Integrating Generative AI and Blended Learning: Enhancing Learning and Teaching in Higher Education

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Abstract

Learner engagement is essential for positive student learning experiences and outcomes. While the higher education sector has accumulated years of experience with learner engagement with conventional face-to-face instruction, it is also placing increasingly more emphasis on the combination of in-person and online teaching and learning (T and L) activities, which enhances T and L in multiple ways. Promoting and supporting learner engagement in blended learning environment is receiving greater attention and scrutiny in recent years. This presentation will be situated in an AI-infused T and L landscape: this article will offer a short survey of recent scholarship on generative artificial intelligence and blended learning and share insights into strategies for delivering blended learning to maximize the benefit for instructors and learners in the emerging digital learning environments of higher education.

1. Introduction

Content design and instructional delivery are crucial components behind positive learning experiences in the context of blended learning (BL). Widely practised as an effective pedagogical strategy that amalgamates the fine features from both face-to-face and online teaching and learning (T and L) activities, BL has been featured frequently in discussions of higher education T and L ever since the early 1990s [1]. BL is an educational practice that cannot be framed by one single definition, owing to the presence of various moving pieces such as human factors, learning variables, institutional variables, and technological variables. In addition, the multiplicities of the variables are manifested and further magnified through the variety and variation present in the typical elements in any one BL course, including:

i. Face-to-face teaching: in-person T and L activities in a physical classroom during face-to-face teaching may or may not be furnished with different types of technologies and/or movable furniture.

ii. Online content: it can be information on the Internet, materials available in an institution's learning management system (LMS) or web-based materials (such as open educational resources, or OERs).

iii. LMS: an LMS is typically a cloud-based learning platform that facilitates dissemination of online learning materials as well as different T and L activities such as polls, quizzes, class discussions, assignment collection, progress tracking, and grading.

iv. Channels of communication: instructor-learner and learner-learner communications outside of classroom can take place via email, mobile instant messaging, and various LMS functions.

v. Feedback: similar to other pedagogical approaches, BL thrives on feedback for learners (either from instructors or automated response systems afforded by, say, LMSs) and feedback for instructors (such as learning analytics, mid-term student feedback and end-of-term student feedback), with which, respectively, learners can experience personalized learning, and instructors can make data-informed decisions in their pedagogical design and delivery.

In the landscape of higher education, generative artificial intelligence (GenAI), as a subset of artificial intelligence enables the automation of various aspects of T and L. Under the guidance of UNESCO, the first-ever global guidelines that aim to help policymakers and instructors navigate the potential of GenAI for learners' benefit, Guidance for generative AI in education and research, was published in 2023. In summer 2024, UNESCO published AI competency framework for teachers and AI competency framework for students, and in both frameworks, having a "human-centred mindset" is foregrounded.

GenAI holds massive potential and can be a game-changer in the creation of educational content as well as the provision of adaptive learning, personalized learning support, learner performance analysis, automated grading and administrative assistance to educators. Having said that, GenAI's potential to revolutionize education systems is accompanied by much skepticism articulated in various studies. At the beginning of this new era of technology-enhanced education that started in November 2022 when ChatGPT was released, immediate concerns shared among educators included reliability issues, equity issues, over-reliance on the new tools, threats and challenges to

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academic integrity, and the possibility of such new tools being used for different types of cheating. Simultaneously, globally educators are quick to rethink the role and the design of assessment, and soon discussions on the opportunities and benefits afforded to higher education by this disruptive new technology have surfaced [2, 3, 4]. Some of the key opportunities and benefits identified and explored in various studies include:

i. personalized learning and adaptive learning materials to suit their individual learning needs;
ii. real-time feedback and evaluation which facilitate effective monitoring of learners' progress and, in turn, allow instructors to make data-informed decisions in their instructional design and delivery; and

iii. a certain degree of removal of linguistic obstacles encountered by individuals whose first language is not English and who need to navigate a predominantly Anglophone academic ecology.

Collaborative relationships exist among different actors partaking in both BL and T and L with GenAI. In both BL and T and L with GenAI, there are instructors, learners, and technology. It is well established that educators can harness BL methodologies to accommodate different learning needs, provide more targeted feedback, create personalized learning experiences and, ultimately, improve learning outcomes. The same can be said about using GenAI in T and L. More importantly, as the role of instructors in BL practices evolves, learners in BL environments are changing from passive receivers of knowledge to active gatherers of knowledge in the process of knowledge construction. This means that effective support and guidance for learners in their largely independent journeys has become critical, and yet, such support and guidance in BL environments are not as readily available and targeted as those offered in traditional face-to-face settings; therefore, learners often find themselves stuck in unresolved problems and difficulties, which can lead to decreased motivation, engagement and self-efficacy, and even failure. This is where GenAI technologies can come in and bridge the gap in asynchronous T and L by providing 24/7, real-time learning support to learners and enhancing their knowledge construction, especially in the online learning components in BL.

The focus of this discussion is BL in an AI-infused T and L landscape. The remainder of the discussion will survey recent scholarship on GenAI in higher education and, specifically, in the context of BL. The author will also present her insights into selected strategies for delivering blended learning that can benefit instructors and learners in the emerging digital learning environments of higher education. It is to be noted that much of the critical commentary in this piece is shaped by two things: a personal conviction that education is fundamentally a human-centric, collaborative endeavour; a recent comment made by Intel Chief Executive Officer Pat Gelsinger who sees "building formal correctness into the underlying models" as the next phase of AI [5]. Readers should also note that the author's intention is not to conduct a systematic literature review (SLR) to synthesize the research findings on GenAI applications in BL, but to present an opinion paper informed by scholarship on GenAI in higher education and in BL.

2. A survey of recent scholarship on GenAI and BL

GenAI in higher education

Bahroun and colleagues review 207 research papers and explore the transformative impact of GenAI in specific educational domains, including medical and engineering education [6]. By looking into ethical considerations, interdisciplinary collaboration, and responsible use of technology, the authors highlight the need for transparent GenAI models and the need to address biases. In their bibliometric analysis of GenAI in education, the authors survey prominent AI tools, research foci, geographic distribution, and interdisciplinary collaboration, and ChatGPT emerges as a dominant GenAI tool.

In an innovative study which is based on conversations with ChatGPT, Michel-Villarreal and colleagues investigate the potential benefits, limitations and challenges of integrating ChatGPT into academic settings in higher education [4]. This study highlights concerns regarding academic integrity, plagiarism detection, and the potential impact on critical thinking skills, and underscores the urgent need for clear policies and guidelines to responsibly integrate GenAI in higher education. This study also emphasizes the importance of thing ethnography as a feasible approach for researches that engage with intelligent AI systems.

Active learning is proven to be one of the most effective approaches to increasing learner success in language learning. Two pieces by Kohnke and colleagues examine the intersection of GenAI and language education: one delves into the specific applications of ChatGPT in language teaching and learning [2] and the other focuses on the preparedness of language instructors to integrate AI in their teaching practices [7]. Both papers underscore the potential of GenAI in reshaping language education, and simultaneously highlight the challenges and ethical considerations that come with it. In the two papers, the authors clearly articulate

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that GenAI tools and technologies are here to stay and, therefore, both language instructors and learners require specific digital competencies to make the most of such tools and technologies while traversing existing and potential pitfalls.

Crosthwaite and Baisa place data-driven learning (DDL) and GenAI side by side and explore the intersection of DDL and GenAI [8]. They believe that DDL techniques, with which language learners learn by exploring and analyzing real-world data, are unlikely to be surpassed or sidelined by GenAI technologies and that GenAI technologies can potentially neutralize some of the limitations of DDL techniques, and, therefore, language learners can benefit from an integrated model that brings together DDL and GenAI, which can engender a more comprehensive understanding of how languages work in different contexts. Mizumoto, building upon the work by Crosthwaite and Baisa, argues that the two fields, DDL and GenAI, can benefit from one another and proposes a new framework of "metacognitive resource use", which stems from the concept of metacognition [9]. Mizumoto studies how learners use their metacognitive skills when working with the resources available to them, including real-world data and GenAI technologies. It is found that learners do not just passively receive information from real-world data and GenAI, but actively engage with them by using their metacognitive skills to guide their own learning process.

GenAI in BL

Park and colleagues investigate how AI helps advance BL practices by surveying 30 researches that look into the integration of AI in BL [10]. Guided by 3 main concerns, namely, key research trends related to AI applications (AIAs) in BL, role of AIAs in BL and how AIAs help mitigate the challenges of BL, Park and colleagues identify three roles of AI, namely, a direct mediator to control flexibility and autonomy of students, a supplementary assistant using advanced learning analytics technologies and a new subject such as pedagogical agents or robots. What is worth noting is that language learning and mathematics have come up as the major subject areas that frequently adopt AI technologies in T and L, and that there is a lack of research on AIAs that connect online activities with classroom-based offline activities. The researchers recommend future research to go beyond learning processes and outcomes, and explore the complexities of AI integration in BL, in particular affective aspects such as changes in learners' motivation, attitudes, and satisfaction in learning.

Sánchez-Ruiz and colleagues investigate the impact of ChatGPT on BL methodologies in engineering education, specifically in mathematics [11]. By surveying students enrolled in a Mathematics course (delivered in a BL methodology), the researchers study the impact of GenAI tools like ChatGPT on the students' acquisition of critical thinking, problem-solving, and group-work skills. It is found that students can quickly adopt the tool of ChatGPT, while exhibiting high confidence in the accuracy of the responses generated by the tool. However, there are concerns regarding the potential impact on developing lateral competencies essential for future engineers. The researchers advise that in engineering education, GenAI should be used as an auxiliary tool rather than "a replacement for traditional teaching methods" (p.18), and that educators should strive to achieve a balance between leveraging the benefits of GenAI and providing students with learning opportunities to develop the necessary competencies required of their future professions.

Alshahrania examines the potential of GenAI in enhancing the sustainability of educational systems, in particular BL systems [12]. This study identifies best practices and strategies for integrating GenAI into BL systems, and discusses how GenAI technologies can enhance educational accessibility and promote educational equity and subsequently help educators and administrators develop more sustainable and efficient methods of education delivery. The researcher, in agreement with many others, cautions that there is a great need for careful implementation, teacher training, and fostering of metacognitive skills to ensure responsible and constructive use of GenAI technologies.

Through exploring the transformative potential of a dozen or so existing chatbots in higher education, Ilieva and colleagues address challenges such as learner engagement, personalized learning experiences, and instructor workload [13]. They propose a five-stage, course-level theoretical framework for BL that integrates GenAI-driven chatbots:

i. In the pre-course stage, the chatbot plays a supportive role by suggesting options and alternatives for course organization (based on information of course structure and content designed by the instructor).

ii. Before class, the chatbot plays an assistant role by providing materials related to upcoming class topics and delivering pre-class learning activities plus study aids.

iii. During class, the chatbot plays a minimal role as T and L activities predominantly involve human actors who engage in synchronous communication.

iv. After class, the chatbot can support both the instructor by assisting with automated tasks such as grading and providing personalized feedback, and the learners by playing the role of a personal tutor through answering questions and suggesting further

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learning and practice materials.

v. In the post-course stage, the chatbot, working with information such as learner performance and course evaluation, can help enhance T and L processes by continuing to identify related resources for future runs of the course.

The framework considers the perspectives of both instructors and learners. It also showcases a comprehensive understanding of chatbots' impact and a holistic methodology for enhancing educational experiences. Also looking at chatbots are Labadze and colleagues, who review 67 studies that investigate the impact of AI chatbots in educational settings [14]. The researchers notice a trend among educators and learners: learners are excited about learning with AI-powered chatbots whereas educators view them with much caution and reservation. The researchers also explain the numerous benefits of integrating AI chatbots in education, as seen from both learners' and educators' perspectives. For learners, the benefits from AI-powered chatbots include homework and study assistance, provision of personalized learning experiences, and assistance in the development of various skills. For educators, the main advantages include the time-saving assistance and augmentation of pedagogy. Nevertheless, alongside its transformative potential are concerns over issues of reliability, accuracy, fair assessment, and ethical considerations.

Wu and colleagues introduce a learning aid called "ChatGPT-based Intelligent Learning Aid" (CILA) [15]. CILA integrates ChatGPT, Apple's Shortcuts, and LINE (an instant messenger): ChatGPT addresses learners' questions; Apple's Shortcuts facilitates seamless communication among Apple devices, ChatGPT, and LINE; learners' questions are archived in LINE, which allows review of course content. CILA is designed to enhance self-regulation progress and knowledge construction in BL. Even though this study primarily targets secondary-school mathematics, the implications from this investigation carry core notions related to self-regulated learning (SRL), which are applicable to BL settings in higher education, especially since SRL is proven to be positively related to success in online higher education, indicators of which include better grades and less academic delay [16]. Typically understood as a 3-part process in which learners i. set goals and develop corresponding methods of study, ii. engage in learning activities and monitor their learning process, and iii. evaluate their results and reflect on the effectiveness of their learning strategies [17], SRL allows students to become less reactive and more proactive in their learning. In their study, Wu and colleagues find that CILA offers prompt, targeted responses to learners' questions and minimizes interruptions during learning processes. The intervention of CILA effectively improves self-regulation progress and knowledge construction in BL contexts, and positively impacts learners' intrinsic motivation, engagement, and self-efficacy.

BL practices require the component of instructional videos. Leiker and colleagues explore the potential of AI-generated synthetic videos in online educational settings [8]. In this study, the control condition and the experimental condition are respectively traditionally-produced instructor video and a synthetic video with a realistic AI-generated instructor. The AI-generated synthetic video is created in an attempt to replicate the traditional talking-head video format and the content thereof remains human-made. This has helped remove a key concern that AI-generated content can be biased, incomplete or inaccurate. The researchers find that significant improvement in pre-learning to post-learning is seen in learners in both conditions. There is no significant difference in gains between learners in the two conditions, nor is there observable difference in the learners' perception of the videos in the two conditions. The researchers also note a few advantages in the production of the synthetic video over that of a traditional instructor video: i. the cost of production of the former is near zero, while the production of the latter would demand human cost, plus film equipment and software; ii. time-wise, to produce the former would take considerably less time, as opposed to hours of human labour required to produce the latter; iii. in terms of making updates or corrections, generating the former would only require editing the text input, whereas generating the latter would require actual filming and editing. This study suggests that there is potential in AI-generated synthetic instructional videos to be "a viable substitute for videos produced via traditional methods in online educational settings" (p. 10). A shift in this direction, directed by information accuracy and guided by further research, would be conducive to the production and dissemination of high-quality educational content across the globe.

3. Discussion

Observations and Strategies

Education is a human-centric, collaborative endeavour and has in the past few decades evolved from a predominantly human-human collaboration into a hybrid of human-human, human-machine, and human-AI collaboration. In the context of BL, working alongside human actors – instructors and learners – is educational technology, which can enhance different aspects in T and L interactions by breaking down the barriers of time and space, contributing towards personalized learning and providing learning analytics to facilitate the documentation of learning progress and the design

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and delivery of instructional materials. Since late 2022, GenAI has quickly found its way into educational settings and become a co-player in education. With it, educational institutions are undergoing massive digital and pedagogical transformations. It is crucial for instructors and learners to develop necessary skills and competencies, and for administrators and AI developers to rethink education and tackle a myriad of issues such as academic integrity, equity, human values, copyright, data privacy, accuracy, and infrastructure. Just like any other technological innovations, integrating GenAI technologies into effective teaching practice requires practitioners' understanding of their capabilities, potentials and limitations; therefore, provision of effective and engaging educational experiences with a synergy of GenAI and BL requires the empowerment of all stakeholders in order that they cooperate in this network of utilization, management, and development. In this section, the author will offer 10 sets of observations and strategies (where appropriate), based on practical experience and established scholarship, which can benefit T and L activities in the emerging digital environments of higher education and can be of relevance to instructors, learners, and administrators, whether or not they are involved in BL.

3.1. AI readiness, literacy, and competency

For learners, AI readiness refers to a preparedness to use AI in their learning, which includes knowledge of AI, ability to use AI, critical evaluation of AI, and ethical and legal knowledge of using AI. For instructors, AI readiness includes their cognition, ability, vision, and ethics in the educational use of AI. AI literacy typically entails a few key components, in particular, an understanding of AI, how to interact with AI, how to use AI ethically, and how AI interfaces with the world. As GenAI technology is increasingly more embedded in various T and L interfaces and increasingly more accessible to instructors and learners alike, one must equip oneself with necessary competencies associated with technology, impact, ethics, collaboration, and self-reflection.

The author believes that to be competent in GenAI, one also needs to be aware of the corresponding corpora of data and how the data is accumulated. It is often postulated that alongside multiple biases, the current corpora capture a Global North perspective of the world, a point to be elaborated later in this section. Therefore, not only do learners need to develop the capacity to exercise their human judgement when working with machine-generated content, they also need to learn to evaluate the quality of the communicative and collaborative processes they have with GenAI, and often such evaluative activities would require input and guidance from educators. Therefore, as educators, we share with our learners the responsibility of practising and sharpening our evaluative judgement, which is a fundamental goal of higher education.

3.2. Professional development for instructors

When it comes to professional development (PD), entities such as centres for teaching and learning (CTLs) can approach GenAI like they do with all other forms and modes of educational technologies, which means that CTLs have the responsibility of providing instructors with training and resources on effective integration of GenAI tools in teaching, learning, and assessment. Instructors' proficiency in using such technologies is conducive to discovering and harnessing the tools' inherent pedagogical potential and creating quality educational experiences for students. Specifically, CTLs can provide the following to help instructors adapt GenAI in their teaching practices:

i. training and PD opportunities for instructors (and institutional administrators) to learn about the potential and limitations of using GenAI in education;

ii. opportunities for instructors to share and reflect on their own pedagogical experiences of using GenAI and discuss best practices for the integration of GenAI in teaching, learning, and assessment;

iii. tailor-made PD events to cater to instructors' GenAI training needs on specific topics (for instance, discipline-specific, function-specific, concern-specific);

iv. resource materials, such as manuals, blog posts, and OERs, to instructors (and institutional administrators);

v. incentives (funding, for instance) for research enquiries into the application, impact, and effectiveness of GenAI in teaching, learning, and assessment.

One particular issue regarding T and L with GenAI has led to much discussion at the author's home institution; it is about the ability of large language models (LLMs) to generate quasi-human text. For learners, this capability makes it hard for them to sieve through the materials generated and distinguish between real knowledge and fabricated, unverified information. For instructors, it may be difficult to distinguish if a text is produced by human or machine. While GenAI content detector tools are available and that strategies to identify work generated by LLMs (especially ChatGPT) have recently been identified [19, 20], in the long run, I believe that instructors (and our learners) cannot just rely on mitigation strategies related to verification

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and detection, instead, we should teach our learners how to make use of credible and reliable resources such as scholarly sources and academic libraries, and, for our practice, design assessments that encourage critical, evidence-based, and creative engagement with learning materials.

3.3. Learners' use and perception

In October 2023, student representatives shared their views on learning with GenAI at a PD event held at the author's home institution [21]. They spoke on how they were using GenAI tools and their concerns regarding GenAI in general and in assessments. They also made known that they wanted clear guidance from the institution and their professors. In general, the students saw GenAI technologies as helpful in providing various kinds of assistance, such as immediate learning support, language support, idea generation support, literature review support, multi-media generation support, and para-academic activity design support.

At the same time, they were aware that an over-reliance on GenAI could be detrimental to their independence, creativity, and critical thinking. In addition, information biases and inaccuracies, privacy issues, academic honesty, equity and accessibility, as well as ethical practices were among their main concerns. The students also felt that the way of learning and assessment might need to be changed in order that they could really apply their newly-acquired skills and knowledge and properly demonstrate that they had done so. Therefore, it is vital that instructors create meaningful opportunities for learners to work with GenAI, which can in turn allow learns to demonstrate how well they have learnt and applied the new knowledge.

3.4. Learning analytics

GenAI technologies can greatly impact how learning analytics (LA) can inform T and L. This sub-section does not intend to put forward strategies related to LA driven by Gen-AI, but highlight some of the opportunities therein.

One of the key LA applications in educational settings lies in the tracking and analysis of student performance. Effective LA can support learners with adaptive materials tailored to their current knowledge, performance, learning process, and contexts, and learners likely benefit from BL environments that make use of LA to support SRL [22], which has much implication in blended learners' success. Another pivotal merit of LA is the provision of early warning system that can identify low-performing learners. These are some of the conventional, long-established uses of LA, which relies on traditional AI algorithms, trained with historical data to predict future outcomes. GenAI, also trained with historical data, surpasses traditional AI by making use of deep learning and neural networks to create new content. One identifies patterns and the other can create something "new". GenAI can elevate the delivery of LA by offering predictive LA and producing trajectories of learning paths, which can enrich instructors' pedagogical design, help them preempt potential learning difficulties and eventually support adaptive intervention. Interventions informed by GenAI-supported LA can become more preventive than corrective, and this could revolutionize different aspects in BL and promote learners' success in BL.

3.5. Infrastructure

Higher education institutions (HEIs), when adapting to such colossal transformation brought about by GenAI, need to address changes in pedagogical design, curricular design, and institutional policies. At the same time, it is vital that positive learning experiences and outcomes for students be ensured. A few things can help HEIs facilitate smooth transition and development.

Establishment of clear and adaptable guidelines and policies

Most HEIs have established or are in the process of establishing guidelines to safeguard responsible and appropriate use of GenAI tools. Since different disciplines view and evaluate GenAI technologies differently, and different teaching and research staff tend to take different stances regarding the use of GenAI, a standardized, one-size-fits-all policy in this context would not be suitable, nor would it be sustainable. Most HEIs, therefore, when devising such guidelines and policies, both demand specific adherence to stipulated principles (such as ethical uses, data privacy and security, academic and institutional integrity) and allow for acceptable and reasonable adaptability in order to acknowledge the autonomy of instructors and learners and to promote discipline-relevant applications of GenAI technologies. Equally important is the practice of reviews and updates of such policies, which are essential for the maintenance and perpetuation of trust and integrity in HEI settings, and they enable HEIs to keep abreast with the rapid development of educational technologies. By being proactive, HEIs can stay adaptable and responsive to changing scene of GenAI, protect the interest of their staff and learners and uphold institutional credibility and reputation.

Introduction of AI-related content and establishment of AI-related programmes

HEIs should be proactive in preparing their

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learners for the ever-growing ubiquity of GenAI technologies in various facets of life. There are plenty of opportunities in both academic and para-academic arrangements:

i. Building upon the first sub-section above, "AI readiness, literacy, and competency", HEIs can incorporate GenAI-related training, such as AI literacy or AI competency modules, into their foundational curriculum.

ii. GenAI-related content can be integrated into the course syllabus across a wide range of disciplines. By infusing GenAI concepts, applications and implications into existing courses, instructors can provide learners with opportunities to develop a multidimensional perception of the relevance of such technologies and help them understand how GenAI connects with various domains of knowledge.

iii. Going beyond integrating AI-related content into course syllabi, HEIs, by taking into consideration global trends and regional/local needs, can explore the establishment of AI-related programmes, which can be theoretical, applied or interdisciplinary in nature. Alternatively, new specialization in AI or Gen-AI can be introduced into existing programmes, such as data science, business, language and culture, public administration, education, and law.

iv. Outside of academic arrangements, HEIs can create GenAI-related opportunities for student-led initiatives in the form of activities such as design contests, hackathons, writing contests, and debates.

Collaboration

Experts at the 54th World Economic Forum Annual Meeting expect GenAI "to affect all industries, albeit with large variations, in a revolution that is just beginning" [23]. Everyone is impacted. Everything is impacted. HEIs can play a phenomenal role by collaborating with different parties and working towards providing accessible, personalized and effective education for our learners. For example, HEIs can bring together different stakeholders – management, policymakers, researchers, industry – and study the impact and effectiveness of existing pedagogies and how well GenAI is integrated in T and L; the findings of which can inform practices and policies. In addition, different service units within an HEI need to work together to give instructors and learners access to and fair usage of the GenAI tools and/or technologies provided and supported by the HEI, and, more importantly, to identify the learning needs of those with underprivileged circumstances and provide targeted support and interventions. A collective effort of such can promote equity and quality in T and L.

3.6. Co-regulation

Co-regulation of learning is a form of social regulation of learning wherein learners regulate their cognition, behaviour, motivation, and emotions together with their peers or their instructor. The previous sub-section looks at regulation exercised by an HEI through the establishment of policies. There is yet another form of regulation, which is more of an intrinsic nature, namely, regulation from within the learners themselves, or, as discussed earlier, self-regulated learning (SRL), which involves learners' metacognitive abilities and calls upon learners' capabilities of evaluation, exploration, investigation, and corroboration. In our current context, co-regulation is a synergy of a few things: regulation from the HEI, instructors' guidance, and learners' SRL.

The author wishes to return to one of the fundamental questions in education: what are we teaching our learners at HEIs? And in this age of GenAI when so much more is available at our learners' fingertips, what *can* we teach them? Ilieva and colleagues observe that acquisition of skills and knowledge, and the process of which, are not fully addressed in the existing frameworks for GenAI and intelligent chatbots in higher education [13]. Therefore, while learners are governed by their respective HEI's rules and regulations regarding academic integrity, they should also receive guidance from educators in developing SRL skills. Within such a system of co-regulated learning are both internal and external agents: individual learners' own strategies and management of their learning, plus the guidance given by instructors and the parametres laid down by HEI. It is widely acknowledged that consistent and meaningful interaction with GenAI can enhance learners' metacognitive and SRL skills. Educators should capitalize on this and create opportunities for learners to exercise individual agency in their learning relationship with GenAI. To encourage productive human-machine collaboration in T and L, here are a few strategies that instructors may consider:

i. Rely on our long-time companion, BL. There is no better set-up than a flipped classroom, in which instructors can use their human perspectives and expertise to guide their learners in reviewing, understanding and evaluating AI-generated content.

ii. Create tasks in which learners can use GenAI tools to brainstorm and generate hypotheses and perspectives (rather than to locate answers).

iii. Create tasks that call for learners' critical thinking skills and problem-solving skills. Avoid tasks that may deprive learners of opportunities to integrate knowledge and conduct their own analysis and investigation.

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iv. Create opportunities for learners to work with credible and reliable resources such as scholarly sources and academic libraries, and then discuss their findings against AI-generated content. In other words, create tasks for learners to evaluate machine-generated content.

3.7. Copyright

While the alchemy of LA and AI-generated content can help educators produce and provide engaging, relevant, and more pertinent materials to cater to different learning needs and styles, there remains the issue related to intellectual property rights, including authorship and ownership. It is vital that institutions and educators navigate carefully AI-generated content: copyright compliance can become a challenge. For example, when performing tasks related to the production of sound BL learning materials (synthetic or otherwise), corresponding input could include information from texts such as course syllabi, quizzes, and academic publications. A prompt can lead to the generation of a response that contains a complete sentence or even a complete paragraph from a journal paper or a web-page, a first-had experience the author has had. To mitigate copyright and plagiarism issues, careful and responsible integration of such content with due acknowledgement has become a crucial step in the GenAI-aided process of creating BL materials. Kasneci and colleagues have recommended a few steps to tackle potential concerns in this aspect [20], including:

i. Transparent communication with the authors of the original texts on matters of purpose, policy of data usage and permission to use their content for training LLMs;

ii. Compliance with copyright terms for content in OERs;

iii. Inheritance and detailed terms of use for LLM-generated content;

iv. Education for users of such technologies and clear information on relevant policies.

3.8. Data Privacy

It is of utmost importance that the vast volume of data in the deployment of BL courses accompanied with GenAI usage be utilized with strict adherence to data privacy regulations. There are legitimate concerns regarding data breaches, unauthorized access to learners' data and various sets of LA as well as the use of learners' data for purposes other than education. Not only is protecting learners' personal information a legal obligation, it is also an ethical imperative. Transparent data usage practices can help foster trust among entities involved, specifically, learners (and, for young students, their families), instructors, IT departments and HEI management. Privacy concerns and security measures can also influence how users perceive and engage with GenAI tools in their learning.

To effectively protect data privacy, similar to the proactive strategy discussed above in the context of establishment of clear and adaptable guidelines and policies of GenAI use, HEIs should also seek to regularly review and update their implementation of data privacy and security policies. An ADRI approach – approach, deployment, result, improvement – can facilitate quality assurance and quality enhancement in a cyclical manner. Moreover, instructors and learners should be duly informed of any updates on relevant policies and regulations as well as best practices, so that they are able to spot and report related risks. This can form part of an incident response plan [20], typically implemented and managed by the IT department of an HEI.

3.9. Inclusivity and accessibility

There are two major issues here: one driven by economic factors and one driven by culturo-linguistic factors. Firstly, digital divides can be a barrier to equity in education, especially in areas that are underprivileged owing to various circumstances. GenAI-aided BL delivery is powerful in supporting personalized learning pathways, but it can widen the gap in access to education and result in a two-tiered education system [24], one in which only the learners in well-resourced educational settings can actually benefit from all the merits afforded by the synergy of pedagogy and technology. UNESCO's Education 2030 Agenda urges that we must ensure that "AI does not widen the technological divides within and between countries" and that we must work towards "AI for all" [25]. HEIs should, therefore, devise strategies to reduce any existing gap and ensure that every learner has access to the necessary technology (including the Internet).

In addition, it has widely been noted that there are multiple forms of bias in LLMs, including race, age, gender, language, culture, and politics, which likely perpetuate and augment current biases and harm the wholesomeness of T and L. It has also been observed that the majority of the research in LLMs is based on and done for the English language [20], which suggests that education for English-speaking users possibly benefit more from these research findings than users of other languages, resulting in unfair knowledge of and access to educational technologies. To say that we should eliminate biases in LLMs and research in LLMs is unrealistic; what we can do to tackle the phenomenon, as educators and researchers, is by conducting research in LLMs of different languages where possible. It is hoped that LLM vendors can play a role in ameliorating

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implicit or explicit biases through transparent communication with users on matters related to the input, assumptions, and output of LLMs, constant monitoring and regular evaluation of the algorithm and performance of LLMs, as well as updates whenever necessary.

3.10. Scalability and Sustainability

As discussed earlier, AI-generated synthetic instructional videos can become a workable replacement for human-instructor instructional videos, thus potentially aiding the scalability of BL courses and materials and promoting equitable learning. There are, however, multiple factors that may impact the resultant quality and effectiveness of BL deliveries with synthetic instructional videos. For instance, would there be observable differentiation in learners' perception, knowledge gains, and learning outcomes when they learn with content videos and when they learn with introductory videos, both of which are generated by GenAI? Would the complexity of material matter? That is, would learners achieve different levels of learning outcomes when they learn with synthetic videos and when they learn with videos narrated by human instructor? How about using the same set of content materials in both types of videos and the only difference is the narrating voice (synthetic vs. human)? Would learners develop fatigue from listening to a synthetic voice for extended periods of time? Along the same line, would the length of the course matter? How about learner demographics? The list of variables goes on. While the cost of production (time cost and money cost) of synthetic videos is minimal, other costs such as maintenance cost and environmental cost are enormous. Environmental costs are particularly alarming concern. GenAI technologies are "energy guzzlers" [26] that need "enormous amounts of fresh water to cool their processors and generate electricity" [27].

As individual users, what can we do? It is certainly not as simple as reducing our conversations with GenAI tools. As major sources of carbon emissions, apparently GenAI tools can also help us find solutions to mitigate the imminent climate problems for which they are responsible. They can likely be called upon in the design of renewable energy systems that are greener and more scalable. However, there is the sustainability conundrum: all these potential participations of GenAI will require energy and, therefore, will likely make it difficult to neutralize the massive energy cost associated with GenAI. For years scientists have been warning that the AI industry is contributing towards a global energy crisis, and earlier in 2024 at the 54th World Economic Forum, Sam Altman, OpenAI chief executive, publicly acknowledged the issue and said that an energy breakthrough was necessary for future AI and that more climate-friendly sources of energy, particularly nuclear fusion or cheaper solar power and storage, could be the way forward for AI [28]. This topic is way beyond the scope of the present discussion, but there is hope when science, academia, business, politics, and technology can join force and look for solutions for more efficient and sustainable utilization of AI.

4. Conclusion

"Artificial intelligence is awesome, but good teaching should always come first", pronounce Crawford and colleagues, who stress the importance of pedagogy, andragogy, and heutagogy over AI [29]. The core of it all is human. Before GenAI, humanity has witnessed several technologies that have engendered great changes in the practice and adaptation of T and L methodologies, such as the personal computer, Web2.0, LMSs, social media, learning analytics, artificial intelligence, to name a few.

Both BL methodology and GenAI application can benefit learning because they make large amounts of materials and information as well as educational assistance accessible to learners free of restrains of time and space. The combination of the two can further promote learners' active participation in learning processes, especially in tasks that require learners to design solutions by integrating their knowledge and skills. Having said that, the quality and outcomes of BL environments and practices may be impaired when GenAI comes into play: are assessments fit for purpose, are learners still as motivated to solve problems using their own knowledge and skills, are learning processes becoming condensed or – heaven forbid – oversimplified? Essentially, the origin of the myriad of doubts and challenges triggered by GenAI can be traced to a shift in educational needs and values, and, by extension, human needs and values.

As the key actors involved in education, both instructors and learners need to look inside ourselves and ask ourselves questions about what and how we teach, what and how we learn, our relationship with knowledge, and our relationship with new technologies. We must understand that GenAI is tool that complements human interactions: it is the human actors that determine what, how and where technologies are used. Crawford and colleagues assert that one must recognize the role of the instructor as a driver for pedagogy: "Whilst Generative AI can drive a change in the way classroom practice happens, it's ultimately the teacher that guides the work in the classroom" [29: p.7]. This view is shared by students at the author's home institution: "[T]eachers are important because they provide students with genuine encouragement, human guidance and emotional support, which

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contribute greatly towards positive learning experiences" [21].

The observations and strategies considered above are valid only when considered together with human actions such as guidance, regulation, supervision, monitoring and critical thinking. Readers would notice that in all of the discussion items, human actors of and associated with education are given ample attention and have due agency and actions. We owe it to ourselves and our learners to explore the long-term implications as well as strategies for optimization of GenAI in T and L. One can see that numerous studies have recommended multidimensional study of the nexus and nuance of human intelligence and machine intelligence, as they can yield findings that can guide and inform human-machine collaboration in T and L processes in the context of GenAI.

The researcher wishes to conclude by putting the spotlight back on human. For any system to work, and in this case, for human actors in education to develop long-term, sustainable, and positive relationships with GenAI tools, we need trust and respect, and we need to use the tools right. Perhaps we can all be inspired by one overarching strategy: "Using GAI (LLMs) for tasks that AI are useful for (efficiency, reliability, ability to learn from large data), while humans retain the critical tasks for learning, such as critical and creative thinking" [30]. In addition, GenAI tools should be trained with an input of "fundamental human rights, respect [for] the expertise of teachers and care for the diversity and development of students" [31: p.166]. Let's remember: we, as humans, are the main players in this big collaborative performance of education, and all administrators, educators, and learners are in various ways supported, but not directed nor dictated, by GenAI, an assistive, supportive co-player.

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