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STEM Undergraduates and Competence in Artificial Intelligence: AI Literacy Perceptions

Hu, Shencheng[1,2], Chammika Mallawaarachchi[3*]

[1] Shandong Vocational and Technical University of International Studies, Shandong, China
[2] Gomeli National University of Belarus
[3] University of the Visual and Performing Arts, Colombo, Sri Lanka

*Corresponding Author: chammika@vpa.ac.lk

Abstract: *Artificial Intelligence and STEM undergraduates are concerned that studying their needs and preferences is critical to initiating AI literacy competence because there is a gap between the link of needs and preferences of user requirements. Many professionals and practitioners believe that this century is described by its rapid information and communication technology development with state-of-the-art- facilities in AI because these technologies turn pervasive interactions, for instance, machine learning, deep learning, and mobile learning. Further, in higher education, private campuses began to use AI-enabled technologies to leverage students' personalized learning and reduce their teaching and administrative work while offering more learning support and interactive learner experiences. This phenomenon leads to higher education in a new arena of AI in education (AIED). With these growing concerns over some periods, the importance of literacy in numerous perspectives, for instance, information, visual, media, computer, and digital are paying attention but not AI literacy. Hence, there is an urgent need to investigate STEM undergraduates' obstacles to learning in an AI environment and related determinants to solve while enhancing their skills, knowledge, and wisdom in AI. Hence, this paper intends to bridge the gap by mainly recognizing the significant contribution of AI literacy towards teaching and learning in education. For that purpose, the main object of this paper is to observe and document machine learners' obstacles encountered during the AI learning environment and their process without skills, knowledge, and wisdom of AI literacy. Also, it identifies available opportunities for further development of hidden areas of AI literacy. However, significant numbers of stakeholders attached to education are not well aware of how AI functions and opt for these facilities in teaching, learning, and research. For that purpose, this study was carried out based on a case study with a qualitative research design with 30 undergraduate students who follow STEM programs in private campuses in Sri Lanka and are engaged in virtual learning environments. As a result, the research findings reflected that AI literacy has significant values on perceptions of the use of AI for teaching and learning, self-efficacy in learning AI, its causes and solutions, interlinks, and benefits concurrently. Finally, the study recommends that examinations and promotion of the power of AI literacy are equally important.*

Keywords: Machine Learning, Artificial Intelligence; AI Literacy, Online Learner, Education, AIED

1. Introduction

In the Artificial Intelligence era, advanced artificial skills and knowledge align with the abundant digital and electronic resources, services, and facilities, enhancing the learning experiences of machine learners significantly, and the challenge they are facing is ever-growing. Hence, the rapid development and expansion of Artificial Intelligence with new practical and theoretical concepts in teaching and learning a few names Online Learning (OL), Mobile Learning (ML), and Machine Learning (ML) have indicated that they have various benefits in both the teaching and learning process. As a result, approaches to virtual teaching and learning have increased drastically in the Artificial Intelligence environment with novel and innovative multidisciplinary curriculums, teaching and learning contents, and multiuser virtual platforms. These virtual platforms have appeared as the most advantageous knowledge-communicating tools for industries and professionals. Consequently, Artificial Intelligence turns a machine learning environment into a beneficial comfort that buzzes the global virtual education at a higher rate than expected a decade ago.

Furthermore, this consistency in AI and its development is making vital changes throughout education while simultaneously being positive for machine learning and teaching tools and systems. Therefore, Manyika, J (2024) insights that the influence of AI and its opt experienced positively in some fields even in the 1940s. However, it identified that Artificial Intelligence plays a vital role in building a solid interaction between humans and a machine than expected by online learners. Further, it hinders one of the significant achievements in the mobile learning environment. In that vogue, Dai et al. (2020) emphasise that the literacy component of AI has not been considered experts in higher education as a priority. Hence, the majority is concerned that AI may shine all domains with a silver line if professionals and practitioners in education take initiatives to enhance skills and knowledge of digital literacy to stand with its facilities, then it would create a balanced milieu for all. The developing phenomena understood by looking at AI software distribution and its annual revenues are buzzing according to the data presented in Figure 1, which predicts income will increase to 126 billion in 2025.

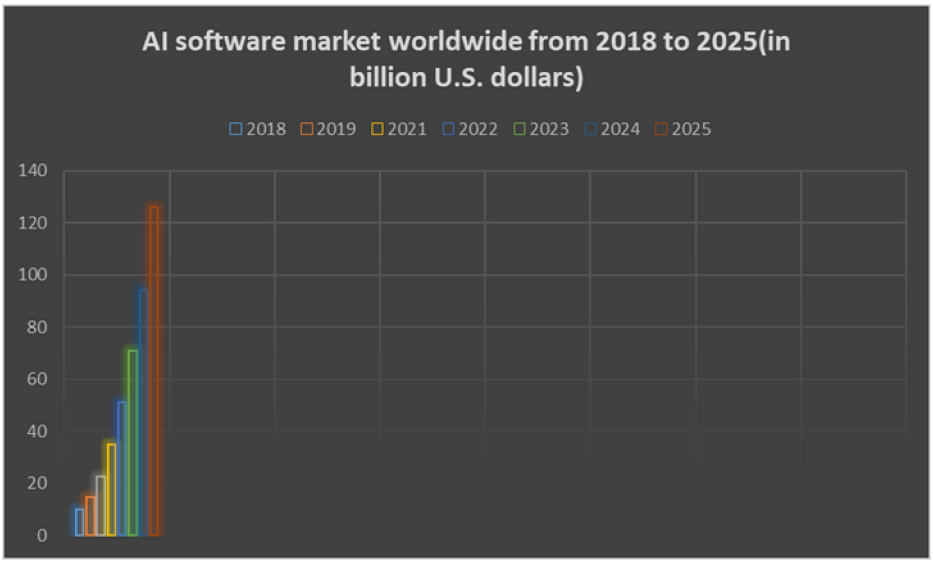

Figure 1: AI software distribution and its annual revenues

This era has been named experts in many industries as the digital epoch. As a result, a broader knowledge and experience in digital literacy and digital competence are significant. These links are vital in teaching and learning environments because electronic tools and platforms are buzzing in formal and informal education landscapes despite the competency of their expertise in digital involvements. Hence, digital literacy Mallawaarachchi, (2019) means a personal capacity to understand, utilize, and evaluate information or knowledge content is developed and shared in electronic or digital format. In addition, it strongly indicates the knowledge and skills of an individual to use digital tools and their techno-facilities to achieve set goals. Therefore, it reflects that digital literacy stands in the AI environment in a position of engaging, enhancing, and consuming digital commodities subscribed or freely delivered. As a result, the concept of literacy in an AI background might be able to promote a broader vision, and that leads to preparing a machine learner to become not only digitally proficient but AI literate as well, which creates opportunities for them to adapt to the latest AI technologies and their platforms.

Furthermore, one of the significant benefits of this development is that the existing machine learner who has gained skills, knowledge, and even wisdom in digital literacy may have minimal possibility of depending on false information. The gained knowledge will lead to being well aware of other cybercrimes in AI environments. Also, it identified that education for all is a fundamental right, but UNESCO (2024) reveals that 244 million children and youth are away from education due to a lack of literacy skills. Having identified further evidence, Yamada-Rice, (2021) indicates that the situation is much doubtful because machine learners' competency in digital and AI literacies is not up to the standard because they are revoking from e-content shared instead of printed. Hence, it is vital to enhance the skills in digital resources for youth because their familiarization with AI is not up to the standard.

With these growing concerns over decades in education the importance of literacy in numerous perspectives, for instance, information, visual, media, computer, and digital. However, this paper intends to bridge the gap in merely recognizing the significant contribution of AI literacy towards teaching and learning in education to address the prime objective to prioritize observing and documenting machine learners' obstacles encountered during the learning process without skills, knowledge, and wisdom of AI literacy. Correspondingly, it identified some areas that are possible to turn opportunities for interested groups to advance AI literacy for their learning benefits.

2. Methodological Approach

The prime objective of this research is to identify the significant contribution towards achieving online learning outcomes of the Machine Learner because of the widespread obstacles in limited competency in AI. The undergraduate students of private campuses in Sri Lanka who engage in virtual learning environments have shown that due to a lack of skills and knowledge in AI literacy, face numerous challenges, therefore based on the qualitative research design carried out in a case study.

2.1 Participants

The data was collected from 30 undergraduate students of STEM from private campuses in Sri Lanka for this study because they face huge barriers, especially in dealing with online learning,

through random sampling. Therefore, this population gave different perspectives in examining the determinants of efficient online learning.

2.2 Data Collection and Analysis

The data was collected through a questionnaire and semi-formal interviews. Also, the "Iceberg model" McClelland, (1973) and the "Onion Model" Boyatzis, (1991) were used to analyses the data.

The "Iceberg Model" assisted in identifying the hidden complex teaching and learning patterns of machine learners rather than the reality. Furthermore, the iceberg model for competencies takes the help of an iceberg to explain the concept of competency when considering AI literacy. Hence, as an iceberg shows that it has just one-ninth of its volume above water and the rest remains beneath the surface in the sea, data reflected that most undergraduates were not well familiar with the in-depth literacy component of AI.

Similarly, one of the significant indicators was that some components of competency are visible, for instance, knowledge and skills, but other behavioural components, such as attitude, traits, and thinking beneath the surface. In addition, during the analysis of data identified that developing two levels of competencies also takes different routes. The visible competencies, for instance, knowledge and skills are able to be developed through training and exercises, but the behavioural competencies were difficult to assess and develop.

The "Onion Model" guides understanding any obstacles to a lack of AI literacy and turns them into opportunities to evaluate the best method to use together. Therefore the onion model has offered an important insight into comprehending the sample group's psychology's complexities because this hinders that consists of multiple layers which foster self-compassion, empathy, and even personal growth working in an AI environment. In addition gaining the capacity to understand emotions, decisions, and behaviors helps to navigate teaching and learning challenges with enhanced awareness and acceptance.

3. Discussion

3.1 Influences in AI in STEM education

In the last decade, the idea of AI has appeared more frequently in most domains of the world and many areas of human activities. Since it influences widely to change function in sharing and creating knowledge content, education is one of the vital domains in AI influences at a larger scale than any other field. Accordingly, policymakers need to consider broadly and positively the impact of this development in the field while responding to transformational change through teaching, learning, research and publications. Furthermore, a broader influence of AI towards education reflects that is happening from primary education to higher education and formal education to informal education globally. It identified that the learner in AI has to act as a machine learner with the required competency in AI and AI literacy. As a result, Lee and Hye-Kyung (2022) highlight that AI buzzes various benefits from AI tools because a learner may have to depend on the decisions given by the AI tools content to be interacted with. Sometimes, the learner has to tolerate and spend time until AI recommendations are received to skip to the next sphere of the learning process. How machine learners manage by AI tools indicated that, for instance, they talk to Alexia

or Siri for help with homework or to navigate a friend's home solely depending on their platforms. As a result, AI in STEM education that ways in which assist students in gaining their learning targets shown in Figure 2 by Wang, W. H. (2024). Digital competence model of STEM education.

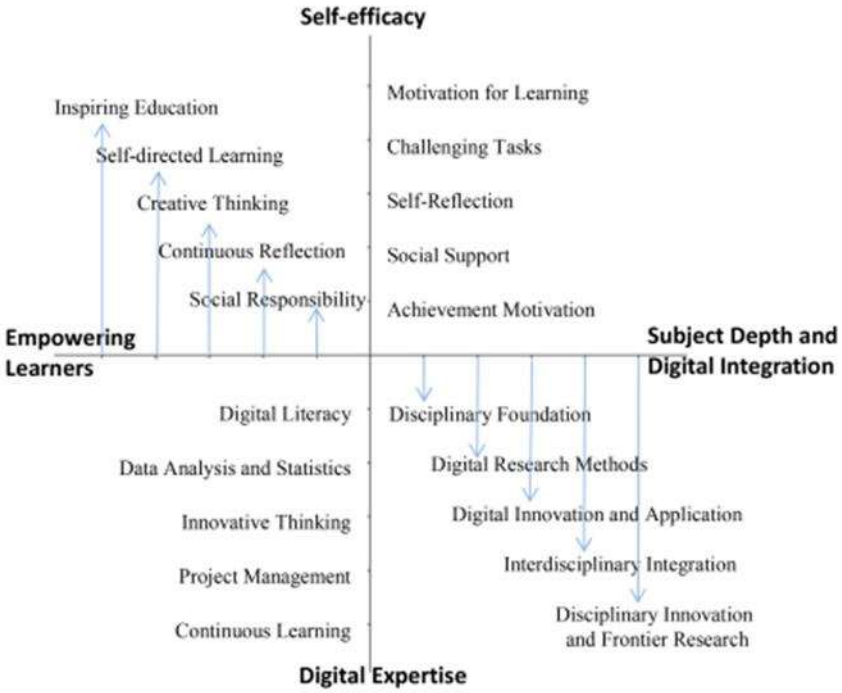

Figure 2: Digital competence model of STEM education

3.2 Importance of AI Literacy skills in Education

Nowadays, the consumption rate of ample digital resources and services is drastically triggered. As a result, the traditional understanding of literacy, which is the ability to read, write, and perform duties seems to be questioned critically due to numerous practical and operational reasons. In addition, new competencies in digital media and digital literacy further Kong, S. C et.al. (2019) and Vuorikari Rina, Riina, Stefano (2022) emerge the situation complex and vital. Hence, the vogue of AI transformed the traditional concept of information literacy into various forms of literacy, for instance, visual literacy, media literacy, language literacy, numerical literacy, and AI literacy. Moreover, one of the significant developments in AI literacy is playing a vital role by integrating other literacies in a new direction with state-of-the-art facilities in the AI sphere. This development is reflected especially in teaching and learning environments because education is one of the main areas that welcome theories and practices of AI into their subjects, syllabi, modules, assignments, libraries and even policies of staff development discussions. As a result, it seems that AI and its literacy change the landscape of the learner despite the digital competencies held in. Therefore, a learner who has learning engagements in the AI epoch reflects that having skills and knowledge in AI literacy direct to gain and entertain opportunities in the virtual learning environment to understand, communicate, and respond to AI runs digital systems and platforms with minimal complications. Hence, machine learners who are competent in AI literacy Mallawaarachchi (2019) explain that AI tools assist them in compiling an academic assignment without errors, and that is one of the significant achievements, initially, in the learning process.

Professionals and practitioners in education and information technology identified the importance of the literacy component of AI due to high involvement in online teaching, learning, research and publication. Literature with an open-access license creates a teaching and learning process that is further horizontal. However, due to various ideas and the significant contribution of AI literacy in education is unsolved but is continuing. As Ng, D. T. (2022) states this development is positive towards the expansion of teaching, learning, and research in many aspects of a digital environment. Also, these characters are involved with their learning perceptions, representations, and reasoning to facilitate enhanced learning processes and engagements. In addition, the interaction of AI and its literacy Long, D., and Magerko, B. (2022) study is vital in digital knowledge competitive advantage because the digital literacy explosion is expected due to complexities in AI tools and platforms. As a result, AI literacy has been identified and grouped in various perspectives, for instance, level of competencies, structure, and technical components and they are shown in Table 1. Characteristics of AI literacy against the definitions hinder that the literacy components in AI are multi-disciplinary and very broad compared to other literacies. In addition, AI literacy shows that it is exclusively neither a single subject nor a technology component. Hence, it consists of skills, knowledge and wisdom of various literacies, and their adaptations are visible in AI literacy.

Table 1: Definitions and other characteristics of AI literacy

Principle Areas AI Literacy	Focused Keywords in AI Literacy	Researchers who acknowledge the areas in AI literacy
Evaluation of AI	Thinking, Knowledge, Solving, Empowerment, Awareness, Attitude	Kong, S. C. (2022); Zheng Q. (2021); Wang, M. (2018); Zhou S. and Wang Fan. (2019); and Zhao F., Zhong K., and Liu M. (2018)
Competence Skills of AI	Pre-requisite, Competitive Advantage; Implicit Knowledge	Ng, D. T. (2022); Long, D., & Magerko, B. (2020); Carolus, A., Yannik A., André M., and Carolin W.(2023); Leichtmann, B., Christina H., Andreas H., Marc S, and Martina M. (2023); Fyfe, P. (2023); Laupichler, M. C. (2022); Kaspersen, M. H.-E. (2022); Cetindamar, D, Kirsty K, Mengjia Wu, Yi Z, Babak A, and Simon K.(2022); Eguchi, A, Hiroyuki O, and Yumiko M. (2022); and Henry, J, Alyson H, and Anne-Sophie C. (2021)
Composite Structure of AI	Knowledge, Understand, Use, Apply, Create, Evaluate	Kong, S. C., Cheung, W. M. Y., & Zhang, G. (2019); and Ng, D. T. (2022).
Technical Knowledge and Skills of AI	Use, Understand, Implement, Solve	Adams, C, Patti P, Gillian L, and Geoffrey R. (2023); Mertala, P, Janne F, and Oscar C. (2022); Lin, C, Chih-C. Y, Po-Kang S, and Leon Y. W. (2021); and Yi, Y. (2021).

4. Research Findings and Recommendations

4.1. Introduce orientation sessions with practical components to acquaint with AI systems, tools, platforms and trends

Pre and post-interviews of the sample group in the research process mentioned that the paramount changes from physical teaching and learning environments to online or virtual platforms as a whole worldwide due to buzz expansion of AI and its sophisticated systems and platforms significantly affect the machine learners who may not familiar with those changes. In addition, the machine

learner has to interact with advanced formats in the AI, which is one of the reasons to observe. However, machine learning and understanding AI and its functions are vital for the learner because knowing the technical aspects may comfort the learning process while interacting with the AI tools to accumulate the given tasks. Also, machine learners may excel in other tools in AI, and their trends towards learning assist in transferring skills, knowledge, and wisdom with peers from numerous perspectives. Hence, orientation programs with hands-on sessions positively turn the learning landscape because the learner interacts with other aspects of AI and its techniques. The significant benefits of such sessions Yi (2021) examines that technical scenarios of AI and their systems should not ignored in online and virtual learning environments because they combine components of the eco-system of the machine learner and the machine learning process. Therefore, it exposed that this segment is vital in teaching and learning environments with AI and that consistency is present in Figure 3 as a solid combination of the platforms of AI and its reactions in the AI literacy environment.

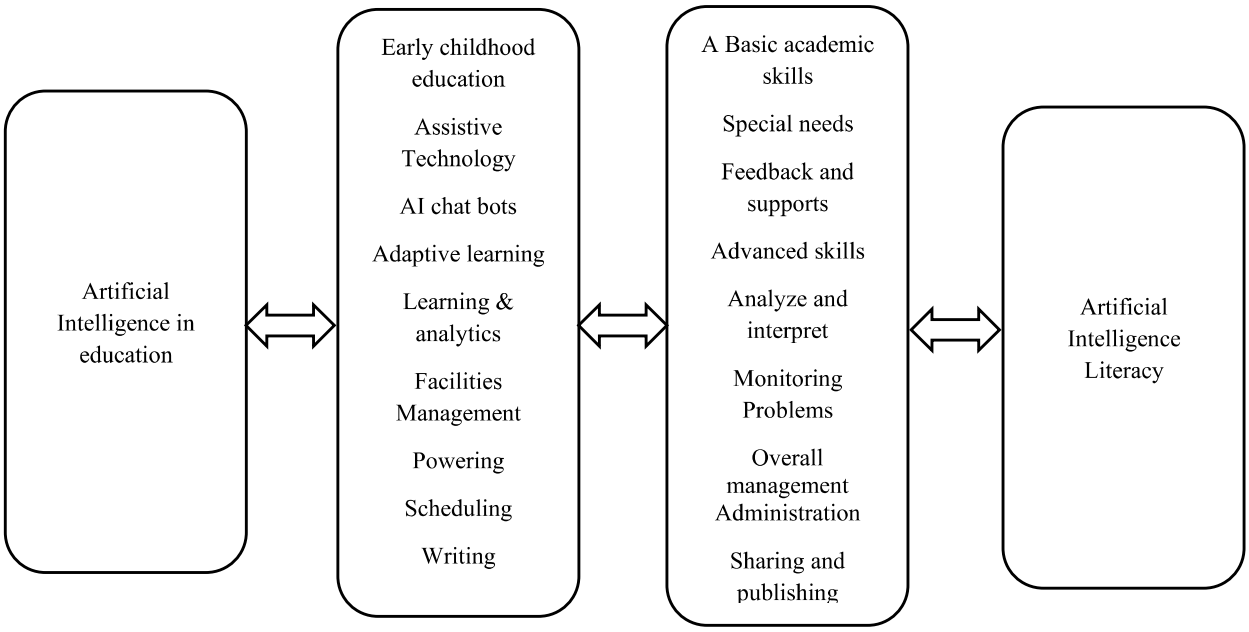

Figure 3: AI platforms, main functions with in literacy component

4.2 A machine leaner and extensive skills, knowledge, and wisdom on avenues in the era of online learning, teaching, and research.

It is recognizable that current learners in higher education, whether in developing or developed countries, are aware of stepping into the epoch of electronic or digital teaching and learning atmosphere. This development and its expansion have various milestones in the teaching and learning environment. As a result, novel systems for that purpose buzz in e-education, for instance. While teaching and learning platforms in online and hybrid modes consolidated, namely Educational Data Mining (EDM), Learning Management Systems (LMS), Massive Online Open Courses (MOOCs), and Machine Learning, to comfort the process. Hence, educational institutions and their libraries should take the initiative to use these teaching and learning systems as opportunities to affluent with large amounts of data to enhance educational psychology, cognitive psychology, and social networking of students.

4.3. Enhance skills, knowledge and wisdom in AI literacy of the machine leaner

Accepting new concepts and ideas from other domains in the society of competitive advantage can benefit in enormous perspectives, and the investment in addressing existing shortages is too significant. Therefore, considering taken actions horizontally to cultivate novel initiatives in AI literacy is extremely important. However, many higher educational institutes in the world have been conducting physically. Development has changed to machine learning since the COVID-19 epidemic. The interesting fact is that, however, many institutes turned into teaching subjects, delivering lectures, assessing students, and marking grades were conducted online and monitored by AI. The educational establishment needs to cope with future education based on AI and machine learning and pay attention to AI literacy in teaching, learning, research and publishing. AI literacy training increase for equipment and AI laboratories to enhance a wide range of knowledge in AI that students adapt to modern life. However, online learners hindered the majority from benefiting from e-activities and e-actions as a drawback of digital literacy and competence. Online learners have appreciated the significant time saved while engaging in tasks because automating grading has increased the emotional involvement in AI in education.

4.4. AI as a Human storyteller vs a robust digital storyteller

Storytellers have played a paramount role in sharing skills and knowledge since civilizations. The importance of this excels through the communication patterns by ancestors as myths and tales to cultivate teaching and learning methods in the community. However, it has reflected that the advancement of ICT and other forms of digital communications have changed traditional ways of storytelling, Mallawaarachchi (2019) examines it leads to forms of digital storytelling. As a result, most careers in every industry transform into digital assets and commodities, while beneficiaries welcome these changes positively. This ongoing development is drastically experienced in education, an example, physical libraries and their resources and services, Hu, Mallawaarachchi, and Karunathilaka, (2023) report that are becoming e-libraries, e-resources and e-services, while book shelving shifts to cloud platforms as e-books, e-journals, e-reports. In addition, the physical classrooms have been named online classrooms, and then learners transform into machine learners Lo (2023) highlights that machine learners benefit horizontally. In addition, students opt for digital stories to gain experiences while engaging in an AI environment. Such a practice assists them in fostering critical thinking skills in AI engagements and developing digital skills.

5. Conclusion

AI in machine learning education has tremendous potential in teaching and learning. Similarly, enhancing skills, knowledge, and wisdom in AI literacy is extremely important. E-society, in particular, the digital learning environments should empower inclusive practices regardless of machine learners' backgrounds or other circumstances. Educational institutions pay attention to continuous investment in AI and AI literacy to enhance skills and knowledge betterment of machine learning. Finally, researchers highly recommend furthering research in AI literacy because investigation may bring valuable emerging research direction for the future of education.

One of the significant developments in higher education is that most universities and campuses globally have taken major initiatives to introduce new teaching and learning systems with advanced development of technologies, especially in AI. Traditional physical classrooms with students are becoming less popular, but online distance education has drastically grown. Most

importantly, virtual learning systems, mobile learning, and machine learning are buzzing all over the globe and create opportunities for access to state-of-the-art facilities equally for developed and developing nations. Therefore, AI in education (AIED) identify an effective platform for online learning. However, the significant contribution of opting for AI in teaching and learning is still debating horizontally worldwide. However, most criticisms are that AI in education has tremendous potential and benefits to enhance learners' skills, knowledge, and wisdom. Therefore, the time has already arisen to study in-depth and communicate the importance of AIED and AI literacy ways in which new positive directions in higher education and future trends of the same.

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