL remains limited, primarily utilized for research purposes rather than practical implementation. Use of these technologies is still in its early stages, with various benefits and challenges associated with these approaches. The studies highlighted the potential of these technologies to provide insights into student motivation, studying patterns, engagement, and performance, as well as to offer personalised support and feedback based on student progress, preferences, and goals. However, the studies also emphasised the need for careful consideration and further exploration of the capabilities, accuracy, ethical implications, and infrastructure requirements of these technologies. Findings from focus group and survey further underscore the cautious adoption of AI and data-driven technologies in PL contexts, while findings from the online survey suggest a familiarity with PL concepts among participants. Despite recognizing the potential benefits, participants expressed concerns regarding credibility, ethical implications, responsible implementation and utilization, due to factors such as lack of support, training, and policy.

Even though results are not generalizable due to limitations to the sample size, this study may contribute to the growing discourse on AI in education by offering insights derived from a multi-country study, thereby informing the development of tailored strategies and interventions to harness the potential of AI for enhancing personalized learning experiences in HEIs. The implication of the findings for policy, practice, and future research are discussed in light of advancing the educational landscape towards greater inclusivity, innovation, and effectiveness through AI integration.

Overall, the research underscores the importance of addressing these challenges to fully realize the potential of AI and data-driven technologies in personalized learning contexts. The findings call for concerted efforts to enhance institutional support, policy frameworks, and technological readiness to facilitate seamless integration. By addressing these challenges, HEIs can harness the transformative potential of AI and data-driven technologies to enhance personalized learning experiences and achieve improved student outcomes.

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