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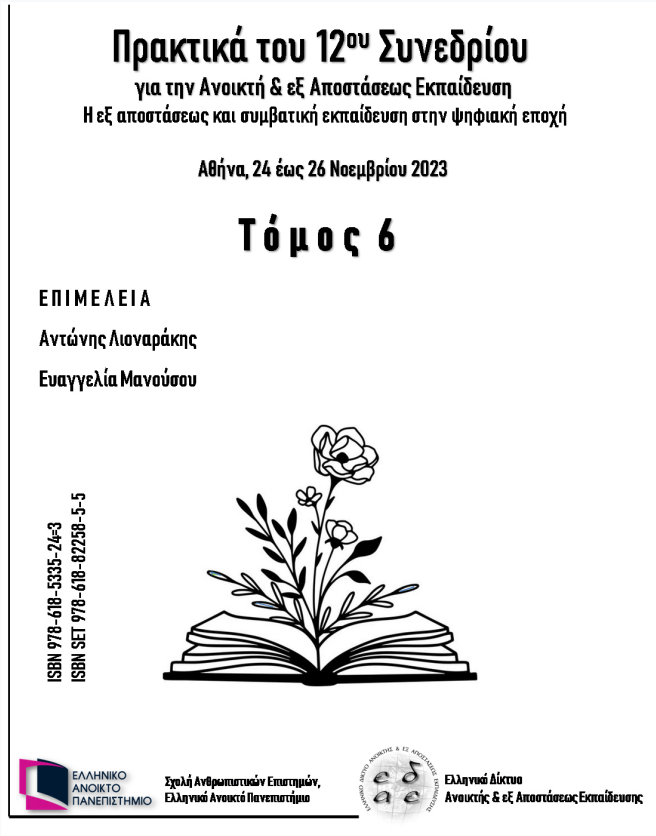
ICODL2023



Decentralisation and Generative Artificial Intelligence in Higher Education

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doi: 10.12681/icodl.5647

Αποκεντροποίηση και τεχνητή νοημοσύνη στην τριτοβάθμια εκπαίδευση

Decentralisation and Generative Artificial Intelligence in Higher Education

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Περίληψη

Ο εκπαιδευτικός σε ένα σύγχρονο τριτοβάθμιο εκπαιδευτικό ίδρυμα οφείλει να είναι ενημερωμένος και εξοικειωμένος στη γνώση του επιστημονικού του πεδίου, στη γνώση της διδακτικής μεθοδολογίας, των τεχνικών και των εργαλείων του γνωστικού αντικειμένου που διδάσκει. Είναι απαραίτητη η ανάληψη σχετικών πρωτοβουλιών όχι μόνο από τους διδάσκοντες, αλλά και από τα τριτοβάθμια ιδρύματα με στόχο την αναβάθμιση της παιδαγωγικής διάστασης του ρόλου των καθηγητών και την κατάρτισή τους σε θέματα διδασκαλίας και μάθησης, ιδιαίτερα σε εξ αποστάσεως μαθησιακά περιβάλλοντα. Σκοπός της εργασίας είναι η ανάξειδη της αναγκαιότητας της συστηματικής επιμόρφωσης των διδασκόντων της τριτοβάθμιας εκπαίδευσης στο εξελισσόμενο πλαίσιο της τεχνητής νοημοσύνης και πιο συγκεκριμένα σε τέσσερις άξονες: Blockchain και αποκεντροποίηση στη δια βίου Εκπαίδευση, Τεχνητή Νοημοσύνη στην εξ αποστάσεως εκπαίδευση, Προσωπικά περιβάλλοντα μάθησης και Πανεπιστημιακή Παιδαγωγική. Οι νέες προοπτικές φαίνεται να είναι δυναμικές και προβλέπεται να δημιουργήσουν αλλαγές στην εσωτερική μεταρρύθμιση των δομών της τριτοβάθμιας εκπαίδευσης καθώς και στο περιεχόμενο της διδασκαλίας, στον τρόπο και στις μεθόδους διδασκαλίας, στις σχέσεις μεταξύ διδασκόντων και διδασκόμενων αλλά και σε θέματα αξιολόγησης.

Λέξεις-κλειδιά

Τεχνητή νοημοσύνη, blockchain, αποκεντροποίηση, προσωπικά περιβάλλοντα μάθησης, πανεπιστημιακή παιδαγωγική

Abstract

The educator within a modern higher education institution must be informed and be familiar with the latest knowledge of the scientific field he/she treats, as well as knowledge of the teaching methodology, techniques and tools of the cognitive subject he/she teaches. It is necessary that relevant initiatives are taken not only by educators, but also by tertiary institutions, with the aim of upgrading the pedagogical dimension of the educators' role, as their training in teaching and learning is crucial, particularly in distance learning environments. The aim of this paper is to showcase the innovative use of emerging technologies in higher education and the necessity for systematic training of higher education teachers in the evolving context of these technologies. We explore four main areas of innovation in higher education: Decentralisation and Blockchain in Lifelong Learning, Generative Artificial Intelligence in Distance Education, Personal Learning Environments and University Pedagogy. The new perspectives of these innovation areas are highly dynamic and can potentially transform higher education structures, the content of teaching, the ways and methods of teaching, the assessment methods, as well as the relationships between educators and students.

Keywords

Blockchain, Decentralisation, Lifelong Learning, Generative Artificial Intelligence, Personalised Learning, Personal Learning Environments, University Pedagogy.

Introduction

In recent years, the landscape of education has witnessed a remarkable paradigm shift driven by the rapid evolution of several emerging technologies. Most notably, Blockchain technology, with its secure and transparent nature, and Generative Artificial Intelligence (AI), with its ability to create and adapt content autonomously, have emerged as transformative forces poised to reshape the foundations of education. In this paper, we delve into these cutting-edge technologies and explore

their potential to revolutionise how knowledge is acquired, disseminated, and personalised.

A *Blockchain* is a publicly shared immutable ledger, which uses crypto-currency techniques to minimise any security risk. This technology offers a decentralised peer-to-peer infrastructure, where privacy, secure archiving, consensual ownership, transparency, accountability, identity management and trust are built-in. Blockchain technology can act as a provenance protocol for sharing data across disparate semi-trusting organisations, without the need for any central control.

The first Blockchain was conceived by Nakamoto (2008) as the basis for Bitcoin, the most well-known Blockchain-based cryptocurrency. The value of Blockchain technology at documenting, verifying, and sharing data across diverse stakeholders can be a particularly valuable asset in today's fast-pacing economy, which is largely driven by continuous learning and credentialing (Crosby et al., 2016).

Web 3.0 (or Decentralised Web) was first proposed by Wood (2018) and promises to use decentralisation in order to 'democratise' the web by offering web users more control over their data. Web 3.0 aims to move data away from the control of a few companies and instead establish web applications and services based on Blockchain technology, so that data control is distributed among web users (Mikroyannidis, 2022). The main characteristics of Web 3.0 are the following:

- *Decentralised*: instead of content controlled and owned by centralised entities, ownership gets distributed among web users.
- *Permissionless*: everyone has equal access to participate.
- *Native payments*: cryptocurrency is used for financial transactions instead of relying on the infrastructure of banks and payment processors.
- *Trustless*: financial incentives and Blockchain mechanisms are used instead of relying on trusted third parties.

Blockchain and Web 3.0 hold the potential to decentralise education by enabling individual learners to take control of their learning journey. More specifically, decentralisation signifies the transition from 'university/school at the centre' (organisational-centric model) towards 'student at the centre' (learner-centric model). This is especially important in the lifelong learning context, where the learner studies and gains accreditation from several different institutions throughout

their lifetime. In this case, decentralisation is about equipping the lifelong learner with immutable and interoperable accreditation across different institutions and geographical borders (Mikroyannidis et al., 2020).

Generative AI refers to a category of AI algorithms and models designed to generate new content, such as images, text, music, or even entire virtual worlds, that resembles human-created content (Sabzalieva & Valentini, 2023). Generative AI utilises techniques such as deep learning and neural networks to mimic human creativity and produce outputs that are not explicitly programmed or predefined. The models are trained on vast amounts of data, learning the underlying patterns, and then generate new content based on those patterns.

A prominent example of a Generative AI tool is ChatGPT, a language model capable of generating coherent and contextually relevant text. It employs a vast array of pre-trained language knowledge, allowing it to engage in text-based conversations and generate responses that mimic human language patterns. In addition to ChatGPT, several other Generative AI tools have emerged, each with its unique characteristics and applications. For example, models like DALL-E and Midjourney allow the creation of visually coherent images from textual user prompts (Gozalo-Brizuela & Garrido-Merchan, 2023).

Generative AI has applications in various fields, including art, entertainment, design, and even scientific research. It can be used to create realistic images, generate natural language text, compose music, create virtual environments, and assist in data augmentation for training other AI models. However, it is important to note that Generative AI also comes with ethical considerations, such as the potential for misuse or the generation of deceptive or malicious content (Bozkurt, Xiao, et al., 2023; Floridi, 2023).

The following sections showcase a set of use cases of the above emerging technologies in higher education. We begin with two broad use cases examining the diverse educational applications of decentralisation and Generative AI technologies, followed by two more specialised use cases examining the use of these technologies to enhance personalised learning and university pedagogy. Figure 1 illustrates these four use cases and their key aspects.

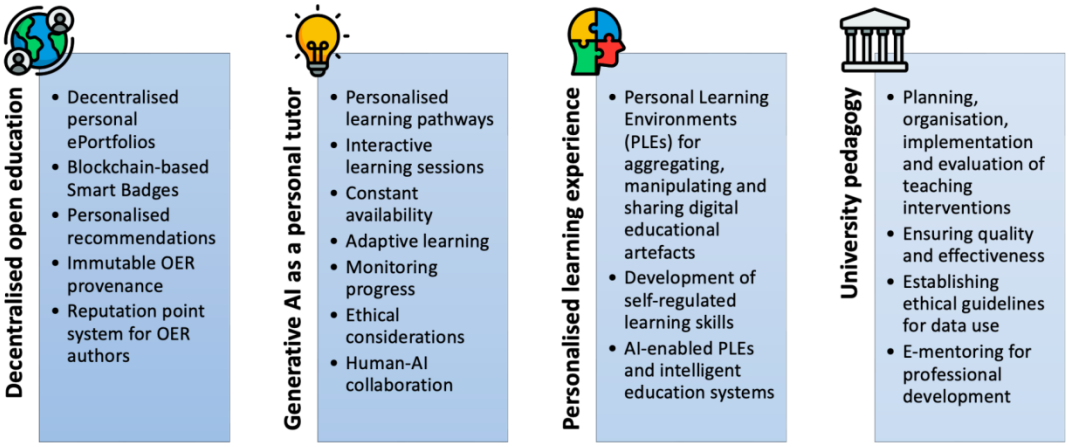

Figure 1: *Use cases for the innovative use of emerging technologies in higher education.*

Decentralised open education for lifelong learning

According to this use case, lifelong learners have access to decentralised personal ePortfolios, which are verified on the Blockchain. Lifelong learners are awarded Smart Badges by educational institutions, upon reaching certain milestones in their studies, e.g., completing part of a course or an entire course. Smart Badges are stored on the Blockchain, thus ensuring the validity of the awarded accreditation and eliminating the risk of fabricated qualifications. Smart Badges include data about the key skills that learners have acquired upon obtaining these badges (Mikroyannidis et al., 2018).

As learners continue to earn Smart Badges, they start receiving personalised recommendations about the latest job offers that match their skills. They also receive recommendations on what to study next, based on the skills they need for the job market. These recommendations assist lifelong learners in making decisions about their personal and professional progression (Mikroyannidis et al., 2020).

This decentralised model can also facilitate open education and can support the reuse of open educational resources (OER) (Bozkurt, Gjelsvik, et al., 2023). The Blockchain offers secure mechanisms for recording the provenance of data, which can securely record the provenance of OER so that intellectual property rights are protected. The immutability offered by the Blockchain ensures that the provenance records of OER always remain valid and cannot be tampered or falsified. Additionally, a Blockchain-based reputation point system can offer incentives to stakeholders for authoring, reusing, adapting and redistributing OER.

Generative AI as a personal tutor

In a university offering distance education, Generative AI can be employed as a personal tutor, in order to enhance the learning experience for students pursuing higher education remotely. Below are the main characteristics of this use case:

- *Personalised learning pathways:* Each student is provided with access to a dedicated AI tutor. At the beginning of the course, the AI tutor conducts an assessment of the student's existing knowledge, learning preferences, and goals. Based on this assessment, the AI tutor can generate a personalised learning pathway for the student.
- *Interactive learning sessions:* Students can initiate interactive learning sessions with the AI tutor through a virtual platform (Su & Yang, 2023). They can ask questions, seek explanations, and request clarification on complex topics. The AI tutor can respond with detailed explanations, examples, and supplementary resources, catering to the student's pace and level of understanding.
- *Constant availability:* One of the advantages of using AI is its round-the-clock availability. Students in different time zones can access the AI tutor whenever they are studying, receiving immediate support and reducing waiting times.
- *Practice and feedback:* The AI tutor can generate practice problems and assignments that align with the student's current learning objectives (Sharples, 2023). After the student completes these tasks, the AI tutor can provide automated feedback, pointing out errors and offering suggestions for improvement.
- *Adaptive learning:* As the student progresses, the AI tutor continuously adapts the personalised learning pathway (Su & Yang, 2023). If the student demonstrates mastery in certain areas, the AI tutor may suggest more advanced topics or specialised subjects based on the student's progress.
- *Exploration of diverse perspectives:* The AI tutor can introduce students to various perspectives and theories related to their field of study. It can recommend supplementary readings, videos, and research papers, thus broadening the student's understanding beyond the core curriculum (Sharples, 2023).

- *Revision and exam preparation:* When preparing for exams or assessments, the AI tutor can assist students in reviewing key concepts of the materials at hand. It can also generate mock tests and quizzes to help students evaluate their preparedness and identify areas that require further attention.
- *Monitoring progress:* The AI tutor can track the student's progress over time by compiling data on the student's performance in assignments, quizzes, and assessments. This information can be shared with human instructors, thus enabling them to intervene if a student is struggling in particular areas.
- *Ethical considerations:* The AI tutor should be programmed to provide accurate and unbiased information. Efforts should be made to mitigate biases and ensure that the information it offers is up-to-date and credible (Chiu, 2023).
- *Human-AI collaboration:* It should be emphasised that the AI tutor cannot replace human instructors, but instead it complements their role. Instructors can focus on facilitating discussions, addressing complex queries, and providing insights that go beyond what Generative AI can offer (Chiu, 2023; Su & Yang, 2023).

By deploying Generative AI as a personal tutor, this use case empowers remote higher education students with a tailored and interactive learning experience, catering to their individual needs and fostering *self-regulated learning* (Nussbaumer et al., 2015). Generative AI as a personal tutor empowers students to be proactive and independent learners. By providing resources, guidance, and adaptive learning experiences, Generative AI can support the development of skills and strategies that are crucial for self-regulated learning (Sharples, 2023).

Personalised learning experience

The PLE is a facility for an individual to access, aggregate, manipulate, and share digital artefacts of their ongoing learning experiences. The PLE follows a learner-centric approach, allowing the use of lightweight services and tools that belong to and are controlled by individual learners (Mikroyannidis, Kroop, & Wolpers, 2015).

Personal Learning Environments (PLEs) help students to manage and take control of their own learning. As such, the PLE promotes self-regulation in learning and allows

learners to aggregate, manipulate and share digital artefacts within a flexible and versatile online space (Armakolas, Mikroyannidis, Panagiotakopoulos, Panousopoulou, 2016). Having in mind the analysis of students' interest, presenting a personalised learning skill to them is also one of the skills that ChatGPT and similar AI tools can offer. These, as well as similar opportunities, have shown that ChatGPT has considerable potential to offer a personalised learning experience, especially in guiding students differently according to their needs (Rudolph et al., 2023; Zhai, 2022; İpek, Gözüm, Papadakis & Kallogiannakis 2023).

Self-regulated learning is activated in the PLE and is focused on connecting independent resources in a way that fulfils a particular learning goal. Following this example, self-regulated learning allows learners to be their own regulator regarding their learning process; thus, learning outcomes are significantly increased (Mikroyannidis, Connolly, & Law, 2012; Armakolas, Panagiotakopoulos, & Massara, 2015). The ability to offer face-to-face and online courses that meet students' interests and abilities has been a subject considered a guide for new materials and content (İpek, et al., 2023). This has led researchers to suggest that a) students should be encouraged to develop skills and gain confidence by selecting, applying and using social media tools for personalised learning, and that b) new pedagogical approaches and models are required in order to enhance students' abilities to organise and adapt their own learning context and to promote their autonomy and self-knowledge in a Personal Learning Environment (Armakolas, et al.,2016).

According to du Boulay, (2022), there are three main implications for Open Distance and Digital Education. The first and one of the oldest technologies for distance learning, the textbook, has been enhanced by the application of AI, either through adapting the content or the route through that content Is transmitted to the reader. The second implication is that online, distance, and digital systems have increasingly incorporated elements of AI in order to make such systems smarter and more responsive to the needs of learners and teachers. The third implication is that the developers and deployers of ODDE systems are already taking an ethical stance on how the systems are designed and built, how they are used in practice, and how their data are collected. AI-enabled education is playing a more important role as learning requirements promote. Intelligent education systems provide timely and

personalised instruction and feedback for both instructors and learners. AI has provided students with improved learning experiences because AI has enabled the customisation and personalisation of learning materials to the needs and capabilities of students (Chen, Chen & Lin, 2020).

University pedagogy

The last few years, a systematic dialogue has started both at a national and European level around issues of pedagogy and teaching approach in the field of higher education (Gougoulakis & Oikonomou, 2014). In the context of the aforementioned raised dialogue, emphasis is placed not only on the content of the teaching, but on the methods and techniques of education, as well as on the climate that develops between the students and the teachers. An essential component of university pedagogy is didactics, which places special emphasis on the planning, organisation, implementation and evaluation of teaching interventions in the field of higher education, with the aim of ensuring quality and effectiveness (Fragoulis & Armakolas, 2019). In any case, in both face-to-face and distance education, teachers must create quality and effective learning environments for their students, and this is achieved by effectively getting to know and familiarising themselves with good practices (Bates, 2021; Armakolas, Ioakeimidou, Fragoulis, 2023).

Learning is inherently social and as such, interaction and communication serve as vital elements of educational processes. In light of this view, the capacity to adeptly engage with Generative AI becomes crucial, positioning prompt engineering as an emerging form of digital literacy (Bozkurt, 2023). The rise of educational technology of all kinds, whether involving AI or not, and its creation of logs of interactions, has produced a huge amount of student data at all levels in education from primary (elementary) schools to universities. Teachers' ethical guidelines, such as those above, need to encompass these extra sources of data (du Boulay, (2022). The emphasis shifts from extensive knowledge to the mastery of inquiry. While it is unlikely that Generative AI will supplant humans, it is plausible that individuals proficient in effective prompting will outpace their less skilled counterparts. In the end, the Generative AI will happen with well-structured, well-designed, and well-devised prompts (Bozkurt, 2023).

E-mentoring in the context of University Pedagogy as a supportive process can be extremely helpful for education teachers, who have little work and teaching experience, and contribute to their smooth integration into the field of higher education, as well as to their professional development. The crucial changes that take place in all sectors of society require adjustments regarding the contents, the methods, the ways of teaching and learning and finally the tools (Fragoulis & Armakolas, 2022). Furthermore, perceived usefulness, perceived ease of use, and perceived trust in these AI-based tools are determinants to be considered when predicting their acceptance by the teachers. A responsible integration of AI into education by involving the expertise of different communities is crucial (Kasneci, et al., 2023).

Conclusions

These days, teachers in higher education must possess not only technological knowledge but pedagogical one as well, to be able to adapt them accordingly in distance teaching and learning environments. The development of interpersonal relationships between instructors and learners is the cornerstone of effective and quality teaching. It is widely acceptable that technology nowadays allows the dynamic and flexible development of such bonds, when those who are involved in the educational process can appropriately use the digital tools that are needed.

By exploring the multifaceted applications of Blockchain and Generative AI in various educational contexts, this paper has aimed to illuminate the possibilities of fostering enhanced collaboration, trust, personalisation, and innovation in education. Through the above analysis, we have endeavoured to provide a comprehensive overview of the transformative impact that Blockchain and Generative AI can have on education, offering insights into the challenges and opportunities that lie ahead.

The penetration of AI through PLEs in education is currently in progress. However, to understand its dynamics is to understand that the conditions for friendship, peer mentoring, collaborative inquiry and social movements are clearly must supported by formal education. Lifelong learning can help at this level much further than formal education. As far as a university teacher's learning ability is concerned, they must not rely on their innate talent but on focused training. Applications regarding

artificial intelligence seem to affect and play a catalyst role in university education, in terms of a new/innovative wider framework of a new university culture.

The potential for misuse is not unique to the application of AI in education. If handled sensibly, these challenges can offer insights and opportunities in education. Universities, students and teachers could acquire early knowledge on the potential societal biases, criticalities, and risks of AI applications and ensure that such models are used in a responsible and ethical manner in education.

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