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AI-Powered Pedagogy: Integrating Artificial Intelligence in Information Technology Education for Future Workforce Readiness

Roger S. Mission[1], Renald Jay O. Fio[2], Annie Rose T. Mission[3]*

Abstract: This study investigates the current state of Artificial Intelligence (AI) integration in Information Technology (IT) education, including the adoption of AI-powered tools, the development of AI-related curricula, and the impact of AI on student learning outcomes. Employing a mixed-methods approach, the research combines quantitative and qualitative data to analyze AI integration in IT education. Findings reveal a significant gap between current AI integration in IT curricula and the skills demanded by AI-driven industries. While respondents demonstrated improved critical thinking and problem-solving skills when engaged in AI-powered learning, challenges such as insufficient faculty training, inequitable access to AI tools, and inadequate emphasis on ethical considerations were identified. The study recommends expanding AI-related topics in curricula, incorporating hands-on learning opportunities, and equipping educators with skills for effective AI instruction. By addressing these gaps, this study contributes to the achievement of SDG 4 (Quality Education) by improving the quality and accessibility of IT education and equipping students with the necessary skills for the 21st-century workforce. Moreover, it supports SDG 8 (Decent Work and Economic Growth) by preparing students for in-demand AI-related careers and contributing to economic development.

Keywords: Artificial Intelligence in Education, AI-Powered Pedagogy, IT Education, Workforce Readiness

1. Introduction

Artificial Intelligence (AI) is revolutionizing IT education, significantly influencing workforce readiness. The UN's Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education), SDG 8 (Decent Work and Economic Growth), and SDG 9 (Industry, Innovation, and Infrastructure),

[1] College of Computer Studies, University of Antique, Sibalom, Antique, Philippines
Email: rsmission@antiquespride.edu.ph
[2] IT/MIS Department, Philippine Merchant Marine School, Inc., Las Piñas, Philippines
Email: fiorenaldjay@pmms.edu.ph
[3]* Barangbang National High School, San Remigio, Antique, Philippines
Email: annierose.tordesillas001@deped.ph (Corresponding Author)

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emphasize the urgent need to equip students with AI-related competencies. AI-powered tools like intelligent tutoring systems and predictive analytics platforms are transforming learning, fostering more inclusive, personalized, and effective educational experiences [1]. These innovations enhance student engagement and knowledge retention, equipping them with crucial skills for the evolving workforce [2]. As AI permeates the IT sector, integrating AI-driven pedagogy becomes vital for bridging the skills gap and ensuring students are prepared for the demands of an AI-powered job market.

Integrating AI into IT education not only strengthens students' technical proficiency but also aligns with SDG 8, promoting sustained, inclusive, and sustainable economic growth. By embedding AI in curricula, students acquire industry-relevant skills, enhancing their employability. AI applications in education extend beyond student learning, supporting educators through intelligent workload management and data-driven insights, and enabling more effective teaching approaches. As education systems prepare students for an increasingly automated future, AI integration is crucial for maintaining competitiveness in evolving job markets [3][4].

From a broader perspective, AI-driven educational infrastructure supports SDG 9 by fostering technological innovation in academic institutions. AI-enabled e-portfolios, learning dashboards, and adaptive learning platforms exemplify the infrastructure that empowers continuous, lifelong learning. As the United Nations and UNESCO emphasize, such technological advancements can reduce educational inequality and build a more inclusive society. By embracing AI-powered pedagogy, IT education institutions position themselves at the forefront of industry innovation, promoting economic growth, sustainable development, and a more agile global workforce [5][6].

However, AI adoption in education faces challenges, including data privacy concerns, ethical considerations, and the need for faculty upskilling. Furthermore, disparities in access to AI tools and infrastructure among educational institutions highlight the need for equitable resource allocation. Addressing these challenges is essential to fully realizing the transformative potential of AI-powered pedagogy in IT education.

This study aims to evaluate the current state of AI integration in IT education and its effectiveness in preparing students for careers in an AI-driven workforce. It focuses on identifying essential AI concepts and skills that should be prioritized to ensure students meet future industry requirements. The research also examines the challenges and opportunities of incorporating AI into IT education, emphasizing the need for adequate resources, support systems, and effective implementation strategies.

By addressing these critical areas, the study highlights the importance of fostering workforce readiness through AI-driven learning frameworks. Developing hybrid learning models that combine human instruction with AI tools can create a more comprehensive and dynamic educational environment. Key components of this transition include faculty training, access to advanced AI tools, and a strong focus on ethical AI practices. By balancing technical proficiency with ethical awareness, educational institutions can better prepare students to thrive in an AI-dominated workforce. Embracing AI-powered pedagogical approaches not only enhances academic outcomes but also cultivates a future-ready IT workforce capable of navigating the complexities of an AI-driven world [7].

2. Research Methods

This study employed a mixed-methods approach to evaluate the integration of Artificial Intelligence (AI) in Information Technology (IT) education. By combining qualitative and quantitative data, the

research aimed to provide a comprehensive analysis of past practices, challenges, and opportunities in AI-enhanced IT education. Qualitative findings will be used to inform the interpretation of quantitative results, and quantitative data will be used to support or challenge qualitative insights.

Three key participant groups were involved: IT educators and administrators, IT students, and industry experts. IT educators and administrators were selected through purposive sampling, prioritizing those with demonstrated expertise in AI integration, such as those involved in AI-related curriculum development or research projects. Industry experts were also selected purposively based on their roles in AI-related fields (*e.g.*, AI researchers, data scientists, AI product managers) and their experience in hiring and training IT professionals. Stratified sampling was used to select IT students from different academic levels (undergraduate, graduate) and different IT majors (*e.g.*, computer science, software engineering, cybersecurity).

Data collection methods included surveys, interviews, and document analysis. Surveys gathered quantitative data from students and educators on AI integration levels, perceptions, and challenges. Statistical analysis will be conducted using SPSS, including descriptive statistics, t-tests, and ANOVA, to analyze differences between groups and identify significant relationships. Semi-structured interviews with IT educators and industry experts provided qualitative insights into best practices, challenges, and future directions for AI in IT education. Thematic analysis, involving open coding, axial coding, and selective coding, was used to identify key patterns, challenges, and opportunities from interview transcripts and document reviews. Data triangulation was employed by comparing survey results with interview data and comparing student perceptions with industry expert opinions to enhance the validity of findings.

Ethical considerations were strictly adhered to. Informed consent was obtained from all participants, and their data were kept confidential and anonymous. Ethical approval was sought from the relevant institutional review boards.

To ensure the validity and reliability of the research instruments, a pilot test was conducted for both the survey questionnaires and interview guides.

3. Results and Discussion

3.1 The Current State of AI Integration in IT Education to Understand its Extent and Effectiveness in Preparing Students for the AI-driven Workforce

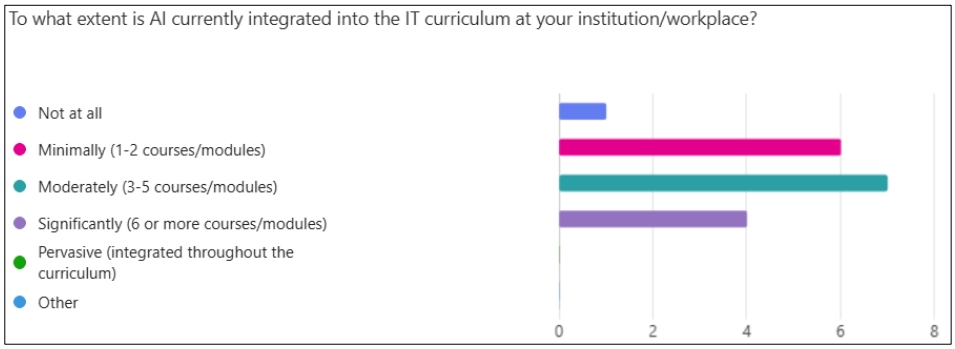

Figure 1. Current State of AI Integration in IT Education

The integration of AI in IT education varies significantly among institutions, as shown in Figure 1. While some have only introduced basic AI concepts through 1-2 courses, others have adopted a more comprehensive approach, offering 3-5 or more AI-related courses. This indicates that, although AI is present in many IT education programs, it is not yet a standard component across all institutions. This observation is supported by the International Society for Technology in Education (ISTE), which highlights that AI adoption in education is still in its early stages. ISTE provides support for educators at different levels of AI adoption, ranging from foundational courses to advanced workshops, illustrating the uneven readiness of institutions to deliver fully developed AI curricula [8].

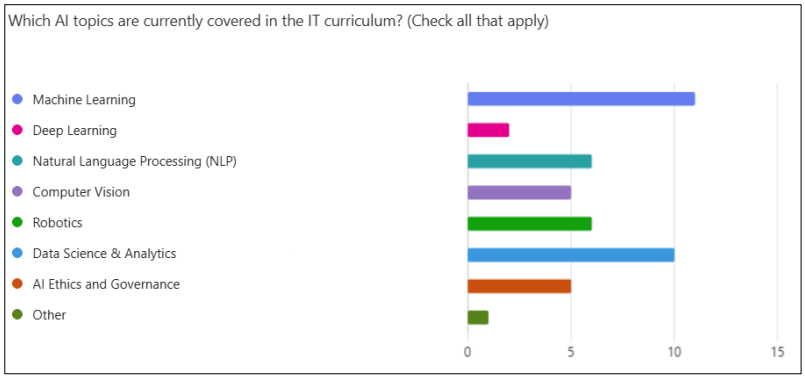

Figure 2. AI Topics Covered in IT Curriculum

IT curricula frequently include essential AI topics such as Machine Learning, Data Science, Deep Learning, and Natural Language Processing (NLP), as shown in Figure 2. However, more advanced subjects like Robotics and AI Ethics are less commonly integrated. This imbalance highlights a gap in the coverage of interdisciplinary AI areas. This pattern is reflected in AI and machine learning courses on platforms like Coursera, where the focus is primarily on core subjects like machine learning, deep learning, and NLP. In contrast, Robotics is often incorporated into specialized tracks in graduate AI programs, while AI Ethics is typically addressed within broader discussions on responsible AI use and development [9]. These trends suggest that while students receive a strong foundation in key AI concepts, there is a need for greater emphasis on advanced and emerging AI topics to better prepare them for the diverse range of AI-related careers.

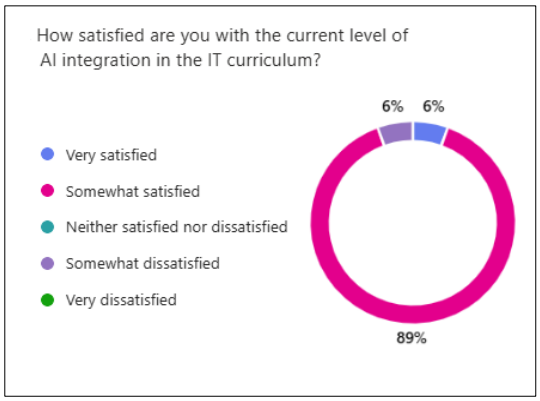

Figure 3. Current Level of AI Integration in IT Curriculum

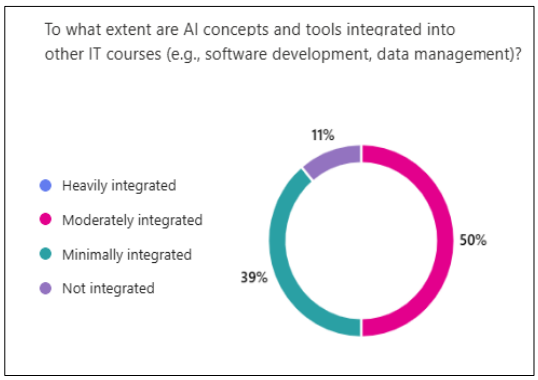

Figure 4. AI Concepts and Tools are Integrated into Other IT Courses

As shown in Figure 3, respondents expressed varied levels of satisfaction with AI integration in education. While some were pleased with the current inclusion of AI topics, others highlighted the need for more extensive and in-depth coverage. This indicates progress but also points to the necessity for a more comprehensive approach to better equip students for AI-driven careers. Reports from the U.S. Department of Education and the World Economic Forum reinforce these findings, emphasizing AI's transformative potential while addressing challenges such as ethics, student privacy, teacher training, and equitable access to resources. Both reports advocate for well-rounded strategies to fully harness AI's benefits, underscoring the need for careful planning to meet the demands of a rapidly evolving workforce [10][11].

The integration of AI concepts across various IT subjects, such as software development and data management, remains inconsistent, as illustrated in Figure 4. While some institutions have successfully incorporated AI into their broader curricula, many still confine its coverage to specialized courses or modules. This reveals a gap that underscores the need for a more integrated approach, where AI concepts are embedded throughout the entire IT curriculum rather than isolated to specific areas.

Research suggests that a holistic integration of AI tools and concepts, particularly within core IT disciplines, would better prepare students for an AI-driven workforce. Embedding AI within software development and data management courses can enable students to develop a deeper understanding and practical application of AI techniques in real-world IT scenarios. However, challenges persist, such as faculty preparedness and limited access to advanced tools, which hinder widespread adoption [12][13].

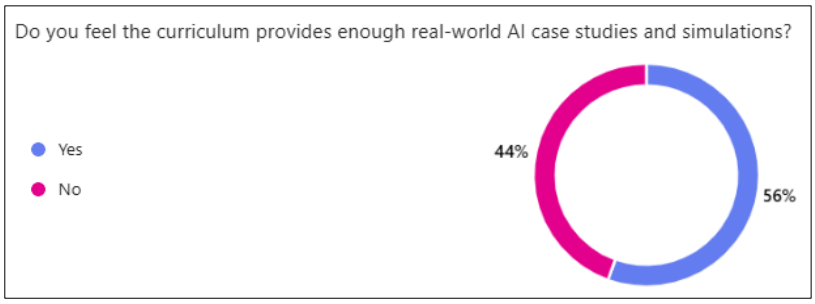

Figure 5. Respondents Expressed Mixed Satisfaction with AI Integration in Education

Figure 5 reveals that respondents voiced concerns about the extent to which the current curriculum prepares students to independently research and adopt new AI tools and techniques. While some felt

adequately prepared, a significant number highlighted the need for greater focus on fostering independent learning and practical experience with emerging AI technologies. This points to the importance of incorporating more hands-on projects, real-world case studies, and exposure to advanced tools. The findings underscore the need for modern AI education to go beyond theoretical instruction, placing greater emphasis on developing independent research skills, experiential learning, and engagement with real-world AI applications [14][15].

3.2 Identifying the Essential AI Concepts and Skills that Should be Prioritized in IT Education to Ensure Students are Equipped for the Future Workforce

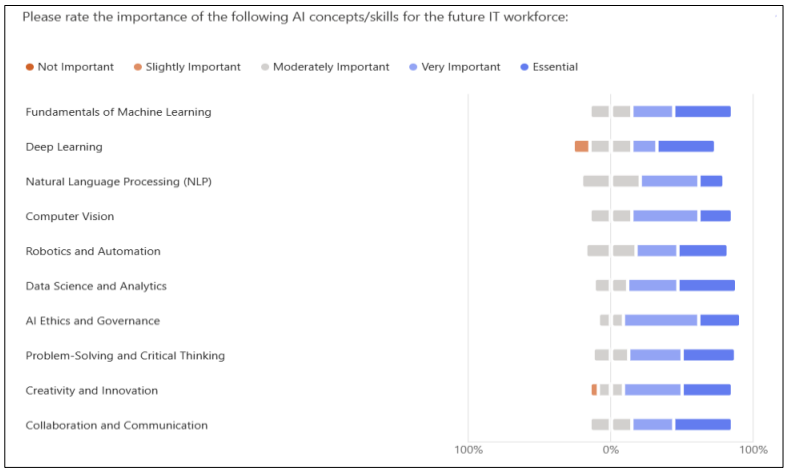

Figure 6. Importance of AI Concepts/Skills for the Future IT Workforce

Figure 6 highlights essential AI concepts and skills that should be prioritized in IT education to prepare students for the future workforce. Respondents stressed the importance of foundational topics such as Machine Learning, Data Science, and Deep Learning, which are considered central to AI applications across industries. While skills like Natural Language Processing (NLP) and Robotics were also noted as important, they received slightly less emphasis. These findings underscore the need to focus on these core areas, as they are crucial for equipping students with the skills necessary to succeed in AI-driven careers.

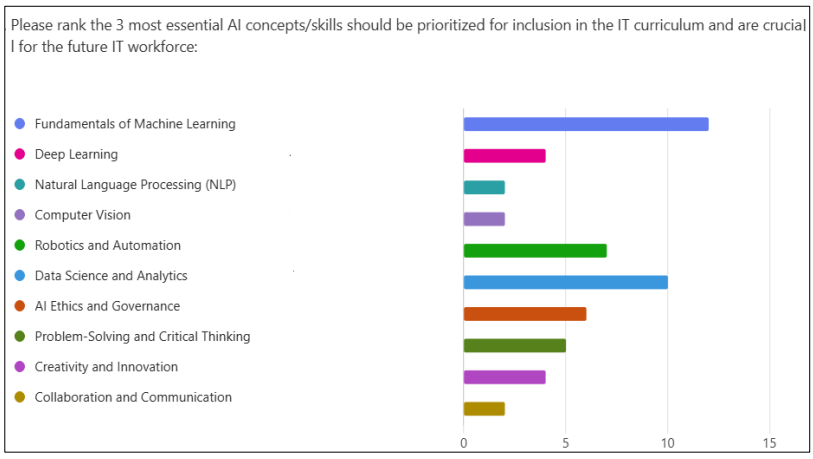

Figure 7. Most Essential AI Concepts/Skills for Inclusion in IT Curriculum

Figure 7 shows the importance of AI concepts and skills for the future IT workforce, as rated by respondents. The results highlight a clear emphasis on foundational AI knowledge (Machine Learning, Data Science) and practical tools (Robotics and Animation) as critical components for IT education. There is also a growing recognition of the importance of ethics and critical thinking, reflecting the need for holistic AI education that combines technical, cognitive, and ethical dimensions.

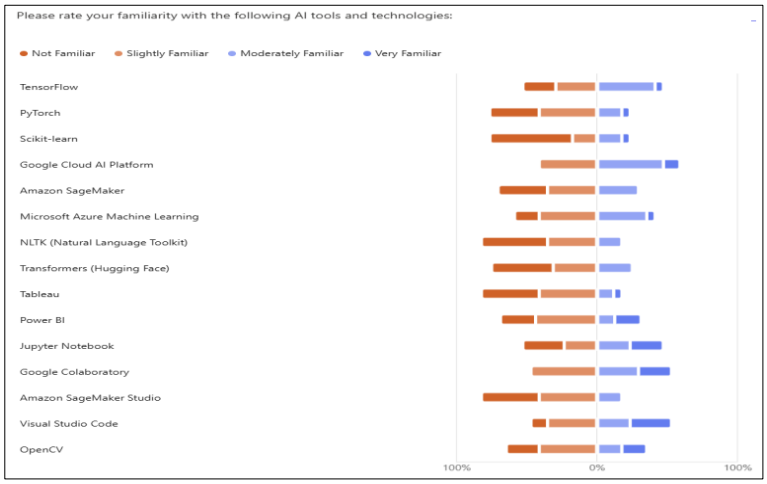

Figure 8. Level of Familiarity with AI Tools and Technologies

Figure 8 illustrates respondents' familiarity with various AI tools and technologies. The findings reveal that respondents demonstrated strong proficiency with widely-used libraries such as *TensorFlow*, *PyTorch*, and *Scikit-learn*, which are central to AI development and widely adopted in academic and industry settings. However, familiarity with cloud-based platforms, including *Google Cloud AI Platform* and *Amazon SageMaker*, was notably lower. This suggests a need for IT curricula to integrate cloud-based AI tools more effectively, as these platforms are increasingly critical for AI development and deployment in industry environments. Strengthening this aspect of education would ensure students are better prepared to meet evolving industry requirements.

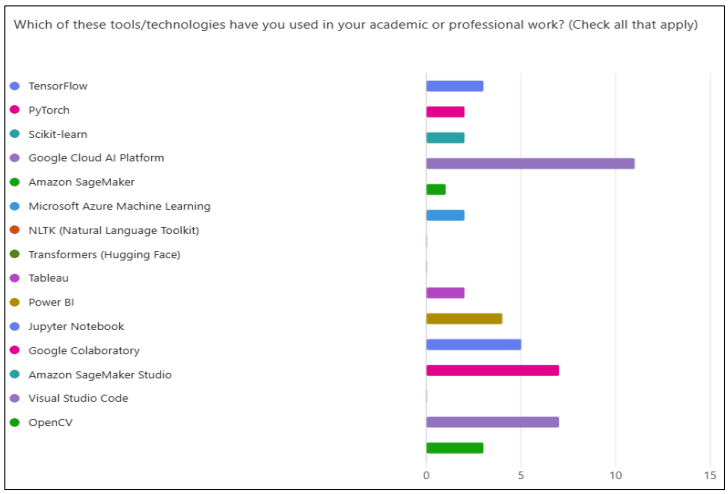

Figure 9. Tools/Technologies Used in Academic and Professional

Figure 9 analyzes the tools and technologies respondents have used in their academic or professional work. The results highlight the growing adoption of cloud-based AI platforms, with *Google Cloud AI Platform* showing the highest usage. However, tools like *Amazon SageMaker* exhibit slightly lower adoption, indicating potential gaps in exposure to alternative cloud solutions. Popular AI libraries, including *TensorFlow*, *PyTorch*, and *Scikit-learn*, remain essential components of AI workflows and show balanced usage across respondents. Additionally, practical tools such as *Jupyter Notebook* and *Google Colaboratory* emphasize the importance of hands-on learning and experimentation in AI development. These findings suggest that AI curricula should prioritize training on cloud-based tools, particularly *Google Cloud AI Platform* and *Amazon SageMaker*, while reinforcing foundational skills in widely-used libraries like *TensorFlow* and *PyTorch*. Furthermore, expanding exposure to specialized tools, such as *OpenCV* and *Hugging Face Transformers*, would better equip students for diverse AI applications in industry.

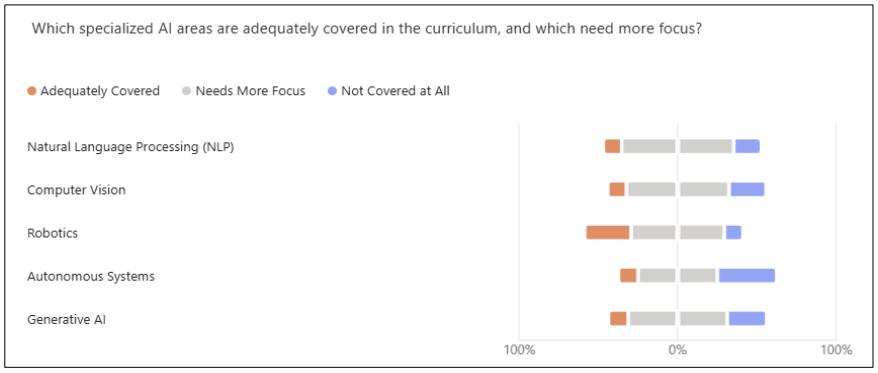

Figure 10. AI Areas Covered in the Curriculum

Figure 10 highlights participants' evaluation of specialized AI areas covered in their curricula and identifies those requiring greater attention. The feedback indicates that while Machine Learning and Data Science are well-represented, fields like Generative AI, Autonomous Systems, and Robotics receive comparatively less emphasis. Given the growing importance of these areas due to rapid advancements in AI technologies, their limited inclusion in current educational programs underscores the need for institutions to expand their curricula. Broadening coverage of these emerging AI fields would better prepare students to adapt to the evolving AI landscape and meet future industry demands.

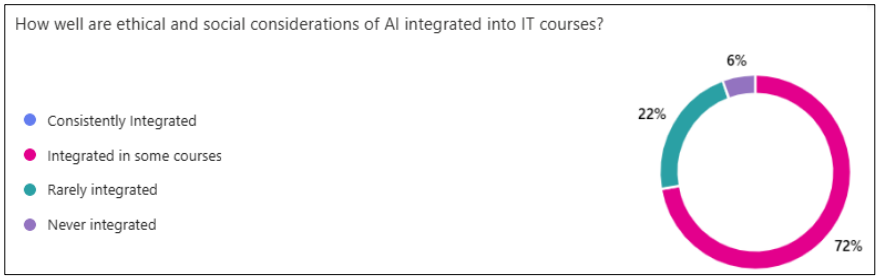

Figure 11. Ethical and Social Considerations of AI Integration into IT Courses

Figure 11 also examines the integration of ethical and social issues related to AI within IT courses. While some institutions incorporate these topics, feedback indicates that many could improve their

coverage of areas like AI bias, data privacy, and the broader societal impacts of AI. With AI playing an increasingly influential role in shaping society, it is essential for students to develop a strong understanding of these ethical considerations. To address this, institutions should prioritize the inclusion of these topics in their AI education programs, ensuring a more well-rounded and responsible approach to AI learning.

3.3 The Most Effective Pedagogical Approaches for Teaching AI in IT Education to Enhance Student Learning and Engagement

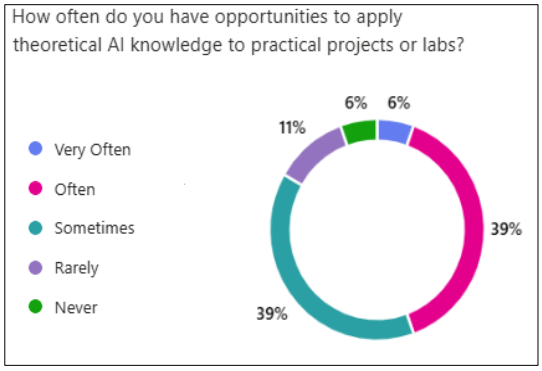

Figure 12. Opportunities to Apply Theoretical AI Knowledge to Projects or Labs

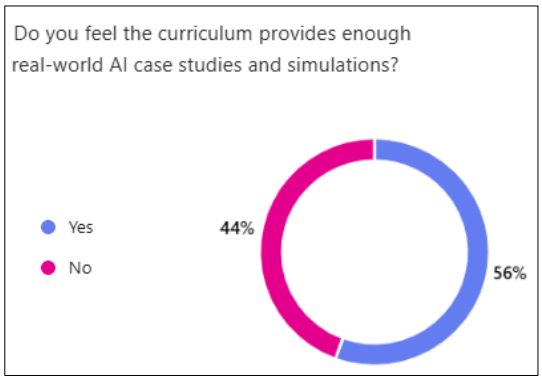

Figure 13. Respondents Addressed Whether the Curriculum Includes Real-World AI Case Studies and Simulations

Figure 12 indicates that while some institutions offer substantial opportunities for students to apply theoretical AI knowledge through practical projects or laboratory work, others lack these provisions. Hands-on experience plays a critical role in strengthening students' understanding, and the absence of such opportunities underscores the need for more practical learning environments that facilitate the application of AI concepts. This observation aligns with the study by Surjadi [16], which highlights that practical learning bridges the gap between theoretical knowledge and real-world application, enhancing students' preparedness for industry roles.

In Figure 13, participants were also asked about the inclusion of real-world AI case studies and simulations in their curriculum. The results indicate that greater emphasis is needed in this area, as these tools are vital for connecting theory to practice. Real-world case studies, technical applications, and simulations [19] provide students with valuable insights into how AI is applied in industry, equipping

them with the contextual knowledge needed to tackle real-world challenges in their future careers. This approach has been shown to improve student engagement, promote critical thinking, and enhance problem-solving skills, as noted by Xu [17]. Furthermore, Rosak-Szyrocka [18] identifies practical projects as one of the most effective methods for building essential AI skills, with case studies serving as a key strategy for contextualizing learning.

Many respondents highlighted the significant value of interdisciplinary collaboration, as seen in Figure 14. Working with students and faculty from fields such as mathematics, statistics, or ethics deepens the scope of AI projects and fosters a more comprehensive understanding of AI's applications. This demonstrates that interdisciplinary collaboration is a vital pedagogical strategy, enhancing the learning experience by expanding students' perspectives [19].

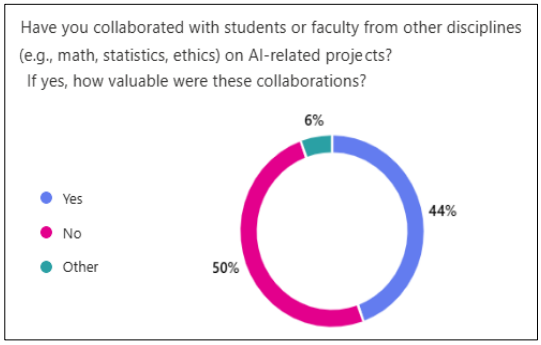

Figure 14. Interdisciplinary Collaboration on AI Related Projects

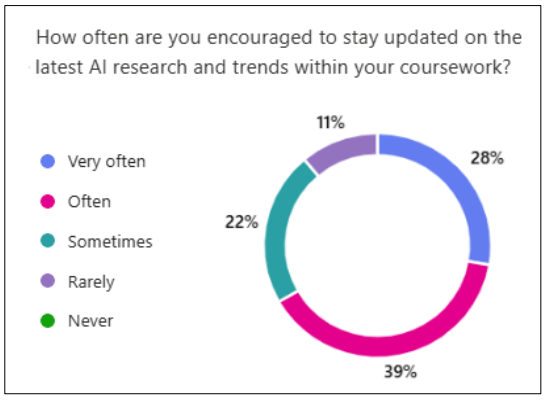

Figure 15. Respondents' Encouragement to Stay Updated on Latest AI Research and Trends

The responses in Figure 15 indicated that while some institutions actively encourage students to stay informed about the latest AI research and trends, others place less emphasis on this aspect as seen in Figure 15. Keeping up with advancements in AI is crucial for maintaining curriculum relevance and equipping students to navigate the field's rapid evolution. The feedback highlights the importance of institutions fostering greater engagement with cutting-edge AI research. As noted by Memarian and Doleck [20], curriculum frameworks must evolve to keep pace with AI's rapid progression, underscoring the role of institutions in supporting continuous learning.

When respondents were asked to rank pedagogical strategies, they identified hands-on labs, collaborative learning, and real-world case studies as the most effective techniques for teaching AI concepts, as shown in Figure 16. These methods promote active student participation, critical thinking,

and practical problem-solving skills. Traditional lectures received lower rankings, indicating a preference for more dynamic and applied approaches in AI education. The findings underscore a growing emphasis on interactive and experiential learning methods, such as labs and case studies, aligning with best practices for teaching AI effectively.

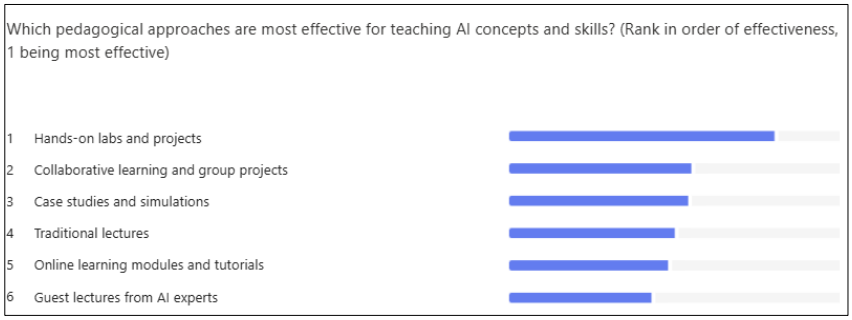

Figure 16. Pedagogical Approaches for Teaching AI Concepts and Skills

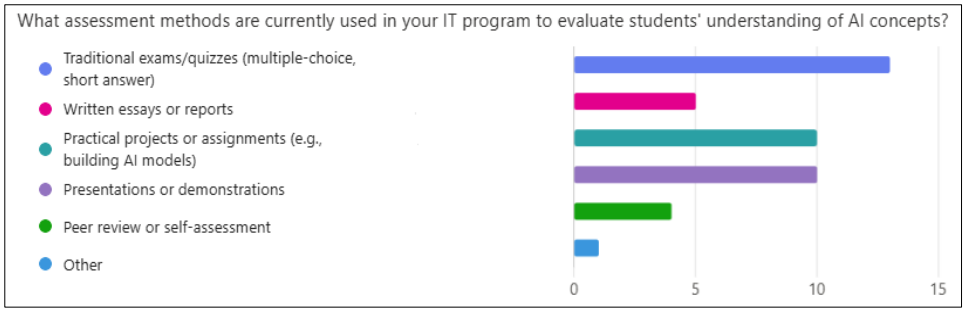

Figure 17. Assessment Methods Used in IT Program to Evaluate Students Understanding of AI Concepts

Figure 17 shows that respondents favor practical projects, presentations, and traditional exams for assessing students' understanding of AI concepts. However, practical projects are viewed as the most effective method for evaluating a student's ability to apply AI tools and knowledge. Such assessments enable students to showcase their real-world problem-solving abilities, which are essential for their future careers in AI.

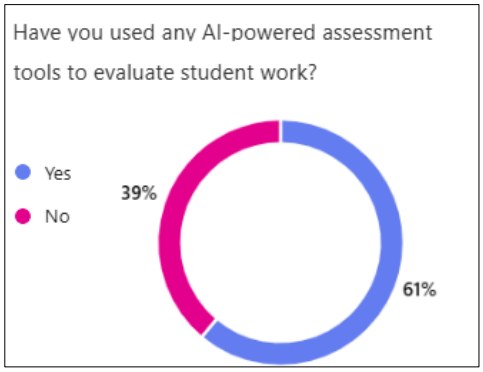

Figure 18. AI-powered Assessment Tools to Evaluate Student Work

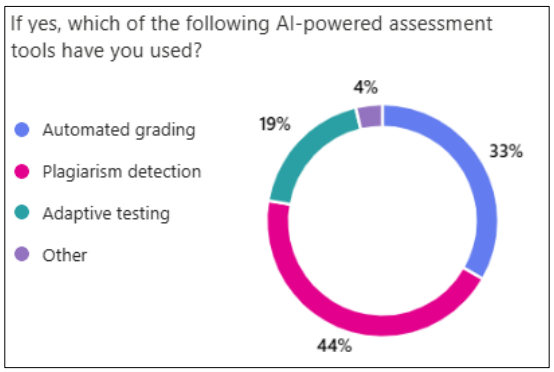

Figure 19. AI-powered Assessment Tools Used

The majority of respondents (61%) reported using AI-powered tools to evaluate student work, while a notable minority (39%) have not, highlighting differing levels of adoption of these tools, as shown in Figure 18. Figure 19 reveals that plagiarism detection tools are the most commonly used AI-powered assessment tools, emphasizing a strong focus on maintaining academic integrity. Automated grading tools are also frequently utilized, likely due to their efficiency in assessing student work. In contrast, adaptive testing and other tools show lower usage rates.

3.4 To Investigate the Challenges and Opportunities Associated with Integrating AI into IT Education, Including the Resources and Support Needed for Successful Implementation

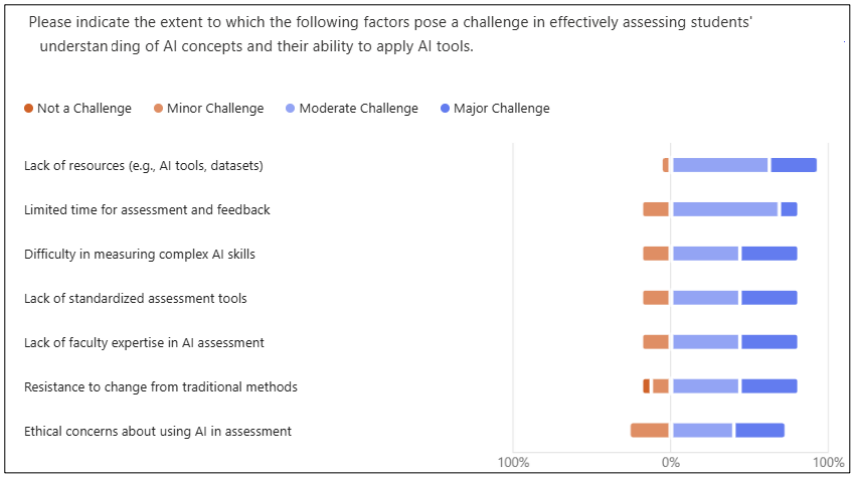

Figure 20. Challenges in Assessing Students' Understanding of AI Concepts and Their Proficiency with AI Tools

Figure 20 highlights several challenges identified by respondents in evaluating students' understanding of AI concepts and their proficiency with AI tools. These challenges include insufficient faculty expertise in AI, difficulties in assessing complex AI-related skills, and a lack of specialized tools for effective evaluation. These findings emphasize the need for better educator training and improved assessment methods to accurately measure students' practical AI abilities. This aligns with the conclusions of Gaber *et al.* [21], which also point to faculty preparedness, assessment difficulties in AI education, and the importance of strengthening educational resources.

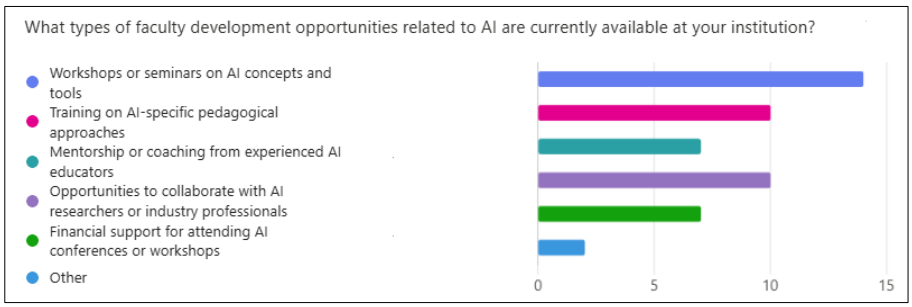

Figure 21. Faculty Development Opportunities Related to AI

The availability of faculty development opportunities in AI was examined as seen in Figure 21. Responses indicated that while some institutions provide workshops, seminars, or mentorship programs, others offer limited or no opportunities for faculty to advance their AI expertise. These development programs are vital for helping instructors effectively teach AI concepts and support students in applying AI tools. Institutions with robust training initiatives are better positioned to integrate AI into their curricula. This aligns with the findings of [22], highlighting the critical role of faculty development in AI and the need for ongoing professional growth to enhance educators' ability to deliver effective AI instruction and curriculum integration.

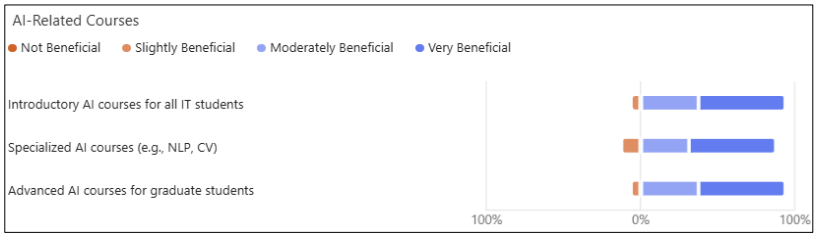

Figure 22. Benefit of AI-related Courses

The study evaluated the perceived benefits of AI-related courses. Most participants reported that these courses were moderately to highly beneficial, especially in providing foundational AI knowledge and practical tool exposure as seen in Figure 22. Additionally, this aligns with the findings of [22], which highlights the value students place on foundational understanding and practical application, as well as the potential benefits of integrating advanced or specialized courses to enhance the curriculum further.

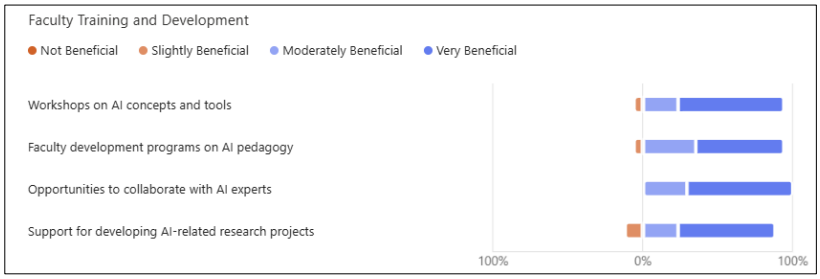

Figure 23. Faculty Training and Development

The study examined the advantages of faculty training and development in AI, as shown in Figure 23. Responses revealed that institutions with well-structured training programs reported significant

benefits, notably enhancing educators' ability to prepare students for AI-related careers [23]. In contrast, institutions with limited or poorly organized training opportunities found them to be only moderately effective. This highlights the critical role of effective faculty development in successfully integrating AI into curricula and preparing students for careers in AI-driven industries.

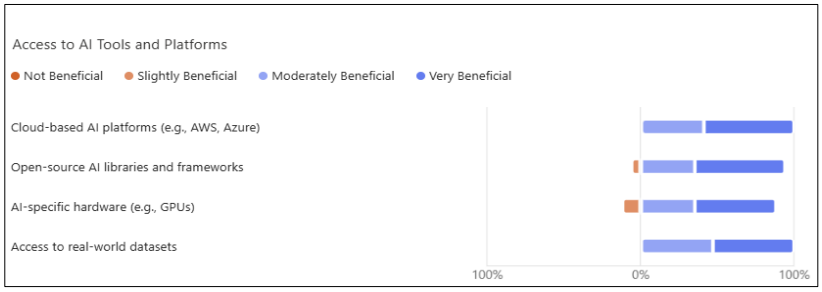

Figure 24. Access to AI Tools and Platforms

Figure 24 the responses indicating that such access is very beneficial when available. It allows students and faculty to work with real-world AI technologies. However, there is significant variation in the extent of access across institutions, with some facing constraints in providing advanced AI platforms or hardware. Greater access to these tools is essential for improving hands-on learning and preparing students for industry applications and the importance of access to real-world AI technologies and how varying levels of availability impact hands-on learning and industry preparedness.

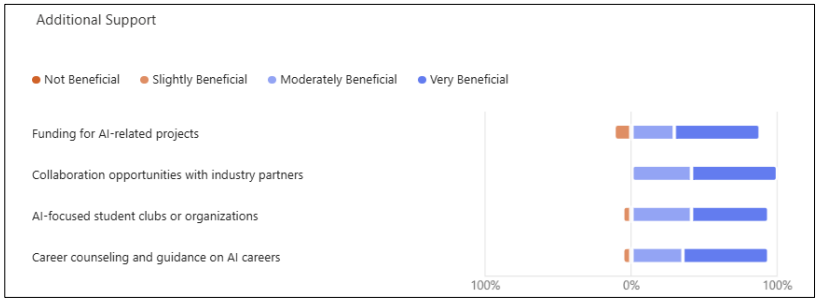

Figure 25. Additional Support for AI Education

Figure 25 highlights the importance of additional support for AI education, such as funding for projects, collaboration opportunities, and access to AI-focused research resources. While most respondents found these forms of support highly beneficial, some institutions continue to struggle with limited resources. This underscores the crucial role of financial investment, institutional collaboration, and research accessibility in strengthening AI education [24]. Providing adequate support in these areas can advance AI curricula, drive innovation, and improve student engagement in AI-related learning. The findings stress the need for strategic support mechanisms to address disparities among institutions, fostering a more inclusive and comprehensive approach to preparing students for careers in AI-driven industries.

4. Conclusion and Recommendations

The findings of this study reveal that while AI integration in IT education is progressing, significant challenges and inconsistencies remain. As revealed in Figure 10, specialized AI areas like Generative

AI and Robotics are often underrepresented in current curricula. This highlights the need to broaden the scope of AI curricula to include these emerging topics, ensuring comprehensive coverage of the field. Furthermore, while the importance of hands-on learning is recognized, as evidenced by the strong preference for practical projects in Figure 13, practical implementation remains limited in many institutions.

To address these challenges and prepare students for an AI-driven future, a holistic and strategic approach is necessary. Institutions should aim to include at least three courses or modules specifically focused on advanced AI topics such as Robotics, Generative AI, and AI Ethics. Greater emphasis must be placed on experiential learning through hands-on projects, real-world case studies, simulations, and industry collaborations. This is crucial to bridge the gap between theory and practice, as highlighted by the strong preference for practical learning methods observed in Figure 12.

Equally important is the need for institutions to prioritize faculty-training programs to equip educators with the technical expertise and pedagogical skills required to effectively teach AI concepts. These programs should prioritize training on inclusive teaching practices and addressing potential biases in AI tools and datasets to ensure equitable access to quality AI education for all students.

Additionally, access to advanced AI tools, cloud-based platforms, and software resources must be improved to support practical learning and research activities. Institutions should strive to provide equitable access to these resources for all students, regardless of their background or socioeconomic status.

Integrating discussions on AI ethics, societal impacts, and potential biases into the curricula is crucial to ensuring that students develop as responsible and ethical AI practitioners. This aligns with the growing recognition of the importance of ethical considerations in AI development, as reflected in the findings related to Figure 11.

Future research should explore key areas to further strengthen AI integration in IT education. Studies on the impact of AI on different learning styles can provide insights into how AI tools and techniques can be adapted to accommodate diverse learning preferences and improve outcomes. Longitudinal research tracking student outcomes over time will help assess the long-term effects of AI integration on academic performance, critical thinking, and career readiness.

Finally, collaboration with industry experts and educational institutions is essential to developing standardized frameworks for designing, implementing, and assessing AI curricula. Advocating for increased government funding for AI education initiatives and supporting the development of national AI education standards can significantly impact the quality and accessibility of AI education programs.

By implementing these recommendations and conducting further research, institutions can advance AI education and empower students to acquire the skills, knowledge, and ethical foundations needed to succeed as AI practitioners in an increasingly technology-driven world.

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