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Towards a call for transformative practices in academia enhanced by generative AI

Research Article

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Abstract: In the present paper, we explore the integration of Generative Artificial Intelligence (GenAI) into the teaching, learning and research practices within the Faculty of Instructional Technologies undergraduate programme at the Holon Institute of Technology (HIT), Israel. Our goal is to examine how GenAI has supported transitions in various courses across three study clusters: core topics related to learning and training, user experience and user interface design (UX/UI), and technological development. Through five case studies from these clusters, we demonstrate how the incorporation of GenAI has enhanced student practices as they conceptualise, design, and create technology-enhanced learning (TEL) tools, systems, and architectures designed to meet real-world needs. In this context, we demonstrate how GenAI integration influences the interrelationship among the three study clusters, thereby facilitating a cohesive approach essential for students developing their capstone projects, which require the integration of knowledge and skills from all courses. This paper situates these efforts within the intelligent-technological pedagogical content knowledge (TPACK) framework, illustrating GenAI's role in TEL. We conclude with recommendations for researchers and practitioners considering the adoption of GenAI to enhance their capabilities in deploying next-generation TEL environments.

Keywords: *Instructional technologies; Artificial intelligence; Generative AI; Technology-enhanced learning; Intelligent-TPACK framework*

Introduction

Integrating generative artificial intelligence (GenAI) into educational practices marks a transformative era in instructional technologies. Technological advancements have revolutionised instructional technologies, evolving from mere facilitators to dynamic catalysts that fundamentally transform educational processes (Kurtz et al., 2024; Winkler et al., 2023). These advancements, underpinned by diverse digital tools and methodologies, have revolutionised how information is conveyed and utilised, enriching educational processes and outcomes (Castro, 2019; Usher et al., 2021). Central to this evolution is the technological pedagogical content knowledge (TPACK) framework, now extended into Intelligent-TPACK, which integrates artificial intelligence (AI) technologies with pedagogy and content knowledge to tailor educational content to diverse learner needs (Celik, 2023; Mishra et al., 2023).

Our study explores the innovative application of GenAI within the Faculty of Instructional Technologies undergraduate programme at the Holon Institute of Technology (HIT), Israel. We specifically examine how these technologies reshape technology-enhanced learning (TEL) by enhancing interactivity, personalisation, and the educational outcomes of both students and lecturers. Our investigation focuses on the way GenAI has supported transitions in various courses across three study clusters within the faculty. These clusters include foundational courses on learning and training principles, design courses focusing on user experience (UX) and user interfaces (UI), and comprehensive technological courses implementing holistic TEL environments. These courses give students the essential knowledge and skills to conceptualise innovative TEL environments and apply them effectively in real-world scenarios.

We have recently made substantial enhancements to our undergraduate programme, including focusing on academic literacy through AI courseware and refined TEL design practices. By embedding GenAI deeply into our teaching and research methodologies, we keep pace with technological advancements and lead their integration into educational practices, preparing students to become creators and innovators in a technology-driven world. By undertaking this

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transformative journey, the faculty is not merely adopting GenAI as a supplementary tool but is embedding it as an integral component of teaching, learning, and research methodologies.

This paper details our approach, which embeds GenAI as a fundamental component of our teaching and research methodologies. We present five case studies demonstrating the integration of GenAI capabilities within the academic courses of our faculty's undergraduate programme. These examples highlight how GenAI improves pedagogical strategies and technological implementations, leading to enhanced academic literacy and more appealing educational content applicable in realistic TELs. We discuss these efforts in light of the TPACK framework, now evolved into Intelligent-TPACK, to critically assess and guide the use of AI technologies in enhancing educational practices.

Literature Review

Instructional technologies represent a dynamic and innovative field at the intersection of education and innovations, aiming to enhance teaching and learning processes (Garrison & Akyol, 2009; Pammer-Schindler et al., 2020). This field utilises digital tools, platforms, and methodologies to create engaging, effective, and accessible educational experiences (Usher & Hershkovitz, 2022). At the core of this mentioned field, instructional technologies are based on the idea that technology can significantly transform the conveyance, understanding, and application of information, thus leading to improved educational outcomes (Malik, 2023; Wekerle et al., 2020). Practices in instructional technologies often involve integrating diverse elements such as tools, systems, and complete educational architectures, which address learning and training settings for schools, universities, and workplaces (Castro, 2019). State-of-the-art approaches in instructional technologies aim to offer educational activities or strategies resulting in effective and appealing learning or training processes that address the realistic needs of the learner (Kohen-Vacs et al., 2019). This field relies on Technology-Enhanced Learning and training (TEL). TEL manifests in forms like platforms, multimedia resources, virtual and augmented reality (AR), and mobile applications, aiming to offer technological support for the educational process, which needs to be aligned with educational requirements (Fonseca, 2019; Shen & Ho, 2020). TEL can be applied to various educationally related contexts, including traditional classrooms and remote learning in blended learning environments, catering to different learning styles and preferences (Kohen-Vacs, 2016; Pammer-Schindler et al., 2020; Usher et al., 2021). As TEL evolves, it continually offers new ways to personalise learning and bridge gaps between educators and learners, preparing individuals for lifelong learning in light of societies experiencing disruptive technological innovations related to the evolution of AI (Palmer et al., 2023). The field of TEL is often explored by communities of researchers addressing the content, educational strategies, and technology used to support or enhance the educational process. In this context, examinations focus on how technology mediates an educational strategy, aiming to conduct teaching, learning, or training effectively and appealingly in each context. One of the main models addressing instructional technologies is the TPACK (Adipat et al., 2023).

TPACK represents a sophisticated approach to integrating technology in education, intersecting three knowledge domains: technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK) (Swallow & Olofson, 2017; Voogt et al., 2016). Central to TEL, TPACK emphasises balancing these areas for effective technology use in learning and training. TK encompasses educators' and trainers' skills in various technologies, PK entails teaching and learning methodologies, and CK involves specific subject matter knowledge. TPACK recognises that effective technology integration in learning and training surpasses the understanding of individual components; it requires their synergistic fusion. This synergy empowers stakeholders to design and deliver content in engaging, innovative, and effective ways, catering to learners' diverse needs (Choi & Young, 2021). As technological advancements reshape educational environments, TPACK serves as a crucial guide for educators and trainers, encouraging them to integrate technology thoughtfully and purposefully, developing relevant and innovative teaching practices for digital-age learners (Mishra et al., 2023; Voithofer & Nelson, 2020).

In the TPACK framework, technological alignment with learners' requirements is emphasised. Before technology deployment, the design and development stages, mainly focusing on UX and UI design, are crucial (Vlasenko, 2022). The design of UX and UI is essential for creating intuitive and engaging experiences tailored to learners' and educators' preferences, aiming to streamline the learning process and enhance outcomes (Miya & Govender, 2022). UI design, concentrating on the visual elements of technology interfaces, is critical for making educational tools accessible to diverse users, regardless of their technical abilities. Effective UX and UI integration strives to lead to inclusive, adaptive learning environments, accommodating various learning styles and ensuring that technology supports, rather than hinders, the learning process (Kurnia & Pujiarti, 2022; Vlasenko et al., 2022). Moreover, well-designed

TEL can enhance digital literacy, fostering confidence in digital tool usage.

Recent evolutions in TEL, particularly with the incorporation of complex architectures involving AI capabilities, mark a shift towards adaptive, personalised learning experiences (Gligorea et al., 2023; Li et al., 2021; Vashishth et al., 2024). Nowadays, AI enhances TEL with capabilities enabling the design, development, and deployment of smart learning environments capable of analysing learner data to offer customised content and feedback catering to individual needs (Cheung et al., 2021; Kataria, 2023). These environments leverage complex, multi-layered architectures with cloud computing, big data analytics, machine learning (ML), and deep machine learning (DML) services. Such architectures enable real-time data processing and decision-making, enhancing learning platform interactivity and responsiveness. AI also facilitates the automation of traditionally time-consuming tasks like grading and progress tracking, allowing educators to focus more on designing optimised learner experiences. The development of GenAI integrated into TEL architectures represents a significant advancement in creating dynamic, effective, and learner-centred experiences.

GenAI represents a transformative evolution in the field of AI. It marks a significant leap from traditional AI methodologies towards more sophisticated, creative, and autonomous systems offering unprecedented opportunities to enhance research and practice in domains related to instructional technologies (Jovanovic & Campbell, 2022; Kurtz et al., 2024; OECD, n.d.; Winkler et al., 2023). The integration of advanced natural language processing (NLP) is at the heart of this progression. In this respect, NLP capabilities have proved imperative for dramatically exploiting GenAI across domains, including those related to learning and training (Dande & Pund, 2023; Shorten et al., 2021). Unlike conventional AI that primarily focuses on understanding and interpreting human language, GenAI goes a step further – it not only comprehends but also generates human-like text, images, and other data forms. This capability stems from breakthroughs in large language models (LLMs), which are intricate algorithms trained on vast datasets of human language (Gozalo-Brizuela & Garrido-Merchán, 2023; Zhao et al., 2023). Generative pre-trained transformers (GPT) rely on such models and are increasingly perceived as excelling at generating coherent, contextually relevant, and often surprisingly creative content (McDermott et al., 2023). By analysing and mimicking the nuances of human language, LLMs empower GenAI with an unprecedented ability to create content that closely resembles human thought and expression. This evolution signifies a major shift in AI's role – from tools that assist in data processing and analysis to sophisticated partners capable of generating novel ideas and solutions, reshaping the landscape of creative and analytical tasks across various industries.

The mentioned evolutions in AI-related technologies required transformations that were suggested for the traditional TPACK framework (Druga et al., 2022; O'Dea & O'Dea, 2023). Specifically, evolutions in teaching, learning, and training practices concerning their adoption of AI-related technologies were reflected in an advanced form of the TPACK framework known as Intelligent-TPACK (Celik, 2023; Mishra et al., 2023). This matured form of the mentioned framework reflects transformations in the evolving landscape of education; the integration of GenAI into teaching, learning, and training practices necessitates a nuanced understanding of how technology, pedagogy, and content intersect (Leahy & Mishra, 2023). The Intelligent-TPACK framework emphasises the synergy of technological, pedagogical, and content knowledge and integrates a critical fourth dimension – ethical understanding of AI tools. This framework offers educators pivotal guidance enabling them to navigate the complex ethical terrains and pedagogical challenges AI presents in educational settings (Eitel-Porter, 2021).

In this paper, we present the ongoing and forthcoming transformations within the undergraduate programme at the Faculty of Instructional Technologies, HIT, driven by advancements in the field of GenAI. We explore how these developments are integrated into various aspects of academic programmes, highlighting their significant role in shaping educational practices. The authors are affiliated with the mentioned faculty and engage in teaching and research in different domains of TEL (Holon Institute of Technology, n.d). Furthermore, we illustrate educational approaches aimed at enhancing creativity and optimising TEL tools, systems, and environments designed, developed, deployed, and explored by faculty staff members as well as by its students. In this sense, we present how the mentioned stakeholders exercise UX as well as UI to enable TEL environments to offer educational approaches that are effective and appealing. Not less importantly, we demonstrate how we exploit AI to enhance courses in the development cluster of studies, using it along the learning process as well to enhance the students' artefacts, resulting in their projects addressing TEL-related aims. For this purpose, we bring a series of examples from across courses and discuss them individually. We also offer a comprehensive view of AI's contribution to transformations recently experienced in academic programmes in the faculty. Consequently, this paper outlines our approach to continuously adopt and adapt AI-related technologies within our undergraduate programme. We discuss the results and explore potential future directions and impacts of these disruptive technologies on the faculty's practices and research.

Overview of Studies at the Faculty of Instructional Technologies

In this section, we describe the practical applications of research and development in the undergraduate programme offered by the Faculty of Instructional Technologies at HIT. This programme is meticulously designed to provide an extensive blend of theoretical understanding and practical expertise in TEL methodologies. We focus on teaching and research efforts exercised within the academic framework of the faculty. An integral component of the programme is the graduation project, structured around three interrelated clusters addressing key instructional technologies domains:

- The Learning and Training Cluster: This cluster lays the foundational knowledge in psychology and learning theories crucial for understanding effective educational practices. Courses in this cluster focus on various topics including those addressing effective presentations, measuring, and evaluating performance, and designing instructional aids and videos. This cluster prepares students for practical application in organisational contexts.
- The interactive Multimedia Design Cluster: Emphasising creativity and design aspects in TEL, this cluster covers UI/UX design, computer graphics, and visual communication. Courses offered in this cluster emphasise knowledge organisation, presentation skills, and interactive learning environment creation.
- The Technological Development Cluster: As the core of the undergraduate programme, this cluster covers new media technologies, computational thinking, procedural programming, and full-stack programming. The processes covered in this cluster also address development in light of various technological innovations including those related to IoT, virtual reality (VR), AR, and mixed reality (MR). Moreover, here we address Humanoid and Social Robotics development and whole environments empowered by GenAI capabilities.

During their studies, students are required to perform two major projects. The first is known as the 'Triangle Project' implying the three aspects it focuses on: learning, designing, and developing originating from materials learned in courses affiliated with the three mentioned clusters. Hence, three courses affiliated to a different cluster collaborate in this project. The process and outcome are supervised, examined, and graded from the individual point of view of a course affiliated with a certain cluster as well as from an integrative point of view reflecting a comprehensive outcome. The triangle project is conducted during the second academic year of the programme.

Additionally, the milestone known as the 'Graduation Project' is performed during the third and last years of studies. This milestone represents a vital component of the undergraduate programmes. Students address real-world challenges presented by actual clients from various industries and organisations from across sectors. This project involves several stages, including discovering stakeholders' requirements, ideation, conceptualisation, design, development, testing, evaluation, and deployment of TEL solutions.

The department's innovative teaching methodologies are complemented by advanced research infrastructures, aiming to support the development of projects conducted during courses and for graduation purposes. Faculty members often integrate projects from courses and graduation projects into their research, contributing insights and innovative ideas back into their teaching practices conducted in learning exercised in the classroom and beyond its boundaries. This symbiotic relationship between research and teaching ensures that imparted knowledge is current and practically relevant.

One of the Faculty's key research infrastructures is the Center for Technological Development and Support, which facilitates faculty collaboration on new tools and technologies, including exploring GenAI capabilities. This centre offers ongoing support for teaching, learning, and research processes mentioned in the previous paragraphs. Additionally, students and staff study at the Faculty's User Experience Lab (Weigelt-Marom, 2020). The lab represents another prominent faculty infrastructure supporting research, teaching, and learning. The lab serves as a student learning facility and a research hub for faculty. Here, faculty members use sophisticated equipment like eye-tracking devices for research projects exploring new methodologies or technologies in educational settings. The lab also explores new directions for integrating AI, particularly GenAI, into its practices.

Problem Definition and Aims

The transformative integration of GenAI into the Faculty of Instructional Technologies undergraduate programme at the HIT poses significant challenges and opportunities. This paper aims to explore and address the multifaceted problems associated with embedding GenAI into diverse educational settings that span the:

1. Courses corresponded to the three clusters, including (1-a) one dealing with core aspects of learning and training, (1-b) another dealing with UX/UI for TEL, and (1-c) a third dealing with core topics in technological development for TEL. For these mentioned courses, we address challenges around effective incorporation of GenAI technologies to enhance educational outcomes. The core issue is determining how these technologies can support and transform learning processes to be more adaptive and personalised. The integration must consider the seamless blend of GenAI with existing pedagogical frameworks, such as the Intelligent-TPACK model, to ensure that technological advancements enrich rather than complicate the learning experience.
2. Capstone Project concluding students' period of studies in which they are expected to demonstrate a how they apply their knowledge and skills in an integrative manner while exploiting of GenAI for benefitting their designed and developed outcome. Here, we deal with creating an environment and project framework that encourages meaningful use of GenAI, aligning with real-world applications while fostering innovation and critical thinking.
3. User Experience Lab serves as both a pedagogical tool and a research environment. The key problem is effectively leveraging GenAI to improve students' educational experiences and faculty's research outcomes. This involves developing methods to utilise GenAI for realistic and relevant UX/UI enhancements, which can be tested and refined within the lab setting.

These challenges are inherently linked to the findings discussed later in the paper, where the successful integration of GenAI across these areas is showcased through specific examples and case studies. These examples highlight how addressing these problems leads to enhanced learning outcomes, more effective pedagogical strategies, and innovative technological implementations.

Methodological Approach Employed for Achieving Aims

This section outlines the methodological approach for considering and implementing aspects of GenAI integration in the faculty's undergraduate programme. For this purpose, we utilise a methodology called 'Discovery of Requirements', described by Alexander and Beus-Dukic (2009). We employ this framework to uncover the requirements needed for integrating GenAI in courses from across study clusters and within the capstone projects conducted by students as a culmination of their learning. Furthermore, we address the integration of GenAI in the User-Experience Lab, which often transforms learning outcomes into research topics of interest to practitioners and researchers in the field of Instructional Technology. Our discovery process includes the identification of stakeholders, data collection, conceptualisation, and development of a prototype concluded by its evaluation and refinement.

Methodology

In this section, we address the cases presented in later sections in light of the guidelines established by Creswell (2014). Our study adopted a qualitative approach to explore the impact of GenAI on educational outcomes across three clusters of study within our undergraduate program. This methodological choice aligns with Creswell's framework for structured and systematic inquiry, allowing for empirical measurement of outcomes through observational data (Creswell, 2014).

A comprehensive stakeholder analysis is critical (Alexander & Beus-Dukic, 2009). Key stakeholders include faculty members, students, and communities of practitioners and researchers who benefit from the faculty's outcomes. Understanding their needs, expectations, and concerns about GenAI about courses, projects, and research efforts conducted within the faculty provides valuable insights into the requirements. In this study, we examined the requirements related to five cases described in Section 'Ethical Considerations'. For each case, we detail the involvement of staff members, students, and external stakeholders. We consider these five cases relevant to all faculty members, as we aim to contemplate GenAI-related transformations across all courses in the undergraduate programme.

Consequently, the remaining faculty members (30) are considered potential and immediate beneficiaries of insights and recommendations that emerge from all the cases. All the cases presented in Section 'Ethical Considerations' are relevant to all students in the undergraduate programme, numbering approximately 300. Additionally, the cases involve 20 external practitioners and educational technology researchers collaborating with HIT on innovative educational projects.

Data collection

We collected data addressing the implementation of TEL cases enhanced by GenAI used among lecturers and students in our undergraduate programme. We will provide an elaboration on these cases in a later section (Kurtz & Ben-Aharon, 2023; Lang & Siemens, 2021).

We conducted the data collection through semistructured interviews with 10 lecturers directly involved in the application of the educational efforts aimed at transforming learning content and outcomes into a result enhanced by GenAI. All interviews were designed to qualitatively assess the influence of GenAI on student learning outcomes and the creation of academic artefacts.

The lecturers reflected on the integration of GenAI across the five distinct case studies, including:

- Enhancing academic literacy through innovative AI courseware: three lecturers were involved, providing insights into the effectiveness of GenAI tools in enhancing academic literacy.
- GenAI-augmented design practices for enhancing TEL: two lecturers discussed how GenAI contributed to the design and personalisation of technology-enhanced learning (TEL) environments, while emphasising UI/UX aspects.
- Technological development integrated with GenAI capabilities: two lecturers, including one who also participated in the GenAI Enhancing a Dashboard for TEL-Related Studies case, offered feedback on the integration of GenAI in developing advanced technological solutions.
- Promoting social inclusion: AI-enhanced learning: two lecturers evaluated their overall experience conducting students' projects that addressed the role of GenAI in fostering inclusive learning environments.
- GenAI enhancing a dashboard for TEL-related studies: two lecturers assessed the analytical capabilities brought by GenAI exploitation in the faculty's user-experience lab, used for assessing TEL artefacts developed by the staff members and students.

Each lecturer provided a structured evaluation of student artefacts and outcomes, focusing on the enhancements attributed to GenAI applications. This approach allowed for an empirical assessment of GenAI's impact, consistent with Creswell's emphasis on systematic inquiry in research (Creswell, 2014).

Conceptualisation and development of a prototype

Following data collection, we conceptualised and developed a prototype concept described in each case in the subsequent section. Each example presented in the Section 'Ethical Considerations' is examined as a seed containing educational methods integrated with GenAI, potentially applicable in other courses and capstone projects. Moreover, the concept illustrating the User Experience Lab is brought forward as we consider its new technological enhancements valuable for contributing to research efforts across projects conducted in our faculty.

Concept evaluation

In each case, we included an evaluation of the described concept. The objective is to develop and refine GenAI-enhanced educational approaches applicable across courses, projects and research conducted in the undergraduate programme. This involves iterative testing and feedback to ensure the efficacy and relevance of the GenAI applications in enhancing educational outcomes.

Ethical Considerations

All cases discussed in this paper, as detailed in the Section 'Outcomes Reflected from Examples Cases Implemented in the Undergraduate programme', including courses, capstone projects and educational and research practices conducted in the User Experience Lab, have been reviewed and approved by the curricular requirements of the HIT and the Faculty of Instructional Technologies. These cases have been meticulously designed to align with the educational objectives and standards prescribed by the respective curricula committees, ensuring that each initiative is pedagogically sound and ethically responsible. Furthermore, approval for all the cases outlined – including those related to courses, capstone projects and practices within the User Experience Lab should comply with regulations from ethics committees at both the institutional and faculty levels. We ensure that all educational and research activities discussed in this paper comply with the rigorous ethical expectations of our academic institution.

Outcomes Reflected from Example Cases Implemented in the Undergraduate Programme

As part of our initiative, staff members and students at the faculty exercised a systematic examination and consideration of motivations for which GenAI should be introduced in courses and research conducted in the faculty. One of the prominent elicitations of these efforts was led by Kurtz et al. (2024), which exercised the specification of requirements addressing courses from across study clusters (Alexander & Beus-Dukic, 2009; Kurtz et al., 2024). Specifically, they invited a team of outstanding students affiliated with an accelerated track of studies (aimed at exceptional students) to be involved in this specification process. Hence, they were involved in a development process concerning the guidelines of faculty members while addressing GenAI-based integration to the core of the studies in the faculty. In their efforts, they emphasise the informed and critical integration of GenAI while maintaining and fostering the values of creativity, ethics, and academic excellence as part of teaching and learning practices in the faculty. The rationale behind this initiative was (and still is) to harness the potential of GenAI to enhance the student's learning experience. Here, we offer examples of students' scenarios and offer recommendations for future projects of this type (Kurtz & Ben-Aharon, 2023). In the following subsections, we present five case studies that illustrate the integration of GenAI capabilities within the academic courses offered in the undergraduate programme at our Faculty of Instructional Technologies. These case studies exemplify how GenAI has been effectively harnessed to enhance teaching and learning processes, showcasing its transformative impact on our curriculum.

Enhancing academic literacy through innovative AI courseware (Aim 1-a)

The course known as 'Academic Literacy' was addressed by Reznik and Elnekave (2024) as they supervised a graduation project. There they focused on examining approaches to introduce GenAI to the mentioned course. This mandatory course is part of the learning and training cluster of studies. The course offers students rich opportunities to develop essential skills for success in higher education. It focuses on reading, understanding academic texts, effective writing, critical analysis, essay summarising, and upholding academic integrity. The course recently incorporated GenAI tools as part of the faculty's efforts to shift from traditional teaching methods to advanced educational strategies. Hence, approaches that prominently exploit innovative technologies, including GenAI, were (and still is) principally addressed. Two students took part in this effort as part of their graduation project. There, they exercised their efforts and redesigned the course to include GenAI, creating courseware for teaching GenAI fundamentals adapted for students without prior AI knowledge. The designed, developed, and deployed courseware was exercised after discovering and accounting for techno-pedagogical requirements reflecting the faculty's curriculum. The discovery of requirements was exercised while addressing needs stated by course lecturers, indicating that courseware was integrated with the specified features they recommended. The courseware resulted in several topics, starting with an introduction to AI, its types, and their applications in light of the theme focused in the course. Moreover, students learned how to formulate effective prompts that serve their academic aims.

The courseware includes an interactive narrative format where students explore in the virtual while questioning a virtual AI expert named Michael (See Figure 1).

During the implementation phase, which was conducted as part of the graduation project, a formative assessment was conducted to gauge the effectiveness and utility of the new syllabus and courseware. The lecturer and the final project supervisors reviewed the

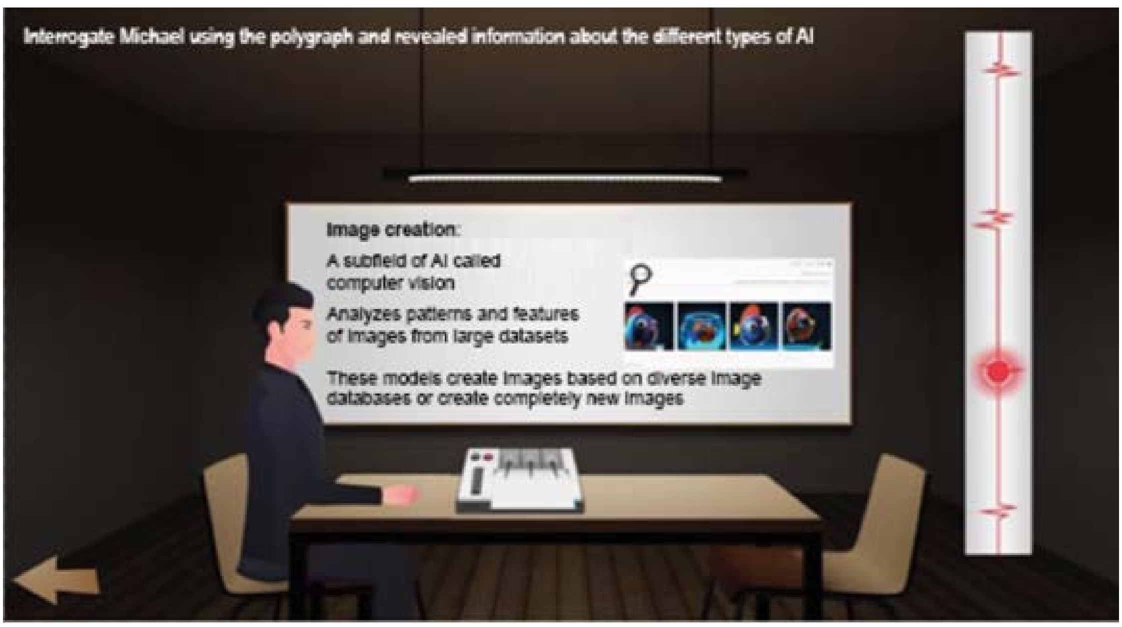

Figure 1: Courseware screenshot showing learners using a polygraph tool to question Michael, uncovering details and illustrations on various AI types by dragging a red dot along an axis. AI, artificial intelligence.

course syllabus. Totally, 14 participants evaluated the innovative courseware, including 11 students and 3 lecturers from the Faculty of Instructional Technologies. Feedback revealed a positive UX, with participants particularly enthusiastic about the narrative framework and the inclusion of gaming elements in learning. Two lecturers noted the potential for this product to benefit students beyond the Academic Literacy course. Overall, the assessment responses underscored the product's effectiveness and efficiency in facilitating an understanding of the capabilities afforded by GenAI.

GenAI-augmented design practices for enhancing TEL (Aim 1-b)

As part of the cluster of studies focused on Multimedia Design, the programme includes a course equipping students with knowledge and tools enabling them to address UX and UI in TEL tools, systems, and environments developed as part of the course, its corresponded project, and its outcomes. The curricula now encourage Project-Based collaboration among students, leveraging GenAI to enhance creativity and skills related to critical thinking while exercising the design of TELs. Furthermore, a methodology emphasising requirement discovery and stakeholder detection optimises concepts into vibrant artefacts tailored to realistic settings (Forsgren & Schröder, 2023).

In Figure 2, we present the workflow across design cluster courses, emphasising collaborative project-based modes enriched by GenAI and reflecting the evolution and innovation within the instructional landscape.

The workflow includes brainstorming and research supported by AI prompting used for consultation purposes, followed by design and production exercised with GenAI tools capable of facilitating the design process. This process commences with brainstorming targeting the graphical concept followed by a research phase enabling students to support their visual concepts with previous ones used as exemplars. Next, students shift to the actual design and its maturity to a production state. Finally, students conduct an evaluation occasionally exercised in a peer assessment mode. In some cases, the workflow is iterative as students are required to refine and further mature their outcomes. Subsequently, GenAI supports students in creating a visual language that is coherent, efficient, and appealing and effectively serves educational purposes.

Furthermore, GenAI is employed by students to translate their visual language seamlessly into effective UIs. In subsequent stages, GenAI is instrumental in achieving optimised integration within the technological solutions developed by students. While working on using GenAI, students are frequently tasked with employing GenAI in prompt writing activities, which we consider alternative forms of representation catering to various desired outcomes, including visual language aligned with the desired design styling. Our preliminary insights suggest that educational activities involving GenAI prompt writing tasks significantly enhance students' skills and knowledge in design-related domains. We underscore this approach as a valuable contribution to a community of educators seeking innovative ways to integrate GenAI-augmented design instruction for educational purposes.

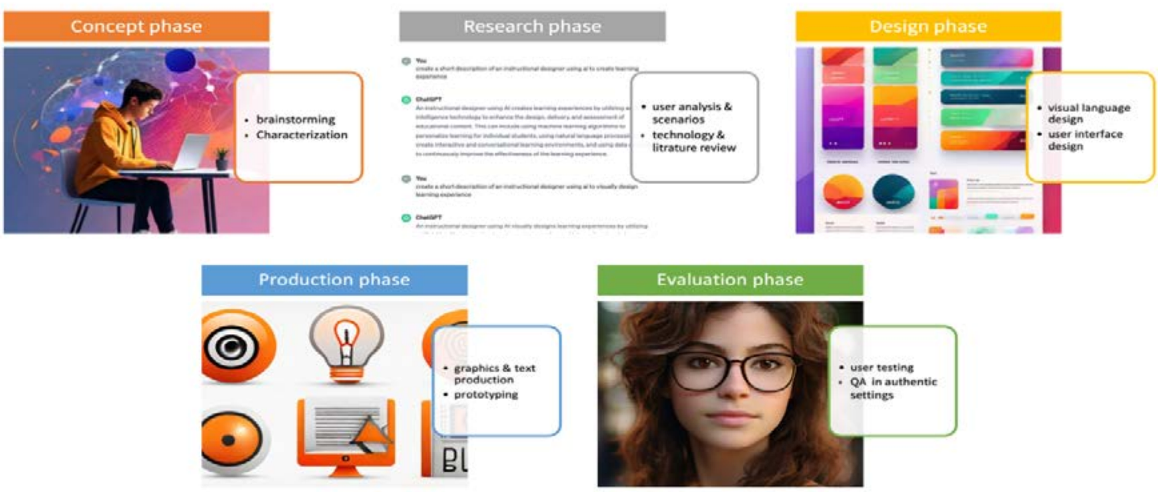

Figure 2: Phases of a workflow for design courses exercised with GenAI-augmented practices. GenAI, generative artificial intelligence.

Technological development integrated with GenAI capabilities (Aim 1-c)

In the Technological Development Cluster, students attending their third year of studies undertake an advanced programming course. They are required to integrate various skills acquired in previous years, including procedural programming and object-oriented programming (OOP), to create comprehensive architectures. These architectures are integrated with databases and controlled through Microsoft .NET 8. A key aspect of this course is learning to enhance these architectures with GenAI capabilities accessed via Representational State Transfer Application Programming Interface (REST API), explicitly focusing on OpenAI's features. Students are taught to enrich their development projects with responses from OpenAI services, including texts and images. Considering the upcoming evolutions offered by the Sora service offered by OpenAI, we believe future activities will include accounting capabilities for generating videos by AI.

Figure 3 illustrates the technological architecture developed by the students.

As shown in Figure 3, students develop the user client, including its UI, as part of their UX and UI design studies, using HTML5, CSS, and Bootstrap. They also integrate a JavaScript module to send prompts to and receive responses from the middleware, the.NET controller. This middleware facilitates communication with other services, including the OpenAI API, as depicted in the architectural overview. This integration allows students to utilise GenAI services, particularly those offered by OpenAI, to enhance their technology enhanced learning (TEL) projects with more prosperous and more engaging interactions. The following example will illustrate how this architecture is applied in a graduation project.

Promoting social inclusion: AI-enhanced learning (Aim 2)

In this example, we address the ongoing intents of researchers and practitioners to explore mobile and seamless learning (MSL) for promoting continuous learning across diverse contexts. This approach adapts to education in flexible conditions, potentially mirroring real-life situations (Kohen-Vacs & Amzalag, 2023). Educational experiences supported by MSL may assist older adults in coping with challenges related to their risk of being socially excluded. Often, social exclusion may occur as older adults cannot engage in instant messaging (IM) in ways common among other groups in the general population. Specifically, one of the common approaches to using IM includes text accompanied by emoji symbols, reflecting, or enhancing the emotions people try to convey. To alleviate this challenge and foster social inclusion among older adults, we present an educational experience supported by the senior emoji trainer (SEmoT), a mobile web application. There, we offer AI-enhanced learning and training for older adults (above 65-years-old) interested in integrating emoji language into their IM practices. The design and development of SEmoT was conducted as part of a

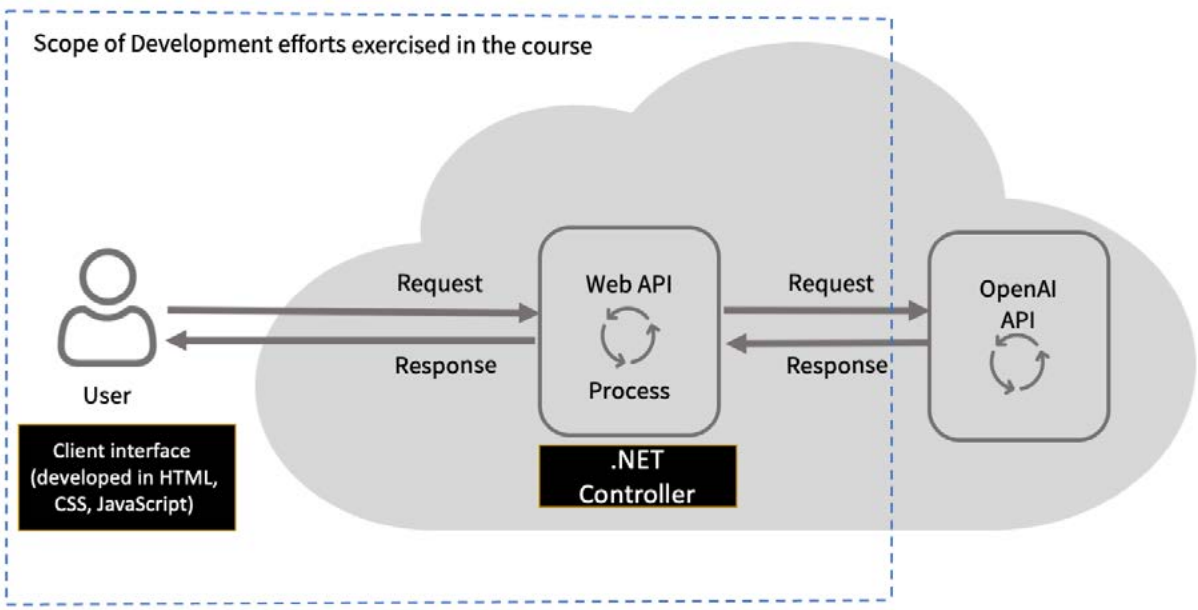

Figure 3: Overview of the course's architectural scope, developed by students.

graduation project. Through this application, we offer a learning and training experience in a realistic IM environment resembling the UX and UI found in social network services (SNS).

SEmoT facilitates older adults' learning and training experiences while enabling them to practice texting incorporated with emoji language with various types of virtual actors, each representing a different context of conversation (see Figure 4)

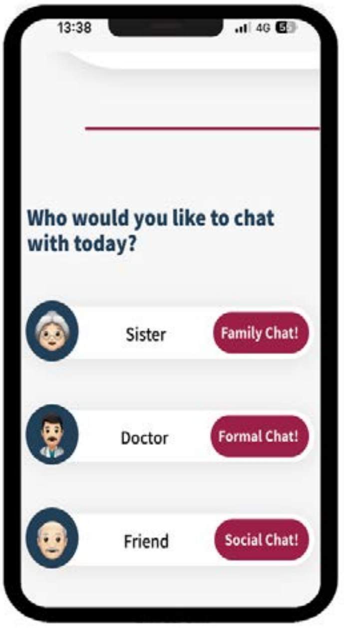

Figure 4: SEmoT application offering training through IM with various types of virtual actors. IM, instant messaging; SEmoT, senior emoji trainer.

SEmoT includes learning and training conducted in an environment in which its UI and UX aspects are customised to preferences occasionally needed by older adults. SEmoT's AI-supported feature simulates authentic conversations, utilising OpenAI's NLP capabilities. Hence, a texting session incorporated with emojis, which is technologically supported by NLP capabilities, enables reflection of various contexts of conversations conducted with the mentioned virtual actors. These capabilities are supported by a technological architecture described in example #3: SEmoT is developed as a client communicating to OpenAI API services through a dedicated controller. We aspire to ensure AI-enhanced learning and training addressing authentic requirements to foster social inclusion for older adults. We conducted an experiment and deployed SEmoT among 30 older adults with ages above 60 (their average age was 69.5-years-old). After using SEmoT to teach them to use emoji Language, they were asked to fill in a questionnaire. The findings from their answers revealed overall positive perceptions concerning the effectiveness of the learning process offered by the application, including the effectiveness of the educational feedback provided during the process by SEmoT.

Additionally, the findings revealed their overall positive opinions concerning SEmoT's UX and UI offerings. We find these initial results promising. In our upcoming work, our goal is to enhance and polish the educational features provided by SEmoT. We plan to expand the definitions of MSL characteristics to include aspects of AI capabilities.

GenAI enhancing a dashboard for TEL-related studies (Aim 3)

In this example, we focus on the practices employed at the User Experience Lab affiliated with the faculty (Weigelt-Marom, 2020). Specifically, we address a student's 'Xsenso' project, aiming to provide a comprehensive dashboard for the aspects measured in the lab and the insights we integrate to be proposed by AI capabilities. As mentioned, the lab is frequently used to examine and explore various technologies, including those emerging from projects conducted by staff members and students in the faculty and beyond. The lab uses multiple sensors, including galvanic skin response (GSR), pulse rate, and eye-tracking sensors, to gather numeric data related to user emotions, physiological responses, eye movements, and visual attention.

This data is then consolidated and presented on a customised dashboard, 'Xsenso', designed and developed by students supervised by staff members conducting their graduation project at the faculty (see Figure 5).

The dashboard provides insights into the nature and quality of the educational experience within the TEL environment. Following data collection, the information from different sensors is organised on the dashboard along a common timeline. AI then analyses and processes the dataset to generate a quick yet in-depth comprehensive overview of the results. This approach allows for a better understanding of study results and enables refining the TEL environment. The AI analysis, which is beyond the dashboard's abilities, particularly focuses on detecting challenges related to UI and UX, aiming to enhance the overall UX in TEL environments. We believe the preliminary examples presented at the conference will serve as a foundation for expanding the AI-enhanced dashboard with additional testing and study opportunities. This effort is undertaken as we envision a comprehensive architecture, including the dashboard, optimised for TEL communities seeking a

Figure 5: 'Xsenso' dashboard.

practical approach to exploit data from users undergoing a learning process to improve educational artefacts and approaches. In our forthcoming endeavours, we intend to continue integrating more sensing capabilities and improving the AI-enhanced means to conduct data analysis, as well as offer real-time recommendations for enhancing the capabilities of the TEL artefacts developed by staff and students in the faculty we examine in the lab.

Summary and Discussion

In this paper, we present an overview of our transformative journey in TEL-related practices, primarily driven by integrating GenAI and other advanced technologies into the Faculty of Instructional Technologies undergraduate programme. This exploration underscores the faculty's dedication to adapting to and pioneering the integration of technological innovations into TEL-related frameworks. In this description, we aim to illustrate the faculty's commitment to staying at the forefront of instructional technology and its potential applications in the education sector. As mentioned, the undergraduate programme is designed to provide a blend of theoretical knowledge and practical expertise in TEL. It focuses on capacitating professionals who can contribute innovatively to the dynamic field of educational technology. The curriculum is divided into three main clusters: Learning and Training, Interactive Multimedia Design, and Technological Development. Each cluster addresses critical aspects of instructional technologies and prepares students for real-world challenges.

Furthermore, we firmly believe the combined knowledge and skills students acquire in these clusters are essential in creating an outstanding professional capable of coping with new required skills in the age of AI. A significant part of the transformations we aspire to in the curriculum concerns incorporating teaching and learning practices into potentials offered by GenAI. Unlike conventional AI, which focuses on understanding and interpreting human language, GenAI extends its capabilities to generate human-like text, images, and data forms. This advancement stems from breakthroughs in LLMs and has dramatically reshaped the role of technology in education, particularly in the aspects of content creation and pedagogical approaches (Gozalo-Brizuela & Garrido-Merchán, 2023; Wen, 2023; Zhao et al., 2023).

By presenting five case studies of such transformations, we illustrated our approach of embracing GenAI both as a tool and as a transformative element in reshaping instructional practices and research in the field of instructional technologies. This integration aligns with the TPACK framework and its matured form known as Intelligent-TPACK (Celik, 2023), addressing the evolving landscape of technology-enhanced learning (TEL) in the age of GenAI.

We suggest that the introduction of GenAI disrupts traditional relationships within the TPACK framework, compelling educators to reconsider their teaching practices and the ways students learn, both intentionally and unintentionally. In this sense, we propose considering an additional aspect concerning the transformations of the content itself in light of AI-related technologies. Accordingly, we suggest that the recent evolutions provoked by these innovations disrupt the traditional balance of elements in the Intelligent-TPACK framework. We advocate that the content aspects that were traditionally considered passive, requiring to be addressed by educational strategies and enhanced by instructional technologies, changed their nature into vivid and dynamic forms of knowledge requiring a different type of addressing by the stakeholders addressing educational strategies as well as by the those exercised development or technological implementation used for mediating it. We argue that AI can facilitate personalised learning experiences, provide real-time data-driven insights, and create dynamic learning environments that adapt to individual learners' needs. This content alteration through AI technologies resonated with Marshall McLuhan's well-known assertion that 'The medium is the message' (McLuhan, 1964), implying that AI not only delivers content but actively transforms it. The medium, in this case, AI technologies, alters the scope and form of the content, influencing how learners perceive and understand it. For example, AI-driven learning platforms transcend the traditional role of information delivery by creating personalised learning environments tailored to individual learning styles, paces, and preferences. Consequently, GenAI impacts both the content (what is learned) and the pedagogy (how it is learned), vividly illustrating McLuhan's notion that the medium shapes the educational experience. AI technologies are not neutral tools but active agents shaping educational experiences, linking the nature of the content to the characteristics of the employed technology. Accordingly, we foresee that these disruptions between content, education, and technology may require rethinking the educational strategies in the age of AI.

We conclude with a call to action for educators and professionals in this field to embrace a flexible, innovative, and critical approach toward incorporating AI technologies into learning and teaching processes. This approach underscores the need for creativity and critical thinking in deploying these tools, ensuring they enhance rather than overshadow educational experiences. A proper response to this call may pave the way to a new educational approach that prepares students for the challenges of the digital age, ensuring that they are not only consumers but also creators and innovators of technology in their own right. The integration of GenAI into higher education represents a critical inflection point, necessitating the development of new practices to maintain the relevance and effectiveness of teaching and learning environments.

As outlined by Kurtz et al. (2024), GenAI offers transformative potential for educational settings, promising to enhance academic literacy, foster personalised learning experiences, and equip students with necessary future skills through sophisticated AI-driven platforms. To leverage these advancements responsibly, institutions should adopt innovative teaching strategies that transcend traditional pedagogical methods. The implementation of GenAI in curricula should not only focus on technological enhancement but also on promoting critical thinking, ethical reasoning, and creative problem-solving. Furthermore, higher education institutions should foster environments that encourage the ethical use of GenAI, integrating these technologies in ways that respect academic integrity and promote a culture of continuous learning and adaptation. By doing so, they will create resilient educational systems prepared to handle future technological disruptions and meet the evolving needs of students and society at large. This holistic approach ensures students are active participants in their educational journeys, well-equipped to navigate and shape a future where AI is ubiquitous.

This call to action for developing new educational practices in higher education underscores the urgency for strategic planning and collaborative efforts among educators, policymakers, and technologists. It is through these collective efforts that the potential of GenAI can be fully realised, transforming the educational landscape into one that is more inclusive, effective and aligned with the demands of the digital age.

Strategic Directions for Future-Ready Education Incorporated with GenAI

As we embark on integrating GenAI into the fabric of higher education, it is imperative to adopt a strategic approach that not only anticipates future educational needs but also actively shapes them. Our proposed strategic directions aim to foster an educational ecosystem that is dynamic, ethical, and aligned with both academic and industry standards, thus ensuring that our graduates are well prepared for the evolving job market and societal needs. In this sense, we continue and elaborate with several aspects and considerations that deserve addressing with respect to these mentioned directions:

• Addressing Ethical Framework adapted for the age of GenAI: Developing an ethical framework for GenAI applications in education is crucial. This framework should address key concerns such as data privacy, bias minimisation, transparency, and the overall impact of AI technologies on student learning and well-being. We advocate for the establishment of a committee dedicated to the ethical use of AI, comprising educators, ethicists, students and external stakeholders, to ensure that our GenAI initiatives are in harmony with our core

educational values and societal norms.
• Enhancing Industry–Academia Collaboration: To make educational practices more relevant and applicable to real-world scenarios, fostering partnerships with industry leaders in the technology sector is essential. These collaborations can provide practical insights into the evolving technological landscape and help tailor our curriculum to include hands-on learning experiences with GenAI tools, preparing students for the demands of the future workplace. Additionally, these partnerships can facilitate internships, joint research projects and guest lectures, enriching the student learning experience and keeping the curriculum at the cutting edge.
• Adapting to Technological Trends: The rapid evolution of technology necessitates continual curriculum updates to include emerging tools and methodologies. Incorporating modular courses or workshops focused on the latest GenAI developments can provide students with up-to-date knowledge and skills. Moreover, adopting a flexible curriculum design that can quickly adapt to new technologies will be vital in maintaining the relevance and efficacy of educational offerings.
• Sustained Professional Development: Implementing GenAI in the classroom requires that educators are not only aware of these technologies but are also proficient in using them effectively. Ongoing professional development programmes should be established to help educators integrate GenAI tools into their teaching practices creatively and effectively. These programmes should include training sessions, workshops and access to GenAI resources, ensuring that teachers are well equipped to guide students in a technology-enhanced learning environment.
• Long-term Impact Studies: To systematically understand the impact of GenAI on learning outcomes, conducting long-term studies is essential. These studies should assess how GenAI tools affect various aspects of education, including student engagement, learning efficiency and the development of critical thinking skills. Insights from these studies will inform continuous improvements in our educational strategies and technology integration, ensuring that the benefits of GenAI are maximised and its challenges are effectively addressed.

In this section, we addressed strategic vision not only reflects a commitment to academic excellence and ethical responsibility but also highlights the importance of proactive adaptation to technological advancements. By following these guidelines, the educational sector can lead in the responsible adoption of GenAI, fostering an environment where technology enhances educational outcomes while preparing students for the future dynamically and ethically.

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