Library Progress International *Print version ISSN 0970 1052*
Vol.44, No.3, Jul-Dec 2024: P.12187-12193 *Online version ISSN 2320 317X*

Original Article *Available online at www.bpasjournals.com*

AI In Sustainable Development: Innovative Teaching Practices In Postsecondary Education

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How to cite this article: Swayam Prabha Satpathy. Priyadarshini Panda, Shibani Pattanayak (2024). AI In Sustainable Development: Innovative Teaching Practices in Postsecondary Education *Library Progress International*, 44(3), 12187-12193.

Abstract
Artificial intelligence (AI) systems are growing at a rapid pace, which has significant effects on education, especially for instructors and the skills they need to adapt to the always changing technology environment. Teachers' agency and their ability to choose when and how to utilize this technology wisely are being called into question by the introduction of AI into the classroom. The technological, ethical, and pedagogical aspects of AI need to be better understood by teachers, and this requires immediate empowerment. By outlining the beliefs, knowledge, and abilities educators must possess in the AI era, the AI competence framework for teachers attempts to close this knowledge gap. The article delineates fifteen competences spanning five aspects, namely: human-centered attitude, ethics of AI, AI foundations and applications, AI pedagogy, and AI for professional development. These competencies were developed with the goals of safeguarding teachers' rights, augmenting human agency, and advancing sustainability. Three progression levels—Acquire, Deepen, and Create—are used to group these competencies. This global resource informs teacher training programs, directs the creation of national AI competency frameworks, and assists in the creation of assessment criteria. Additionally, it offers methods for teachers to advance their professional development, apply moral concepts, and increase their knowledge of AI. By 2022, just seven nations had created teacher-focused AI frameworks or programs.

Keywords: ethics, competencies, pedagogy, artificial intelligence.

Introduction:
The aim of this empirical study was to map undergraduate business administration students' perceptions and abilities regarding artificial intelligence (AI) and how it can address questions about sustainable social change, as well as to learn more about the best pedagogical approaches to improve students' knowledge and comprehension of these topics. **Approach:** The information was collected from students in higher education (HE) through a workshop that included an introduction to AI and sustainable development, survey and questionnaire responses, group discussions, and reflective narratives. A qualitative research methodology based on abductive reasoning was used for data analysis. **Results:** fresh perspectives were gained and fresh information about AI literacy in the context of sustainable development was developed through abduction. In the area of HE studies, this provided new information. A new reference framework for learning activities and course planning in higher education was established by the taxonomy of AI literacy in sustainable development. The results demonstrated that the students' inability to comprehend the fundamentals of sustainable development and artificial intelligence contributed to their inability to solve the real problem. But in groups where one member understood the material better than the others, the group as a whole started to grasp the assignment and worked on both practical and meta-level ethical problems. Talk about the possibility of using AI to help build solutions that promote sustainable development. But using this potential means being literate in AI. HE is a major contributor to this task. The integration of AI and sustainable development into HE courses is a pedagogical strategy that this study supports.

The world's growing crises have brought amazing risks to humankind. Reducing biodiversity, depleting natural resources, and climate change caused by humans all require action. All societal and international community levels require effective solutions. The rapid advancement in AI literacy and the various applications of AI have sparked both dread and hope. The reason behind this study is the question we asked ourselves: in Higher Education (HE), what pedagogical solutions should be created to embrace AI literacy while incorporating the demands of the twenty-first century? According to Laupichler

et al. (2022), the concept of AI literacy is still developing and lacks a universally recognized definition. According to one description, it might be "a set of competencies that enables individuals to communicate and collaborate effectively with AI; use AI as a tool online, at home, and in the workplace; and critically evaluate AI technologies" (Long and Magerko, 2020). The ability to cope with artificial intelligence, improved products, or services, as well as to use basic AI-powered software and assess its effects on people, societies, and the environment, is what is meant by AI literacy. It is challenging to understand how artificial intelligence functions in daily life. Artificial intelligence has advanced quickly and has had as-yet-unknown effects. Ignoring AI could result in one-dimensional answers and dichotomous thinking. Understanding AI and being aware of it helps direct its application toward morally defensible goals. For instance, privacy issues when utilizing digital services may pose risks when utilizing artificial intelligence (Alamäki et al., 2023). However, understanding AI may assist direct its application for morally defensible goals. Correcting prejudices and promoting inclusivity when using AI are the goals of education. Despite its widespread application, artificial intelligence is still developed, used, and understood by a tiny number of people. Additionally, there is a very uneven distribution of AI application worldwide. In the context of higher education, this study focuses on issues related to AI literacy in sustainable development. There hasn't been much research done on AI literacy before, and even less has been done on what AI literacy looks like in relation to sustainable development. Thus, in order to gain both a situational picture and pedagogical models that would aid in developing artificial intelligence literacy in teaching and learning, we have focused our attention in this study on the condition of AI literacy in the setting of HE institutions. The study aims to map the present knowledge and attitudes of higher education students on artificial intelligence and its potential to address issues pertaining to the transition to a sustainable society. The study also attempts to gather data regarding appropriate pedagogical approaches to raise the level of knowledge and comprehension associated with these themes. 2 Theoretical foundation 2.1 Sustainable development The contemporary world demands sustainable development. According to Steffen et al. (2015), Figueres et al. (2017), Ripple et al. (2017), and others, humans' quest of a happy life irreversibly alters the socio-ecological system that supports our daily existence. This explains why the years 2005–2014 were designated as "Education for Sustainable Development" (UNDESD) decade, emphasizing the role of education in global sustainable development. Following that time, the 17 Sustainable Development Goals (SDGs) were developed and ratified by the United Nations (UN) in September 2015. While the former advocated for the implementation of universally high standards of education to guarantee a sustainable future, the latter (SDG 4) called for universally high standards of education, grounded in the Universal Declaration of Human Rights. In addition to supporting "lifelong learning opportunities for all," SDG 4 asks for guaranteeing "inclusive and equitable quality education" and making sure that everyone has access to the information and skills needed to lead sustainable lives. Therefore, one of the most important tactics for accomplishing the SDGs is the role that education plays, particularly in fostering networking opportunities, research and innovations, and communication. HE must address important issues such as how to update people's skills and ways of living well without endangering the ability of future generations to meet their requirements (Redecker et al., 2011). Practically speaking, this entails making sure that 21st-century pedagogical methods are used to ensure that students acquire critical competences such as sustainable lifestyles, jobs, and habitats (Van den Branden, 2015) while utilizing renewable resources devoid of fossil fuels. Over the past few years, research on the combination of artificial intelligence and sustainable development has grown significantly (Leal Filho et al., 2023). The advancements of AI provide several significant technological opportunities to sustainable development and its initiatives (Goralski and Tan, 2020; Vinuesa et al., 2020), and their integration is also a main priority of policymakers (e. Initially, literacy refers to specific ways of thinking about and performing reading and writing in order to comprehend or express ideas or thoughts in writing within a particular context of use [26]. Digital literacy refers to the ability to appropriately use, assess, and apply digital tools, resources, and services to lifelong learning processes [17]. Clearly, digital competency encompasses more than just proficiency in operating devices and programs; it is also closely intertwined with the ability to communicate using technologies and digital skills. It should include a balanced view of technology for responsible and healthy use of digital technology. Knowledge and attitudes about privacy and security, legal and ethical considerations, and the role of digital technologies in society should be included [17]. Therefore, literacy is directly tied to skills and is more about knowing. Beyond that, competency is the ability to perform a task effectively and successfully [17]. Broadly speaking, literacy is more about knowing, and competency is more about applying the knowledge in an effective and beneficial way. It is related to confidence and attitude and focuses on how well an AI user does.

A review of the literature.

Long and Magerko [31] define AI literacy as "a set of competencies that enables individuals to critically evaluate AI technologies, communicate and collaborate effectively with AI, and use AI as a tool online, at home, and in the workplace." They see this literacy as a set of 17 skills and as an operational definition. AI literacy is clearly related to other literacy such as digital, data, and computational literacy. The relationships could be mutually dependent but exclusive [31]. For example, AI literacy requires users to have a fundamental understanding of how to utilize computers in order to comprehend AI. Therefore, digital literacy, which refers to the ability to use computers to complete a task [33], is a prerequisite for AI literacy. Considering the close connection between data and machine learning (a branch of AI), data literacy refers to the capacity to understand, work with, evaluate, and argue with data as part of a more comprehensive process of inquiry into the world [45], which largely overlaps with AI literacy. Furthermore, there's a chance that AI literacy and the other two literacies—computational and scientific—have little in common. It is not always necessary to write codes in order to comprehend how artificial intelligence functions, as computational literacy also entails expressing

and exploring ideas using code [44]. A similar understanding of the nature, contributions, and fundamental limitations of science is not necessary for AI literacy [22]. This concept of AI literacy is among the first for non-AI experts, which may provide academics and K–12 educators with fresh perspectives on the subject matter and skill evaluations associated with AI. A literature review conducted by two engineering professors served as the foundation for its creation. During 2018 and 2019, the majority of the literature was released at engineering conferences. These suggest that higher education and an engineering viewpoint inform this definition. The authors' major constraints on this concept [31] provide evidence that it may not be suited for K–12 schooling. They pointed out that more empirical research is needed, particularly on the viewpoints of teachers, as AI education is still in its infancy, in order to provide a thorough and reliable knowledge of AI literacy for a non-technical audience [31]. Furthermore, the definition used terminology that had differing definitions in the literature (e.g., [31]). But as we've discussed, competency and literacy are connected but distinct in the field of educational research [17]. As such, a redefinition of AI literacy and proficiency is required.

In the context of AI education, process and praxis design methods Using a certain curriculum design approach has a big impact on how things are taught and learned [38]. Content, Product, Process, and Praxis are the four fundamental approaches to curriculum design. While the curriculum as product sees teaching as grading and concentrates on student performance, or student learning outcomes, the content approach sees education as the transmission of knowledge, such as through a syllabus with defined content [20, 27]. It stresses education with predetermined ends and frequently develops lists of competencies, instructing students on what to learn and how to learn it. These two methods of teaching AI are based on the definitions of AI literacy and competency.

Teaching is seen as development under the process design approach, which emphasizes how teachers, students, and content adapt rather than pre-defined content and results. Learning goals are altered by triadic interactions [27]. The curriculum serves as a manual for educators rather than a list of topics that teachers must learn and impart [20]. Learning objectives are decided upon by teachers and students and are not always appropriate; content is adapted to the requirements and interests of the pupils. Learning experiences that are focused on the learner are valued in this method. The praxis design method focuses on practical applications of what is being learnt in order to help students make sense of what they are learning. Students work together to solve real-world problems and devise a plan for acquiring the required knowledge and achieving the intended goals while being supervised by their teachers. Continuous evaluations are conducted on both the learning process and its results. Consequently, the use of problem-based learning is widespread. Schools are still implementing AI education, thus further empirical study is needed to clarify its process and praxis approaches.

The third two techniques support student-centered approaches, moving the curriculum's emphasis from teaching to learning. Overall, the first two approaches produce a set of documents for implementation [27]. Thus, an AI education framework for grades K–12 would be developed with input from teachers regarding pedagogies and definitions of AI literacy and competency.

Three main paradigms for K–12 AI education in the last five years, research on AI in K–12 education has proposed a few important paradigms. Touretzky et al. proposed "Five Big Ideas in AI," one of the earliest frameworks [43]. Regarding the scope and substance of AI education for K–12 pupils, there was not much external guidance available in 2018 [42]. To start, the four members of the AI4K12 Steering Committee—Deborah Seehorn, Fred Martin, Christina Gardner-McCune, and David Touretzky—developed a list. The recommendations are produced on the basis of the CSTA Computing Standards, and this list acts as their organizing structure. The same five fundamental concepts serve as the framework for those standards [11].
The following are the five main ideas:
Perception: Sensors are used by computers to gather data about their surroundings. Perception is the ability to interpret what the senses are attempting to convey to us.
Representation and Reasoning: Agents use their models of the world to inform their decision-making. Reasoners employ representations because they are the fundamental building block of reasoning.
Computers are always picking up new skills from data. A machine learning method generates a reasoner by changing the representations inside a decision tree or neural network.

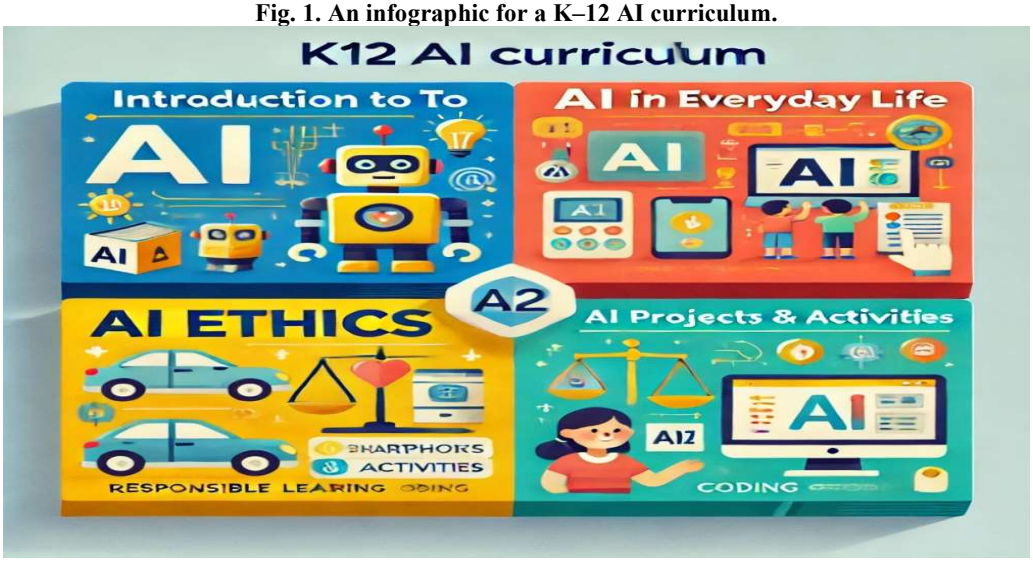
Natural Interaction: Access to a vast array of information is necessary for intelligent agents to interact with humans in a natural fashion. Language proficiency, culture, human emotions, and common sense are all included in the content.
AI will have an impact on society, both positively and negatively. The themes cover the following: the application of AI for social good; the cultural implications of AI algorithms; the economic repercussions of automation; and the fairness and transparency of automated decision-making systems.

These broad concepts assist researchers and educators in defining the objectives of their planned AI education and in determining the necessary content. As a result, content and product methods were applied in this framework.

In their project AI4future, Chiu et al. [8] presented the second framework that was covered. Professors of engineering and education collaborated with middle school teachers to create the framework. Figure1 displays an infographic outlining the

suggested AI course. The program starts with an introduction to artificial intelligence (AI), which includes big data, machine learning, and cloud computing. The ethical implications of using AI applications and their effects on society are another area of great interest. The first framework also focuses on content and product approaches, assisting AI educators in creating their learning and teaching content. The outside green circle depicts many AI-supported applications, many of which have significant societal ramifications, particularly for the future workforce. The middle pink circle represents our coverage of various branches of AI, including perceptual machine intelligence, e.g., "see" and "hear," human language technologies, e.g., "speak" and "read and write," integrated intelligences, e.g., machine reasoning, simulation for problem solving, and content creation and generation.

Fig. 1. An infographic for a K–12 AI curriculum.



Here's the infographic for a K12 AI curriculum. It visually presents topics such as an introduction to AI, everyday applications, ethics, and hands-on coding activities, making it engaging for young learners.

Artificial literacy and intelligence.

It is a premise of contemporary economics that the development of new technologies is driven by a desire to improve the lives of individuals. However, human progress has resulted in environmental deterioration, social inequity, resource depletion, disputes, and even international wars since the beginning of the industrial revolution. For these reasons, the United Nations (UN) and other international organizations have long advocated for the concept of 'sustainable development,' seeing it as a framework for achieving human progress that strikes a good balance between economic, environmental, and social concerns. Artificial intelligence (AI) is currently being widely used with continuous improvements in science and technology, producing a dramatic shift in human civilization (Johnson et al., 2022). It is, practically, hard to block the development of increasingly powerful AI technology due to people's hunger for positive advances.1 Concurrently, many are anxious about the possibility of expanding wealth gaps and hastening the death of our civilization (Lee et al., 2022). These scenarios are referred to as a dilemma or a trilemma. People have either balanced or polarized attitudes to these concerns, much like other concerns, such as climate change, where the trend is visible and unavoidable. In recent years, the integration of artificial intelligence (AI) technologies in education, particularly in foreign s drawn from teachers' perspectives in a school-university partnership project. Chiu [6] added pedagogy to the framework; see Fig. 3. The framework has three layers, shown in light blue, white, and dark blue. The core of the model in light blue shows the three core content components that should be included in AI education for middle school students. The content components are what AI is, how AI processes data, and what impact AI has. The middle layer in white suggests three pedagogies: student relevance, teacher-student communication, and flexibility. They are essential for the effective teaching of AI concepts and knowledge. Students should feel relevant when learning AI, as it is around students' lives. Students should use design solutions for authentic problems. In teacher-student communication, teachers should utilize unfamiliar graphics and consistent language to convey AI terminologies and algorithms since they are too new and abstract for young children. This language is more likely to foster teacher-student communication. The last component is flexibility. Teachers can use module and level-up content that provides a learning pathway that directs and guides learning. The last layer in dark blue is the outcome of AI education. The model used the roles of students in an AI-based society. The outcomes include AI users, developers, researchers, and ethical designers. The approach makes the outcomes explicit to students. The process approach was added to the framework.

Conclusion.

These three frameworks are significant as they set the content knowledge school students need to learn and suggest pedagogies for teachers. However, they were developed at an early stage [31]. AI learning for K–12 should provide

education equality, reducing the digital divide [46]. Literacy (knowing) and competency (how well you do) are related, but different [17]. Literature on AI education interchanges the terms AI literacy and competency (e.g., [31]). We frequently settle with literacy instead of striving for competency since it requires less effort. AI education should focus on AI competency due to its disruptive nature. With the advent of generative AI tools such as ChatGPT and Sora, AI literacy and competency need to be revisited [3]. Self-reflective mindsets and life-long learning skills are important to AI education. Therefore, it is necessary to re-examine these three pieces of work for a more comprehensive framework from the perspective of experienced AI K–12 teachers, as teacher perspectives could refine the existing frameworks.

It is a premise of contemporary economics that the development of new technologies is driven by a desire to improve the lives of individuals. However, human progress has resulted in environmental deterioration, social inequity, resource depletion, disputes, and even international wars since the beginning of the industrial revolution. For these reasons, the United Nations (UN) and other international organizations have long advocated for the concept of 'sustainable development,' seeing it as a framework for achieving human progress that strikes a good balance between economic, environmental, and social concerns. Artificial intelligence (AI) is currently being widely used with continuous improvements in science and technology, producing a dramatic shift in human civilization (Johnson et al., 2022). It is, practically, hard to block the development of increasingly powerful AI technology due to people's hunger for positive advances.1 Concurrently, many are anxious about the possibility of expanding wealth gaps and hastening the death of our civilization (Lee et al., 2022). These scenarios are referred to as a dilemma or a trilemma. People have either balanced or polarized attitudes to these concerns, much like other concerns, such as climate change, where the trend is visible and unavoidable. In recent years, the integration of artificial intelligence (AI) technologies in education, particularly in foreign language acquisition, has seen significant growth, leading to notable improvements. This paper explores the potential of AI to enhance the efficiency of foreign language learning through personalized learning, interactive practice, real-time feedback, diagnostic evaluation, flexible learning paths, cultural immersion, and efficient learning strategies. Additionally, it addresses concerns regarding over-reliance on technology, potential negative impacts on self-learning abilities, diminished interpersonal communication and cultural understanding, limitations of personalized education, technical challenges and reliability issues, as well as ethical considerations such as data privacy. Furthermore, the paper highlights the risk of marginalizing the role of human teachers in the learning process. Drawing on both positive and negative impacts of AI in foreign language learning, the paper concludes by offering suggestions for effective language learning strategies

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