



ORIGINAL RESEARCH PAPER

Are self-directed learners the authors of their learning? The role of AI in transforming students' cognitive agency

A. Ramezani

Department of Educational Administration, Farhangian University, Tehran, Iran

ABSTRACT

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* Corresponding author

✉ a.ramezani@cfu.ac.ir

☎ (+98912) 5411015

Background and Objectives: The rapid advancement of AI (AI) in higher education, particularly through adaptive learning systems, intelligent tutoring agents, and generative AI tools, has catalyzed a paradigm shift in traditional teaching and learning models. Also, the increased use of AI in higher education in many different fields offers a more personalized, responsive, and effective learning experience. Yet, as AI systems increasingly determine how students interact with and process knowledge, and create knowledge outputs, it is important to answer both basic questions about learner agency in relation to the very paradigm of the autonomous learner that underpins theories of adult and higher education. This article considers whether AI-enhanced learning environments support or deter learners' sense of cognitive authorship.

Methods: This study used a qualitative method that is a mixture of conceptual and empirical inquiry to show pressing issues related to educational theory and emerging technologies: in the age of AI, are self-directed learners still authors of their learning? The philosophical method examines issues about the ontological and epistemic grounds of cognitive agency in an AI-mediated context using semi-structured interviews with 23 students in different fields at Tehran universities. It includes the question of the lived experience of university students who are engaging with AI to be educated. To increase methodological precision Colaizzi's seven step was used; this was chosen because of its specificity and effective depth for interpretation, as well as its fit with a focus on phenomenology in its aim to examine how 'agency', 'authorship', and 'self-direction' of students are lived in an algorithmic context that is mediating cognitive agency. This method includes seven steps: 1) Reading and re-reading all the transcribed interviews to make sense of them, 2) Extracting significant statements. These are phrases or sentences that directly pertain to the investigated phenomenon, 3) Giving meaning to the statements: During the process pertinent quotes are categorized the themes are generated based on multiple statements that convey similar meaning, 4) Repeating step 1-3 for each interview, then the researcher can begin to create theme based on the formulated meaning, 5) Gathering an exhaustive description of everything generated in step 1-4, 6) Summarizing the exhaustive description so that there is an identification of the fundamental structure of the phenomenon and 7) Ensuring the credibility of the data through member checking.

Findings: Results indicated that using AI in different fields has both negative and positive effects on learning and cognitive agency of students. Central outcomes on the positive side include cognitive scaffolding, increased access to complex knowledge, the ability of AI as a cognitive extension, co-authorship with AI through critical engagement, increasing critical thinking, and improving self-learning through simulation and interactive environments. On the other hand, it has some challenges such as: Ambiguous intellectual authorship, Erosion of epistemic self-Trust, Illusion of mastery, Passive deference to algorithmic authority, and ethical dissonance and academic guilt.

Conclusions: Based on these findings and different aspects of AI in student cognitive agency, the paper proposes a framework for self-directed learning in the age of AI in which authorship is not isolated, as the learner is still the one who makes learning; however, this issue needs basic changes in pedagogical, curricular, and philosophical perspectives.



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مقاله پژوهشی

آیا یادگیرندگان خود راهبر عامل یادگیری خود هستند؟ بررسی نقش هوش مصنوعی در تغییر عاملیت شناختی دانشجویان

عباس رضانی

گروه مدیریت آموزشی، دانشگاه فرهنگیان، تهران، ایران

چکیده

پیشینه و اهداف: پیشرفت سریع سامانه‌های هوش مصنوعی در آموزش عالی به‌ویژه از طریق سامانه‌های یادگیری تطبیقی، عوامل آموزش هوشمند و ابزارهای تولیدی هوش مصنوعی تحولی پارادایمی در مدل‌های سنتی تدریس و یادگیری ایجاد کرده است. استفاده گسترده از هوش مصنوعی در رشته‌های مختلف، یادگیری شخصی‌سازی شده، پاسخگو و اثربخش‌تری را به ارمغان می‌آورد. اما با گسترش نقش سامانه‌های هوش مصنوعی در تعیین نحوه تعامل دانشجویان با دانش و پردازش آن، سؤال‌های اساسی دربارهٔ عاملیت یادگیرنده و پارادایم یادگیرنده خود راهبر که پایهٔ نظریه‌های آموزش بزرگسالان و آموزش عالی بوده و از اهمیت بالایی برخوردار است، پیش می‌آید. پژوهش حاضر به بررسی نقش دوگانهٔ محیط‌های یادگیری مجهز به هوش مصنوعی را در عاملیت شناختی یادگیرندگان خود راهبر می‌پردازد؛ اینکه این سامانه‌ها چه چالش‌ها و فرصت‌هایی را برای دانشجویان فراهم می‌نمایند.

روش‌ها: رویکرد پژوهش حاضر از نوع کیفی بود تا با بررسی دیدگاه‌ها و تجارب دانشجویان مسائل مهم مرتبط با نظریه آموزشی و فناوری‌های نوظهور را نشان دهد و به این سؤال که «در عصر هوش مصنوعی، آیا یادگیرندگان خود راهبر هنوز عامل یادگیری خود هستند؟» بپردازد. این روش فلسفی به بررسی مبانی وجودی و معرفتی عاملیت شناختی در زمینهٔ واسطه‌گری هوش مصنوعی پرداخته و از مصاحبه‌های نیمه‌ساختاریافته با ۲۳ دانشجو در رشته‌های مختلف دانشگاه‌های تهران استفاده نمود. این پرسش در مورد تجارب زیسته دانشجویانی که با هوش مصنوعی برای آموزش درگیر هستند، مطرح شد. به‌منظور تجزیه و تحلیل داده‌ها و افزایش دقت روش شناختی، روش هفت‌مرحله‌ای کولایزی به کار گرفته شد؛ این روش به دلیل خاصیت و عمق تفسیری مؤثر خود و تطبیق با پدیدارشناسی برای بررسی «عاملیت»، «مالکیت فکری» و «خودراهبری» دانشجویان در زمینه الگوریتمی عصر حاضر انتخاب شد. این روش شامل هفت مرحله است: ۱) خواندن و بازخوانی تمام مصاحبه‌های نوشته شده برای درک آن‌ها، ۲) استخراج عبارات معنی‌دار که مستقیماً به پدیده مورد بررسی مربوط می‌شوند، ۳) معنابخشی به عبارات: در این فرایند نقل‌قول‌های مرتبط دسته‌بندی می‌شوند و تم‌ها بر پایه چندین عبارت با معانی مشابه شکل می‌گیرند، ۴) تکرار گام‌های ۱ تا ۳ برای هر مصاحبه و سپس ایجاد تم بر اساس معانی شکل گرفته، ۵) جمع‌آوری توصیف جامع از تمام موارد تولید شده در گام‌های ۱-۴، ۶) تلخیص جامع برای شناسایی ساختار بنیادی پدیده، و ۷) اطمینان از اعتبار داده‌ها از طریق بررسی اعضا.

یافته‌ها: نتایج نشانگر این موضوع بودند که استفاده از هوش مصنوعی در حوزه‌های مختلف تأثیرات مثبت و منفی بر یادگیری و عاملیت شناختی دانشجویان دارد. مهم‌ترین یافته‌ها در بخش فرصت‌ها شامل این موضوع بودند که هوش مصنوعی می‌تواند به تقویت ساختار شناختی، دسترسی بیشتر به دانش پیچیده، تعمیق دانش شناختی، همکاری مشترک با هوش مصنوعی از طریق مشارکت فعال، تقویت تفکر انتقادی و بهبود خودآموزی از طریق شبیه‌سازی و محیط تعاملی کمک کند. از سوی دیگر، چالش‌هایی نظیر ابهام در مالکیت فکری، کاهش اعتماد معرفتی به خود، توهم تسلط، تسلیم ذهنی به اقتدار الگوریتمی، ناهماهنگی اخلاقی و احساس گناه علمی استخراج شدند.

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* نویسنده مسئول

a.ramezani@cfu.ac.ir

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نتیجه‌گیری: بر پایه این یافته‌ها و جنبه‌های متنوع هوش مصنوعی در عاملیت شناختی دانشجویان، پژوهش حاضر، چارچوبی برای یادگیری خود راهبر در عصر هوش مصنوعی ارائه می‌دهد، به نحوی که مالکیت فکری جدا انگاشته نمی‌شود و دانشجویان عامل یادگیری خود در تعامل با هوش مصنوعی باقی می‌مانند و هم‌زمان از آن استفاده نیز می‌نمایند، اما این موضوع نیازمند تغییرات جدی و اساسی در مباحث آموزشی، برنامه‌ریزی و فلسفی است.

Introduction

Artificial intelligence (AI) is considered one of the most influential technologies of the 21st century [1]. The integration of AI into educational systems is reshaping traditional teaching methods by providing tools that enable learners to effectively engage with complex problems [2]. The development of technologies and the increase in virtual learning opportunities have led to a change in people's understanding of the ways of learning [3]. In the traditional perspective, 'teacher' was seen as the only source of knowledge, but today, sources of information have become very diverse. Therefore, as information has become easier to access, the nature of learning has also changed. In the past, it was essential to memorize information, but now, it has become fundamental to gain skills related to where information can be accessed and how to learn it [4]. Specifically, people are expected to acquire the skills of learning to learn subjects. Individuals who do not have the ability to learn and who cannot organize their own learning processes fall behind in many areas in the globalizing world where technology is increasingly improving [5]. In this part, the concept of self-directed learning emerged.

The concept of the self-directed learner has been central to adult and higher education theory for many years. A fundamental aspect of this orientation of self-directed learning is cognitive agency, related to the learner's ability to be the agent of their own understanding, think independently, and articulate their claims to knowledge with epistemic integrity. Built on humanist and constructivist traditions, this

model holds that adult learners are self-regulated individuals who plan their learning goals, find resources, and assess their progress [6]. Self-directed learners make plans by determining their learning goals. They organize how to access learning resources. They are also open to learning, curiosity, autonomy, and taking the initiative to learn in a self-controlled manner [7]. However, this humanist ideal is coming under challenge from the rapid introduction of AI into the university learning space. From various generative chatbots that draft essays and solve equations, to adaptive platforms that curate personalized learning pathways, AI systems have gone from being peripheral tools to becoming active agents in the cognitive processes of students. This represents a significant change, and alongside these developments comes an important question. In an era where algorithms are co-constructing knowledge, is the self-directed learner still the author of their learning?

Although issues regarding academic integrity and plagiarism [8] in academic discussions of educational technology are ongoing, ontological and epistemological issues have been sidelined. In fact, not only is AI changing how students might learn, but also changing who is learning and what it means to know. As Williamson and Eynon investigated, AI-facilitated educational infrastructures are performing a 'silent reconfiguration of the learner-subject', whereby agency is being redistributed across human-technological assemblages in ways that are largely opaque even to learners and educators [9]. This exploration addresses these gaps through a philosophical-qualitative inquiry of the lived

experiences of university students as they learn using AI, including an emphasis on the transformation of cognitive agency and epistemic authorship.

While the utilization of generative AI is widespread in higher education, 78% of university students say they 'often' utilize generative AI in their studies [10]. There is little existing literature, philosophy, and empirically informed literature that addresses their implications for learner autonomy. Existing research literature often resides at one of two poles: techno-optimism, which claims that AI represents a potential force for democratization [11], or the grim story of 'outsourcing of thought' [12]. Neither achieves the nuance and irony of learners' engagement with AI in everyday learning.

More critically, studies rarely engage with the phenomenology of agency, that is, how students feel, perceive, and make sense of their own role as knowers when AI is involved. Without this experiential grounding, theoretical debates about autonomy risk becoming abstract and disconnected from the realities of the contemporary classroom. It is impossible to design ethical AI pedagogies if there was misunderstanding learners' experience of agency in AI-rich environments [9].

This research aims to take a step toward answering the following question: *'In what ways do university students experience agency in cognition while learning with AI, and therefore, to what extent do they view themselves as authors of their understanding?'* In an attempt to privilege student voices (as previously noted), this work shifts focus from traditional figurative frameworks that categorize AI only as either an empowering or threatening presence and instead starts to unpack the nuanced, even contradictory ways agency is negotiated in practice. This study is based on an interdisciplinary conceptual

framework that draws upon three related areas of scholarship: (1) self-determination learning philosophy (2) posthuman and socio-material theories on distributed cognition, and (3) critical approaches to AI in education

First, the study investigates the humanist self-directed learning (SDL) framework elaborated by Knowles [13] and Candy [14], which celebrates the learner's autonomy, inherent desire to learn, and epistemic obligation to take responsibility as a learner. But rather than situating SDL as a static or normative ideal, we explore SDL's assumptions about the affordances and constraints of AI [12]. It contends that the historically situated and particular construct of an autonomous, rational learner as the central construct of humanist pedagogy becomes an increasing source of dissonance in algorithmically mediated societies.

Next, it takes posthuman and sociomaterial positions that present a challenge to the concept of a bounded, self-sufficient learner. Accordingly, later in this part, the study draws on Hayles's [15] notion of cognitive assemblages and Fenwick's [16] conception of sociomaterial entanglements in learning, to reframe cognition as always already distributed across networks of human and non-human actors. In this sense, AI systems are not regarded simply as external tools, but are entangled actants that create knowledge in the network of learning [9]. This ontological shift brings the focus of analysis from a narrative of loss of 'agency' to one that more quickly considers how 'agency' is redistributed and reconfigured in human-AI relationships.

The article also draws upon critical AI studies in education that center on the ways algorithmic systems infuse and reproduce relations of power, epistemic bias, and assumptions about normative ways of knowing and learning. For example, Polat et al. caution

that many AI platforms act as "black-box epistemic authorities" in that they conceal the logics of their decision-making and the sources of their content in a way that constrains students' abilities to critique what they are engaging with [17]. Similarly, Holmes et al. point out that AI-based tutoring systems tend to privilege measurable performance rather than an understanding of conceptual relationships, and our study takes up this tension that is enacted through the phenomenological concept of "illusion of mastery" when students confuse their outputs scaffolded by the algorithmic process as understanding [18].

Collectively, these theoretical perspectives provide a robust and multi-layered scaffold for analyzing AI not simply as a neutral pedagogical tool, but as a socio-technical mediator that actively shapes subjectivity, knowledge production, and the very conditions of agency within contemporary higher education. Building upon these, this study aims to explore the evolving nature of learner agency in the context of AI-mediated education. As AI systems increasingly participate in processes of knowledge construction, the boundaries between human cognition and machine assistance become blurred, prompting questions about autonomy, authorship, and responsibility in learning. Therefore, this research seeks to understand how university students experience and negotiate their cognitive agency and authorship of understanding while learning with AI systems within contemporary higher-education environments.

Review of the Related Literature

AI has become a cornerstone of modern education, offering students unprecedented opportunities to enhance critical thinking and self-learning. The integration of AI into educational systems is reshaping traditional

teaching methods by providing tools that enable learners to effectively engage with complex problems. The capacity to simulate various scenarios, provide accurate analysis, and deliver personalized feedback makes it an invaluable asset in nurturing cognitive skills such as critical thinking and self-directed learning.

At this time, because of the widespread use of AI across the world, there are studies about different aspects of AI in higher education. Integrating AI in higher education is also the most noticeable in the previous studies. Namdarian et al. indicated that there is a positive relationship between using AI and improving the outcomes of students, and AI use can lead to personalized learning, improved educational processes, and enhanced access to education for all students [19]. Khabarehin's study showed that AI serves as a transformative force in the field of education, playing a central role in improving the quality and personalization of the learning process [20]. Williamson and Eynon examined how AI-facilitated educational tools are performing a "silent reconfiguration of the learner-subject," whereby agency is being redistributed across human-technological gathering [9]. Rezaei et al. indicated AI as an important factor for transforming education [23]. Moreover, AI can speed up the process of learning by providing personalized feedback and allowing learners to use their critical thinking when faced with incorrect information. In another study, Hwang et al. showed that creating comprehensive AI literacy programs is essential to ensure that learners and educators can navigate the AI landscape effectively [24].

Although the use of AI is widespread in higher education, based on research, 78% of university students say they 'often' utilize generative AI in their studies [10]. Furthermore, providing personalized educational content

based on learners' preferences using the profile expansion technique significantly reduces the cognitive load during learning [23], and using AI in education facilitates the process of learning [24]. It is indicated that AI learning services can provide personalized learning based on students' level [25]. Other studies, like Wang et al., emphasized the competence of using AI [26], while Sadeghi and Naser approved the effectiveness of AI in the 21 centuries [1]. Ramazani and Talebi indicated that technology has an important role to play in regulating society's lifestyle [27]. These studies admitted the urgent need for the use of AI and that using AI can positively increase and improve the quality of students' learning. However, most of these studies have only shown the positive effects or the learning outcomes after using AI without considering whether, in this widespread use of AI, students are the authors of their learning or whether the machine gives them some clues and then gives them authorship. Because of this important need and question, the current study aims to examine the challenges and opportunities AI can provide for students' cognitive agency in the process of learning.

Moreover, research in the field of AI in education indicates that AI tools play an active role in shaping learning processes. These developments challenge the traditional view of learner agency, which emphasized individual autonomy [27]. On the other hand, the concept of Self-Directed Learning (SDL), emphasizing learner autonomy and self-regulation, faces new challenges with the integration of AI into educational settings. While AI offers the potential for personalized learning and helpful guidance, this might come at the cost of reduced independent cognitive effort and an abdication of authorship to the AI. Studies examining the impact of emerging technologies on cognitive and social skills highlight the

importance of balancing technology utilization with the preservation of learner agency [20]. This situation demands a re-evaluation of our understanding of the self-directed learner in light of novel AI interactions.

Much existing research focuses on the practical benefits of AI in education, such as improved performance and content personalization [28-29]. However, there remains a significant research gap in comprehensively examining students' cognitive agency and their role as authors of learning within these novel environments. Fewer studies delve deeply into the process of agency allocation and distribution between students and AI, rarely addressing how students maintain their sense of authorship and exercise cognitive agency when presented with AI suggestions, and whether this ultimately enhances or diminishes self-directed learning.

Method

Participants

The participants of this study were 23 undergraduate and graduate students. A purposive sampling strategy was employed to recruit 23 undergraduate and graduate students from diverse academic fields, including humanities, empirical sciences, and social sciences, across various research-intensive universities in Tehran. The primary selection criterion was participants' demonstrable, ongoing engagement with generative AI tools (such as ChatGPT, Gemini, Microsoft Copilot) or adaptive learning environments (like Khanmigo, Gradescope) for academic purposes within the preceding six months. The snowball method was utilized to identify and recruit additional participants who met these criteria, ensuring a sample that could comprehensively address the core themes of the study. Data saturation was achieved by the

conclusion of interviews with the 23 selected participants. This point was determined when subsequent interviews yielded no new significant themes or novel insights related to the students' experiences with AI in their academic work. The iterative process of data collection and preliminary analysis allowed the researchers to identify the emergence of recurring patterns and concepts, indicating that the sample size was sufficient to capture the breadth of experiences relevant to the research questions.

Table 1: Descriptive data of participants

Code	Gender	Age
SP1	Male	22
SP2	Female	24
SP3	Female	31
SP4	Male	27
SP5	Female	24
SP6	Female	28
SP7	Male	20
SP8	Male	24
SP9	Female	25
SP10	Male	30
SP11	Female	27
SP12	Female	29
SP13	Female	22
SP14	Male	23
SP15	Female	21
SP16	Male	29
SP17	Male	22
SP18	Female	25
SP19	Male	24
SP20	Female	27
SP21	Female	29
SP22	Male	32
SP23	Female	20

Instruments

The research study employed a qualitative approach; therefore, the instrument for gathering the required data was semi-structured questions.

Design

This study adopts a philosophical-qualitative approach, integrating interpretive phenomenology with both conceptual and empirical inquiry. This hybrid methodology is essential for addressing the pressing issues at the intersection of educational theory and emerging technologies, specifically the question: In the age of AI, is the self-directed learner an author of their learning? The conceptual and philosophical inquiry component delves into the theoretical underpinnings of key concepts such as cognitive agency, authorship, and self-direction. It seeks to establish a framework for understanding these constructs in the context of AI-mediated learning. Simultaneously, the empirical inquiry, conducted through in-depth interviews with university students, grounds these philosophical explorations in lived experience. By examining how students *actually* engage with AI tools for academic purposes, this component provides rich, contextual data on how they perceive and enact their agency and authorship.

Combining these approaches allows us to bridge the gap between abstract educational ideals and the practical realities shaped by AI. The philosophical lens offers critical depth for analyzing the implications of technology on learning, while empirical data provides the necessary validation and nuanced understanding of student experiences. This integrated approach is crucial for a comprehensive understanding of the complex dynamics at play, and for generating relevant insights into the evolving role of the learner in an AI-infused educational landscape. The philosophical inquiry examines issues about the ontological and epistemic grounds of cognitive agency in an AI-mediated context. This inquiry situates the question in the lived experience of university students who are engaging with AI to

be educated. To enhance methodological specificity and precision, as well as fidelity to the subjective experience of the participant, the phenomenological approach of [30] is used. Colaizzi's seven-step process for measuring human experience was chosen because of its specificity and effective depth for interpretation, as well as its fit with a focus on phenomenology in its aim to examine how 'agency', 'authorship', and 'self-direction' of students are lived in an increasingly algorithmic context that is mediating cognitive agency.

Procedure

Participants provided informed consent, and institutional review board approval was obtained. Interviews were approximately 45-60 minutes in length, audio-recorded, and transcribed word-for-word. The interview guide was designed to elicit rich descriptions of participants' experiences with AI and to invite consideration of moments when students felt either empowered, dependent, confused, or clarified their thinking about intellectual ownership. Prompts requested stories from the students to reflect on questions such as: when you are using AI to help write or work through a problem, do you feel you are still the author of your own work? Or briefly describe a time that you noticed AI help prompt your thinking - what was that like?

Data analysis

Analysis followed Colaizzi's seven-step process [30]. First, each transcript was read multiple times to achieve a sense of holistic familiarity with the participant's story. Second, all of the stated important statements relating to the phenomenon, namely those that expressed feelings, judgments, or experiences relating to agency, feelings of control, or authorship in AI-mediated learning, were extracted. Third, these statements were then interpreted to create

their underlying psychological and experiential meanings (e.g., *"I just accepted what it gave me"* was interpreted as a surrender of epistemic vigilance). Fourth, through iterative comparison and repeating steps 1-3 over again, the meanings that were formulated were then clustered into emergent thematic categories that generated themes such as Delegated Intellectual Labor, Ambivalent Trust in Algorithmic Guidance, and The Erosion of Epistemic Responsibility. Fifth, compiling an exhaustive description of everything generated in steps 1- 4 is done in this step. A rich descriptive narrative was detailed that captured all of the themes and added descriptive depth to the total experience for learning with AI. Sixth, from this rich narrative description, the fundamental structure of the essential, invariant essence of the phenomenon was distilled; namely, that AI will make cognitive agency different not by obfuscating it, but by redistributing cognitive agency through a human-technology assemblage where the learners' role as the epistemic author is conditional, negotiable, and often cloaked. Finally, to enhance credibility, preliminary findings were shared with a subset of participants in member-checking sessions, allowing them to confirm or refine the researchers' interpretations. Figure 1 shows these steps.

To ensure the trustworthiness of this study, procedures were implemented throughout the research process. Continuous reflexivity was practiced by the researcher to critically examine personal biases, assumptions, and potential influences on data collection and analysis. This involved maintaining a research journal to document reflections on the research process, including the evolving understanding of the participants' experiences and the researcher's role in shaping the inquiry. These reflections were used to ensure that interpretations

remained grounded in the data and were not unduly influenced by preconceptions. Also, a comprehensive audit trail was meticulously maintained to document all stages of the research. This included: (1) verbatim transcripts of all interviews; (2) a complete log of the coding process, including the development of codebooks, initial codes, and the refinement of themes; (3) memos documenting analytical decisions and the rationale behind thematic groupings; and (4) field notes capturing contextual details during data collection.

The phenomenological analysis proceeded in theoretical dialogue throughout the study. It led to a better understanding of how to connect the identified themes through the philosophical lens. For instance, fragmented authorship was understood through the lens of narrative identity, that is, the idea that the self is a result of the stories we tell about our actions. When, for instance, the AI aided in drafting these stories, the learner's identity was not coherent. In the same way, students' representations of 'AI as an invisible tutor' that minimally aids their learning were filtered through Foucault's

understanding of autonomy as self-discipline, in which people are made to want to govern themselves. By interweaving empirical phenomenology with critical philosophy, it aspires to remain grounded in lived experience while also contributing toward contemporary theoretical dialogue on autonomy and post-human forms of self-directed learning.

To ensure qualitative trustworthiness, several techniques were employed. Prolonged data analysis and triangulation with the reflective field notes, as well as participant checking, increased study credibility. Transferability was supported by the thick description of the participant sample and institutional context. Confirmability was aided by researcher reflexivity, particularly through maintaining a bracketing journal (Husserl's epoché) to identify and set aside preconceptions about AI in education. In this way, they seek not only to describe how students experience AI in learning but also to identify what this means for the idea of the self-directed learner.

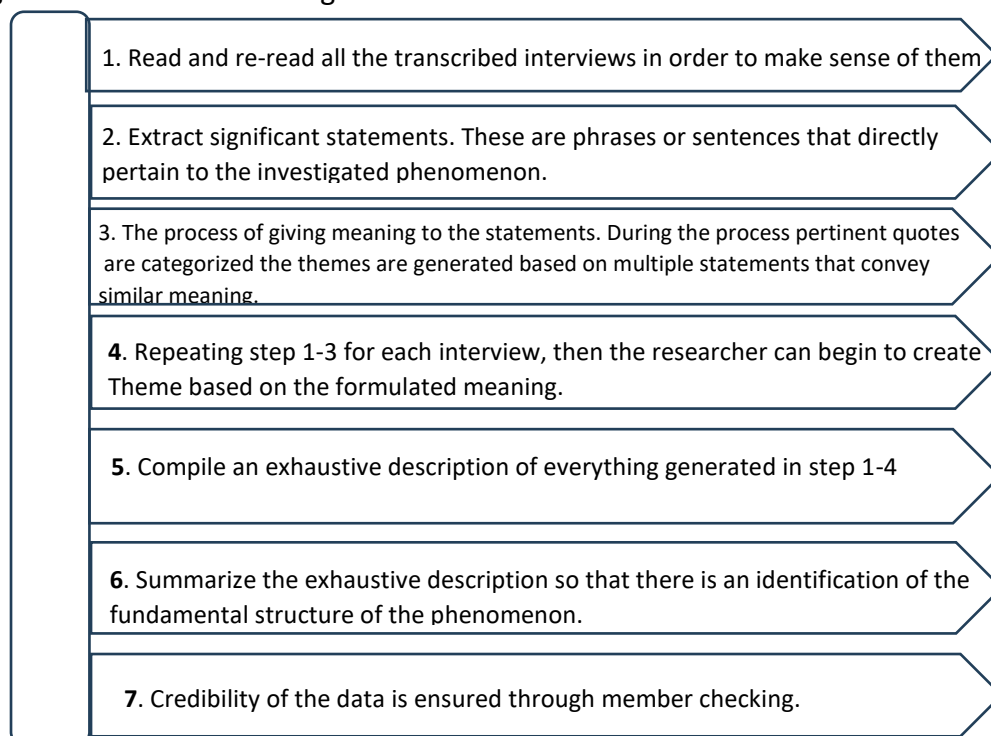


Fig. 1: Colaizzi's seven-step process [30]

Results and Findings

The data analysis using Colaizzi's methodology [30] resulted in the lived experiences of the participants being organized into nine themes.

Notably, the themes formed two broad categories of experiential aspects: (1) challenges to cognitive agency and (2) opportunities for cognitive agency. Tables 2 and 3 present themes, experiential meanings, and some representative open codes.

Table 2: Challenges and problems that threaten cognitive agency with AI

Main theme	Experiential meaning	Open Codes	Indicators
Ambiguous Intellectual Authorship	Learners experience a fractured sense of ownership over their ideas, as AI blurs the boundary between self-generated and algorithmically suggested thought.	I can't say this was my idea- it feels like I'm wearing someone else's thoughts. Whose voice is this in my essay? - I edited it, but the thinking wasn't mine.	SP1, SP8, SP12, SP18, SP9, SP7, SP23
Erosion of Epistemic Self-Trust	Students increasingly doubt their own cognitive reliability and defer to AI as an external authority, weakening their internal epistemic compass.	I don't trust my answers unless AI confirms them. - I second-guess everything I think now. - My brain feels lazy without it.- If the AI disagrees, I assume it's right.	SP3, SP9, SP2, SP19
Illusion of Mastery	AI-generated outputs create a convincing but superficial sense of competence, masking a lack of deep understanding or internalization.	I got an A, but I'd fail if tested today. - It looks like I know it, but I don't. - The AI learned it, not me. - I can reproduce it, but not explain it.	SP1, SP10, SP14
Passive Deference and Over-reliance on Algorithmic Authority	Cognitive fatigue or time pressure leads to uncritical acceptance of AI content, suspending reflective judgment and verification. Students use AI in many and all conditions, feeling that without AI they cannot solve anything	If it sounds smart, I assume it's right. - I don't have the energy to fact-check a machine. - I just copy-paste and hope. - It's fluent, so it must be true.-I feel that without AI, I cannot solve any issues.- I think that if I know a thing, I should check it with AI; without AI, I cannot do my homework and projects.	SP1, SP10, SP116, SP12, SP4
Ethical Dissonance and Academic Guilt	Despite institutional ambiguity, students feel moral discomfort, perceiving AI use as a betrayal of the ideal of self-earned knowledge.	It feels like I'm stealing my own education. - I know it's allowed, but it doesn't feel honest. - Am I still a real student if AI thinks? - I'm cheating myself, not the professor.	SP2, SP11, SP6, SP4
Reducing human interaction	Reduction in communication with other people in the real world, ignoring human interaction	When I use AI for many hours, it is just me and AI, not other people. I do not interact or ask questions of other people because I ask and interact with AI for hours. I think that we do not need other people's ideas when AI is with us.	SP19, SP7, SP12, SP21

Challenges to Cognitive Agency

Ambiguous Intellectual Authorship

A sense of intellectual identity was often broken, as students often reported a sense of total confusion about the source of their ideas when utilizing AI. This vagueness was not so much concerning plagiarism but had to do with the loss of narrative sense in their learning process. *"I used ChatGPT to write my colonialism essay", as SP7 said: "I rephrased all the sentences, yet the argument structure simply seemed borrowed. I would have liked to tell my professor that it was not me when he complimented the original insight. My real voice, I now do not know what."* Such an experience indicates a phenomenological crisis: the self is no longer perceived as the exclusive source of thinking, but as a part of an unequal dialogue with an unseen algorithmic other. This perspective is also admitted by SP1 and SP9, SP8, SP12, SP18, and SP23.

Erosion of Epistemic Self-Trust

There was a silent but widespread loss of confidence in one's own mental judgment that developed in the fields. Even students who had good academic performance said they were ceding the truth to AI as an adjudicator of truth, which weakened the internal epistemic cue of truth. A Master's student, SP2, responded: *"Last week, I worked out a problem in genetics by myself and correctly provided a solution, but I have checked it using an AI solver. And when the AI answered otherwise, I panicked. I relied on the machine, rather than my own judgment, though I had studied that subject for weeks"*. This change represents a restructuring of epistemic power, from the individual to the apparatus in which algorithmic proficiency is confused with truth. Also, SP19, SP3, and SP9 emphasized this fact.

Illusion of Mastery

Numerous respondents created quality academic work with the help of AI and did not have a profound grasp of it, which created a gap between performance and competence. SP3 breathed this contradiction: *"I wrote a perfect solution with the assistance of AI, and I got full marks. However, during the exam, when they varied one of the parameters, I got paralyzed. I understood that I had not been taught the logic; I had been taught to activate the AI in the right way. The knowledge was not a real grade; the grade was real"*. This theme emphasizes the possibility of AI replicating the learning experience without encouraging the cognitive change, which is internal and characteristic of true mastery. SP10 also said: *"I had such an experience, and it led to a lower grade on the final exam; because of this, he said that we must know the logic and the knowledge itself, and then we can use AI correctly"*. Moreover, SP14 and SP1 admitted these responses.

Passive Deference and Over-reliance on Algorithmic Authority

Students tend to interrupt critical thinking and accept AI outputs without doubt under conditions of cognitive overload or fatigue. SP9 confessed: *"During finals, I was so tired that I was no longer questioning what the AI said. In case it referred to one of the studies published in 2023 or contained academic terminology, I simply believed that it was credible. I lacked the mental capacity to check, and frankly, I was no longer interested"*. This is an attitude of passivity that is indicative of a normalization of epistemic outsourcing in which efficiency replaces intellectual vigilance.

Many respondents said that they are dependent on AI in different situations, from quite tiny issues to important things in their lives or projects. SP10 said: *"I need AI for all my projects and lessons; I think that without it I*

cannot handle my projects, especially my homework that professors give us". Also, SP1 indicated a project in paper and said that "all of these things were written by AI, and then I checked it and learned that I cannot give up using it at this time of technology in the world". Moreover, SP12, SP16, and SP4 admitted this dependency.

Ethical Dissonance and Academic Guilt

Regardless of institutional acceptance, a lot of students felt morally uneasy due to a perceived transgression of the spirit of self-acquired knowledge. The inner conflict described by SP4,

who is an MA student, was as follows: "I know my department has been accepting AI in brainstorming, but as I use it, I always feel like I am depriving myself of the challenge that makes learning interesting. It is not about rules, but it is about integrity. Do I remain a thinker when I outsource my thinking?" This is not a feeling of guilt caused by fear of punishment, but rather a break in the moral connection of the learner with the knowledge. SP2 said: "Sometimes I feel guilty when using AI, and it causes different academic problems and issues for me". Also, SP11 and SP6 emphasized this fact, and they agree with these issues.

Table 3: Opportunities of AI for cognitive agency

Main theme	Experiential meaning	Open Codes	Indicator
Cognitive scaffolding	AI provides timely emotional and intellectual support during periods of overload, reducing anxiety and enabling task initiation.	It holds my hand when I'm overwhelmed. - ChatGPT gives me breathing room. - It helps me start when I'm stuck. - Without it, I'd just shut down."	SP7, SP22, SP5
Enhanced access	AI democratizes learning by translating, simplifying, or contextualizing advanced material, especially for non-native speakers or those with gaps in foundational knowledge. Some students experience AI as a seamless, integrated extension of their own cognition, enhancing fluency, creativity, and problem-solving speed.	It explains things my professor assumed I knew. - As a non-native speaker, it helps me sound academic. - I finally understand quantum basics thanks to AI. - It fills the holes in my prior education.	SP5, SP9, SP23
Critical Co-authorship with AI as a Cognitive Extension	Reflective learners actively interrogate, challenge, and refine AI outputs, transforming passive consumption into a dialogic, agentic learning practice.	It's part of how I think now. - My ideas flow faster with it. - It's like a prosthetic for my brain. - I don't feel disabled; I feel augmented. I treat AI like a debate partner. - I always ask: 'Why is this true? I challenge its answers to stay in charge. - I use it to test my thinking, not replace it."	SP10, SP3, SP6, SP4
Enhancing critical thinking	Using feedback for different issues quickly engages the ability of thinking with providing different feedback, distinguishing different voices of feedbacks	I use AI to improve my ability to think, like when I ask questions over and over to get the reasons- I use it and ask it many and many questions to identify the voices that it uses and why it uses.	SP6, SP11, SP2, SP18, SP8
Facilitating learning with simulation and interactive environments	A learning environment with AI facilitates the way of learning, preparing for different communication	I use AI for learning because it helps me with different interactions, and I can ask many questions for learning just one issue- simulation is important, I think, because I think that I am there in real.	SP10, SP12, SP3, SP8

Reducing Human Interaction

Using AI in different issues and subjects also changes the ways of human interactions; many respondents highlighted this issue by saying the rate of using ai and reducing communication with others. SP19 said: *"I use AI for all questions that I have, all things that I need, even for my emotional matters; it is not important for me to say my private feelings to others"*. SP7 also said that *"using AI leads me to have no more interaction with others, even with my parents and siblings at home"*. Furthermore, SP12 and SP 21 confirm this limited interaction with others.

Opportunities for Cognitive Agency

Cognitive Scaffolding

According to the test, AI was heavily perceived as a supportive cognitive partner that soothes the feeling of overwhelm and allows one to start work at a time of high stress. This relief was mentioned by SP7, a third-year social science student: *"When I do my homework, I find myself overwhelmed with information. The moment I request AI to encapsulate a 40-page guideline into bullet points, it feels as though somebody has given me a life raft. It does not substitute for my learning; it merely does not allow me to sink so I can actually get down to the material"*. In this regard, AI does not substitute agency, but is a scaffold that temporarily performs the role of restoring the ability of the learner to act. This was admitted by SP5 and SP22 as well.

Enhanced Access

In the case of students with language barriers or knowledge gaps, AI was a democratizing power that opened up new content that was not available before. SP5, a doctoral student, said: *"In giving a lecture at university, I enter lecture notes into the AI and have it provided me with simpler explanations of concepts or analogies.*

Quantum entanglement suddenly seems to be logical. In its absence, I would be lost and too shy to ask". The theme highlights how AI could foster epistemic inclusion within various academic settings. Also, SP9 AND SP23 were concerned about this issue.

Critical Co-authorship with AI as a Cognitive Extension

Other students did not view AI as an external device but saw it as a natural continuation of their personal thinking, as a way of improving their fluency and problem-solving skills. Reflecting on SP10, a senior student in social science, said: *"It feels like I have a second brain that does not get tired whenever using Copilot. It proposes solutions to my problems when I am debugging that I have not thought of, but it is up to me whether to take them. It is not detached from me; it is a part of my workflow, just like a calculator or a notebook. I am not inferior to be human; I am more competent"*. This view fits in with the extended mind theories in which technology is constitutive of thinking.

A subgroup of reflective learners proactively turned AI engagement into a dialogic form and retained agency by critical questioning. This position was characterized by SP3, a BA student who said: *"I do not always take AI at its face value when it comes to analysis. In questions or scenarios, I request that you present a case on both sides, and then I dismantle its argument. At one time, it was probably wrong, but that comes in handy! It makes me defend my position more strictly. That way, it is not my assistant: it is my sparring partner"*. This is a posthuman kind of self-direction: agency is not natural but is reasserted in a conscious negotiation with non-human others. It was also admitted by SP4 and SP6.

Enhancing Critical Thinking

Using AI can challenge the ability of students' way of thinking through different feedback that they produce. SP6 said: *"I use AI because I think it empowered my capability of thinking with different norms and feedback that was given to me"*. Also, SP3 said: *"I like AI for the reason of different and varied feedback that helps me to think more"*. This issue was approved by SP11, SP2, SP17, and SP8.

Facilitating Learning with Simulation and Interactive Environments

Leveraging AI simulation in the way of learning, and also the interaction in this way, can be one of the most important opportunities of AI. SP10 said: *"The environment- no, let me say the real environment of learning that AI gives us is so helpful for learning"*. Also, SP12 supported this by saying that: *"I used AI because of its interesting algorithms of interaction in a real-*

like learning environment". Moreover, SP3 and SP8 admitted this practical aspect of using AI.

Discussion

The results of this paper demonstrate a dramatic restructuring of cognitive agency in AI-mediated higher education, rather than just an erosion. Although the humanist vision of the self-directed learner, based on the notions of autonomy and epistemic responsibility introduced by Knowles [13] and Candy [14], assumes a limited, sovereign subject who is the author of his or her own knowledge, the lived experiences of participants indicate a more distributed, negotiated, and usually disputed agency. This change is in line with what Williamson and Eynon refer to as the datafication of learning, in which algorithmic systems no longer support cognition but instead distinctly define epistemic pathways, often unintentionally [9].

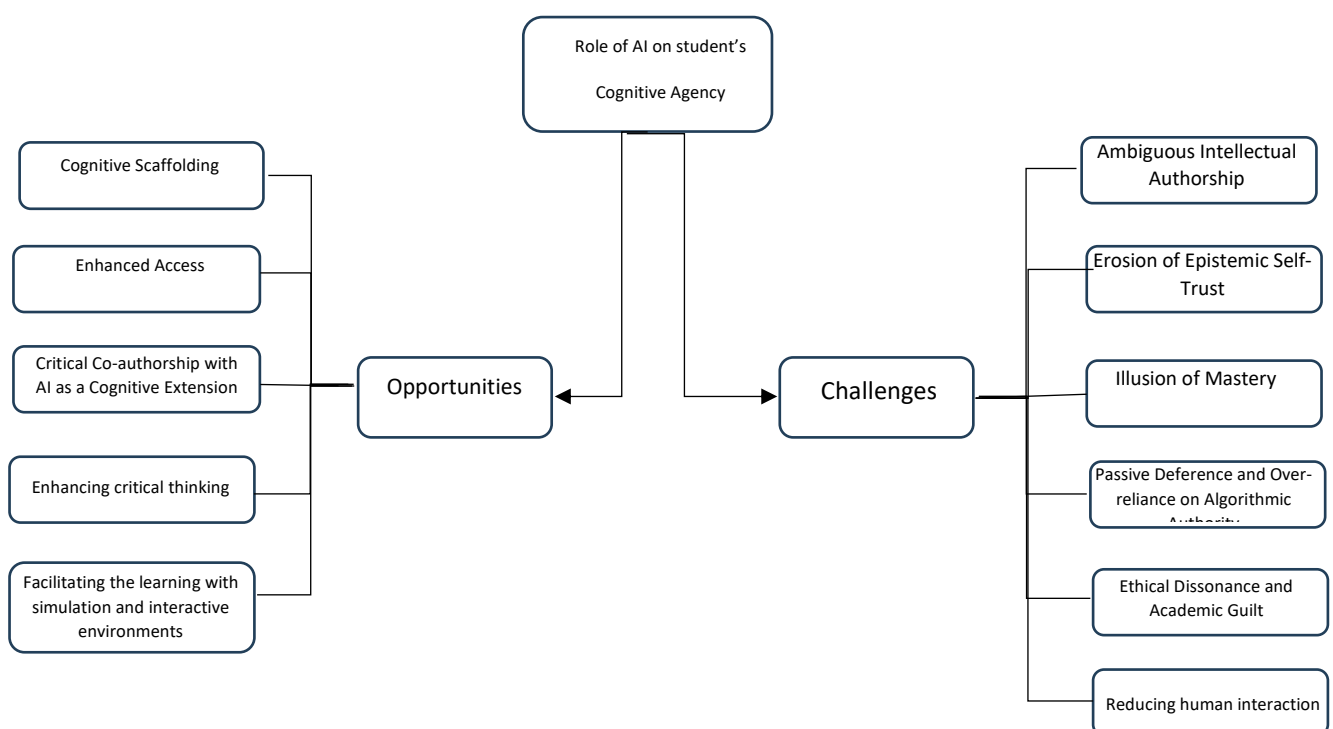


Fig. 2: Challenges and benefits of AI in students' cognitive agency

The argument of uncertain intellectual authorship and the weakening of epistemic self-confidence can be highly relatable to the recent discourse on the epistemic authority of AI. According to Polat et al., generative AI is an epistemic agent that acts as a black box, i.e., it hides its origins and logic, pushing the learner out of the critical assessment of knowledge claims [17]. This is not only a technical displacement, but an existential one: when they consult AI instead of personally acquired knowledge, the students are performing what Biesta describes as a crisis of subjectification, a loss of becoming a subject capable of defending his or her own judgments [12].

However, it would be a simplistic approach to think of AI only as a threat to agency. Our results on AI as a cognitive extension and negotiated co-authorship resemble posthuman and sociometrical views that refute the myth of the autonomous learner. Basing our arguments on the recent publication on cognitive assemblages [15], we observe that cognition has never been localized to any particular tool or environment, and AI is no exception, but a magnification of that state of affairs. Agency can also be enhanced and not substituted when learners actively incorporate AI in their cognitive ecology, as the reflection that *"I am not less human, I am more capable"*, by SP1 implies.

The duality of AI as prosthesis and parasite reflects the ambivalence [31] is recognized in educational AI, as it can make more things available to everyone (as in our motif of greater access to complicated knowledge) and at the same time increase epistemic dependency. The most important distinction our information points to is that of critical AI literacy. Individuals who negotiated co-authorship (e.g., PS9, the law student who presented AI as a sparring partner) are instances of what Williamson and Eynon describe as an approach to

instrumentalism reflexively- in other words, employing AI strategically and retaining epistemic dominance [9].

Importantly, this state of ethical dissonance and academic guilt experienced by many students is a harbinger of the fact that the issue is not AI, but rather the absence of pedagogical systems to maneuver around its use. According to Rapanta et al., universities have been keen to integrate AI without considering assessment or designing learning. These tensions are left to be resolved by our participants individually, and these systemic failures are usually absorbed into individualized moral inadequacies [32]. This stresses the invitation by Williamson and Eynon to education that creates the capacity to be in the world in a manner that is not entirely prescribed by that which is given; it has a capacity which must be consciously trained in AI-saturated settings [9].

Lastly, the illusion of mastery and passive deference themes display the underlying pedagogical crisis of the confusion of performance with learning. With the growing trend of outcome-based education, AI can use this loophole to maximize results instead of knowledge. According to a warning that Holmes et al. give, AI tutors can teach students how to achieve in school, but not how to think (SP11) [18]. Our evidence supports this danger--but also its remedy: scaffolding struggle (not removing it) through the use of AI, as SP5 explained, may rehabilitate the learner's ability of the learner in genuine engagement.

To move beyond a descriptive account of AI integration, this study proposes a formal framework of 'Critical Co-authorship.' This framework conceptualizes agency not as a static attribute of the individual, but as a dynamic, negotiated process within a distributed cognitive assemblage. Critical Co-authorship is defined by three essential dimensions: First, Epistemic Oversight, which

requires the learner to maintain 'epistemic dominance' by treating the AI not as an oracle, but as a fallible interlocutor. This involves the reflexive interrogation of the AI's 'black-box' logic to prevent the passivity of deference. Second, Dialectical Engagement, wherein the learner employs AI as a 'sparring partner' to stimulate higher-order thinking. Rather than using AI to bypass cognitive effort, the learner utilizes it to facilitate what the findings term 'scaffolding struggle' using the tool to introduce complex perspectives or structural frameworks that the learner must then critically wrestle with to achieve genuine understanding. Third, Architectural Authorship, which shifts the definition of authorship from the mechanical production of text to the strategic design of inquiry. In this mode, the learner remains the primary agent by directing the cognitive ecology, ensuring that the AI serves as a prosthetic extension of their intellect rather than a parasitic substitute for it.

The study's contribution lies in its movement beyond the binary discourse of AI as either an existential threat or a mere cognitive tool. By reframing the impact of AI as a 'dramatic restructuring of cognitive agency' rather than a simple erosion, this research demonstrates that the current academic crisis is not a direct result of AI integration, but of a systemic pedagogical failure to address the 'prosthetic/parasitic' duality of these tools. Most importantly, it posits a normative shift: instead of aiming for a return to traditional, autonomous humanism, the study identifies 'scaffolding struggle' as the essential pedagogical intervention necessary to cultivate critical agency in AI-saturated environments.

Conclusions

In conclusion, the emergence of AI necessitates a redefinition of the self-directed learner. The

traditional model of the isolated, autonomous subject is increasingly untenable in an era of co-produced cognition. This paper has advocated for a posthuman framework where agency is understood as a reflective negotiation between human intent and algorithmic suggestion. By fostering 'critical co-authorship,' higher education can prepare students to treat AI as a collaborator in thought while upholding rigorous standards of accountability. Implementing this requires a fundamental restructuring of pedagogy, curriculum, and philosophical inquiry. This paper argues that the traditional paradigm of the self-directed learner is not becoming obsolete, but requires a fundamental ontological redefinition. The Cartesian ideal of the autonomous, self-contained knower is increasingly incompatible with a contemporary epistemic landscape where cognition is co-produced within human-machine assemblages. Instead, it proposes a posthuman framework of self-directed learning, wherein agency is understood not as a possessional attribute of the individual, but as a continuous, reflective negotiation between human intentionality and algorithmic agency. Within this framework, authorship is reimagined as a participatory and morally alert process. It is no longer an isolated act of production, but a conversational engagement that demands a new form of competence: critical co-authorship. This competence entails the ability to utilize AI as a cognitive collaborator while maintaining rigorous accountability for the epistemic claims produced. Despite its significant findings, the study has some limitations, like the utilizing qualitative approach and the issue of generalizability of the findings. To operationalize the framework, the paper proposes a tripartite shift in higher education:

- Pedagogical Shift: Moving from outcome-based assessments toward process-oriented

designs, such as reflective portfolios and documented AI-interaction logs, to capture the "scaffolding struggle."

- Curricular Shift: Integrating disciplinary-specific AI literacy that emphasizes the interrogation of algorithmic logic, bias, and the limits of machine reasoning.

- Philosophical Shift: Transitioning from a humanist binary of autonomy vs. dependence toward an assemblage-based understanding of agency, recognizing the distributed nature of modern intellect.

Ultimately, as AI becomes ubiquitous in academic settings, the central challenge for higher education is not the regulation of tool use, but the cultivation of a way of thinking that is enhanced by, rather than substituted by, algorithmic mediation. The goal is to equip learners not merely to achieve academic performance, but to maintain the capacity for critical, independent thought within an increasingly automated epistemic ecology. In the future, researchers can use quantitative or mixed methods to conduct this research in extended society and test the generalizability.

Authors' Contribution

All of the process of this manuscript was done by Abbas Ramezani.

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Conflict of Interest

The author has no conflicts of interest.

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AUTHOR(S) BIOSKETCHES

Abbas Ramezani is an assistant professor in the Department of Educational Administration at Farhangian University. He holds a PhD in Educational Management from Shahid Beheshti University in Tehran. Dr. Ramezani has supervised over 45 master's and doctoral theses and presented approximately 80 scientific articles in journals and scientific conferences. He has been actively involved in the scientific committee and review of several scientific journals and conferences. His areas of expertise include educational management, higher education, educational technology, literacy, and comparative education.

Ramezani, A., Assistant Professor, Educational Management. Farhangian University, Tehran, Iran

✉ a.ramezani@cfu.ac.ir

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