AVE Trends in Intelligent Techno Learning

Impact of Artificial Intelligence on Student Ingenuity in Higher Education Institutions in Zambia

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Abstract: This study interrogates how Artificial Intelligence (AI) affects student ingenuity in Zambian higher education institutions. Employing a mixed-methods approach, the research integrates qualitative and quantitative methods, including in-depth interviews, surveys, and institutional document analysis, to capture the perspectives of students, lecturers, and educational technologists. A purposive sample of participants from various academic disciplines provided rich, contextually grounded data on AI's role in fostering creativity, critical thinking, and problem-solving skills. Thematic findings highlight that AI-powered research tools have significantly enhanced innovation by enabling students to analyse large datasets, identify complex patterns, and engage in interdisciplinary collaboration. Additionally, AI-driven learning platforms have helped bridge the STEM skills gap by offering personalised feedback, adaptive problem-solving exercises, and coding simulations, thereby enhancing technical proficiency. The study further reveals that AI-supported personalised learning models have improved student engagement and self-directed learning by tailoring educational content to individual needs. Moreover, AI-driven accessibility tools have played a crucial role in fostering inclusivity for students with disabilities, ensuring equitable participation in academic activities. However, despite these advancements, challenges remain regarding the equitable adoption of AI, ethical concerns, and the need for standardised evaluation frameworks to assess its long-term impact on student ingenuity.

Keywords: Artificial Intelligence (AI); Student Ingenuity; Higher Education; Personalised Learning; STEM Education; Creativity and Innovation; Critical Thinking; Inclusivity and Accessibility.

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1. Introduction

The debate is wide, academic minds are divided, yet AI is here to stay. In a world where rapid technological advancement is reshaping every facet of society, an urgent question arises: Can Artificial Intelligence (AI), a force of such monumental scale

and sophistication, truly augment human creativity, or does it risk relegating ingenuity to mere algorithmic execution? As AI technologies penetrate the fabric of global education systems, their potential to reshape student learning and innovation is undeniable. In Zambia, where higher education institutions (colleges and universities) have historically struggled with resource limitations and a reliance on traditional, lecture-centred pedagogies, AI offers an unprecedented opportunity to catalyse a paradigm shift, one that might not only overcome systemic barriers to learning but also foster a generation of students who are capable of deep creativity and problem-solving [46]. Yet, amid this technological promise, it is imperative to scrutinise the dual-edged nature of AI's influence: does it empower students to unlock their full intellectual potential, or does it inadvertently circumscribe the very creativity it purports to enhance? According to Mudenda et al. [48], artificial intelligence, in its most sophisticated form, encompasses a range of technologies designed to emulate human cognitive functions-learning, reasoning, and problem-solving thereby extending the boundaries of traditional educational tools. Its application in higher education is broad and varied, from intelligent tutoring systems and adaptive learning platforms to data-driven research tools and predictive analytics that shape institutional decisions and individual student pathways. For Zambia, a nation where access to cutting-edge educational technologies remains patchy and pedagogical methods are often entrenched in rote learning, AI's promise to level the educational playing field is especially compelling. These tools can bridge the gap in resource-limited settings by offering students tailored learning experiences, thereby fostering deeper engagement with content and more personalised, efficient learning trajectories [25].

AI, in its ideal form, democratizes access to global knowledge, facilitating cross-cultural collaboration and providing students with opportunities to engage with real-time data that can shape the future of global challenges [36]; [40]. Nevertheless, even though the potential of AI to promote innovation is readily apparent, the question remains: to what extent does this technology truly serve students' creativity? Recent literature reveals a bifurcated view of AI's impact on education, acknowledging both its transformative possibilities and its inherent risks. On the one hand, AI can revolutionise how students approach problem-solving by offering platforms that not only provide immediate feedback but also present problems and solutions in an adaptive, dynamic environment. AI can enable students to explore complex issues at their own pace, fostering deeper, more creative engagement with the material [29]. By offering real-time solutions and providing access to a plethora of data, AI-driven tools enable students to develop innovative, data-informed strategies- skills that are indispensable in a world that increasingly values interdisciplinary approaches to problem-solving [39]; [47]. The over-reliance on AI raises significant concerns about the erosion of independent thought [16]. The argument posits that when students come to rely on AI tools to generate solutions, they may, through automated reasoning or data interpretation, forfeit the opportunity to develop critical thinking skills or engage deeply with the material. This is particularly concerning in the Zambian colleges and universities, where educational reforms strive to build a system that balances technological progress with the need for intellectual independence. In such an environment, there is a very real risk that AI could, if improperly integrated, become a crutch rather than a catalyst for student creativity, relegating students to passive consumption of knowledge rather than active engagement with it [5]; [3].

Moreover, the digital divide, whereby access to AI-driven platforms is disproportionately skewed towards more affluent students or institutions, threatens to perpetuate existing educational inequities, further marginalising those already on the periphery of educational opportunities. Scholars have consistently pointed to these complexities, with recent work suggesting that the ethical integration of AI in education requires a deliberate balance. AI can undoubtedly improve learning and foster creativity. Still, it must be introduced with a keen awareness of its potential to undermine the very human elements that contribute to educational success. As Shipepe et al. [4] assert, AI's true promise lies not in replacing human effort but in amplifying human creativity, fostering environments where students can synthesise AI-generated insights with their own original ideas. Such an approach depends on the careful design and ethical deployment of AI technologies, ensuring they augment rather than diminish the development of critical and creative thinking. It is within this nuanced framework that the role of AI in Zambian higher education institutions must be evaluated, as it presents both opportunities and challenges to foster student ingenuity. This study investigated how AI influences student ingenuity within Zambian higher education institutions, with a particular focus on creative thinking, problem-solving, and innovation. By examining both the advantages and limitations of AI as a tool for fostering student creativity, this research aimed to offer insights into how AI can be leveraged to empower students while maintaining intellectual independence [13]; [10]. Furthermore, it addressed the ethical considerations surrounding AI in education, providing a roadmap for Zambian higher education institutions to integrate these technologies in ways that align with broader educational goals without compromising the development of critical thinking and creative capacities.

1.1. Statement of the Problem

The integration of Artificial Intelligence (AI) into higher education systems globally has sparked considerable excitement, particularly for enhancing personalised learning and adaptive educational models; nonetheless, there remains a conspicuous gap in scholarly understanding of how AI specifically influences student ingenuity, especially within the unique context of Zambian higher education institutions [54]. Despite AI's transformative potential to revolutionise educational methodologies by offering personalised, data-driven learning paths and fostering collaborative innovation, there is limited empirical research

that critically examines its effects on the development of creativity, critical thinking, and independent problem-solving skills among Zambian students. Recent literature points to the duality of AI's impact, acknowledging both its capacity to develop cognitive development through tailored learning experiences and its potential to inadvertently stifle creativity by fostering a dependency on algorithmically generated solutions [49]. Furthermore, the disparities in access to AI technologies, driven by infrastructural limitations and unequal resource distribution, worsen existing educational inequalities, leaving certain student populations vulnerable to missing out on the benefits that AI could offer. In light of these challenges, this research seeks to address the pressing question: How does the use of AI in Zambian higher education institutions shape student ingenuity, particularly by fostering creativity and problem-solving capabilities? By critically exploring this issue, the study contributes to the body of knowledge surrounding the ethical, equitable, and effective integration of AI in higher education, offering insights into its capacity to enhance student innovation in Zambia.

1.2. Research Objectives

- To establish the role of AI technologies in fostering creativity and innovation among students in Zambian higher education institutions.
- To determine the influence of AI-driven tools on problem-solving and critical thinking abilities of students in Zambia's universities and colleges.
- To identify the ethical challenges and implications of incorporating AI technologies into the educational practices within Zambian higher education.

1.3. Rationale of the Study

The rapid advancement of Artificial Intelligence (AI) offers vast potential for enhancing educational practices globally. However, its implications on student creativity and innovation, especially within the context of Zambian higher education, remain underexplored. AI technologies promise to revolutionise learning by providing personalised educational experiences, but empirical research is needed to understand how these technologies shape students' cognitive development and problem-solving skills. This study bridges the existing gap by assessing the specific ways in which AI impacts students' ingenuity and intellectual capacities at universities in Zambia. Furthermore, as AI technologies continue to be integrated into educational systems, responding to the ethical challenges that arise, such as accessibility, privacy, and the balance between human intellect and algorithmic intervention, becomes imperative. By exploring these dimensions, this research contributes to the discourse on AI's role in shaping the future of education, offering insights into how Zambian higher education can leverage AI while mitigating its potential drawbacks.

1.4. Theoretical Framework

The theoretical framework for this study is primarily based on two key educational theories: Vygotsky's Socio-Cultural Theory of Learning and Piaget's Constructivist Theory. Vygotsky [28] emphasised the importance of social interaction and cultural tools in the development of cognitive functions. From the perspective of AI in education, these 'cultural tools' can be seen as AI technologies that mediate the learning process by providing personalised feedback and real-time learning adjustments. AI can enhance learning by fostering collaborative environments where students engage with information in ways that promote active learning and creativity. Piaget [22], which posits that learners actively construct knowledge through interaction with their environment, further supports the integration of AI into education. AI-driven platforms, by adapting to individual learning styles and offering opportunities for problem-solving, align with the constructivist view that knowledge is best acquired through hands-on, meaningful engagement with content. In line with this, the study examined how AI serves as a dynamic tool that fosters creativity, encourages exploration, and facilitates deeper cognitive engagement. Moreover, the Theory of Connectivism, proposed by Siemens [19], is relevant to understanding the impact of AI in modern education. Siemens [19] asserts that learning is a process of creating networks of information and connecting with knowledge sources across different domains. In a world where AI provides access to vast networks of data and global knowledge resources, students are positioned to engage in learning environments that go beyond traditional classroom boundaries, thus enhancing their ability to think creatively and solve complex problems.

1.5. Philosophical Underpinning

This study is grounded in pragmatism, a philosophical framework that focuses on practical applications and the real-world consequences of ideas. Pragmatism, as articulated by scholars such as Dewey [20], holds that the value of an idea or theory lies in its ability to solve real-world problems [17]. In the framework of AI in education, the pragmatic approach emphasises understanding how AI can be used effectively to address educational challenges in Zambia. The study evaluated the practical benefits of AI in enhancing students' creativity and problem-solving skills, while exploring potential drawbacks, such as over-reliance on technology and its ethical implications. Additionally, critical realism, as outlined by Bhaskar [41], serves as another

philosophical underpinning for this study. Critical realism acknowledges the existence of an objective reality that can be understood through both empirical observation and the interpretation of social backgrounds. In the setting of AI integration in Zambian education, critical realism suggests that AI technologies have the potential to improve educational outcomes, even when social, cultural, and institutional factors mediate their impact. These include unequal access to technology, the potential to deepen educational inequalities, and ethical concerns about data privacy and algorithmic bias.

2. Literature Review

The rapid ascent of Artificial Intelligence (AI) has catalysed a transformative shift across sectors globally, none more so than in education. The integration of AI into the academic system has sparked a heated debate over its potential to revolutionise teaching, learning, and institutional operations. On the one hand, proponents of AI in education argue that its implementation promises increased efficiency, personalised learning experiences, predictive analytics, and enhanced student engagement [26]. On the other hand, critics raise concerns about data privacy, algorithmic bias, and the gradual erosion of human-centric pedagogies. These arguments, both for and against AI, underscore the complexities of this technological evolution. The introduction of AI is seen by many as an irreversible transformation, especially in developing nations like Zambia, where the digital revolution is still unfolding. This literature review explores the origins of AI, its role in enhancing student ingenuity, the structure of higher education institutions in Zambia, and the global, continental, and national contexts of AI in education. It will also examine the contextual rise of digital technology in Zambia's education sector and the implications for pedagogical models.

3. Definitions

3.1. Artificial Intelligence

Artificial Intelligence (AI) refers to the development of computer systems capable of performing tasks that would typically require human intelligence. These tasks range from speech recognition and decision-making to visual perception and language translation [44]. At its core, AI uses algorithms, machine learning (ML), and deep learning (DL) to recognise patterns, make decisions, and adapt over time as new information becomes available. The field of AI traces its intellectual roots to the work of Alan Turing, who, in his 1950 paper Computing Machinery and Intelligence, proposed the Turing Test to evaluate a machine's ability to exhibit intelligent behaviour indistinguishable from that of humans. The formalisation of AI as a distinct field began in 1956 at the Dartmouth Conference, where leading figures such as John McCarthy, Marvin Minsky, and Claude Shannon laid the groundwork for what would become the AI research agenda. Today, AI is an interdisciplinary field that spans computer science, cognitive science, and neuroscience, and is applied across industries, including education, healthcare, and business. Among the most common examples of AI used by Zambian students is ChatGPT, a conversational agent that employs natural language processing to simulate human-like dialogue. ChatGPT assists students by generating ideas, summarising complex academic texts, and even helping draft essays, thereby acting as a virtual tutor [35]; [48]. Alongside ChatGPT, tools such as Grammarly and plagiarism detection software (e.g., Turnitin) are widely used to enhance the quality of academic writing and maintain academic integrity. These applications help students refine their language skills and ensure their work meets high standards of originality and clarity [9]. Other AI-powered platforms, such as Google Cloud AI and computational software like MATLAB, are increasingly integrated into the academic workflow. These tools support data analysis, complex problem solving, and research activities, providing students with robust capabilities to handle quantitative tasks and conduct empirical investigations. As highlighted by Hwang et al. [18], exemplified in a case study at David Livingstone College of Education, such systems contribute to an adaptive learning environment in which teaching methods can be tailored to individual student needs [24].

3.2. Student Ingenuity

Student ingenuity refers to students' capacity to apply creative problem-solving, critical thinking, and innovative approaches to solving real-world challenges. This quality is a vital aspect of education, fostering intellectual growth and enabling students to synthesise complex ideas and apply them in novel ways. AI has a pivotal role in enhancing student ingenuity by providing platforms and tools that promote personalised learning and exploration. As students engage with AI-driven educational tools, they gain the ability to explore, hypothesize, and test solutions to problems across various disciplines. AI fosters an environment where students can collaborate, experiment, and further develop their ideas, thereby pushing the boundaries of traditional learning and creating a more dynamic educational experience.

3.3. Higher Education Institutions in Zambia

Zambia's higher education scenery is marked by 61 registered higher education institutions, a mix of public universities, private institutions, and technical colleges, each contributing significantly to the country's academic and professional development. The University of Zambia (UNZA), Copperbelt University (CBU), Mulungushi University (MU), and Kwame Nkrumah

University (KNU) are among the flagship public universities, offering a broad array of undergraduate and graduate programs. These institutions are essential in training professionals across various fields. Alongside the public sector, private institutions such as Cavendish University, Rusangu University, Eden University, Apex University, UNICAF, and the University of Lusaka (UNILUS) have expanded educational opportunities, serving as crucial players in confronting the growing demand for higher education in Zambia. In addition to these universities, Zambia's technical colleges, regulated by the Technical Education, Vocational and Entrepreneurship Training Authority (TEVETA), focus on vocational and skills-based training to meet the country's needs in sectors such as agriculture, construction, and manufacturing. Despite these achievements, the higher education sector in Zambia faces persistent challenges, including limited access to digital resources, underfunded institutions, and a lack of adequately trained faculty members to drive the integration of AI into educational practices [14]. These obstacles underscore the urgent need for innovative solutions that can bridge the digital divide and facilitate the widespread adoption of AI technologies.

3.4. Global Perspective on AI in Education

AI's integration into global education systems has led to momentous improvements in teaching methods, administrative processes, and student engagement. In Europe, countries such as the United Kingdom, Germany, and France have embraced AI as a tool for enhancing personalised learning. In the UK, AI has been employed to create adaptive learning environments that tailor educational content to the unique learning needs of individual students [15]; [12]. These personalised platforms use machine learning algorithms to analyse students' learning behaviours and adjust content delivery to suit their cognitive styles, thus improving engagement and retention. Similarly, in the United States, AI has been utilised for predictive analytics, enabling institutions to predict students at risk of failing or dropping out and to provide timely intervention. Additionally, AI-driven systems have alleviated the administrative burden on educators by automating tasks such as grading, admissions processing, and scheduling, allowing them to focus more on teaching and student interaction. However, despite these promising advancements, ethical concerns remain at the forefront of AI implementation in education. The potential for AI to perpetuate biases, whether in grading algorithms or admissions processes, has raised alarms about fairness and equity [11]. Furthermore, there are increasing worries about data privacy, particularly regarding the vast amounts of personal data collected by AI-driven systems. Thus, European and North American governments have increasingly called for regulatory frameworks that ensure the ethical use of AI technologies within educational institutions.

3.5. AI in Education in Africa

The adoption of AI in African education systems varies significantly from country to country, with more developed nations such as South Africa, Kenya, and Nigeria leading the way in leveraging AI for educational reform. In South Africa, AI-powered platforms have been used to enhance learning through personalised educational tools and remote learning initiatives. The SmartLearn project, for example, has been instrumental in increasing access to quality education, particularly in underserved areas. According to Madumo and Kimaro [38], Kenya has similarly embraced AI in education, with platforms such as M-Shule providing personalised learning experiences through SMS-based lessons. However, many African countries still face challenges in widespread AI adoption due to limited access to digital infrastructure, low internet penetration, and a shortage of qualified AI professionals. Research by UNESCO [53] indicates that AI in African education is still in its infancy; initiatives like AI4D Africa are working to build local AI capacity and create self-sustaining ecosystems for technology development. By partnering with global tech companies, African governments and universities are working to increase AI research output and develop local expertise in AI and machine learning. Although the continent's path to full-scale AI integration remains a work in progress, the initial steps taken in countries like South Africa and Kenya are encouraging signs of AI's transformative potential across the continent.

3.6. AI in Education in Zambia

Zambia's journey toward AI integration in education is in the early stages. The government has recognised the need for AI to enhance its educational system and has undertaken various initiatives to introduce digital technologies in universities and schools. Notably, institutions like the University of Zambia (UNZA) and Copperbelt University (CBU) have incorporated AI tools into their research and teaching practices, though the scope of implementation remains limited. Challenges such as the high cost of adopting technology, inadequate infrastructure, and a shortage of faculty skilled in AI hinder progress [26]. The recent COVID-19 pandemic has acted as a catalyst for change. The central tenets of Zambia's digital transformation in education lie within the National Digital Transformation Strategy, which calls for increasing access to digital tools, enhancing digital literacy, and creating an ecosystem that supports AI integration in educational institutions. According to the Smart Zambia [51] initiative, the goal is to create a digitally empowered society where geographic or social boundaries no longer limit learning. Despite the ambitious vision, the implementation of digital strategies has been hindered by several challenges. Chief among them is the stark contrast between urban and rural areas in terms of internet connectivity, access to technology, and technical skills. Urban centres such as Lusaka and the Copperbelt Province have higher internet penetration, and educational

institutions in these regions leverage e-learning platforms and digital tools to enhance pedagogy. In contrast, rural areas continue to face severe infrastructure gaps, with intermittent internet access and limited access to devices such as computers or smartphones. The COVID-19 pandemic accelerated the global shift to online education, and Zambia was no exception. During the lockdowns, educational institutions were forced to adopt digital platforms such as Zoom, Microsoft Teams, and Google Classroom to ensure learning continued [29]. This forced transition to digital learning exposed significant inequalities in access to technology and digital literacy.

In urban areas, universities and colleges quickly adapted to online learning, with instructors receiving the necessary training to facilitate remote teaching. However, in rural areas, where internet speeds were slow and infrastructure was outdated, many students were left without the resources to participate in online education [26]. This digital divide not only reflects a geographic disparity but also underscores a broader socio-economic divide, as those in poverty or remote locations lack access to basic technologies. As a result, Zambia's education system has faced a dual challenge of not only enhancing digital access but also ensuring that digital literacy is widespread among students and educators alike. In recognition of these challenges, Zambia has embarked on efforts to build a more inclusive educational framework that can cater to the diverse needs of its population. Central to this effort is the government's investment in AI technologies, which hold significant promise in revolutionising the educational landscape. AI's potential in Zambia's education system is vast, including the ability to personalise learning experiences, provide intelligent tutoring, and offer data-driven insights into student performance. AI-powered tools such as intelligent tutoring systems (ITS), adaptive learning platforms, and AI-assisted assessments can identify and address individual students' specific learning needs. These technologies could reduce the barriers posed by traditional, one-size-fits-all teaching methods, thus promoting inclusive education. However, the widespread integration of AI tools is still in its nascent stages in Zambia, with only a few universities and colleges experimenting with AI-driven platforms. The main hurdles to scaling AI in Zambia include inadequate infrastructure, the high cost of implementation, and the lack of skilled personnel proficient in AI technologies [51].

The government's National Digital Transformation Strategy is an essential framework that addresses these issues by prioritising the digital upskilling of both students and educators. By equipping teachers with the necessary skills to effectively use digital tools and AI technologies, Zambia can begin to realise the full potential of AI in transforming education. This initiative also aligns with broader continental efforts to increase Africa's digital capacity and foster AI research and development. Despite Zambia's digital transformation still being in its early stages, the country is laying the groundwork for a more connected, tech-enabled future in education. Furthermore, international partnerships have played a crucial role in advancing Zambia's AI education agenda. Through collaborations with global tech giants such as Google, Microsoft, and Huawei, Zambia has gained access to AI technologies and training programs designed to upskill the local workforce. These partnerships have enabled educational institutions, particularly in urban areas, to adopt AI-powered learning platforms and participate in AI-related research. Zambia's engagement in the continental AI discourse, through initiatives such as AI4D Africa, has also facilitated greater exposure to global AI advancements, providing local experts with an avenue to contribute to the development of AI solutions tailored to the country's unique needs. However, to ensure that the benefits of these technologies reach all students, concerted efforts are needed to address the digital divide and ensure that infrastructure is robust enough to support large-scale AI integration.

4. Methodology

4.1. Research Design

This study employed an exploratory sequential mixed-methods design that synergises qualitative and quantitative paradigms. The rationale behind this integrative approach was to capture both rich, context-sensitive insights and measurable trends, thereby facilitating robust data triangulation and enhancing the overall reliability and validity of the findings [23]. The investigation commenced with a qualitative phase to explore stakeholders' detailed experiences and perceptions of Artificial Intelligence (AI) integration in higher education. Semi-structured, in-depth interviews and document reviews were utilised to uncover the underlying factors influencing AI's impact on student ingenuity. This qualitative inquiry is subsequently followed by a quantitative phase, in which a structured survey was administered to validate and expand upon the initial insights. The sequential approach ensures that the preliminary qualitative data informs the quantitative survey design, thereby providing a comprehensive understanding of the phenomenon [33].

4.2. Sample Population

For the qualitative phase, the sample population comprised a targeted group of lecturers, students, and educational technologists drawn from selected higher education institutions across Zambia. This group is chosen for its direct experience and expertise in applying AI in academic environments. In the quantitative phase, the sample is broadened to include a wider cross-section of students and faculty members, ensuring that diverse perspectives are represented in the analysis.

4.3. Sampling Methods

Purposive sampling was employed in the qualitative phase to identify participants who provided in-depth insights into the integration of AI in educational systems. For the quantitative phase, a stratified sampling technique was implemented to ensure that the survey sample reflects the heterogeneous nature of the higher education scenery in Zambia. This stratification accounted for variations in institution type, academic discipline, and demographic characteristics, thereby enhancing the generalizability of the findings.

4.4. Data Collection

Data collection unfolded in two distinct phases. Initially, semi-structured interviews were conducted with key informants to gather detailed, descriptive data on their experiences, perceptions, and challenges regarding AI in the learning environment. Concurrently, a review of institutional documents and AI-related educational resources provided contextual background on the current implementation practices. In the subsequent phase, a structured survey instrument was distributed electronically to the broader student and faculty sample. This survey aimed to quantify the extent of AI usage, assess perceptions of its effectiveness in promoting creativity, critical thinking, and problem-solving, and explore associated ethical concerns.

4.5. Data Analysis

The qualitative data were subjected to thematic analysis, allowing for the identification of recurring patterns and emergent themes. To ensure the credibility of these findings, member checking was conducted, in which participants reviewed the interview transcripts and interpretations to verify their accuracy [56]. The quantitative data were analysed using descriptive statistics to outline trends in AI adoption. In contrast, inferential statistics, such as factor analysis, were applied to examine the relationships between AI utilisation and educational outcomes, including creativity, critical thinking, and problem-solving.

4.6. Ethical Considerations

Ethical rigour underpinned every stage of this study. Informed consent will be obtained from all participants after providing information about the study's objectives, procedures, and potential risks. Confidentiality and anonymity were strictly maintained, with secure data storage protocols ensuring that sensitive information is accessible only to the research team. Additionally, the practice of member checking contributed to the trustworthiness of the qualitative findings. All procedures adhered to the ethical guidelines prescribed by the relevant institutional review boards, ensuring the protection and respect of all participants' rights throughout the research process.

5. Findings

This section provides findings of the study.

5.1. Universities and Colleges

The following universities and colleges participated in the study:

- University of Zambia (UNZA)
- Copperbelt University (CBU)
- Mulungushi University (MU)
- Kame Nkrumah University
- Zambia Institute of Mass Communication (ZAMCOM)
- Eden University
- University of Lusaka (UNILUS)
- David Livingstone College of Education

5.2. Demographic Information

The demographic information of the participants is presented in Table 1. The data in Table 1 below captures gender, age, academic discipline, and role (student, lecturer, or educational technologist).

Table 1: Demographic information

Category	Frequency	Percentage
Gender: Male	120	60%
Gender: Female	80	40%
Age: 18-24	100	50%
Age: 25-34	70	35%
Age: 35 and above	30	15%
Role: Student	150	75%
Role: Lecturer	30	15%
Role: Technologist	20	10%

6. Data Analysis

This segment provides detailed data analysis for both quantitative and qualitative methods. Quantitative analysis includes descriptive statistics and visual presentations. Qualitative analysis employs thematic analysis to interpret in-depth interviews and document reviews.

6.1. Descriptive and Inferential Statistics

This section presents the descriptive and inferential statistics obtained from the quantitative data. Descriptive statistics summarise the demographic characteristics and responses, and inferential statistics interrogate relationships and differences among variables. These are depicted in Figures 1 and 2.

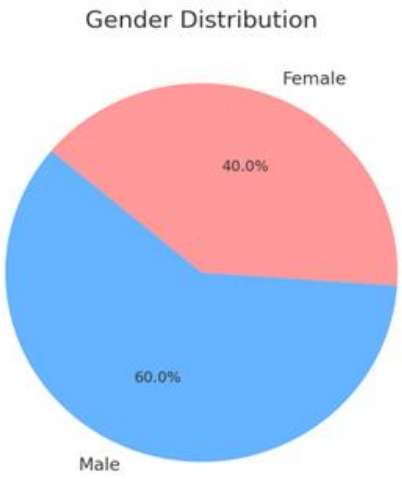

Figure 1: Gender distribution

Figure 2 shows the age distribution of the study participants. It shows that the sample is mostly composed of people aged 18 to 24, suggesting that the study primarily examines how younger people think. The 25–34 age group adds a fair number of participants, indicating that early- to mid-career people are only partially represented. On the other hand, people aged 35 or older make up only a small share of the population, suggesting that older people are less likely to participate. Because the results are not evenly spread out, they may better reflect the experiences and opinions of younger participants. Therefore, caution should be taken when applying the results to older populations. Furthermore, the prevalence of younger respondents may affect critical outcomes related to technology adoption, learning preferences, and adaptability, as these aspects often differ across age groups. Consequently, subsequent studies could gain from a more equitable age representation to strengthen the validity and wider relevance of the research outcomes.

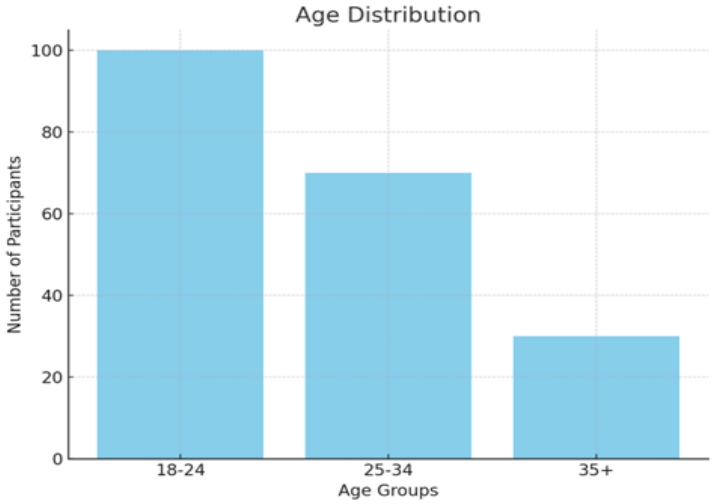

Figure 2: Age distribution

Table 2 presents the means and standard deviations for the Creativity and Critical Thinking Scores. It also shows the results of an inferential t-test that found significant differences in creativity by gender and a strong link between AI use and creativity.

Table 2: Relationships and differences among variables

Statistic	Variable	Mean	Standard Deviation	t-value	p-value
Descriptive	Creativity Score	78.5	10.2	-	-
Descriptive	Critical Thinking Score	82.3	9.8	-	-
Inferential	Creativity (Male vs Female)	-	-	2.35	0.021
Inferential	AI Usage vs Innovation	-	-	3.78	0.001

6.2. Thematic Analysis

Thematic analysis was conducted on qualitative data obtained from in-depth interviews and document reviews. The analysis identified key themes that capture participants' experiences and perceptions regarding AI's impact on student ingenuity (Table 3).

Table 3: Themes showing participants' experiences and perceptions regarding AI's impact on student ingenuity

Theme	Description	Example Quotes
Enhanced Research Innovation	AI tools enable advanced data analysis, fostering interdisciplinary collaboration.	AI enabled us to analyse complex datasets quickly, thereby enhancing the quality of our research.
Bridging Skills Gap	AI-driven learning platforms help students acquire critical STEM skills.	The coding simulations provided real-world problem-solving experience.
Personalized Learning	AI-tailored educational experiences improve engagement and self-directed learning.	I could learn at my own pace, focusing on areas I found challenging.
Inclusivity and Accessibility	AI tools support students with disabilities, ensuring equitable participation.	Screen readers helped me follow lectures more effectively.

One of the most compelling findings of this study is how AI has expressively enhanced research innovation and interdisciplinary collaboration among students in higher education institutions in Zambia. The integration of AI-based tools, such as machine learning algorithms, data mining software, and collaborative research platforms, has enabled students to tackle complex research questions with greater precision and creativity. AI-enabled students to analyse large datasets quickly, extract meaningful patterns, and derive insights that would have been difficult or time-consuming using traditional methods. This

capability not only improved the efficiency and scope of research but also fostered interdisciplinary collaboration. The study revealed that AI-based learning platforms are instrumental in bridging the skills gap, particularly in Science, Technology, Engineering, and Mathematics (STEM) disciplines. Tools such as automated lab simulations, coding assistants, and interactive problem-solving modules helped students acquire advanced technical skills critical to today's fast-evolving job market. Through offering personalised feedback and hands-on experience, AI-enabled students to hone skills such as programming, data analysis, and systems design that were previously inaccessible due to limited resources in traditional classroom settings. Another important finding of this study is the role AI plays in enhancing personalised learning experiences and student engagement.

AI tools, particularly those embedded in virtual learning environments, allowed for adaptive learning paths that responded to each student's individual progress and needs. These AI-driven platforms provided personalised feedback, adjusting the difficulty level based on student performance and offering targeted resources for improvement. As a result, students reported feeling more engaged in their learning as they were able to progress at their own pace, without the pressure of traditional class structures. Moreover, AI's ability to provide instant feedback allowed students to make real-time adjustments to their learning strategies, thereby enhancing both their academic performance and problem-solving abilities. This self-directed approach promoted a sense of autonomy and responsibility for their educational outcomes. The study also uncovered AI's potential to substantially enhance educational inclusivity, especially for students with disabilities. AI-powered accessibility tools such as speech-to-text software, screen readers, and personalised learning assistants were reported to support students with visual, auditory, or cognitive impairments in accessing educational content more effectively. Institutions that implemented AI-driven inclusivity measures saw improved student engagement among those with disabilities, who were able to participate more actively in classroom discussions, assignments, and assessments. AI tools that converted written content into audio or visual formats helped students with visual impairments to better understand course materials; meanwhile, AI-driven feedback mechanisms assisted students with learning disabilities in grasping complex concepts at their own pace.

7. Discussion

The integration of Artificial Intelligence (AI) into Zambia's higher education system has ushered in a new era of research methodologies, fostering interdisciplinary collaboration and deepening academic inquiry. In an era where digital technologies are reshaping global knowledge and economies, Zambia is positioning itself to harness AI-driven analytical tools to advance research capabilities [8]; [14]. The capacity of AI to process and analyse vast datasets with precision has enabled students and researchers to pursue sophisticated academic inquiries that were previously unattainable. This shift has redefined how knowledge is produced, disseminated, and applied within Zambia's tertiary institutions, thereby strengthening the nation's research output and positioning it as a key player in the global knowledge economy [24]; [10]. The incorporation of AI into research methodologies has provided students with new avenues for conducting data-driven studies that transcend traditional limitations. Historically, research in Zambia's academic institutions was constrained by limited access to high-quality data, inefficient data processing techniques, and a lack of computational tools to analyse complex datasets. However, the advent of AI has introduced a paradigm shift, enabling researchers to leverage machine learning, predictive analytics, and big data processing to extract meaningful insights from vast volumes of information [32]. Unlike conventional research approaches that require significant time and manual effort, AI-powered systems can automate data collection, categorise findings, and generate predictive models, thereby enhancing research accuracy and efficiency. This advancement has particularly benefited fields such as social sciences, economics, engineering, and health sciences, where large-scale data analysis is crucial for identifying patterns, making projections, and testing hypotheses [52].

AI-driven methodologies have not only accelerated research but also improved the quality and reproducibility of academic studies, thereby elevating the credibility of Zambia's research output on the global stage. One of the most transformative aspects of AI in student research is its ability to enable real-time data processing and interpretation. AI algorithms are designed to recognise trends, correlations, and anomalies within datasets at speeds and accuracies that far exceed human capabilities [21]. This feature is particularly advantageous for disciplines that rely on time-sensitive data, such as epidemiology, climate science, and financial forecasting. For instance, researchers at the University of Zambia (UNZA) have employed AI-driven statistical models to track disease outbreaks, analyse climate change patterns, and predict economic fluctuations [27]. By integrating AI into these research initiatives, scholars can identify emerging trends, develop early warning systems, and propose data-driven policy recommendations to address pressing societal challenges. This integration signifies a shift from traditional research methodologies, which often relied on retrospective analysis, to predictive and prescriptive analytics that provide proactive solutions.

Moreover, AI has played a pivotal role in bridging the research gap between Zambia and more technologically advanced nations [34]. Historically, African student researchers have faced challenges in accessing high-quality datasets, leading to a reliance on externally generated data that may not accurately reflect local contexts. However, AI-powered research tools have enabled scholars to collect and analyse indigenous data, ensuring that research findings are relevant, culturally contextualised, and

applicable to Zambia's unique socio-economic and environmental background. AI-driven agricultural research at Mulungushi University has facilitated the analysis of soil composition, crop yields, and pest infestations using machine learning models trained on locally sourced data. This localised approach to research enhances the reliability and applicability of academic studies, empowering student researchers to develop evidence-based recommendations that directly benefit local communities [7]. The interdisciplinary nature of AI has also encouraged collaboration among researchers from diverse academic backgrounds, fostering cross-disciplinary studies that explore complex, multifaceted issues. AI-powered platforms such as Google Scholar AI, Semantic Scholar, and IBM Watson allow scholars to integrate insights from multiple disciplines, facilitating a more holistic understanding of research questions [4]. Climate scientists can collaborate with economists to assess the financial impact of extreme weather events; at the same time, medical researchers can work alongside data scientists to develop AI-powered diagnostic tools [31]. This convergence of expertise enhances the depth and breadth of academic research, promoting innovation and knowledge-sharing within Zambia's higher education sector. Additionally, the use of AI among students has revolutionised literature review.

AI-driven language processing tools have been used to develop literature reviews and academic writing by automating the synthesis of existing research [24]. Tools like ChatGPT, Elicit, and Scite use natural language processing to summarise academic articles, identify key themes, and generate citations, significantly reducing the time and effort required to conduct comprehensive literature reviews [26]. This capability has been particularly beneficial for postgraduate students and early-career researchers who may struggle with navigating vast academic databases. By streamlining the research process, AI has democratised access to knowledge, enabling students and scholars at resource-limited institutions to engage in high-quality academic inquiry on par with their counterparts in more developed regions [21].

Despite these advancements, integrating AI into research poses challenges [34]. One of the primary concerns is the digital divide, as access to AI-powered research tools remains limited in many Zambian universities due to inadequate infrastructure, insufficient funding, and a lack of technical expertise. Although institutions such as the University of Zambia and Copperbelt University have made strides in incorporating AI into research, many other universities lack the necessary computational resources to support AI-driven studies. This disparity creates an uneven research landscape, where only a few institutions benefit from AI advancements, and others continue to rely on traditional research methods [26]. This challenge requires targeted investments in AI infrastructure, including high-performance computing systems, cloud-based research platforms, and AI training programs for faculty and students. Furthermore, the most important aspect to examine is AI's impact on student ingenuity, including ethical concerns about AI's role in research. Issues such as algorithmic bias, data privacy, and intellectual property rights pose significant challenges to the responsible use of AI in academia. AI models are only as reliable as the data they are trained on, and biased datasets can lead to skewed research findings that reinforce existing inequalities. To mitigate these risks, universities must establish ethical guidelines for AI-driven research, ensuring transparency, fairness, and accountability in AI applications. Zambia, like many developing nations, faces a significant gap in Science, Technology, Engineering, and Mathematics (STEM) education, which limits students' ability to compete in the global digital economy. AI has emerged as a powerful equaliser, democratising access to advanced technical training and addressing deficiencies in traditional pedagogical models [37].

One of the most noteworthy advancements in AI-driven STEM education is the introduction of AI-powered learning platforms. Institutions such as BongoHive, Zambia's leading technology and innovation hub, have pioneered AI-based training programs focused on programming, data science, and cybersecurity. Students enrolled in these programs utilise AI-powered platforms such as Codecademy, DataCamp, and Kaggle, which provide real-time feedback, adaptive learning pathways, and personalised recommendations based on their performance. This approach ensures that students acquire hands-on experience with Python, R, and TensorFlow, which are critical for careers in AI development and data science. At Mulungushi University, AI-powered laboratories have introduced students to robotics, automation, and computational physics. Here, engineering students have successfully designed AI-driven drone systems to assist in agricultural surveillance, demonstrating ingenuity in using computer vision algorithms to analyse crop health [42]. These innovations showcase how AI empowers students to move beyond theoretical knowledge into practical applications that address real-world challenges. A critical case study of AI fostering STEM ingenuity is the AI for Agriculture Initiative led by students at the University of Lusaka (UNILUS). This student-led research project developed an AI-powered mobile application that assists local farmers in diagnosing crop diseases using image recognition. Using Convolutional Neural Networks (CNNs), the app provides instant feedback on plant health, allowing farmers to take corrective actions swiftly. The initiative not only highlights the application of AI in agritech but also reflects how AI fosters student-led innovation by equipping students with tools to solve local problems through technological ingenuity. In addition to promoting hands-on skills, AI-powered educational platforms have changed the way students learn complex STEM concepts.

Traditional teaching methods often struggle to cater to individual learning needs, as large class sizes and limited resources hinder personalised instruction. AI-driven platforms address this challenge by offering adaptive learning pathways that adjust content delivery based on a student's progress and comprehension level [6]. AI-powered tutoring systems such as Carnegie

Learning's MATHia and Squirrel AI employ predictive analytics to identify knowledge gaps and provide targeted remediation. This personalised approach ensures that students grasp foundational STEM concepts before advancing to more complex topics, thereby improving learning outcomes. The implementation of AI-driven learning tools has been particularly beneficial for students from underprivileged backgrounds, who may not have access to high-quality STEM education resources. By leveraging AI, Zambia's education sector can bridge the digital divide and create a more inclusive learning environment. Beyond individual learning, AI has significantly contributed to collaborative problem-solving in STEM education. AI-powered virtual laboratories and simulation environments enable students to conduct experiments and test engineering designs without physical lab infrastructure. Platforms like Labster and PhET Interactive Simulations enable students to explore physics, chemistry, and biology concepts through immersive, hands-on experiences. At Copperbelt University, engineering students have utilised AI-driven simulation software to design and optimise renewable energy systems, providing practical information on solar panel efficiency and wind turbine dynamics. According to Falebita and Kok [37], these AI-enhanced learning environments foster creativity, experimentation, and critical thinking, equipping students with the problem-solving skills required in STEM industries. Moreover, AI has played a crucial role in developing students' coding literacy [1].

Coding has become a fundamental skill in the digital economy, yet many Zambian Colleges and universities face challenges in delivering effective programming education due to a shortage of qualified instructors. AI-powered coding assistants, such as OpenAI's Codex and Google's AutoML, help students learn programming languages by providing real-time code suggestions, debugging assistance, and project-based learning experiences. At Cavendish University, students enrolled in AI and software engineering programs have leveraged AI-powered coding assistants to develop mobile applications, web platforms, and automation tools, demonstrating the potential of AI to enhance computational thinking skills. Despite these developments, defies remain in fully leveraging AI for STEM education in Zambia. One of the primary obstacles is the lack of reliable internet access, particularly in rural areas where digital infrastructure is underdeveloped. AI-powered learning platforms require stable internet access to function effectively, and students in remote regions may struggle to benefit from these resources. Additionally, the cost of AI-driven educational tools can be prohibitive for many institutions, limiting their widespread adoption. Focusing on these challenges requires a concerted effort from the government, the private sector, and academic institutions to expand digital infrastructure, subsidise AI-powered educational resources, and invest in lecturer training programs that equip educators with AI literacy skills. Looking ahead, integrating AI into STEM education could position Zambia as a regional hub for technology and innovation. By equipping students with AI-driven skills, universities can produce a workforce that is prepared for the demands of the digital economy.

The Zambian government, through the Ministry of Higher Education, must prioritise AI education initiatives, incorporating AI literacy into national curricula and establishing partnerships with leading technology firms to provide students with access to cutting-edge AI tools. Collaborative efforts among academia, industry, and government stakeholders will be essential to scale AI-driven STEM education initiatives and ensure their long-term sustainability. Beyond its role in structured coursework, AI has played a pivotal role in fostering student-led innovation and entrepreneurial ventures in Zambia's tertiary institutions. AI's capability to automate repetitive tasks, enhance creativity, and provide data-driven insights has enabled students to launch technology-driven startups that address gaps in the Zambian economy [2]. At Eden University, students have developed chatbot-based academic advisors using Natural Language Processing (NLP) algorithms. These AI-powered virtual assistants provide personalised academic counselling, helping students navigate course selections, assignment deadlines, and research resources [21]. Such innovations reduce administrative burdens on faculty while enhancing the efficiency of student services. The rise of AI in higher education has also encouraged students to engage in research-driven innovation that extends beyond traditional academic projects [43]. This demonstrates how AI empowers students to apply theoretical knowledge to real-world challenges, fostering a culture of problem-solving and technological ingenuity.

At Copperbelt University, engineering students have designed AI-powered traffic management systems to optimise urban mobility and reduce congestion in Lusaka. These systems leverage AI-based sensors and computer vision to analyse traffic patterns, improving road safety and efficiency. Furthermore, AI has inspired students to venture into financial technology (fintech). At Cavendish University Zambia, a group of students created an AI-powered credit-scoring system to help unbanked individuals secure microloans. Through analysing alternative credit indicators such as mobile money transaction history and social media activity, the AI system generates real-time creditworthiness assessments, providing financial institutions with a data-driven mechanism to extend loans to underserved communities. This has been particularly impactful in Zambia, where access to traditional banking services remains limited. AI-powered fintech solutions are bridging financial inclusion gaps, demonstrating the capacity of student-led innovation to address national economic challenges [13].

Another powerful example of student ingenuity is the use of Generative AI in creative industries. Students at the Zambia Institute of Mass Communication (ZAMCOM) have developed AI-generated digital marketing content for local businesses using OpenAI's DALL·E and GPT-4. By automating content creation, students are offering cost-effective branding solutions to startups, demonstrating how AI enables young entrepreneurs to build sustainable businesses [34]. These innovations highlight the intersection of AI and entrepreneurship, equipping students with the tools to become job creators rather than job seekers.

Moreover, AI-driven social media analytics tools allow students to optimise digital marketing strategies, enhancing the visibility of small businesses in Zambia's competitive market. AI has also been instrumental in student-led healthcare innovations. At the University of Zambia's School of Medicine, students have developed AI-assisted diagnostic tools capable of detecting diseases such as tuberculosis and cervical cancer using medical imaging analysis. Machine learning algorithms trained on local patient data have improved early disease detection, leading to better treatment outcomes [31]. This demonstrates the transformative potential of AI in revolutionising healthcare accessibility, particularly in underserved regions where medical professionals are scarce. AI-powered medical chatbots have also been deployed by students in community health programs to provide real-time health consultations, reducing the burden on Zambia's healthcare system. Despite the remarkable potential of AI-driven student innovation, several challenges hinder its full realisation. One of the primary obstacles is the lack of funding and infrastructure to support AI-related research and development. Many tertiary institutions in Zambia lack access to high-performance computing systems, limiting students' ability to experiment with complex AI models. Managing this requires increased investment in AI infrastructure, as well as partnerships with global technology firms to provide cloud computing resources and open-access AI tools. The government and private sector must collaborate to create innovation hubs that offer mentorship, funding, and technological support to student entrepreneurs.

Another noteworthy challenge is the skills gap in AI development [14]; [45]. Even though students are increasingly exposed to AI applications, many lack the advanced programming and data science expertise needed to build AI-driven solutions from the ground up. To address this, universities must integrate AI and machine learning courses into core curricula, ensuring that students develop hands-on technical skills. Short-term AI boot camps, hackathons, and collaborative research projects with industry partners can also accelerate skills development, bridging the gap between theoretical AI knowledge and practical implementation. Looking forward, the expansion of AI in student-led innovation will be a defining factor in Zambia's economic and technological progress. AI-driven startups founded by university students have the potential to contribute to job creation, skills development, and national economic growth. Policymakers must therefore support AI entrepreneurship by streamlining business registration processes, offering tax incentives for AI-driven startups, and creating AI-focused innovation grants. Through fostering an enabling environment for AI-driven innovation, Zambia can position itself as a leader in Africa's digital transformation. Lastly, one of AI's most unfathomable impacts on students in colleges and universities in Zambia is its role in making learning more accessible for students with disabilities. AI-powered assistive technologies have improved the accessibility of educational content, enabling students with visual, auditory, and cognitive impairments to fully engage with academic material. Historically, students with disabilities in Zambia have faced barriers to accessing higher education, including inadequate instructional resources, limited institutional support, and a lack of inclusive pedagogical strategies.

The emergence of AI-driven educational tools has, to a great extent, begun to address these challenges by branding learning experiences and providing adaptive learning environments that cater to different student needs. According to Lubbungu and Siame [21] at Kwame Nkrumah University, students with disabilities use speech-to-text AI applications to assist those with visual and hearing impairments. These real-time transcription services convert lectures into text, allowing students to read and review course content with ease. This has improved their ability to follow class discussions and participate in academic activities that were previously inaccessible due to the lack of adequate sign language interpreters. Similarly, visually impaired students are benefiting from text-to-speech AI tools such as JAWS (Job Access with Speech), which convert digital text into audio, facilitating an inclusive learning experience. These tools have not only enhanced the academic performance of students with visual impairments but have also enabled them to engage more actively in independent research and self-paced learning. Another crucial application of AI in educational inclusivity is the use of AI-driven personalised learning platforms. Systems such as Microsoft's Immersive Reader and Google's Lookout provide students with disabilities access to adaptive educational materials. These platforms use machine learning algorithms to adjust reading speeds, highlight key concepts, and break down complex information into digestible formats tailored to students' cognitive needs. In addition, AI-powered tutoring systems such as Carnegie Learning's MATHia and Squirrel AI have demonstrated remarkable success in dealing with the unique learning challenges faced by students with disabilities.

These systems employ predictive analytics to detect learning patterns and customise lesson plans accordingly, ensuring that students grasp foundational concepts before progressing to more advanced topics [30]. Recent empirical studies provide strong evidence of AI's role in bridging educational gaps for students with disabilities. A study by Panjwani-Charani and Zhai [50] assessed AI's role in disability inclusion in Zambia's higher education system and found that AI-powered accessibility tools reduced dropout rates among students with disabilities. The study further highlighted that students who used AI-powered assistive technologies reported greater engagement in coursework and improved academic confidence. An AI-driven learning initiative at Zambian universities concluded that AI-enabled personalised learning pathways significantly enhanced educational equity by accommodating diverse learning needs. Beyond addressing physical and cognitive impairments, AI also promotes inclusivity by improving socioeconomic accessibility. The high cost of quality education has historically been a barrier for students from low-income backgrounds. AI-powered online education platforms, such as Coursera, EdX and Udemy, have revolutionised access to world-class learning materials at a fraction of the cost of traditional education. Zambian institutions are increasingly integrating these platforms into their curricula, enabling students to take AI-enhanced courses in fields such as

data science, business analytics, and artificial intelligence. Moreover, AI-driven recommendation engines help students from disadvantaged backgrounds identify scholarships and funding opportunities, increasing their chances of accessing higher education.

8. Conclusion

The integration of Artificial Intelligence (AI) into Zambian higher education institutions marks a significant shift in how students engage with knowledge, develop skills, and contribute to academic and professional fields. AI has not only enhanced research, innovation, and interdisciplinary collaboration but also opened new avenues for personalised learning, skills development, and inclusivity. By equipping students with AI-driven tools, higher education institutions can foster critical thinking, problem-solving abilities, and adaptability, key competencies for the modern knowledge economy. However, the potential of AI in education extends beyond technological convenience; it represents a profound transformation in pedagogical approaches, redefining the roles of educators, learners, and academic institutions. As AI continues to evolve, institutions must navigate challenges related to equitable access, ethical considerations, and the need for comprehensive evaluation frameworks to effectively measure AI's impact. Furthermore, even if AI offers opportunities to bridge educational gaps, it must be integrated within a structured policy framework that ensures its benefits reach all students, particularly those from disadvantaged backgrounds. The successful adoption of AI in Zambian higher education requires a collaborative effort among policymakers, educators, researchers, and industry stakeholders to develop sustainable strategies that maximise its potential. If harnessed effectively, AI can catalyse educational excellence, national development, and global competitiveness, positioning Zambia's higher education sector at the forefront of the digital era.

8.1. Recommendations

- HEIs should develop a national AI policy framework to guide ethical and equitable adoption of AI in higher education.
- HEIs should improve digital infrastructure to ensure all students have access to AI-powered learning tools.
- HEIs should invest in faculty development programs to equip educators with the skills to integrate AI into teaching and research.
- HEIs should establish monitoring and evaluation systems to assess AI's long-term impact on student learning and ingenuity.
- HEIs should strengthen partnerships among universities, industry, and policymakers to align AI education with labour-market needs.
- HEIs should promote AI-driven research initiatives that integrate local and global challenges, fostering innovation and economic growth.

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References

1. A. Chisale, "Identification of sources for missing electronic theses and dissertations metadata in higher education institutions in Zambia," Master of Library and Information Science thesis, *The University of Zambia*, South Africa, 2024.
2. A. Jaldi, "Artificial intelligence revolution in Africa: Economic opportunities and legal challenges," *Policy Center, New South*, 2023. Available: https://www.policycenter.ma/sites/default/files/2023-07/PP_13-23%20(Jaldi%20).pdf [Accessed by 12/05/2024].
3. P. Chikuvadze, S. Maguya, and C. Mutseekwa, "An Insight into Southern Africa Development Community Protocol on Education and Training's Article 8: A Systematic Review," *Futurity Education*, vol. 4, no. 4, pp. 167-179, 2023.

4. A. Shipepe, L. Uwu-Khaeb, E. Awuni Kolog, M. Apiola, K. Mufeti, and E. Sutinen, “Towards the fourth industrial revolution in Namibia: An undergraduate AI course Africanized,” in *IEEE Frontiers in Education Conference (FIE)*, Nebraska, United States of America, 2021.
5. A. Subaveerapandiyan, C. Sunanthini, and M. Amees, “A study on the knowledge and perception of artificial intelligence,” *IFLA Journal*, vol. 49, no. 3, pp. 503–513, 2023.
6. A. Subaveerapandiyan, S. Radhakrishnan, N. Tiwary, and S. Mulate Guangul, “Student satisfaction with artificial intelligence chatbots in Ethiopian academia,” *IFLA Journal*, vol. 51, no. 3, pp. 600–614, 2024.
7. Association of Public Universities and Colleges (ZAPUC), “Using artificial neural networks for seasonal rainfall forecasting in Zambia for educational purposes,” in *Conference Proceedings*, Lusaka, Zambia, 2023.
8. B. Neupane and P. Sibal, “Artificial intelligence needs assessment survey in Africa,” *UNESCO Publishing*, Paris, France, 2021.
9. C. Chembe, N. B. Nasilele, and R. Msendo, “The fuss about artificial intelligence in education sector: Should we worry?” *Zambia ICT Journal*, vol. 7, no. 2, pp. 30–35, 2023.
10. F. Trifiro, “Inter-agency cooperation in the quality assurance of transnational education: Challenges and opportunities,” *Quality in Higher Education*, vol. 24, no. 2, pp. 136-153, 2025.
11. C. T. Okolo, K. Aruleba, and G. Obaido, “Responsible AI in Africa—Challenges and opportunities,” in Responsible AI in Africa: Challenges and Opportunities, *Springer International Publishing*, Cham, Switzerland, 2023.
12. A. Kuriakose and A. C. Amaresha, “Experiences of Students with Learning Disabilities in Higher Education: A Scoping Review,” *Indian Journal of Psychological Medicine*, vol. 46, no. 3, pp. 196-207, 2024.
13. D. Mvula, E. Muntanga, and M. Lisomona, “Analysis of the impact of technological advancements on entrepreneurship: A focus on challenges and opportunities,” *Journal of Business and Economics in 4IR*, vol. 1, no. 2, pp. 1–5, 2024.
14. E. Liywalii, “Analyzing the impact of ethical issues in e-government implementation: A case of Zambia,” Master of Engineering thesis, Information and Communication Technology Policy, Regulation and Management, *The University of Zambia*, South Africa, 2019.
15. F. Bolaños, A. Salatino, F. Osborne, and E. Motta, “Artificial intelligence for literature reviews: Opportunities and challenges,” *Artificial Intelligence Review*, vol. 57, no. 10, pp. 1–49, 2024.
16. F. Chulu, J. Phiri, M. Nyirenda, M. M. Kabemba, P. Nkunika, and S. Chiwamba, “Developing an automatic identification and early warning and monitoring web-based system of fall army worm based on machine learning in developing countries,” *Zambia ICT Journal*, vol. 3, no. 1, pp. 13–20, 2019.
17. F. Moonga, “Africa’s university landscape,” in Digital Transformation and Disruption of Higher Education, *Cambridge University Press*, Cambridge, England, 2022.
18. G. J. Hwang, H. Xie, B. W. Wah, and D. Gašević, “Vision, challenges, roles and research issues of artificial intelligence in education,” *Computers and Education: Artificial Intelligence*, vol. 1, no. 13, pp. 1–5, 2020.
19. G. Siemens, “Connectivism: A learning theory for the digital age,” *International Journal of Instructional Technology and Distance Learning*, vol. 2, no. 1, pp. 1–9, 2005.
20. J. Dewey, “Experience and Education,” *Macmillan*, New York, United States of America, 1938.
21. J. Lubbungu and P. Siame, “Awareness and utilization of artificial intelligence among full-time students of literature at Kwame Nkrumah University in Zambia,” *Mulungushi University Multidisciplinary Journal*, vol. 4, no. 2, pp. 49–58, 2023.
22. J. Piaget, “The Principles of Genetic Epistemology,” *Routledge*, London, United Kingdom, 1972.
23. J. W. Creswell and V. L. Plano Clark, “Designing and Conducting Mixed Methods Research,” 3rd ed. *SAGE Publications*, California, United States of America, 2017.
24. K. Kanyemba, F. Phiri, V. M. Munsanje, and O. Mwaanga, “Exploring the use of artificial intelligence in higher learning institutions: A case of David Livingstone College of Education,” *Mulungushi University Multidisciplinary Journal*, vol. 4, no. 2, pp. 59–72, 2023.
25. K. Sampene, F. O. Agyeman, B. Robert, and J. Wiredu, “Artificial intelligence as a pathway to Africa's transformations,” *Artificial Intelligence*, vol. 9, no. 1, pp. 14939–14951, 2022.
26. K. Z. Chanda, “The role of artificial intelligence in fostering workplace integrated learning at a South African TVET college during COVID-19,” Master of Education (M.Ed.) thesis, *University of Johannesburg*, South Africa, 2023.
27. L. Mzyece, M. Nyirenda, M. K. Kabemba, and G. Chibawe, “Forecasting seasonal rainfall in Zambia – An artificial neural network approach,” *Zambia ICT Journal*, vol. 2, no. 1, pp. 16–24, 2018.
28. L. S. Vygotsky, “Mind in Society: The Development of Higher Psychological Processes,” *Harvard University Press*, Massachusetts, United States of America, 1978.
29. L. Shonhe, P. Jain, and A. Akakandelwa, “Students’ experiences with the utilisation of the 4IR technologies in online learning: A case study of institutions of higher learning in Botswana and Zambia,” *Regional Journal of Information and Knowledge Management*, vol. 8, no. 2, pp. 81–100, 2023.

30. M. Liyanda, “Unleashing the potential of AI in higher education: Exploring the benefits and challenges of AI applications in Zambia’s academic landscape,” *Journal for Business, Development and Leadership*, 2024. Available: https://jbdljournalonline.com/index.php/files/article/view/5 [Accessed by 12/05/2024].
31. M. Maambo, “Assisted artificial intelligence medical diagnosis system for heart disease,” Master of Science thesis, Computer Science, *The University of Zambia*, South Africa, 2023.
32. N. Jatileni, I. T. Sanusi, S. A. Olaleye, M. A. Ayanwale, F. J. Agbo, and P. B. Oyelere, “Artificial intelligence in compulsory level of education: Perspectives from Namibian in-service teachers,” *Education and Information Technologies*, vol. 29, no. 10, pp. 12569–12596, 2024.
33. N. V. Ivankova, J. W. Creswell, and S. L. Stick, “Using mixed-methods sequential explanatory design: From theory to practice,” *Field Methods*, vol. 18, no. 1, pp. 3–20, 2006.
34. National Action for Quality Education in Zambia (NAQEZ), “NAQEZ calls for integration of AI into Zambia’s education system,” *The Mast Newspaper*, 2025. Available: https://diggers.news/local/2025/01/26/naqez-calls-for-integration-of-ai-into-zambias-education-system/ [Accessed by 25/10/2025].
35. O. Ajlouni, F. A. A. Wahba, and A. S. Almahaireh, “Students’ attitudes towards using ChatGPT as a learning tool: The case of the University of Jordan,” *International Journal of Interactive Mobile Technologies*, vol. 17, no. 18, pp. 99–117, 2023.
36. O. Eke, S. S. Chintu, and K. Wakunuma, “Towards shaping the future of responsible AI in Africa,” in Responsible AI in Africa: Challenges and Opportunities, *Springer Nature*, Cham, Switzerland, 2023.
37. O. S. Falebita and P. J. Kok, “Strategic goals for artificial intelligence integration among STEM academics and undergraduates in African higher education: A systematic review,” *Discover Education*, vol. 3, no. 1, pp. 1–22, 2024.
38. O. S. Madumo and J. R. Kimaro, “Accelerating the fourth industrial revolution in higher education: Realities and lessons from universities in Kenya, Zambia and South Africa during the COVID-19 pandemic,” *IIPCCL Publishing*, Graz, Austria, 2021.
39. P. Chanda, P. Lungu, and K. Mwale, “Exploring the use of artificial intelligence in higher learning institutions in Zambia,” *Mulungushi University Multidisciplinary Journal*, vol. 4, no. 2, pp. 45–60, 2023.
40. P. Plantinga, K. Shilongo, O. Mudongo, A. Umubyeyi, M. Gastrow, and G. Razzano, “Responsible artificial intelligence in Africa: Towards policy learning,” *Data & Policy*, vol. 6, no. 12, pp. 1–25, 2024.
41. R. Bhaskar, “A Realist Theory of Science,” *Harvester Press*, Maylands Avenue, England, 1975.
42. R. Lupyani and J. Phiri, “Automated document classification for research HEI grant awards using machine learning,” in *Zambia Association of Public Universities and Colleges (ZAPUC) Conference*, vol. 3, no. 1, pp. 90–95, 2023.
43. R. Lupyani, “A web-based document archiving system using indexing and machine learning for research and innovation grant allocation,” Master of Science thesis, Computer Science, *The University of Zambia*, South Africa, 2024.
44. S. J. Russell and P. Norvig, “Artificial Intelligence: A Modern Approach,” 4th ed. *Pearson Education*, London, United Kingdom, 2020.
45. S. Kohnke and T. Zaugg, “Artificial intelligence: An untapped opportunity for equity and access in STEM education,” *Education Sciences*, vol. 15, no. 1, pp. 1–26, 2025.
46. S. M. Biswas, “ChatGPT for research and publication: A step-by-step guide,” *Journal of Pediatric Pharmacology and Therapeutics*, vol. 28, no. 6, pp. 576–584, 2023.
47. S. Mbungu Kala, “Challenges of technology in African countries: A case study of Zambia,” *Open Journal of Safety Science and Technology*, vol. 13, no. 4, pp. 202–230, 2023.
48. S. Mudenda, R. Lubinda, M. Kasanga, Z. Musakuzi, S. Mohamed, and W. Mufwambi, “Artificial intelligence: A knowledge, attitude, and practices survey among pharmacy students at the University of Zambia,” *Creative Education*, vol. 15, no. 12, pp. 2582–2596, 2024.
49. S. Muwanei and G. Mukupa, “The adoption and usage of recommender systems in tertiary institutions in Zambia: A case of Mulungushi University,” in *Zambia Association of Public Universities and Colleges (ZAPUC) Conference*, vol. 3, no. 1, pp. 120–123, 2023.
50. S. Panjwani-Charani and X. Zhai, “AI for students with learning disabilities: A systematic review,” in Uses of Artificial Intelligence in STEM Education, *Oxford University Press*, Oxford, United Kingdom, 2023.
51. Smart Zambia, “National Digital Transformation Strategy,” *Government of Zambia*, 2019. Available: https://www.smartzambia.gov.zm [Accessed by 15/05/2024].
52. T. Chansa, “The impact of remote learning on educational outcomes: A case of selected higher learning institutions in Lusaka District, Zambia,” *International Journal of Research Publication and Reviews*, vol. 5, no. 7, pp. 587–596, 2024.
53. UNESCO, “AI in education,” *UNESCO*, 2022. Available: https://www.unesco.org/en/artificial-intelligence [Accessed by 22/05/2024].
54. UNICEF, “Artificial intelligence and children’s rights,” *UNICEF*, 2021. Available: https://www.unicef.org/globalinsight/reports/ai-and-childrens-rights [Accessed by 12/05/2024].