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Beyond Digital Natives: Examining Artificial Intelligence Literacy, Digital Proficiency and Academic Engagement among Generation Z in Universities

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Abstract

The study was an attempt to understand the concept of being able to be literate about artificial intelligence (AI), digital skilled and dedicated to their studies in a digital revolution influencing Universities. The study employed a quantitative design with data collection done using a structured questionnaire being administered to the undergraduate students from various disciplines. The instrument measured 3 variables measured on a 5 point like Rt scale of varying degrees of AI literacy, digital skills and academic involvement, where descriptive and inferential statistics could be used. It was found that students exhibited a high overall AI literacy, but level of AI literacy differed across students, particularly knowledge about the ethical aspects and limitations of AI, understanding how algorithms work, and knowledge about applying AI tools within an academic context. We found a positive association between collaborative learning and online learning abilities with academic engagement, and between a lack of students' AI literacy skills with their ability to critically assess and use AI tools in their academic studies. Differences also happened across disciplines; students' attainment in AI literacy proved to be more for CS department than that of SS and Humanities department. The findings reiterate that it is not the same thing to be proficient with the digital tool and to be successful at academic involvement but rather speaking the language of AI becomes a critical component to academic engagement. The study advances the discussion of educational change by emphasizing the need to integrate the knowledge of AI into educational practices and educating Generation Z pupils to handle the academic and employment environment that is growing increasingly anchored in intelligent technologies.

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Introduction

Also called Generation Z, the 1995-2010 student generations are the first to have lived their entire life in digital environments. They are commonly referred to as “digital natives” coined by Prensky (2001), indicating that their early upbringing in a tech-savvy environment has informed their development with the ability to perform with high proficiency on digital tasks (Abbas & Faisal et al., 2024). This has been disputed with some research though, however, since information about possessing digital devices isn't synonymous with critical digital literacy or technological expertise, being technoliterate has been challenged (Kirschner & De Bruyckere, 2017).

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This discourse has been made more complex by the quick introduction of artificial intelligence (AI) in higher education (Faisal, et al., 2023). These technologies are presently used in teaching, learning, and assessment in many different ways and have found their way into tools such as adaptive learning systems, automatic grading systems, and intelligent tutoring tools (Zawacki Richter et al., 2019). AI technologies can now be utilized within the teaching and learning platform, as well as in assessment. As universities continue to integrate these tools in their curriculum, AI literacy is increasingly important as it involves an understanding, critical evaluation and responsible use of AI technologies (Long & Magerko, 2020).

Despite the developments in digital technology infrastructure and its application of some AI tools by higher education institutions (HEIs), there are still gaps in Pakistan (Faisal, et al., 2023). While students are quite knowledgeable about maximizing social media and digital communication tools, they lack proficiency in applying AI tools to information evaluation, comprehending ethical issues related to AI use, and embedding AI in their studies (Begum, Yaseen & Faisal et al., 2025). The disconnect highlights the need to explore the intricate link between AI literacy, digital proficiency, and academic involvement beyond a one-dimensional understanding of digital nativity.

Significance

The facts of this study have importance for a number of reasons. First, it continues the trend of this conversation about AI Literacy by placing Generation Z at the core of the conversation of higher education reform. Second, it offers empirical evidence of the relationship between digital proficiency and academic engagement, in which regard the AI literacy acts as a mediator. Third, it provides a foundation for curriculum planning and policy implementation including bringing AI literacy into the curriculum or making it a part of classroom efforts or policies, making sure that students are exposed to intelligent technologies in their professional and academic lives.Third, it guides curriculum planning and policies that will integrate AI literacy in the curriculum or expose it in classroom efforts, making students ready to use intelligent technology in their professional or academic lives (Makhdum, et al., 2023). Lastly, the addresses Sustainable Development Goal (SDG) 4: Inclusive and equitable quality education, which considers differences in AI literacy among fields and science contexts (Faisal, et al., 2024).

Problem Statement

Despite the general belief that Generation Z are proficient with technology, there is a lack of strong evidence that Gen Z's level of AI literacy is cohesive or across the board. For each of the technical subjects including computer science, students are more knowledgeable about AI than students in other academic areas, SS and Humanities, resulting in inequities in academic preparation. Furthermore, the restricted AI literacy affects students' capacity to critically read and assess digital sources, interact with smart technologies, and fully take part in academic practices. The challenge is made even greater by the absence of a systematic approach in introducing AI functions and literacy education into the curricula of universities, resulting in students lacking the necessary knowledge and skills to meet the demands of higher education in the modern era.

Objectives

- To assess the AI knowledge of University students from Generation Z.
- To explore the connection between students' use of digital and academic behaviors.
- To examine the differences in the AI literacy of different disciplines and its implications for higher education reform.

Research Questions

- What is the AI literacy level of students in the universities nowadays, belonging to Generation Z?
- How does digital proficiency affect academic engagement in HE contexts, what is the impact of having digital competence broadly, and on academic engagement specifically?
- What are the main differences in discipline in terms of AI literacy, and what implications do these have in terms of academic readiness?

Gaps

The notion of digital natives has been explored in great detail in the existing literature, but there has been little empirical study of AI literacy skills of Generation Z. It is important to highlight that most research papers are based only on users' digital competency and don't consider digital AI literacy as a key factor which drives academic engagement (Kirschner & De Bruyckere, 2017; Iqbal & Bhatti, 2022). In addition, there are few studies that analyze the cross-disciplinary aspects of AI literacy, resulting in a lack of knowledge about how AI literacy is being studied across disciplines and disciplines' preparation of students for AI-driven environments. They are bridged in this study, which utilizes a quantitative research design to investigate the AI literacy, digital proficiency, and academic engagement in each discipline.

Literature Review

Digital Natives and the Myth of Technological Competence

The theory of a "digital native" (Prensky, 2001) indicated that younger generations are equipped with "highly developed adaptable knowledge for the digital world. However, this idea has been challenged by subsequent studies which suggested that familiarity with digital texts is not necessarily similar to critical digital literacy and more sophisticated technological skills (Kirschner & De Bruyckere, 2017). Research shows that although Generation Z students use social media and communication tools well, they may not be adept at analyzing and evaluating digital content or utilizing new technologies in the school environment (Ng, 2012).

Artificial Intelligence Literacy in Higher Education

AI literacy is comprised of "understanding AI concepts, understanding ethical implications of AI and competency to use AI tools in scholarly and professional contexts" (Long & Magerko, 2020). Research has shown that there is a gap in AI competences related to the student's domain with the technical domain showing higher competences than the nontechnical domain (Zawacki Richter et al., 2019). Ethical aspects, such as algorithmic bias and data privacy,

frequently come secondary to their other importance, highlighting the need to introduce and integrate AI literacy in curricula systematically (Tuomi, 2018).

Digital Proficiency and Academic Engagement

Digital proficiencies are the capacity to be proficient in digital tools for communication, collaboration and knowledge building (van Laar et al., 2017). There is a positive relationship between students' involvement in learning activities (called academic engagement) and their digital proficiency, more specifically in online research and collaborative learning (Fredricks et al., 2004). But, a lack of literacy in the field of artificial intelligence greatly limits the ability of students to use these tools to engage in deeper textbook learning, which means that approaches that are integrated in the field of digital and artificial intelligence education are needed. (Iqbal & Bhatti, 2022).

Disciplinary Differences in AI Literacy

Previous research has shown that there are substantial differences in AI literacy across disciplines: Computer science and engineering students perform better than social sciences and humanities (SSH) students (Zawacki Richter et al., 2019). This gap explains it based on the curricular vary in addition to the accessibility to AI tools, which results in inequities in educational readiness (Makhdum & Khanam, 2021). Close these gaps will be impossible without cross disciplinary integration of AI literacy, in which all students will be provided with possibilities to interact with intelligent technologies (Tuomi, 2018).

International Perspectives on AI Literacy and Higher Education Reform

Following international experiences along AI literacy in higher education provides valuable insights into AI literacy in higher education. A teacher education approach focused on research (Sahlberg, 2015), the evaluation and integration of AI in national education (Tan 2020), and the inclusion of equity and inclusion in digital education (Martel & Gauthier 2019) are among the policy components that are highlighted in every one of these. The examples highlight the importance of establishing equitable and cohesive policy frameworks, targeted investments, and a focus on equity in integrating AI literacy throughout sectors.

Gaps in Existing Literature

While there has been a significant increase in the interest of AI literacy, empirical studies on the topic are limited, especially in developing countries, like Pakistan. In today's digital age, a teacher's familiarity with AI technologies is essential for crafting a meaningful educational experience, but much of the existing AI research neglects this point of teacher AI literacy and therefore fail to directly address it's role in academic engagement (Maria & Makhdum, et al., 2025). In addition, there are even less cross-disciplinary comparisons; in fact, few insights exist on how various disciplines train students for AI-fueled environments and how that relates to GCP's role.Moreover, there exist even fewer cross-disciplinary comparisons and insights on how various disciplines train students for AI-driven environments and how that pertains to GCP's role. To fill these gaps, this study aims to provide empirical evidence on AI literacy, Digital proficiency and Academic engagement of Generation Z students in universities.

Methodology

The study used a quantitative research design approach to conduct a systematic examination of the literacy in AI, digital ability and academic involvement of the Generation Z students in universities. The design selected minimized the compromising of both the analysis of measurable data as well as using a design so that the data could be analysed with a statistics approach to gain empirical evidence to show the relationship among these constructs. The primary research instrument employed was a structured questionnaire, which was based on a comprehensive literature review of the concept of AI literacy, digital competencies and engagement in HE. The instrument could be divided into two parts, the demographic part and the standardized part which was measured using the five point Likert scale from Strongly Disagree to Strongly Agree. The demographic section gathered data on age, sex, targeted factor: interest area, college class standing and targeted factors: type of college or university. The following sections were focused on the targeted factors relating to AI literacy, digital proficiencies and academic engagement as assessed by the Likert scale. The resulting questionnaire was intended to gain a breadth and depth of student experiences to include in the data collected in this study that would be amenable to both descriptive and inferential statistical analysis.

This activity of data gathering was done in one phase at the selected universities which have undergraduate programs. The material is formally listed by permission of the institutional authorities before giving. To ensure maximum access to the questionnaire and participation, both the electronic and print versions were sent out. Clear information introduced to the participants about the effort of the study and fixing their participation to be voluntary was done and the follow procedure of confidentiality introduced. Completed questionnaires were pre-worded to determine whether they were complete for coding and statistical manipulation. Where the amount of data was missing too much, the responses were discarded to check its quality and reliability.

The study generation Z (undergraduate students of science, technology, engineering and mathematics (STEM) subjects from public and private universities in the study population category were sampled purposefully to ensure their situatedness with the study objectives. The sample consisted of 400 respondents which is found appropriate for descriptive and inferential statistical analysis for representing the different institutional contexts. The following criteria were used to determine inclusion: 1) participants being enrolled in the undergraduate programs, and 2) a minimum of one year of experience using academic tools and AI technologies. This helped to ensure that the constructs measured were familiar to respondents.

This method of sampling was chosen as it enabled the researcher to select participants who were most likely to be able to contribute the information required for the study regarding AI literacy, digital skills, and academic engagement. This method was suitable since it deals with a different generation of students in higher education, the Generation Z. A detailed set of data addressed the research questions, given the study participants' first-hand experience with digital and AI technology in educational environments.

The instrument used was tested to ensure both its reliability as well as validity. The data obtained from the pilot study is not used in the selection process, but 40 students who met the inclusion criteria were included in the pilot study. The pilot tested the clarity of items,

ordering, question options, and responses time. Feedback from participants was used to make some minor changes to improve the readability and clarity of the wording. Internal consistency (Cronbach's alpha) was evaluated with the obtained coefficients above 0.70 which is recommended, satisfying the reliability of the questionnaire. To validate the construct of the instrument, the instrument was evaluated by educational technology and higher education policy experts, based on the congruence of the instrument with the aims of the study and the theories in the field. The questions were also being culled from the literature on AI literacy, digital skills, and student engagement, to further affirm content validity.

The instrument was therefore reliable, valid and could then be administered to large populations. Descriptive and inferential (correlation- rating-regression analysis) statistics have been used on data to explore the relationships between AI literacy, digital skill and academic participation. This methodological strategy ensured that the study is descriptive and explanatory and that it has information that serve the objects of the study.

In conclusion, the study employed a quantitative research design and developed strong instruments that were tested and validated, purposive sampling and stringent data collection process, and a detailed assessment of aspects of AI literacy, digital skills and academic involvement of students in universities among Generation Z at university level. An improved reliability and level of validity facilitated trustworthiness of the results and the use of a sampling method allowed for the portrayal of breadth of institutional experiences. This allowed the study to go beyond the definition of digital natives and collect empirical data on the significance of AI literacy and academic involvement.

Data Analysis

Descriptive Analysis

The descriptive analysis gave an overview of the demographic information of the respondents and their answers on the constructs of AI literacy, digital skills and academic involvement. The respondents were 400 students in the Generation Z of public and private universities. Among these 52% were female and 48% were male and majority of them aged between 18-23 years. The distribution according to discipline revealed that 35% of students studied computer science and engineering, 30% of students' social sciences and 15% humanities and 20% business studies.

Relative performances were relatively high with a mean overall score of 4.12 (SD = 0.61) suggesting that students' abilities in using digital tools for communication, collaboration and online research were relatively competent. Academic engagement was likewise positively correlated (M = 3.98, SD = 0.72), as students were actively engaged in academic activities. However, in the field of AI literacy, only moderate scores were obtained and there was a considerable lack of ethical awareness and algorithmic understanding. The findings are also consistent with previous studies about generation Z students showing that they are more aware of the possibilities of AI, than of using it (Kirschner & De Bruyckere, 2017; Long & Magerko, 2020).

Table 1. Descriptive Statistics of Key Constructs

Construct	Mean	SD	Minimum	Maximum
AI Literacy	3.21	0.84	1.80	4.90
Digital Proficiency	4.12	0.61	2.50	5.00
Academic Engagement	3.98	0.72	2.10	5.00

Next, the table displays that the digital proficiency subscale is the highest among respondents, compared to AI literacy, which indicates that it is a dimension that requires curricular interventions.

Inferential Analysis

To analyse the relationships between AI literacy, digital competency, and academic involvement, inferential statistics were used. The results showed significant positive relationship between digital proficiency and academic engagement ($r = .62$, $p < .01$), meaning that the digital skilled students were more engaged in academic activities. Academic engagement was also significantly related to AI literacy ($r = .47$, $p < .01$), but to a lesser degree than with digital proficiency.

A regression analysis was performed to test the ability of the AI literacy and digital skills measures to predict academic engagement. The model was statistically significant ($F(2, 397) = 56.21$, $p < .001$), explaining 28% of the variance in academic engagement ($R^2 = .28$). AI literacy ($\beta = .29$, $p < .01$) and digital proficiency ($\beta = .51$, $p < .001$) were most significant. The results highlight that digital competency is a pivotal factor to academic participation, but AI literacy is also significant, highlighting its value in educational settings.

ANOVA was used to analyse the disciplinary differences. Results showed that there was significant difference between discipline in AI literacy scores ($F (3, 396) = 12.34$, $p< .001$). Following these comparisons, a post hoc analysis with Bonferroni correction was conducted to examine the scores in AI literacy by discipline. The results indicated that there were statistically significant differences between the scores in AI literacy between students majoring in computer science and engineering, and students majoring in social sciences and humanities. Generally speaking, there were no significant differences found across disciplines for digital proficiency indicating that this competency is more distributed across disciplines, whereas there were significant differences across disciplines for AI literacy.

Table 2. Regression Analysis Predicting Academic Engagement

Predictor	β	t	p
Digital Proficiency	.51	9.84	<.001
AI Literacy	.29	5.62	<.01
R^2	.28		

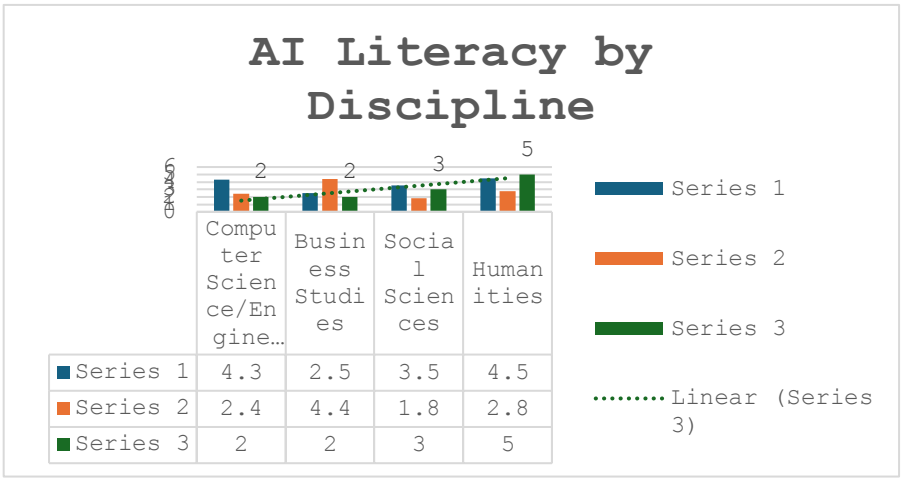
Results from the regression model support the findings of the other two, as both constructs – digital proficiency and AI-literacy – are significant predictors of academic engagement, and digital proficiency has greater influence on the model.

The figure shows there is a positive linear relationship between AI literacy and academic engagement. There was a positive correlation between higher AI literacy scores and students' reports of increased academic engagement, but with some variation indicating that other factors may contribute to engagement. This aligns with the results of the regression, where AI literacy is a relevant factor but it takes more than that to indicate academic engagement.

Disciplinary Differences in AI Literacy

Discipline	Mean AI Literacy	SD	N
Computer Science/Engineering	3.89	0.65	140
Business Studies	3.25	0.72	80
Social Sciences	2.98	0.81	120
Humanities	2.85	0.77	60

It is evident from the table that there is a wide range of variables between the different subjects when it comes to AI literacy. Top scoring departments were computer science and engineering, which emphasizes more on AI tools and application. While it is possible that the lowest performing results were due to shortcomings in the writing abilities of the students in this subject, the result indicates the Humanities students may not have had sufficient exposure to AI technologies. The study results are consistent with earlier ones on the fact that there isn't a uniform distribution of AI literacy across disciplines, thus the issue of inequities in academic preparedness (Zawacki Richter et al. 2019).



The findings of the table can be reinforced and made clear in the chart. There is a clear disparity between computer science and engineering students and those from the humanities,

with the former having the highest AI literacy. Business studies and social sciences are in the mid-level. This trend signifies the importance of embedding AI leadership in all disciplines to create equitable learning opportunities. It further reinforces Tuomi (2018) in his call for proper education in AI for the training of students in non-technical fields as well.

The addition of this table and diagram further clarifies the disciplinary differences in terms of AI literacy, in addition to the regression and correlation results. The collected findings highlight that students from Generation Z are confident with digital skills, but not necessarily with AI skills, which questions the necessity of curricular changes and equity-oriented strategies.

Overall, both descriptive and inferential analyses indicate some important learnings. First, the students studied the generational dimensions of digital skills and found a gap between their digital skills, which are strong, and their demystification of AI, which is not.First, students of Generation Z showed that they display strong digital skills and weakness in understanding AI, challenging the concept of digital native and requiring a rejection of it. Second, digital proficiency and AI literacy both had a stronger impact on academic engagement, and digital proficiency had the stronger predictive power. Thirdly, there are found disparities in academic readiness between disciplines, with technical disciplines having greater AI literacy than non technical disciplines. The results were consistent with previous studies highlighting the need for AI-literacy to be integrated into all curricula to promote equal learning outcomes (Zawacki Richter et al., 2019; Tuomi, 2018).

The analysis suggests that overall digital competence is not a key determinant of effective academic engagement. AI literacy is emerging as a crucial factor that defines the capacity of students to critically analyze digital instruments, skillfully embed artificial intelligence in education, and engage with universities in a manner that transcends the margins.AI literacy becomes a crucial competency that determines students' capacity to critically investigate digital tools, intelligently incorporate the technology into learning, and meaningfully engage in higher education. Systematic reform of the curriculum, incorporating the application of AI into other subjects, and targeted interventions to enhance the awareness of AI among the "Z Generation" are crucial. The curriculum of AI education needs to be made a system of reform; it is essential to cross teach it to other subjects and undertake targeted interventions so as to strengthen the awareness of the ‘Z Generation’ on AI.

Findings

This research's findings offer useful insights regarding the relationship between AI Literacy and Digital Skills of the Gen Z students of the universities. Students were found to be relatively competent in digital skills, achieving mean scores of >4.0 on a 5-point scale, as a result of their descriptive analysis, with high levels of competence in employing digital tools for communication, collaboration and accessing online learning. Academic engagement was also positive, with values around the 4.0 mark, and representing active engagement in learning activities. There were also relatively fewer people who were familiar with AI literacy, with mean scores approximately 3.2, indicating significant gaps among respondents in both ethical awareness and understanding of algorithms, as well as knowledge and implementation of AI

tools in academic settings. The results of this study demonstrate that students in the GZ are digital savvy but not very knowledgeable about AI with discipline-related differences (Kirschner & De Bruyckere, 2017; Long & Magerko, 2020).

Additionally, the relations of the constructs were emphasized from an inferential perspective. The Pearson correlation analysis showed that there were statistically significant positive correlations between digital competence and academic engagement ($r = .62$, $p < .01$) and between AI literacy and academic engagement ($r = .47$, $p < .01$). Digital proficiency and AI literacy both had significant effects on academic engagement, with digital proficiency having a greater impact ($\beta = .51$, $p < .001$) than AI literacy ($\beta = .29$, $p < .01$). The results confirm this, with digital competence being a factor for academic engagement, and AI literacy also being a factor, which underlines the importance of AI competence in the educational context.

Some disciplinary differences existed, too. The ANOVA results showed that there was a significant difference between the disciplines with respect to AI literacy ($F(3, 396) = 12.34$, $p < .001$). The difference between students during the computer sciences & engineering and those during business studies and social sciences & humanities was observed with the former group doing the best and the latter group doing the worst. This is not only a curricular shift but also a different access to AI tools, that creates academic disparities. The results are consistent with those of Zawacki Richter et al. (2019) who found that AI-literacy tends to be more common in technical groups and less in other (non-technical) groups.

Discussion

The results help to continue the discussion on the so-called 'digital natives' and the necessity of rethinking conceptions of technological competence in higher education. Prensky (2001) referred to it as the 'digital native' theory, implying that young people are naturally more attuned to technology than their older counterparts, but in this study that proved not to be the case with digital familiarity being no substitute for AI literacy. Whilst Generation Z students have general digital skills, they struggle to have a critical understanding of intelligent technologies and use them in academic practice. This aligns with Kirschner and De Bruyckere's (2017) view that it is not digital natives who are more digital than teachers but rather that specific education is needed to build up the deeper competencies.

Positive correlation between digital proficiency and academic engagement echoes previous studies which highlight the importance of digital skills to increase the student involvement in the learning activities (Fredricks et al., 2004; van Laar et al., 2017). The close relationship of AI literacy with academic engagement, however, demonstrates the developing yet less mature adoption of AI in higher education (Lyu & Faisal, et al., 2026). The higher AI literacy students were more engaged, but the overall mean scores were lower, indicating a non-adequate exposure to AI tools. This is another reminder that it's crucial to integrate artificial intelligence into education curricula so students can access intelligent tools to participate in education as a meaningful experience (Long & Magerko, 2020).

Equity is key to consider due to the disparities that exist in relation to discipline and AI literacy (Lyu & Faisal, et al., 2026). The curriculum in computer science and engineering benefits from a focus on AI, however, students of all other subjects from the social sciences and

humanities continue to be disadvantaged. An international experience is useful in this context. Coherent policy frameworks and sustained investments are needed, as illustrated by Finland's emphasis on research-based teacher education, or the integration of AI literacy in Singapore's national policy agendas, and the focus on equity and inclusion in the Canadian context in digital education (Sahlberg, 2015, Tan, 2020, and Martel & Gauthier, 2019).

The results also can make a contribution to theoretic views of educational reform. The cyclical nature of the process of reform as described by Fullan (2016) is also strengthened by a transformative interaction of policy, institutional capacity, curriculum application and classroom practice (Makhdum, et al., 2022).

Equity is especially important for consideration. Reduced AI literacy among different subjects and different institutions underscore the danger of mainstreaming/dis-wamping educational inequities. For the identified gaps, interventions are needed to support the marginalised people and under-resourced institutions. A consensus presented by Cochran Smith et al. (2016) is that in order to deal with inequity in teacher education, all barriers faced by disadvantaged groups must be explicitly discussed. Incorporating AI literacy into inclusive education systems will become a key component to make it sustainable and ensure that reforms lead to long-term educational quality enhancements.

Conclusion

This study offers empirical evidence that refutes the notion of a digital native in Generation Z since it can be said that they are proficient with the digital context, but not in the usage of AI, as there are a number of skills they lack and are not used by every student in every discipline. Digital proficiency has a greater predictive power, and both digital proficiency and AI literacy contribute to academic engagement (Lyu & Faisal, et al., 2026). The significance of AI literacy highlights the fact that AI is gaining importance in higher education, however, and it emphasizes the need to address this issue in a systematic way and especially in educational curricula.

While there is a difference in level of AI literacy between disciplines, as there is also a difference based on academic readiness, it seems that disciplines that have a more technical focus would have an edge over disciplines that are not as technical. The results can be used in theory and practice of the educational reform. In theory, they facilitate ideas that reform is a process that is impacted by policy, institutional, curriculum and practice interaction at the system level. They underscore three key practical recommendations: integrating AI literacy into learning outcomes, enhancing institutional capacities, and tackling equity issues.

Overall, it is a positive sign of reforms in higher education in Pakistan, which, if implemented effectively, will go a long way in meeting with international standards, it would require sustained efforts of institutional reform efforts, policy implementation with the sensitivities of Pakistan, strong professional support systems and concerted actions of all stakeholders to sustain the process of reform. Replacing the “digital natives” with “digital literacy” and emphasizing “AI literacy” will enable universities to prepare students for an environment surrounded by intelligent technologies in both the academic and professional contexts of Generation Z.

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