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Generative Artificial Intelligence and the Transformation of Higher Education: A Critical Review of Implications for Higher-order Thinking, Learner Autonomy and Academic Achievement in Zambia

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Abstract
The rapid emergence of generative artificial intelligence (GenAI) is transforming teaching and learning in higher education by changing how students access information, construct knowledge and undertake academic activities. Although these technologies offer opportunities for personalized learning, immediate feedback and improved academic productivity, concerns have emerged regarding cognitive dependence, reduced independent reasoning and academic integrity. This article critically examines the implications of generative AI for higher-order thinking, learner autonomy and academic achievement, with particular attention to the Zambian higher education context. Drawing on relevant theoretical perspectives and contemporary empirical literature, the review explores the dual role of generative AI as both a potential cognitive support mechanism and a possible substitute for independent intellectual engagement. It considers the influence of AI literacy, responsible use, pedagogical guidance and institutional preparedness on educational outcomes. The review argues that the educational value of generative AI is not determined by technology adoption alone but by the conditions under which students interact with AI-generated information. It proposes a Responsible Generative AI Integration Framework to guide universities in promoting critical thinking, learner autonomy, academic integrity and meaningful learning. The article provides conceptual and practical insights for educators, institutional policymakers and researchers seeking to integrate generative AI responsibly into higher education in Zambia.

Keywords: Generative Artificial Intelligence, Higher-Order Thinking, Learner Autonomy, Academic Achievement, Higher Education, Zambia

1. Introduction

1.1 Background of the Study

The rapid development of artificial intelligence (AI) has introduced significant changes across various sectors, including healthcare, business, scientific research and education. Among the most influential developments is generative artificial intelligence (GenAI), which has expanded the capacity of digital technologies beyond information retrieval towards the generation of new content, interactive explanations, analytical assistance and problem-solving support. Applications such as ChatGPT, Google Gemini, Microsoft Copilot and Claude enable users to generate written content, interpret information, explore complex concepts, develop computer programs and engage in conversational interactions. These capabilities are increasingly influencing how knowledge is accessed, produced and communicated within contemporary educational environments [1, 2].

The emergence of generative AI represents an important development in the transformation of higher education. Traditionally, university teaching and learning have relied on lectures, textbooks, academic journals, library resources, classroom discussions and independent study. Although these approaches remain fundamental to academic development, digital technologies have progressively expanded opportunities for flexible and interactive learning. Generative AI introduces a further dimension by providing students with immediate, interactive and increasingly personalised academic assistance. Students can request alternative explanations of difficult concepts, obtain feedback on their work, generate practice questions, explore different perspectives and receive guidance when undertaking academic tasks. These applications create opportunities for more

interactive and personalised learning experiences, while also introducing new considerations for teaching, assessment and academic support [1, 2, 3]. Consequently, the relationship between students, lecturers, academic knowledge and digital learning resources is undergoing considerable transformation.

The educational significance of generative AI extends beyond its ability to improve the efficiency of academic activities. Its capacity to participate in tasks involving explanation, interpretation, synthesis and reasoning raises important questions about the development of students' intellectual competencies. Higher education institutions are expected to produce graduates who can independently analyse information, evaluate evidence, formulate arguments, solve unfamiliar problems and apply knowledge in different professional and social contexts. These competencies are closely associated with higher-order cognitive processes, including analysing, evaluating and creating, as reflected in the revised Bloom's taxonomy [4]. They require more than the ability to retrieve information or produce academically structured assignments. Rather, they involve sustained intellectual engagement, independent judgement and the ability to construct and defend knowledge-based conclusions.

From this perspective, generative AI presents both opportunities and potential challenges for higher-order thinking. When appropriately used, AI systems can provide alternative explanations, generate counterarguments, facilitate exploratory learning and expose students to different approaches to complex problems. Such interactions may encourage analytical reasoning and support the development of critical thinking. A meta-analysis by Zhao *et al*. [5], examining 29 experimental and quasi-experimental studies, reported positive effects of generative AI on students' higher-order thinking, although the extent of these effects varied across cognitive dimensions. Similarly, Chen and Cheung [3] identified potential learning benefits associated with generative AI while highlighting the need to consider the conditions under which these technologies are used. However, when students rely on AI-generated responses without independently examining their accuracy, assumptions and supporting evidence, opportunities for intellectual engagement may be reduced. This concern is consistent with research on cognitive offloading, which explains how individuals use external tools to reduce the mental effort involved in cognitive tasks [6]. The central educational question is therefore not simply whether students use generative AI, but whether their interaction with these technologies strengthens or substitutes the cognitive processes that higher education seeks to develop.

Another important dimension concerns learner autonomy and self-regulated learning. Learner autonomy involves students taking responsibility for identifying their educational needs, establishing learning objectives, selecting appropriate resources, monitoring their understanding and evaluating their academic progress. Zimmerman [7] explains self-regulated learning through interconnected processes of forethought, performance and self-reflection, emphasising the active role learners play in managing their educational activities. Generative AI may support these processes by providing personalised explanations, immediate feedback, study guidance and opportunities for independent exploration. Nevertheless, excessive dependence on AI-generated answers may weaken students' willingness or ability to undertake intellectual tasks independently. This creates a tension between the convenience of AI-assisted learning and the development of self-directed learning competencies. Research on the relationship between generative AI, self-regulated learning and critical thinking further highlights the importance of ensuring that AI-supported activities preserve learners' active participation and responsibility for their learning [6].

The relationship between generative AI and academic achievement is similarly complex. AI applications may help students improve their understanding of difficult concepts, organise academic information, receive feedback and complete learning activities more efficiently. These capabilities may contribute to improved academic performance, particularly when AI assistance is integrated into purposeful learning activities [5, 3]. However, increased academic productivity should not automatically be interpreted as evidence of improved learning. The ability to generate a well-structured assignment using AI does not necessarily demonstrate that a student understands the underlying concepts or possesses the analytical skills required to independently explain and apply the knowledge. The distinction between task performance and the development of durable knowledge and independent competence is therefore important when evaluating the educational contribution of generative AI. This concern reinforces the need to examine learning outcomes beyond the immediate quality or completion of academic outputs [3, 8].

The growing influence of generative AI has consequently attracted attention from educational institutions and international policy organisations. The United Nations Educational, Scientific and Cultural Organization (UNESCO) advocates a human-centred approach to the integration of generative AI in education and research, emphasising the importance of human agency, ethical considerations, institutional preparedness and the protection of learners' interests [1]. UNESCO's guidance also highlights the need for appropriate institutional policies and safeguards when adopting generative AI in educational settings. This perspective suggests that the educational value of AI should not be assessed solely through technological adoption or efficiency gains, but also through its contribution to meaningful learning, intellectual independence and educational quality.

1.2 Generative AI and the Zambian higher education

The transformation associated with generative AI is particularly relevant to higher education in developing countries, where institutions must balance opportunities for technological advancement with challenges relating to infrastructure, digital competencies, affordability and institutional preparedness. Differences in internet connectivity, access to appropriate devices, digital literacy and institutional resources may influence how students interact with AI technologies and the educational benefits they obtain. Consequently, the implications of generative AI cannot be assumed to be uniform across universities, academic disciplines or student populations.

In Zambia, the growing interest in artificial intelligence forms part of broader national efforts to strengthen technological development, innovation and digital transformation. The National Artificial Intelligence Strategy 2024–2026 identifies opportunities associated with AI

development, skills enhancement, infrastructure and responsible utilisation [2]. Within higher education, these developments create opportunities for universities to reconsider teaching approaches, academic assessment, research practices and institutional policies governing emerging technologies.

Recent empirical evidence confirms that generative AI is already becoming part of the academic experiences of Zambian university students. Mudenda and colleagues [9], in a multi-institutional cross-sectional study involving 1,829 students from five Zambian universities, reported that 96.8% of participants had heard of ChatGPT, while 85.6% indicated that they had used the application before the study. The researchers also identified perceived usefulness, ease of use, social influence and perceived risks as important dimensions associated with students' attitudes and utilisation of the technology. Notably, 74.8% of respondents perceived high risks associated with AI use, illustrating that widespread adoption exists alongside substantial concerns regarding its implications.

The findings of Mudenda and colleagues [9] provide an important foundation for understanding the adoption of generative AI in Zambian higher education. However, awareness, attitudes and patterns of utilisation do not necessarily establish whether students' cognitive competencies, independent learning practices or academic achievement have improved. Understanding the educational consequences of AI use therefore requires attention to outcomes beyond technology acceptance. In particular, it is necessary to examine whether students use generative AI to strengthen their reasoning and knowledge construction or increasingly depend on it to perform intellectual activities that would ordinarily contribute to their academic development.

This distinction is especially important for Generation Z university students, who form a substantial part of the contemporary higher education population. Although this generation has experienced increasing exposure to digital technologies, smartphones, online communication and internet-based information resources, digital exposure should not automatically be equated with AI literacy, critical thinking or responsible technology use. Students may differ considerably in their ability to evaluate AI-generated information, recognize inaccuracies, formulate effective prompts and retain responsibility for their academic decisions. These differences may influence the relationship between generative AI utilisation and educational outcomes.

1.3 Problem statement

The rapid integration of generative artificial intelligence (GenAI) into higher education has created an important challenge concerning the relationship between technological adoption and meaningful student learning. Tools such as ChatGPT, Google Gemini and Microsoft Copilot can provide explanations, generate academic content, assist with problem-solving and offer immediate feedback. These capabilities present opportunities for improving access to academic support and facilitating personalised learning. However, they also raise concerns about students' increasing reliance on AI-generated information, reduced independent intellectual engagement, academic integrity and the ability to demonstrate genuine understanding. The central concern is that students may become increasingly efficient at producing academic outputs without necessarily developing the higher-order thinking skills and independent learning competencies that higher education is expected to cultivate [1, 3, 6].

In Zambia, the growing adoption of generative AI is taking place within an evolving national policy environment. The Government, through the Ministry of Technology and Science, introduced the National Artificial Intelligence Strategy 2024–2026 to provide direction for the development and utilisation of AI in national development. The strategy identifies human-capital development, digital infrastructure, research and innovation, sectoral adoption and responsible AI governance as important priorities [2]. These policy commitments create opportunities for higher education institutions to strengthen AI-related competencies and incorporate emerging technologies into teaching, learning and research. However, the existence of a national AI strategy does not, by itself, establish how effectively universities are preparing students to use generative AI in ways that strengthen independent reasoning, learner autonomy and academic achievement. This raises an important question concerning the extent to which national AI ambitions are being translated into appropriate pedagogical practices, institutional guidance and measurable educational outcomes within higher education.

The scale of student adoption makes this concern particularly significant. A recent multi-institutional cross-sectional study by Mudenda *et al*. [9], involving 1,829 students from five Zambian universities, established that 96.8% of respondents had heard of ChatGPT, while 85.6% reported having used it before the study. The findings further indicated that 74.8% perceived high risks associated with AI use, 73.3% considered ChatGPT easy to use, and 64.0% perceived it as useful. Although 56.8% reported behavioural intention to use AI tools, the study also identified academic dependence as one of the dimensions associated with students' patterns of ChatGPT utilisation [9]. These statistics demonstrate that generative AI is already a significant part of the academic experiences of students in the participating Zambian universities. They also reveal a tension between perceived usefulness and concerns about the potential consequences of AI utilisation.

Nevertheless, an important limitation of the available Zambian evidence is that the study by Mudenda *et al*. [9] primarily examined students' awareness, attitudes, perceived risks and patterns of ChatGPT use. It did not directly establish whether students' use of generative AI improves or undermines higher-order thinking, learner autonomy or academic achievement through objective measurements of these educational outcomes. Consequently, widespread awareness and adoption cannot automatically be interpreted as evidence of improved learning. Equally, students' perceptions of risk and academic dependence should not be taken as conclusive proof that their cognitive abilities or academic performance have deteriorated. The actual educational implications of generative AI therefore remain insufficiently understood within the Zambian higher education setting.

A further dimension of the problem concerns the distinction between academic productivity and genuine learning. Generative AI can enable students to complete assignments, organise information, formulate arguments and generate solutions more efficiently. However, the production of academically acceptable work does not necessarily demonstrate that students can independently analyse

information, evaluate evidence, explain concepts or apply acquired knowledge to unfamiliar situations. Where students delegate essential intellectual activities to AI systems, there is a possibility that the quality of submitted academic work may not accurately reflect their actual level of understanding and independent competence. This creates challenges for lecturers and institutions seeking to assess students' knowledge and ensure that academic achievement represents meaningful learning rather than task completion alone [6, 8].

The problem is therefore not simply that university students are adopting generative AI, nor that these technologies are inherently harmful to education. Rather, there is insufficient context-specific understanding of how different patterns of GenAI utilisation relate to the development of higher-order thinking, learner autonomy and academic achievement, and how pedagogical guidance, AI literacy, institutional governance and equitable access may shape these relationships. Without such understanding, higher education institutions risk developing responses that either restrict potentially beneficial technologies or encourage their adoption without adequate attention to students' cognitive development, independent learning and academic responsibility.

This article addresses this problem through a critical conceptual review of relevant theoretical perspectives, contemporary empirical evidence and national and international policy considerations. It examines the dual role of generative AI as a potential cognitive support mechanism and a possible substitute for independent intellectual effort. It further proposes a Responsible Generative AI Integration Framework intended to guide higher education institutions in promoting responsible AI utilisation while strengthening higher-order thinking, learner autonomy and meaningful academic achievement.

1.4 Purpose and objectives of the review

The purpose of this article is to critically examine the implications of generative artificial intelligence for higher-order thinking, learner autonomy and academic achievement in higher education in Zambia.

The review is guided by the following objectives:

1. To examine the potential contributions and limitations of generative AI in developing higher-order thinking among university students.
2. To critically analyse the relationship between generative AI utilisation, learner autonomy and self-regulated learning.
3. To examine the implications of generative AI for academic achievement and genuine conceptual understanding.
4. To identify the pedagogical, ethical and institutional conditions necessary for responsible generative AI integration in Zambian higher education.
5. To propose a conceptual framework for promoting responsible AI utilisation while strengthening students' cognitive development and independent learning.

1.5 Contribution and Organisation of the Article

This article contributes to the growing discussion on generative AI in higher education by bringing together three educational dimensions that are frequently examined independently: Higher-order thinking, learner autonomy and academic achievement. Rather than treating AI adoption as an indication of educational improvement, the review examines the mechanisms through which AI utilisation may support or potentially undermine these outcomes.

Its principal conceptual contribution is the proposed Responsible Generative AI Integration Framework for Independent Learning and Cognitive Development in Zambian Higher Education. The framework proposes how AI literacy, critical evaluation, responsible utilisation, lecturer guidance and institutional support may shape the relationship between generative AI integration and student learning outcomes.

The remainder of the article is organised into twelve sections. Section 1 introduces the review, outlines the problem and establishes its purpose and contribution. Section 2 presents the review methodology, including the approach to identifying, selecting and synthesising relevant literature. Section 3 discusses the conceptual and theoretical foundations underpinning the review. Sections 4, 5 and 6 critically examine the implications of generative AI for higher-order thinking, learner autonomy and academic achievement, respectively. Section 7 discusses critical issues associated with generative AI integration, including academic integrity, information reliability, ethical concerns and institutional preparedness. Section 8 examines generative AI within the Zambian higher education context. Section 9 presents the proposed Responsible Generative AI Integration Framework. Section 10 discusses the implications of the review for universities, lecturers, students and policymakers. Section 11 identifies research gaps and directions for future investigation, while Section 12 presents the conclusion and recommendations.

2. Review methodology

2.1 Review design

This article adopted a critical conceptual review approach to examine the implications of generative artificial intelligence (GenAI) for higher-order thinking, learner autonomy and academic achievement in higher education in Zambia. Unlike an empirical study, the review did not involve the collection of primary data from students or lecturers. Instead, it drew on existing scholarly literature, theoretical perspectives and relevant institutional and national policy documents to develop a critical understanding of the educational implications of GenAI. The critical conceptual approach was considered appropriate because the relationship between GenAI and student learning outcomes involves multiple educational, cognitive, technological and institutional dimensions. It therefore allowed the review to examine contrasting perspectives, identify areas of agreement and disagreement, and develop a conceptual framework for responsible GenAI integration in higher education.

2.2 Critical analysis and synthesis of literature

The selected literature was examined thematically in relation to the three principal learning outcomes: Higher-order thinking, learner autonomy and academic achievement. The review considered both the potential benefits and limitations of GenAI rather than assuming that increased technology adoption necessarily produces improved educational outcomes.

Evidence relating to higher-order thinking was examined in terms of critical evaluation, analytical reasoning, problem-solving and creativity. Literature on learner autonomy was considered in relation to self-directed learning, goal setting,

self-monitoring, reflection and academic responsibility. Studies addressing academic achievement were examined with attention to assessment performance, conceptual understanding, knowledge retention and the independent application of acquired knowledge.

The analysis also considered factors that may influence the relationship between GenAI integration and student learning outcomes, including AI literacy, lecturer guidance, institutional policies, academic integrity and digital access. Particular attention was given to the Zambian higher education environment to identify context-specific opportunities, challenges and research gaps.

Where findings differed across studies, the review considered differences in research context, educational interventions, measures of learning outcomes and patterns of AI use. This enabled a more balanced interpretation of the literature and helped distinguish evidence of technology adoption or academic productivity from evidence of meaningful learning.

2.3 Development of the conceptual framework

The Responsible Generative AI Integration Framework was developed through the synthesis of the reviewed literature and the theoretical perspectives underpinning the article. For purposes of future empirical investigation, the framework positions GenAI integration as the central explanatory construct and higher-order thinking, learner autonomy and academic achievement as the intended learning outcomes. It also identifies lecturer guidance, institutional governance and digital infrastructure and equitable access as contextual enabling conditions that may shape how GenAI is used and how learning outcomes are experienced.

Within this conceptualisation, responsible GenAI integration is reflected in five interconnected pillars: AI literacy and technological competence, critical evaluation of AI-generated information, independent reasoning and problem-solving, ethical AI use and academic integrity, and assessment strategies that measure genuine understanding. The intended learning outcomes comprise higher-order thinking, learner autonomy and meaningful academic achievement.

The institutional and pedagogical enabling conditions represent the institutional and pedagogical environment within which students interact with generative AI. These conditions may strengthen or weaken the relationship between GenAI integration and the identified learning outcomes.

The framework is presented as a conceptual proposition intended to guide responsible institutional practice and future empirical investigation.

2.4 Methodological scope and limitations

This review adopted a critical conceptual approach rather than a systematic review methodology. Consequently, it did not apply a formal systematic screening protocol, calculate a pooled effect size or undertake a quantitative assessment of the quality of all available studies. The literature identification process was targeted towards sources relevant to the article's objectives and conceptual focus and should not be interpreted as an exhaustive representation of all research on generative AI in higher education. Furthermore, the rapidly evolving nature of generative AI means that new applications, research findings and institutional policies may emerge after the literature considered in this article. The conclusions should therefore be interpreted within the scope of the literature examined.

Despite these limitations, the approach provides a foundation for critically examining the educational implications of GenAI, identifying context-specific research gaps and proposing a conceptual framework for responsible integration in Zambian higher education.

3. Conceptual and theoretical foundations

3.1 Conceptualising generative artificial intelligence in higher education

Generative artificial intelligence (GenAI) refers to computational systems capable of producing new content, including text, images, code, summaries and other forms of information, in response to user instructions. In higher education, commonly used applications include ChatGPT, Google Gemini, Microsoft Copilot and Claude. These systems enable students to interact with digital information through conversational prompts, making it possible to request explanations, generate examples, summarise academic materials, explore research topics and obtain assistance with writing and problem-solving.

Unlike conventional digital information systems that primarily retrieve or display existing information, GenAI systems generate responses based on patterns learned from their training data and the context supplied by users. This creates opportunities for interactive and responsive learning support. For example, a student studying computer science may request an explanation of a programming concept, ask for alternative examples or seek assistance in identifying errors in a section of code. Similarly, a student undertaking research may use GenAI to explore a topic, clarify concepts or obtain suggestions for structuring an argument.

However, the ability to generate convincing responses should not be interpreted as evidence that the information is necessarily accurate, complete or academically appropriate. GenAI systems can produce inaccurate statements, fabricated references, biased content and explanations that appear authoritative despite being incorrect. Their outputs may also lack the contextual understanding required to address specialised academic questions accurately. Consequently, students require the ability to verify AI-generated information against credible academic sources and exercise independent judgement before incorporating it into their work.

For this review, GenAI is conceptualised not simply as a technological resource but as an interactive learning tool whose educational value depends on the nature of student engagement, the quality of instructional guidance and the extent to which learners retain responsibility for their intellectual activities.

3.2 Generative AI as a cognitive support mechanism and cognitive substitute

A central distinction underpinning this review is the difference between using GenAI to support cognitive activity and using it to replace cognitive activity. This distinction is important because the same technology can contribute to meaningful learning in one situation while encouraging intellectual dependence in another.

As a cognitive support mechanism, GenAI may assist students in understanding unfamiliar concepts, generating alternative explanations, identifying gaps in their arguments and receiving feedback during learning activities. When

students question AI-generated responses, compare them with academic literature and use the feedback to improve their own reasoning, the technology may function as a learning scaffold. In this situation, students remain actively involved in interpreting information, evaluating alternatives and constructing knowledge.

Conversely, GenAI may become a cognitive substitute when students delegate essential intellectual activities to the system. Examples include requesting complete assignments without critically examining the responses, accepting generated explanations without verification, allowing AI to formulate arguments without personal evaluation, or relying on generated answers instead of attempting to solve problems independently. Such practices may produce completed academic tasks without necessarily developing the underlying knowledge and skills expected from the learning process.

The distinction is therefore not determined by whether a student uses GenAI, but by how the technology is incorporated into the learning process. The educational concern is not assistance itself; rather, it is the possibility that assistance may displace the intellectual effort through which understanding, judgement and independent competence are developed.

This review adopts the position that responsible GenAI integration should preserve student cognitive agency. AI-supported activities should therefore encourage questioning, verification, reflection and independent application rather than passive acceptance of generated content.

3.3 Higher-order thinking

Higher-order thinking refers to complex intellectual processes that extend beyond the memorisation and reproduction of information. These processes include analysing information, evaluating evidence, developing arguments, solving unfamiliar problems, making informed decisions and generating original ideas.

The revised Bloom's Taxonomy by Anderson and Krathwohl identifies six cognitive processes: Remembering, understanding, applying, analysing, evaluating and creating [4]. Although the processes are not always performed in a strictly linear sequence, the taxonomy provides a useful conceptual basis for distinguishing basic knowledge acquisition from more complex intellectual engagement.

Within higher education, higher-order thinking is particularly important because students are expected to interpret academic information, evaluate competing explanations, apply theoretical knowledge to practical situations and develop solutions to discipline-specific problems. The development of these capabilities requires active engagement with learning materials rather than the reproduction of information alone.

GenAI may support higher-order thinking by presenting alternative viewpoints, generating questions, explaining complex concepts and providing examples that students can critically examine. For instance, students may use an AI-generated explanation as a starting point and subsequently compare its arguments with scholarly literature, identify weaknesses and develop their own conclusions.

Nevertheless, the same capabilities may be undermined when students use generated responses as final answers without engaging in analysis or evaluation. A student who submits an AI-generated solution without understanding the reasoning behind it may demonstrate task completion without demonstrating the expected cognitive competence.

Accordingly, this review considers higher-order thinking in terms of students' capacity to demonstrate independent critical thinking, analytical reasoning, evaluation, problem-solving and creativity, rather than their ability to produce polished academic outputs with technological assistance.

3.4 Learner autonomy and self-regulated learning

Learner autonomy refers to students' capacity to take responsibility for their own learning by identifying learning needs, setting goals, selecting appropriate strategies, monitoring progress and evaluating learning outcomes. Autonomous learners are not necessarily expected to work without assistance. Rather, they are expected to make informed decisions about when, why and how to seek support while maintaining responsibility for their learning.

Self-regulated learning provides a related theoretical explanation of how students manage their academic activities. Zimmerman [7] describes self-regulated learning as a cyclical process involving three broad phases: forethought, performance and self-reflection.

The forethought phase involves establishing learning goals, analysing tasks and planning appropriate strategies. The performance phase involves implementing learning strategies, maintaining attention and monitoring progress. The self-reflection phase involves evaluating performance, identifying areas requiring improvement and adjusting future learning activities.

GenAI may contribute to these processes by assisting students to clarify learning objectives, generate revision questions, obtain explanations and receive feedback. For example, a student may use an AI tool to identify areas of difficulty, develop a study plan and test understanding through practice questions. When the student independently evaluates progress and adjusts learning strategies, AI assistance may complement self-regulated learning.

However, excessive dependence on AI-generated explanations and solutions may weaken the learner's active involvement in planning, monitoring and evaluating learning. If students consistently rely on AI to determine what to study, how to approach problems and whether their answers are correct, opportunities to develop independent learning judgement may be reduced.

Therefore, the relationship between GenAI and learner autonomy is likely to depend on whether students use AI to strengthen their capacity for self-direction or transfer responsibility for important learning decisions to the technology.

3.5 Academic achievement and genuine learning

Academic achievement commonly refers to students' demonstrated performance in educational activities, including examinations, coursework, continuous assessments, practical assignments and other forms of academic evaluation. It provides an important indication of whether students have attained specified learning outcomes.

The introduction of GenAI creates a need to distinguish between improved academic productivity and genuine learning. Productivity may be reflected in the speed with which students complete assignments, generate reports, organise information or prepare academic submissions. Genuine learning, however, requires the development and

retention of knowledge, understanding and skills that students can independently apply in different situations.

For example, a student may use GenAI to generate a well-structured assignment and obtain a high mark. However, if the student cannot explain the central arguments, defend the conclusions or apply the concepts to an unfamiliar problem, the submitted work may not provide sufficient evidence of independent understanding.

This distinction does not imply that AI-assisted academic work cannot represent genuine achievement. When students use GenAI to clarify difficult concepts, receive feedback, practise problem-solving and improve their understanding, the technology may contribute positively to learning. The critical issue is whether the resulting academic performance reflects knowledge and competencies developed by the learner.

Consequently, this review treats academic achievement as a multidimensional educational outcome. It considers not only assessment performance but also conceptual understanding, knowledge retention, independent application and the ability to transfer learning to unfamiliar academic or practical situations.

3.6 Theoretical foundations

This review draws on three complementary theoretical perspectives: Constructivist Learning Theory, Self-Regulated Learning Theory and Cognitive Offloading Theory. Together, these perspectives provide a basis for examining how GenAI may influence knowledge construction, independent learning and the distribution of cognitive effort.

3.6.1 Constructivist learning theory

Constructivist Learning Theory proposes that learners actively construct knowledge through engagement with information, experience, prior understanding and interaction with their learning environments. Knowledge acquisition is therefore not simply the passive reception of information; it involves interpretation, reflection and the development of meaning.

Piaget [10] emphasises the active role of learners in constructing and reorganising knowledge, while Vygotsky [11] highlights the importance of social interaction, cultural tools and guided learning in cognitive development. Vygotsky's perspective is particularly relevant to the concept of scaffolding, in which support enables learners to undertake tasks that may initially be beyond their independent capabilities.

Within this theoretical perspective, GenAI may function as a technological resource that provides explanations, examples, prompts and feedback to support knowledge construction. Students may use these resources to explore unfamiliar concepts, compare interpretations and develop a deeper understanding of academic material.

However, constructivist learning requires learners to participate actively in the construction of meaning. Simply receiving AI-generated explanations does not necessarily constitute knowledge construction. Students must interpret, question, connect and apply the information within their existing knowledge structures.

Furthermore, although GenAI can provide interactive responses, it should not automatically be equated with a human lecturer, knowledgeable peer or social learning environment. Its responses may lack contextual understanding and may contain inaccuracies. Human guidance and interaction therefore remain important in supporting meaningful learning.

Constructivist Learning Theory provides a basis for examining whether GenAI encourages active knowledge construction or promotes passive consumption of generated information.

3.6.2 Self-regulated learning theory

Self-Regulated Learning Theory explains how learners exercise control over their cognitive processes, motivation and learning behaviours. Zimmerman [7] identifies self-regulated learning as an active and cyclical process involving forethought, performance and self-reflection.

This theory is particularly relevant to the relationship between GenAI and learner autonomy. Students who use AI to identify learning needs, develop study plans, test their understanding and reflect on feedback may strengthen their capacity to manage learning activities. In such circumstances, GenAI can provide resources that support planning, monitoring and evaluation.

Nevertheless, self-regulation requires the learner to remain responsible for learning decisions. When students depend excessively on AI to formulate responses, evaluate their work or determine the direction of their studies, they may become less involved in the processes through which independent learning skills are developed.

The theory therefore suggests that the educational value of GenAI should be assessed not only by the assistance it provides but also by its influence on students' ability to regulate learning independently. This perspective informs the review's examination of learner autonomy, academic responsibility and the importance of reflective engagement with AI-generated content.

3.6.3 Cognitive offloading theory

Cognitive offloading refers to the use of external resources or actions to reduce the mental demands associated with a task. Risko and Gilbert [6] explain that individuals may rely on external tools to alter information-processing demands, thereby reducing the amount of information or cognitive activity that must be maintained internally.

In educational settings, cognitive offloading can take different forms. Students may use calculators for mathematical operations, search engines to locate information, digital calendars to manage deadlines and note-taking applications to retain important information. Such practices are not inherently harmful; external resources can support efficiency and allow learners to concentrate on more demanding aspects of a task.

GenAI introduces a more extensive form of potential cognitive offloading because it can perform activities that involve summarising, explaining, drafting, comparing and generating solutions. These capabilities may reduce unnecessary cognitive demands and provide useful assistance during complex learning activities.

However, a distinction must be made between offloading routine or supportive tasks and delegating the central intellectual processes that students are expected to develop. When AI is used to generate initial examples or provide feedback, students may retain responsibility for interpretation and evaluation. When it is used to perform the analysis, construct the argument and formulate the final conclusion without meaningful student engagement, opportunities for cognitive practice may be reduced.

Cognitive offloading is therefore treated in this review as a conditional process rather than an inherently negative

outcome. Its implications depend on the nature of the task, the cognitive processes being delegated and the extent to which students continue to engage in independent reasoning.

3.7 Integration of the theoretical perspectives

The three theoretical perspectives provide complementary explanations of the potential educational implications of GenAI.

Constructivist Learning Theory explains how students may use AI-generated information and feedback to construct knowledge through active engagement. Self-Regulated Learning Theory explains how students may manage their learning activities, monitor progress and maintain responsibility for academic development. Cognitive Offloading Theory explains how reliance on external technological support may alter the distribution of cognitive effort during learning.

Taken together, these perspectives suggest that GenAI's educational influence cannot be understood solely through the frequency of technology use. It is also necessary to examine the nature of student engagement, the degree of independent cognitive participation and the pedagogical conditions under which AI assistance is provided.

The integrated perspective establishes the theoretical foundation for the subsequent analysis of higher-order thinking, learner autonomy and academic achievement. It also supports the development of a responsible integration framework in which GenAI is used to strengthen learning while preserving students' capacity for independent reasoning, self-direction and meaningful academic performance.

4. Generative artificial intelligence and higher-order thinking

4.1 Generative AI and the development of critical thinking

Critical thinking involves the ability to interpret information, examine assumptions, evaluate evidence, identify inconsistencies and develop reasoned conclusions. In higher education, it enables students to move beyond accepting information at face value and to engage with academic arguments in a questioning and reflective manner.

GenAI presents opportunities to support the development of critical thinking by exposing students to alternative explanations, contrasting viewpoints and possible solutions to academic problems. Students can use conversational AI tools to challenge initial assumptions, request counterarguments, examine different interpretations of a concept and obtain explanations of complex subject matter. When these activities are followed by independent verification and reflection, AI interaction may encourage deeper engagement with academic content.

For example, a student examining the implications of artificial intelligence for employment may request arguments supporting and opposing its adoption. Rather than accepting the generated responses, the student can compare the arguments with scholarly literature, assess the credibility of the evidence and formulate an independent position. In this context, GenAI provides material for critical examination rather than replacing the student's responsibility to reason.

However, the availability of generated explanations may also create conditions in which critical engagement is reduced. Students may accept AI-generated arguments because they are presented fluently and confidently, even when the information contains inaccuracies or unsupported conclusions. Where learners rely on generated answers without examining their assumptions, sources and logical consistency, the technology may encourage passive information consumption.

Recent research provides evidence of both possibilities. Zhao *et al*. [5], in a meta-analysis of 29 experimental and quasi-experimental studies, reported a moderate positive overall effect of GenAI on higher-order thinking, with stronger improvements in problem-solving and critical thinking than in creativity. The authors also identified self-regulated learning as an important factor influencing the observed outcomes. This suggests that the benefits of GenAI are not necessarily uniform across students and may depend partly on their capacity to manage and evaluate AI-supported learning activities.

Similarly, Chen and Cheung [3] synthesised 57 studies and reported positive effects on higher-order thinking and academic achievement. Nevertheless, their findings also indicated that GenAI did not produce a statistically significant effect on metacognition. This distinction is important because improvements in performance on particular learning tasks should not automatically be interpreted as evidence that students have developed stronger independent thinking or monitoring capabilities.

The implication is that critical thinking should be assessed through activities that require students to justify conclusions, evaluate evidence, identify limitations and defend their reasoning. The use of GenAI in academic activities should therefore create opportunities for critical examination rather than encourage unverified acceptance of generated responses.

4.2 Generative AI and analytical reasoning

Analytical reasoning involves breaking complex information into constituent parts, identifying relationships, recognising patterns and examining how different elements contribute to an overall conclusion. It is particularly important in higher education, where students are expected to interpret research findings, examine theoretical arguments, evaluate case studies and apply concepts to practical situations.

GenAI may support analytical reasoning by assisting students in organising information, comparing concepts, identifying possible relationships and exploring alternative interpretations. For instance, students may request a comparison of two theoretical approaches, examine the differences between competing explanations or obtain assistance in identifying potential weaknesses in an argument. These interactions can provide useful starting points for further investigation.

In disciplines such as computer science, information technology and business, GenAI may also assist students in understanding complex technical problems by presenting explanations in different formats. A student learning database management, for example, may request an explanation of the differences between primary and foreign keys, examine sample database structures and subsequently evaluate whether a proposed design satisfies the relevant requirements.

Nevertheless, analytical reasoning requires more than receiving organised information. Students must understand why particular relationships exist, determine whether the reasoning is valid and apply the resulting knowledge

independently. If students depend on AI to perform these activities without examining the reasoning process, the apparent quality of their academic work may exceed their actual analytical competence.

This concern reinforces the distinction between AI-assisted task completion and cognitive development. The educational value of GenAI depends on whether students actively engage with the analytical process or merely reproduce the conclusions generated by the system.

4.3 Generative AI and problem-solving abilities

Problem-solving involves identifying a problem, understanding its underlying conditions, generating possible solutions, evaluating alternatives and selecting an appropriate course of action. Higher education places considerable emphasis on these abilities because graduates are expected to apply theoretical knowledge to unfamiliar academic, professional and real-world situations.

GenAI can support problem-solving by helping students break complex tasks into manageable components, explore alternative approaches, generate possible solutions and receive explanations of unfamiliar procedures. In programming education, for example, students may use AI to understand error messages, examine alternative algorithms or obtain explanations of why a particular solution may not work. In research and project-based learning, students may use AI to explore possible approaches before independently evaluating their suitability.

Evidence from Zhao *et al*. [5] indicates that problem-solving was among the higher-order thinking dimensions showing comparatively strong improvement in the studies included in their meta-analysis. This provides support for the potential of GenAI to contribute to problem-solving development, particularly when its use is integrated into structured learning activities.

However, the effectiveness of AI-supported problem-solving should not be judged solely by whether students arrive at correct answers. The process through which a solution is developed is equally important. Students need to understand the problem, justify their selected approach, evaluate alternative solutions and demonstrate that they can apply the underlying principles without depending entirely on AI assistance.

A potential limitation arises when students submit AI-generated solutions without attempting the problem independently. Although this may increase the speed of task completion, it can reduce opportunities to practise problem identification, logical reasoning and independent decision-making. Such practices may become particularly problematic when students encounter examination questions or professional situations in which AI assistance is unavailable or inappropriate.

Consequently, GenAI should be incorporated into problem-solving activities in ways that require students to explain their reasoning, compare alternative solutions and demonstrate independent application of acquired knowledge.

4.4 Generative AI and creativity

Creativity involves generating original or valuable ideas, exploring alternative possibilities and developing new approaches to existing problems. In higher education, creative thinking is reflected in students' ability to develop innovative solutions, formulate research questions, design projects and produce original academic or professional outputs.

GenAI may support creativity by generating initial ideas, suggesting alternative approaches, presenting different perspectives and helping students explore possibilities beyond their initial understanding. Students may use these capabilities during brainstorming, concept development, research planning and project design. Such interactions can be particularly useful during the early stages of creative work, when learners are exploring possible directions.

Nevertheless, the generation of multiple ideas does not necessarily demonstrate that students have developed creative competence. AI-generated suggestions may encourage students to converge around familiar patterns, reproduce conventional approaches or rely on outputs that lack originality. Where students accept generated ideas without modification or independent contribution, the final product may reflect technological assistance more than personal creative development.

The distinction between AI-supported creativity and AI-substituted creativity is therefore important. In the former, students use generated suggestions as starting points, evaluate their relevance, combine them with personal insights and develop original outcomes. In the latter, students rely on AI to produce the central ideas and final outputs without meaningful intellectual contribution.

Zhao *et al*. [5] reported that the effect of GenAI on creativity was comparatively limited when measured against its effects on problem-solving and critical thinking. This suggests that the ability of AI systems to generate creative-looking content should not be confused with the development of students' own creative thinking capabilities.

A more educationally meaningful approach would require students to document how they developed an idea, explain the decisions made during the creative process and demonstrate how their contributions differ from AI-generated suggestions.

4.5 The risk of cognitive offloading and over-reliance

Although GenAI can provide useful cognitive support, its capacity to perform complex intellectual tasks raises concerns about cognitive offloading and over-reliance. Cognitive offloading occurs when individuals use external resources to reduce the mental effort required to complete a task. As discussed in Section 3, this process is not inherently negative because external tools can improve efficiency and allow learners to concentrate on other important activities.

The concern arises when students consistently delegate the very cognitive processes that higher education is intended to develop. If students rely on GenAI to interpret academic materials, formulate arguments, evaluate evidence and generate conclusions, they may have fewer opportunities to practise these capabilities independently.

Over-reliance may also affect students' confidence in their own reasoning. Learners who become accustomed to receiving immediate AI-generated answers may find it difficult to persist with challenging tasks that require independent investigation, reflection and problem-solving. In addition, repeated exposure to fluent but potentially inaccurate responses may encourage excessive trust in automated information.

Recent reviews reinforce the need to distinguish between structured and unstructured use. A 2026 systematic review of 67 empirical studies examining ChatGPT and critical and

creative thinking found that outcomes depended substantially on the instructional conditions in which the technology was used. Its synthesis indicated that scaffolded, inquiry-oriented activities were more supportive of cognitive development, whereas unstructured use was associated with concerns about cognitive offloading and reduced independent engagement [8].

These findings suggest that cognitive dependence should not be treated as an inevitable consequence of GenAI adoption. Rather, it is a potential risk that can be influenced by instructional design, assessment practices, AI literacy and the expectations established by lecturers and institutions.

4.6 Conditions for strengthening higher-order thinking through GenAI

The preceding discussion indicates that GenAI can contribute to higher-order thinking when its use is guided by learning activities that preserve independent intellectual engagement. Several conditions are particularly important.

First, critical evaluation of AI-generated information should be an explicit component of AI-supported learning. Students should be encouraged to verify factual claims, examine the credibility of references, identify possible bias and compare generated responses with reliable academic sources.

Second, inquiry-based learning activities should require students to question, investigate and defend ideas rather than simply request completed answers. For example, lecturers may ask students to identify weaknesses in an AI-generated argument and develop a revised position supported by scholarly evidence.

Third, independent problem-solving should precede or accompany AI assistance. Students may first attempt a problem independently, then use GenAI to compare approaches, obtain feedback or identify errors. This preserves opportunities for cognitive practice while allowing students to benefit from technological support.

Fourth, reflective learning activities should require students to explain how AI contributed to their work, which suggestions they accepted or rejected and why. Such activities may help learners become more conscious of their reasoning processes and the limitations of AI-generated information.

Finally, assessment methods should measure reasoning and understanding rather than output quality alone. Oral presentations, practical demonstrations, supervised problem-solving, reflective explanations and follow-up questions can help lecturers determine whether students understand and can independently apply the knowledge presented in their submissions.

4.7 Critical synthesis

The literature reviewed suggests that the relationship between GenAI and higher-order thinking is conditional rather than uniformly positive or negative. GenAI can provide opportunities for critical thinking, analytical reasoning, problem-solving and creativity by making information more accessible, supporting exploration and providing interactive feedback. However, these potential benefits may be weakened when students accept generated content without evaluation or delegate essential intellectual activities to AI systems.

The findings of Zhao *et al*. [5] provide evidence of a moderate positive effect on higher-order thinking, particularly problem-solving and critical thinking, while also highlighting the importance of self-regulated learning. Chen and Cheung [3] similarly report positive effects on higher-order thinking but identify limitations concerning metacognition. These findings indicate that improved performance in selected cognitive activities does not necessarily demonstrate equivalent development across all dimensions of higher-order thinking.

An important implication for the Zambian higher education context is that the growing availability and use of GenAI should be accompanied by deliberate pedagogical strategies that promote independent reasoning. Mudenda *et al*. [9] provide evidence of substantial awareness and use of ChatGPT among university students in Zambia. However, evidence of awareness and adoption alone does not establish whether students' critical thinking, analytical reasoning, problem-solving and creativity have improved or declined.

There is therefore a need for further context-specific research examining how students use GenAI during actual learning activities and how different patterns of use relate to measurable cognitive outcomes. For universities, the central challenge is not simply to encourage or restrict AI adoption, but to establish learning environments in which students use AI to extend their intellectual capabilities without surrendering responsibility for independent thought.

5. Generative artificial intelligence and learner autonomy

5.1 generative AI and self-directed learning

Self-directed learning refers to the process through which learners take initiative in identifying their learning needs, establishing objectives, selecting appropriate resources and evaluating their progress. It is an important dimension of learner autonomy because it enables students to manage academic development beyond the immediate direction of lecturers.

The availability of GenAI has introduced new opportunities for self-directed learning in higher education. Students can interact with AI systems to obtain explanations, clarify unfamiliar concepts, generate revision questions and explore academic subjects according to their individual learning needs. Unlike conventional learning resources that may present information in a fixed format, conversational AI tools can provide alternative explanations in response to students' questions and requests.

For example, a student who has difficulty understanding a database concept may request a simpler explanation, ask for practical examples and subsequently request exercises to test understanding. Such interaction may enable the student to address learning difficulties outside formal classroom sessions. It may also support students who require additional explanations before participating confidently in classroom activities.

However, the availability of personalised assistance does not automatically produce self-directed learners. Autonomy requires students to identify what they need to learn, determine whether the information provided is appropriate and evaluate whether their learning objectives have been achieved. When students rely on AI to determine every learning activity and provide all necessary explanations, they may become dependent on external direction rather than develop independent learning strategies.

The educational value of GenAI therefore depends on whether it strengthens students' capacity to initiate and

manage learning or simply makes it easier to obtain information without sustained intellectual engagement.

5.2 Generative AI and self-regulated learning

Self-regulated learning involves the processes through which students plan, monitor and evaluate their academic activities. As discussed in Section 3, Zimmerman [7] conceptualises this process through three interconnected phases: forethought, performance and self-reflection.

GenAI may support each of these phases.

During the **forethought phase**, students may use AI tools to clarify learning objectives, identify topics requiring attention, organise study schedules and explore possible learning strategies. For example, a student preparing for an examination may request a revision plan based on the topics covered in a course. The student can then evaluate and adapt the proposed plan according to available time, academic priorities and personal learning needs.

During the **performance phase**, GenAI may provide explanations, practice questions, examples and feedback that assist students in monitoring their understanding. Students may use these resources to identify difficulties, test their knowledge and seek clarification while undertaking independent study.

During the **self-reflection phase**, students may use AI to review completed work, identify possible weaknesses and consider alternative approaches to future learning activities. However, meaningful reflection requires students to assess the feedback critically rather than accept AI-generated evaluations without independent judgement.

Despite these opportunities, excessive reliance on AI may weaken the development of self-regulatory skills. If students routinely depend on AI to establish learning priorities, select strategies and evaluate performance, they may become less involved in the decisions that constitute self-regulated learning.

Consequently, GenAI should be used to support students' capacity to regulate their learning rather than replace the planning, monitoring and reflection that learners need to develop independently.

5.3 Generative AI, learner motivation and engagement

Learner motivation influences students' willingness to participate in academic activities, persist when confronted with difficulties and invest effort in achieving learning objectives. GenAI may influence motivation and engagement by making academic information more accessible and providing immediate responses to students' questions.

The ability to request explanations, obtain examples and receive feedback without waiting for formal classroom interaction may encourage students to explore subjects independently. Students who initially find a topic difficult may become more willing to engage when alternative explanations are available. Similarly, interactive practice activities may encourage continued participation by providing opportunities for students to test their understanding.

Nevertheless, the relationship between GenAI and motivation is not necessarily straightforward. The convenience of obtaining immediate answers may reduce students' willingness to engage in challenging tasks that require persistence and independent investigation. Where learners become accustomed to receiving completed responses, they may be less inclined to undertake the effort required to understand complex academic concepts.

Another consideration is the distinction between motivation to complete an academic task and motivation to develop knowledge. A student may become more productive because AI reduces the time required to prepare an assignment, but this does not necessarily indicate increased interest in the subject or stronger commitment to learning.

The influence of GenAI on motivation should therefore be considered in relation to the nature of student engagement. Its contribution is more educationally meaningful when it encourages curiosity, sustained participation and intellectual exploration rather than merely accelerating the completion of academic tasks.

5.4 The risk of learner dependence and reduced autonomy

Although GenAI may provide valuable learning support, its convenience and accessibility create the possibility of excessive dependence. Learner dependence occurs when students increasingly rely on external technological assistance for activities that they should be capable of undertaking, or are expected to develop the ability to undertake, independently.

In higher education, this may occur when students consistently use AI to generate assignment responses, summarise all required reading, formulate research arguments or answer questions without first attempting to understand the underlying concepts. Such practices may reduce opportunities for independent study, information evaluation and personal knowledge construction.

Dependence may also affect students' confidence in their ability to solve academic problems without technological assistance. Students who routinely request AI-generated solutions may become less willing to attempt difficult tasks independently, particularly when the task requires sustained reasoning or several stages of investigation.

However, it is important to distinguish appropriate technological assistance from problematic dependence. Students have always used external resources, including textbooks, lecturers, libraries, search engines and digital learning platforms. The use of such resources does not necessarily undermine autonomy. The concern arises when students transfer responsibility for essential learning decisions and intellectual activities to the technology.

This distinction is particularly relevant to GenAI because the systems can generate complete responses rather than simply provide access to information. Students may therefore obtain outputs that appear academically complete without necessarily engaging in the learning processes that those outputs are expected to demonstrate.

The challenge for higher education institutions is to encourage responsible assistance while ensuring that students retain the capacity and confidence to learn, reason and make academic decisions independently.

5.5 Generative AI and academic responsibility

Learner autonomy is closely connected to academic responsibility. Autonomous learners are expected to take ownership of their academic progress, exercise judgement when selecting learning resources and demonstrate accountability for the work they submit.

The introduction of GenAI creates additional responsibilities because students must make decisions about when to use AI,

how to evaluate its outputs and whether its use is consistent with institutional academic integrity requirements. They must also recognise that responsibility for submitted academic work remains with the student, even when AI tools have contributed to its preparation.

Responsible use requires students to understand the limitations of generated information, verify factual claims and references, acknowledge AI assistance where required and avoid presenting generated content as independently produced work when this would violate institutional rules.

Academic responsibility also involves recognising situations in which AI assistance may be inappropriate. For example, students may be required to complete supervised examinations, practical demonstrations or individual assessments without external assistance. The ability to perform independently in such circumstances remains an important indication of learning competence.

5.6 Digital and AI literacy as conditions for learner autonomy

The ability to use GenAI effectively requires more than access to an application. Students need appropriate digital and AI literacy to understand how these systems operate, recognise their limitations and evaluate the quality of generated information.

Digital literacy provides the foundation for accessing and using digital resources, while AI literacy involves understanding the capabilities, limitations and implications of artificial intelligence systems. In the context of higher education, AI literacy includes the ability to formulate appropriate prompts, assess generated responses, identify possible inaccuracies and use AI responsibly.

Students with limited AI literacy may struggle to distinguish reliable information from fabricated or misleading responses. They may also misunderstand the limitations of AI-generated references, assume that fluent explanations are necessarily accurate or fail to recognise the importance of independent verification.

AI literacy is therefore an important condition for meaningful learner autonomy. Students cannot make fully informed decisions about technological assistance if they do not understand the nature and limitations of the tools they are using.

Universities should consequently incorporate AI literacy into teaching and learning activities. Such initiatives should go beyond demonstrating how to operate AI applications and should develop students' ability to evaluate outputs, protect academic integrity and maintain responsibility for their learning.

The reviewed concepts and theoretical perspectives indicate that GenAI has the potential to strengthen learner autonomy by supporting self-directed learning, providing accessible explanations and assisting students in planning, monitoring and evaluating academic activities. Its interactive capabilities may enable students to obtain additional learning support and engage with academic content beyond scheduled classroom sessions.

However, these potential benefits are accompanied by risks associated with over-reliance, reduced independent effort and the transfer of learning responsibilities to AI systems. The availability of immediate explanations and generated answers may encourage students to prioritise task completion over the development of independent learning strategies.

The distinction between AI-supported and AI-dependent learning is therefore central to understanding its influence on learner autonomy. AI-supported learning occurs when students use technology to improve their understanding while retaining responsibility for learning decisions. AI-dependent learning occurs when students increasingly transfer the planning, reasoning and evaluation of academic activities to the technology.

Within the Zambian higher education context, these issues should be considered alongside differences in digital access, AI literacy, institutional guidance and students' learning environments. Although the study by Mudenda *et al*. [9] provides evidence of widespread ChatGPT awareness and use among students at selected Zambian universities, awareness and adoption do not establish whether students have developed stronger self-regulatory skills or greater independence in their academic activities.

Further context-specific research is therefore necessary to examine how students incorporate GenAI into their study practices and whether different patterns of use are associated with changes in goal-setting, independent study, self-monitoring and academic responsibility.

6. Generative artificial intelligence and academic achievement

6.1 Generative AI and academic performance

Academic achievement is an important indicator of students' progress towards educational objectives. In higher education, it is commonly assessed through examinations, coursework, practical assignments, research projects, presentations and continuous assessment activities. These forms of assessment are intended to establish whether students have acquired the knowledge and competencies required by their programmes of study.

The emergence of GenAI has introduced new possibilities for supporting academic performance. Students can use AI applications to obtain explanations, organise academic information, generate practice questions, receive feedback and improve the presentation of written work. These capabilities may help students address learning difficulties, prepare for assessments and engage more effectively with academic tasks.

For example, students may use GenAI to clarify difficult concepts before examinations, generate practice questions for revision or obtain feedback on the structure and clarity of an assignment. When these activities are accompanied by independent study and verification, AI assistance may contribute to improved academic preparation.

Evidence from recent research suggests that GenAI can have positive effects on student learning outcomes. Chen and Cheung [3], in their systematic review and meta-analysis of 57 studies, reported positive effects of generative AI on academic achievement and higher-order thinking. Zhao *et al*. [5] also identified positive effects on higher-order thinking, including problem-solving and critical thinking, which are important capabilities underpinning academic performance.

Nevertheless, these findings should be interpreted carefully. Improvements in academic performance across particular studies do not establish that every form of GenAI use produces better learning. Outcomes may differ according to the subject, learning activity, assessment design, student characteristics and degree of instructional guidance.

Therefore, the relationship between GenAI and academic

achievement should be examined in terms of both measurable academic performance and the learning processes that contribute to that performance.

6.2 Generative AI and conceptual understanding

Conceptual understanding refers to students' ability to comprehend the meaning of academic concepts, explain relationships between ideas and apply knowledge beyond the memorisation of definitions or procedures.

GenAI may support conceptual understanding by providing alternative explanations, examples and step-by-step descriptions of complex topics. Students can request that difficult concepts be explained using simpler language, practical illustrations or examples relevant to their disciplines. This flexibility may be particularly useful when students require additional explanations outside scheduled teaching sessions.

In technical disciplines, for instance, a student learning computer programming may request explanations of variables, functions, loops and data structures. The student may then request examples, examine the generated code and test their understanding through independent exercises. Such interaction can provide additional opportunities to engage with concepts that may initially appear difficult.

However, conceptual understanding cannot be established merely by the ability to reproduce an AI-generated explanation. Students need to demonstrate that they can explain concepts in their own words, identify relationships between them and apply the underlying principles to new situations.

A potential limitation arises when students memorise generated explanations or copy completed solutions without understanding the reasoning involved. In such circumstances, the quality of submitted academic work may not accurately represent the student's conceptual knowledge.

Consequently, GenAI is more likely to support conceptual understanding when it is used to stimulate questioning, provide explanatory support and encourage independent application rather than replace the intellectual processes involved in learning.

6.3 Generative AI and knowledge retention

Knowledge retention refers to the ability to maintain and recall acquired information over time. It is an important component of academic achievement because students are expected not only to understand concepts during instruction but also to retain and apply them in subsequent learning activities.

GenAI may contribute to knowledge retention by supporting revision, providing practice questions, explaining difficult concepts and enabling students to revisit topics according to their individual learning needs. Students may use AI-generated quizzes and exercises to test their understanding and identify areas requiring additional study.

However, the relationship between AI assistance and long-term retention requires careful consideration. If students routinely obtain completed answers without attempting to recall or reconstruct information independently, they may reduce opportunities to practise retrieval and reinforce their own understanding.

For example, a student who requests an immediate answer to every revision question may complete a study session quickly but may have limited opportunity to assess what they can remember independently. By contrast, a student who first attempts the question, then uses AI to examine errors and clarify misunderstandings, remains actively involved in the learning process.

The distinction suggests that GenAI should complement effective learning strategies rather than replace the cognitive activities necessary for retaining knowledge. Practice questions, independent recall, explanation in the student's own words and repeated application of concepts can help preserve active engagement.

Importantly, the positive effects of GenAI on academic achievement reported in some studies should not automatically be interpreted as evidence of improved long-term knowledge retention. These are related but distinct educational outcomes and require appropriate assessment.

6.4 Generative AI and assessment outcomes

Assessment is one of the principal mechanisms through which higher education institutions evaluate student learning. Traditional assessment methods include examinations, written assignments, practical demonstrations, presentations and research projects. The increasing availability of GenAI challenges some conventional approaches because students can use these systems to generate text, explanations, code and other academic outputs.

On one hand, GenAI may help students improve the quality of academic submissions by supporting writing, organising ideas, explaining concepts and providing feedback. These capabilities may be beneficial when students use AI transparently and remain responsible for the accuracy and quality of their work.

On the other hand, AI-generated outputs may make it difficult to determine the extent to which submitted work reflects a student's independent knowledge and competence. A well-written assignment may contain arguments and explanations that the student cannot independently defend or reproduce.

This creates an assessment challenge for lecturers and universities. The quality of a final submission may no longer provide sufficient evidence of the learning process or individual competence, particularly where the assessment can be completed using unrestricted AI assistance.

Consequently, assessment practices may need to place greater emphasis on the demonstration of understanding and the ability to apply knowledge. Oral examinations, supervised practical exercises, individual presentations, reflective reports and follow-up questions can provide additional evidence of students' competence.

This does not mean that written assignments should be abandoned. Rather, they should be designed to assess reasoning, application, evaluation and independent contribution, while clearly communicating acceptable forms of AI assistance.

6.5 Academic productivity versus genuine learning

One of the most important distinctions in evaluating GenAI's educational influence is the difference between academic productivity and genuine learning.

Academic productivity relates to the efficiency with which students complete academic activities. GenAI can improve productivity by reducing the time required to search for initial information, organise ideas, prepare drafts, summarise materials and generate examples.

Genuine learning, however, involves the development of

knowledge, understanding, reasoning abilities and competencies that students can demonstrate independently. It requires more than the production of completed assignments or the submission of polished academic work.

The distinction can be illustrated through two hypothetical learning situations.

In the first situation, a student uses GenAI to generate an entire research assignment and submits the output without examining the sources, understanding the arguments or making an independent contribution. Although the task may be completed efficiently, the process provides limited evidence of the student's own learning.

In the second situation, a student independently explores the research topic, uses GenAI to clarify difficult concepts, evaluates the suggested information against scholarly sources and develops an original argument. In this case, AI assistance contributes to the learning process while the student remains responsible for the intellectual work.

These examples demonstrate why the presence of GenAI in academic work should not, by itself, be interpreted as evidence of either improved or diminished achievement. The nature of student engagement and the extent of independent understanding are equally important.

For this review, the distinction between productivity and genuine learning is central to evaluating the educational value of GenAI. Universities should therefore avoid relying exclusively on the speed, presentation or apparent sophistication of student submissions when determining whether learning objectives have been achieved.

6.6 Conditions influencing the relationship between GenAI and academic achievement

The potential influence of GenAI on academic achievement is shaped by several interacting conditions.

First, pedagogical integration determines whether AI use is connected to meaningful learning objectives. Activities that require students to explain, apply and evaluate generated information may provide greater educational value than unrestricted use for completing assignments.

Second, student AI literacy influences the ability to identify inaccurate responses, evaluate generated information and select appropriate applications. Students who understand the limitations of AI systems are better positioned to use them critically and responsibly.

Third, lecturer guidance helps establish expectations regarding appropriate AI use. Lecturers can identify activities where AI assistance is beneficial, clarify academic integrity requirements and design tasks that preserve independent student engagement.

Fourth, assessment design determines whether students are required to demonstrate genuine understanding. Assessments that include independent explanations, practical application and opportunities to defend conclusions can provide stronger evidence of learning than submissions evaluated solely on presentation.

Fifth, institutional preparedness and access influence the extent to which students and lecturers can use GenAI effectively. Differences in internet connectivity, device availability, digital competence and institutional support may create unequal opportunities for AI-supported learning.

These conditions indicate that academic achievement cannot be explained by AI access or frequency of use alone. The educational effects of GenAI are likely to depend on the interaction between student behaviour, instructional practices, assessment approaches and the institutional environment.

The literature reviewed indicates that GenAI has potential to support academic achievement by providing accessible explanations, facilitating revision, supporting academic preparation and improving the efficiency of learning activities. Recent meta-analytic evidence, particularly Chen and Cheung [3], provides support for positive effects on student learning outcomes, including academic achievement. However, academic performance must be interpreted alongside the quality and independence of student learning. The ability to produce completed assignments, generate technically correct responses or improve written presentation does not necessarily demonstrate conceptual understanding, knowledge retention or the ability to apply learning independently.

This distinction is particularly important in the context of higher education, where academic achievement is expected to reflect the development of knowledge and competencies required for professional and intellectual practice. Students should be able to explain their conclusions, justify decisions and apply concepts beyond the specific tasks for which AI assistance was provided.

In Zambia, the growing use of GenAI among university students provides a relevant foundation for examining its educational implications. Mudenda *et al*. [9] demonstrate substantial awareness and adoption of ChatGPT among students from selected universities. Nevertheless, evidence of technology adoption should not be confused with evidence of improved academic achievement. Further research is needed to examine relationships between different patterns of AI use, assessment performance, conceptual understanding and independent application of knowledge.

7. Critical issues in the integration of generative artificial intelligence in higher education

7.1 Academic integrity and responsible AI use

Academic integrity is a fundamental principle of higher education, requiring students to demonstrate honesty, accountability and originality in their academic activities. The emergence of GenAI has complicated conventional understandings of authorship and independent academic work because students can now generate essays, reports, research summaries, computer code and other academic outputs with relatively little effort.

The use of GenAI does not automatically constitute academic misconduct. Students may legitimately use these technologies to clarify concepts, obtain feedback, generate practice questions and improve their understanding of academic materials. However, problems arise when AI-generated content is submitted as independent work without appropriate acknowledgement, verification or meaningful student contribution.

A particularly important concern is the difficulty of distinguishing between acceptable assistance and inappropriate delegation. For example, using AI to identify grammatical errors in a student's own writing differs substantially from asking an AI system to produce an entire assignment that the student submits without understanding or evaluating its contents.

This distinction requires higher education institutions to establish clear policies defining acceptable and unacceptable forms of AI assistance. Such policies should explain

disclosure requirements, permitted uses, prohibited practices and the responsibilities of students when AI-generated material contributes to academic submissions.

Lecturers also need guidance on designing assessments that remain meaningful in environments where AI-generated responses are readily available. Rather than relying exclusively on detecting AI-generated text, institutions should emphasise the demonstration of understanding through practical activities, oral explanations, supervised assessments and the ability to defend academic arguments.

Academic integrity in the age of GenAI should therefore focus not only on identifying inappropriate use but also on developing a culture of responsible technological engagement and student accountability.

7.2 Accuracy, misinformation and reliability of AI-generated content

The reliability of AI-generated information presents another significant challenge for higher education. Although GenAI systems can produce detailed and coherent responses, their outputs are not necessarily factually accurate. They may generate incorrect explanations, misrepresent academic arguments, provide outdated information or produce references that cannot be verified.

This limitation is particularly important in research and academic writing, where the accuracy of information and credibility of sources are essential. Students who rely on generated references without checking the original publications may unintentionally introduce fabricated or misleading citations into their assignments and research projects.

The problem also extends to technical and professional subjects. Incorrect explanations, programming solutions or procedural recommendations may affect students' understanding and practical competence if they are accepted without verification.

Consequently, students should be encouraged to treat AI-generated content as information requiring evaluation rather than as an authoritative academic source. They should verify important claims against scholarly publications, textbooks, official documentation and other credible sources.

Lecturers have an important role in developing these verification skills. Learning activities can require students to identify inaccurate AI-generated statements, locate supporting evidence and explain why particular responses are incomplete or misleading.

The ability to recognise the limitations of AI-generated information should therefore form an essential component of AI literacy in higher education.

7.3 Bias, fairness and ethical considerations

GenAI systems may reproduce biases present in their training data, including social, cultural, linguistic and geographical biases. These limitations may influence the examples, explanations and recommendations generated by AI applications.

In higher education, biased outputs can affect how students interpret social issues, evaluate evidence and understand knowledge produced in different geographical and cultural contexts. For institutions in developing countries, an additional concern is that AI-generated explanations may prioritise examples and perspectives from regions that are more strongly represented in the systems' training data.

For Zambian students, this may create situations in which generated academic explanations do not adequately reflect local institutions, policies, professional environments or social conditions. Students may therefore need to supplement AI-generated information with relevant Zambian research, official publications and locally grounded examples.

Ethical concerns also extend to transparency, accountability and the appropriate use of personal information. Students and lecturers should understand what information they submit to AI platforms, how that information may be processed and whether confidential academic or institutional information is appropriate for use with external systems.

Institutions should consequently promote responsible use that considers fairness, transparency, accountability, privacy and respect for the intellectual contributions of others.

7.4 Data privacy and information security

The integration of GenAI into higher education introduces data protection and information security concerns. Students and lecturers may submit personal information, academic records, research materials, unpublished work and institutional information to AI platforms. Depending on the platform and its settings, submitted information may be processed or retained under conditions that users do not fully understand.

This creates potential risks where confidential information is entered into external AI applications without appropriate institutional authorisation. Research students, for example, may inadvertently submit sensitive interview information, unpublished findings or identifiable participant details when seeking assistance with data analysis or academic writing.

Universities should therefore establish guidance on the types of information that may be entered into public AI systems and the circumstances under which institutionally approved tools should be used. Particular attention should be given to confidential research data, personal information, examination materials and institutional records.

Students and staff should also be encouraged to review platform privacy settings and terms of use before submitting information. Where personal or research data is involved, applicable data protection requirements and research ethics procedures should take precedence over convenience.

Data privacy should therefore be treated as a central consideration in institutional AI governance rather than as an issue limited to technical departments.

7.5 Unequal access and the digital divide

The educational benefits of GenAI may not be equally available to all students. Access to reliable internet connectivity, suitable devices, affordable data and appropriate digital infrastructure can influence whether students are able to use AI applications consistently.

Students with reliable connectivity and access to suitable devices may have more opportunities to explore AI-supported learning than those who experience frequent internet interruptions, limited data availability or inadequate computing resources. Differences in digital literacy may further influence the ability of students to use these tools effectively.

These inequalities are particularly relevant to higher education institutions operating in developing contexts. Although GenAI may provide additional learning support, unequal access could create new differences in academic opportunities if some students are able to benefit from AI

assistance while others cannot.

There is also a distinction between access to an AI application and access to its full capabilities. Different platforms and subscription arrangements may provide different levels of functionality. Consequently, students' educational experiences may vary according to the tools and resources available to them.

Universities should therefore consider digital inclusion when developing AI integration policies. This may involve improving access to institutional digital facilities, providing appropriate connectivity, promoting digital literacy and ensuring that essential learning activities do not depend exclusively on access to paid AI services.

Responsible integration should aim to reduce educational inequalities rather than create additional barriers for students with limited technological resources.

7.6 AI literacy and lecturer preparedness

Effective integration of GenAI requires both students and lecturers to develop appropriate knowledge and competencies. AI literacy involves understanding the capabilities and limitations of AI systems, evaluating generated information and making informed decisions about their use.

For students, AI literacy is necessary to formulate useful prompts, assess the reliability of generated responses, recognise possible bias and maintain academic responsibility. Without these competencies, students may misunderstand the capabilities of AI systems or rely excessively on generated content.

Lecturer preparedness is equally important. Lecturers need to understand how students may use GenAI in their disciplines, identify appropriate learning applications and develop assessment strategies that encourage meaningful intellectual engagement.

However, technological familiarity alone is insufficient. Effective lecturer preparedness also requires pedagogical judgement. Lecturers must determine which activities benefit from AI assistance, which competencies require independent demonstration and how students can be guided towards responsible use.

Professional development programmes should therefore combine technical AI literacy with teaching strategies, assessment design, academic integrity and ethical considerations.

Universities should also recognise that AI applications and their capabilities change rapidly. AI literacy should consequently be approached as an ongoing institutional development priority rather than a once-off training activity.

7.7 Institutional policy and governance

The integration of GenAI requires institutional guidance that establishes clear expectations for students, lecturers, researchers and administrators. Without appropriate policies, different departments may develop inconsistent practices concerning acceptable AI use, disclosure, assessment and academic misconduct.

Institutional AI governance should provide a coherent framework for addressing the educational, ethical, legal and operational implications of GenAI. Such guidance should identify approved or restricted applications where appropriate, clarify the responsibilities of users and establish procedures for handling concerns involving academic integrity, privacy and inappropriate use.

A useful institutional approach should distinguish between different academic activities. For example, AI assistance may be permitted for brainstorming or language improvement in one assignment but restricted during a supervised examination. Policies should therefore communicate expectations at the level of specific learning activities rather than relying exclusively on broad statements either permitting or prohibiting AI use.

Institutional governance should also involve lecturers, students, information technology personnel, research offices and academic management. This collaborative approach can help ensure that policies reflect actual teaching and learning practices while addressing institutional risks.

In the Zambian context, institutional approaches should also be informed by relevant national policy direction, particularly the Zambia National Artificial Intelligence Strategy 2024–2026 [2]. The strategy provides a national policy context for considering the development and responsible application of AI. However, higher education institutions still need to translate national priorities into practical academic policies, staff development initiatives and student guidance.

7.8 Critical synthesis

The integration of GenAI in higher education presents a combination of educational opportunities and institutional challenges. Academic integrity, information reliability, bias, data privacy, unequal access, AI literacy and institutional governance are interconnected issues that influence the conditions under which students and lecturers use these technologies.

These challenges demonstrate that the educational value of GenAI cannot be determined solely by the capabilities of the applications or the frequency with which students use them. Its influence is also shaped by the quality of institutional guidance, the availability of digital resources, lecturer preparedness and students' ability to evaluate generated information.

For developing higher education systems, these concerns are particularly important because technological adoption may progress faster than institutional capacity to regulate and support its use. Without adequate guidance, students may adopt AI applications informally, creating differences in practice across courses and departments. At the same time, restrictive approaches that do not recognise the potential educational benefits of GenAI may prevent institutions from exploring useful applications.

The challenge is therefore to establish a balanced approach that promotes innovation while protecting academic standards, student development and institutional responsibilities.

This review argues that responsible GenAI integration requires coordinated action at student, lecturer and institutional levels. Students need AI literacy and academic responsibility; lecturers need pedagogical and assessment competencies; and institutions need clear policies, digital infrastructure and appropriate governance arrangements.

These conditions provide an important foundation for examining how GenAI can be integrated into Zambian higher education in ways that promote higher-order thinking, learner autonomy and genuine academic achievement.

8. Generative artificial intelligence in the Zambian higher education setup

8.1 The development of artificial intelligence in Zambia

Zambia's engagement with artificial intelligence is developing within a broader national agenda focused on digital transformation, technological innovation and the application of emerging technologies to socioeconomic development. The National Artificial Intelligence Strategy 2024–2026 identifies AI as an important area of national development, with attention to enabling infrastructure, skills development, innovation and responsible utilisation [2].

This policy direction provides an important foundation for considering the role of AI in higher education. Universities are expected to contribute to national technological development by preparing graduates with the knowledge, digital competencies, research capabilities and problem-solving skills required in an increasingly technology-driven environment.

The growing availability of GenAI applications presents opportunities for universities to strengthen teaching, learning, academic research and institutional productivity. Students can access conversational AI tools to obtain explanations, explore research topics, practise problem-solving and receive additional learning support. Lecturers may also use these technologies to develop teaching materials, generate learning activities and explore alternative instructional approaches.

However, the adoption of AI in higher education requires more than the availability of digital applications. It also requires appropriate institutional policies, technological infrastructure, lecturer preparedness, student AI literacy and mechanisms for protecting academic integrity. The national strategy provides a policy direction, but universities must translate this direction into practical approaches that reflect their educational priorities and institutional capacities.

8.2 Evidence of generative AI adoption among Zambian university students

An important contribution to the understanding of GenAI adoption in Zambia is the multi-institutional study by Mudenda *et al.* [9], titled Integrating Generative Artificial Intelligence in African Higher Education: University Students' Awareness, Attitudes, and Use of ChatGPT in Zambia.

The study involved 1,829 university students from five Zambian universities and examined their awareness, attitudes and utilisation of ChatGPT. Its findings provide empirical evidence that generative AI is already part of the academic experiences of many students in the country.

The study reported the following findings:

- 96.8% of participants had heard of ChatGPT.
- 85.6% had previously used ChatGPT.
- 73.3% perceived ChatGPT as easy to use.
- 64.0% perceived ChatGPT as useful.
- 74.8% perceived high risks associated with its use.

The findings indicate substantial awareness and adoption among the surveyed students. They also reveal that perceived usefulness and perceived risks coexist, suggesting that students recognise both the potential benefits and possible limitations of the technology.

These results are important because they challenge the assumption that GenAI is still an unfamiliar technology within Zambian university environments. Instead, the evidence suggests that many students have already begun incorporating conversational AI into their academic activities.

Nevertheless, the findings must be interpreted within the scope of the study. Mudenda *et al.* [9] primarily investigated awareness, attitudes and usage patterns. The reported percentages should not be interpreted as measurements of improvements or declines in critical thinking, learner autonomy or academic achievement.

This distinction is essential to the present review. Evidence that students use GenAI establishes the relevance of the technology to higher education, but it does not independently establish its educational consequences.

8.3 Digital infrastructure and access to AI-supported learning

The potential contribution of GenAI to Zambian higher education must be considered alongside differences in technological access and institutional digital infrastructure.

Access to reliable internet connectivity, appropriate devices, affordable data and digital learning facilities influences the extent to which students can benefit from AI-supported learning. Students with consistent access may have more opportunities to use AI applications for revision, research, assignment preparation and independent study than students who experience connectivity limitations or lack suitable devices.

These differences may create inequalities in the availability of additional academic support. Students who can access AI applications regularly may benefit from more opportunities to obtain explanations, practise questions and receive feedback. Those with limited access may experience fewer opportunities to use such resources.

There may also be differences in the quality of access. Some AI applications provide different features depending on subscription arrangements, platform availability and technical requirements. Therefore, access to an AI application does not necessarily mean that all students have equivalent opportunities to use its full capabilities.

For universities, these issues highlight the importance of considering digital inclusion when developing AI integration strategies. Institutional computer laboratories, campus connectivity, digital libraries and student support services may contribute to more equitable access to technology-supported learning.

However, access should not be treated as the only measure of successful integration. Universities must also consider whether students possess the competencies required to use AI effectively and whether the technology contributes to the development of meaningful academic skills.

8.4 institutional readiness and lecturer preparedness in Zambia

Institutional readiness is an important condition for the effective integration of GenAI into higher education. It involves the availability of technological infrastructure, appropriate policies, staff competencies, institutional leadership and mechanisms for supporting responsible use.

The development of AI-related governance in Zambian higher education requires institutions to translate national policy direction into practical academic arrangements. Hambulo, Simataa and Musonda [12] examine the governance framework for AI in Zambian higher education in relation to the National AI Strategy 2024–2026. Their work highlights

the importance of aligning institutional governance with national policy direction.

For universities, this alignment involves establishing clear expectations concerning acceptable AI use, academic integrity, data protection, research ethics and the educational responsibilities of students and lecturers.

Lecturer preparedness is particularly important because lecturers influence how AI is incorporated into classroom activities, assignments, examinations and research supervision. Without appropriate guidance, students may develop inconsistent practices based on personal experimentation rather than structured educational objectives.

Professional development initiatives should therefore equip lecturers with the competencies required to evaluate AI applications, design appropriate learning activities, assess AI-assisted academic work and guide students in critically examining generated information.

Universities should also recognise that different academic disciplines may require different approaches. For example, the use of GenAI in programming education may involve code explanation and debugging, while its use in social sciences may involve argument evaluation, literature exploration and interpretation of theoretical perspectives.

Institutional readiness should consequently be understood as both a technological and pedagogical requirement.

8.5 Generation z and digital learning practices

Generation Z represents an important student population within contemporary higher education. Members of this generation are commonly associated with growing up during a period of expanding internet connectivity, smartphones, social media and digital communication.

These experiences may influence how students access information, communicate and interact with digital learning resources. The conversational nature of GenAI applications may therefore appeal to students who are accustomed to using interactive digital platforms.

However, it is important to avoid assuming that membership of Generation Z automatically implies high digital competence or AI literacy. Students' technological experiences may differ according to socioeconomic circumstances, geographical location, educational background, device availability and institutional resources.

Furthermore, familiarity with digital platforms does not necessarily translate into the ability to evaluate AI-generated information critically. A student may be comfortable using social media and online applications but still lack the skills required to verify generated academic claims, recognise fabricated references or identify biased explanations.

For this reason, the educational implications of GenAI should be examined in relation to students' actual knowledge, usage practices and learning behaviours rather than generational characteristics alone.

The present review therefore retains the relevance of Generation Z to contemporary university learning while recognising that digital competence and responsible AI use require deliberate development.

8.6 The research gap in the Zambian higher education

The growing body of literature on GenAI has established its potential to influence teaching, learning and academic activities. International studies have examined its relationship with academic achievement, higher-order thinking, self-regulated learning and cognitive dependence. However, the findings indicate that the educational consequences of GenAI may differ according to how students use the technology and the conditions under which it is integrated into teaching and learning.

In Zambia, the study by Mudenda *et al*. [9] provides an important empirical foundation by documenting student awareness, attitudes and use of ChatGPT across five universities. Its findings demonstrate that GenAI adoption is already a relevant issue within Zambian higher education.

Nevertheless, several areas remain insufficiently addressed.

First, the cognitive development gap: Evidence of widespread AI adoption does not establish whether students' critical thinking, analytical reasoning, evaluation, problem-solving and creativity are strengthened or weakened through different forms of AI engagement.

Second, the learner autonomy gap: There is a need for greater understanding of whether GenAI supports students in planning, monitoring and evaluating their own learning or encourages excessive reliance on generated explanations and answers.

Third, the academic achievement gap: Student perceptions of usefulness and ease of use do not establish whether AI assistance improves conceptual understanding, knowledge retention, independent application or actual assessment performance.

Fourth, the pedagogical gap: More attention is required to understanding how lecturer guidance, assessment practices, AI literacy and institutional policies influence the educational value of GenAI.

Fifth, the contextual gap: The educational implications of GenAI need to be understood within the realities of Zambian higher education, including differences in digital access, institutional resources, technological preparedness and student learning environments.

These gaps should not be interpreted as evidence that no relevant research exists in Zambia. Rather, they indicate that the available evidence on adoption and attitudes needs to be complemented by research and conceptual analysis focused more directly on educational processes and outcomes.

8.7 Implications for Zambian universities

The preceding discussion has several implications for universities in Zambia.

First, institutions should move beyond approaches that focus exclusively on whether students are using AI. Greater attention should be given to how students use these technologies and whether their use contributes to the development of knowledge, independent reasoning and academic competence.

Second, AI literacy should be incorporated into student development and lecturer professional development. Students should understand the limitations of AI-generated information, while lecturers should be equipped to guide responsible use within their disciplines.

Third, universities should develop clear institutional policies that explain acceptable AI assistance, academic disclosure requirements, data protection responsibilities and assessment expectations.

Fourth, assessment strategies should increasingly incorporate opportunities for students to demonstrate independent understanding. Practical demonstrations, oral

explanations, supervised activities and reflective assessments can complement conventional written assignments.

Finally, institutions should consider digital inclusion when implementing AI-supported learning initiatives. The benefits of GenAI should not be limited to students who can afford premium services or consistently access reliable internet connectivity.

These implications provide a basis for developing a framework that connects responsible AI use with cognitive development, learner autonomy and genuine academic achievement.

8.8 Integrative analysis

The Zambian higher education context presents both opportunities and challenges for the integration of GenAI. National policy direction provides a foundation for AI development, while the findings of Mudenda *et al*. [9] demonstrate substantial awareness and adoption of ChatGPT among students at selected universities.

However, adoption should not be equated with educational transformation. The extent to which GenAI contributes to meaningful learning depends on students' patterns of engagement, institutional readiness, lecturer guidance, digital access and the effectiveness of assessment practices.

The evidence also suggests that universities need to avoid two extreme approaches: unrestricted adoption without adequate educational guidance and complete rejection of a technology that may offer useful learning support. A more balanced approach would promote responsible experimentation while preserving academic standards and the intellectual independence of students.

The central issue for Zambian higher education is therefore how to integrate GenAI in ways that support technological innovation without weakening the educational purpose of developing knowledgeable, critical, autonomous and competent graduates.

This challenge provides the justification for a contextually relevant framework that connects AI literacy, critical evaluation, independent reasoning, ethical use and assessment of genuine understanding.

9. Proposed responsible generative AI integration framework

9.1 Rationale for the proposed framework

The preceding sections demonstrate that the educational influence of generative artificial intelligence (GenAI) is not determined solely by its availability or frequency of use. Rather, its contribution to higher education depends on the manner in which students interact with AI-generated information, the extent to which they retain responsibility for their intellectual activities, and the pedagogical and institutional conditions within which the technology is adopted. Consequently, the educational value of GenAI should be examined in relation to the quality of students' engagement with learning activities rather than technological adoption alone.

The literature reviewed identifies opportunities for GenAI to support critical thinking, analytical reasoning, self-directed learning, conceptual understanding and academic performance. However, these opportunities exist alongside concerns regarding cognitive offloading, excessive dependence, academic integrity, inaccurate information, algorithmic bias and unequal access to technological resources. This dual character suggests that GenAI can function either as a resource that extends students' learning capabilities or as a substitute for the intellectual activities through which knowledge and academic competence are developed. The challenge for higher education institutions is therefore to establish conditions under which technological assistance complements rather than displaces independent learning.

In response to these concerns, this article proposes the Responsible Generative AI Integration Framework for Independent Learning and Cognitive Development in Zambian Higher Education (RGAI Framework). The framework provides a conceptual approach for understanding how responsible GenAI integration can be aligned with the educational purposes of higher education. It is intended to guide universities, lecturers and students in using generative AI to support learning while maintaining student intellectual agency, academic responsibility and independent reasoning.

The framework is conceptually informed by the three theoretical perspectives discussed in Section 3: Constructivist Learning Theory, Self-Regulated Learning Theory and Cognitive Offloading Theory. Constructivist Learning Theory informs the emphasis on active knowledge construction and meaningful engagement with information. Self-Regulated Learning Theory provides a basis for promoting students' responsibility for planning, monitoring and evaluating their learning. Cognitive Offloading Theory explains the importance of distinguishing between the productive use of external technological assistance and the delegation of essential cognitive activities. The framework also builds on the five pillars identified in the original research proposal and the educational challenges synthesised throughout this review.

Its central proposition is that GenAI can contribute to meaningful educational outcomes when students possess the competencies to use it effectively, critically evaluate its outputs, retain responsibility for independent reasoning, observe ethical requirements and demonstrate genuine understanding through appropriate assessment. These practices require institutional support, lecturer guidance and equitable access to digital resources. The framework therefore brings together student competencies, pedagogical practices and institutional responsibilities within a single conceptual structure.

9.2 Structure of the proposed framework

The proposed RGAI Framework consists of five interconnected pillars, supported by three institutional enabling conditions and directed towards three principal educational outcomes. The five pillars are AI literacy and technological competence; critical evaluation of AI-generated information; independent reasoning and problem-solving; ethical AI use and academic integrity; and assessment strategies that measure genuine understanding. Together, these pillars describe the competencies and practices required to ensure that GenAI contributes constructively to students' academic development.

The operation of the five pillars is supported by three enabling conditions: lecturer guidance and pedagogical support, institutional policies and governance, and digital infrastructure and equitable access. These conditions recognise that responsible AI integration cannot depend exclusively on individual students. Lecturers must provide

appropriate learning guidance, universities must establish institutional expectations and safeguards, and students must have reasonable access to the technological resources required to participate in AI-supported learning.

The framework identifies three intended educational outcomes: improved higher-order thinking, strengthened learner autonomy and meaningful academic achievement. Higher-order thinking encompasses students' abilities to analyse, evaluate, create, reason and solve problems. Learner autonomy concerns their capacity to direct, monitor and evaluate their own learning. Meaningful academic achievement extends beyond the completion of academic tasks to include conceptual understanding, knowledge application and the ability to demonstrate acquired competencies independently.

The five pillars are mutually reinforcing rather than independent activities that can be implemented in isolation. AI literacy provides students with the foundational knowledge required to interact effectively with GenAI, while critical evaluation enables them to assess the accuracy, relevance and reliability of generated information. Independent reasoning ensures that students remain actively involved in intellectual tasks, while ethical use establishes accountability and academic responsibility. Assessment strategies provide opportunities to determine whether students have developed the knowledge and competencies that academic activities are intended to measure.

The three enabling conditions create the environment within which these pillars can operate effectively. For example, students may receive AI literacy training, but without lecturer guidance they may lack direction on how to apply their skills to specific learning objectives. Similarly, institutional policies may establish appropriate standards, but their implementation may be constrained by inadequate internet connectivity, limited access to devices or insufficient institutional resources. The framework therefore assumes that meaningful GenAI integration requires coordination between student competencies, teaching practices and institutional support.

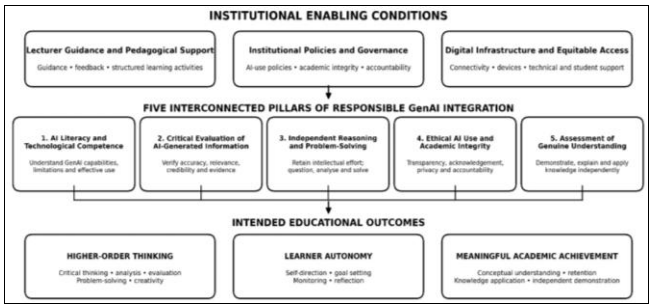

Fig 1: Proposed Responsible Generative AI Integration Framework for Independent Learning and Cognitive Development in Zambian Higher Education

9.3 The five pillars of the framework

9.3.1 Pillar one: AI literacy and technological competence

AI literacy and technological competence constitute the foundational pillar of responsible GenAI integration. Students require more than the ability to access and operate AI applications; they need an understanding of how generative AI systems produce responses, the types of tasks for which they may be useful and the limitations that may affect the reliability of their outputs. Without this foundational understanding, students may struggle to distinguish between information that is credible and information that is inaccurate, incomplete or misleading.

This pillar encompasses the ability to interact effectively with GenAI systems, formulate appropriate prompts, interpret generated responses and recognise the limitations of automated information generation. It also includes an understanding of fabricated references, inaccurate outputs, algorithmic bias, data privacy and the importance of independently verifying information. AI literacy should therefore be understood as a combination of technical competence, critical awareness and responsible decision-making rather than merely familiarity with particular applications.

In higher education, this pillar can be developed through structured AI literacy programmes, introductory training, discipline-specific learning activities and continuous digital skills development. For example, students may be taught to use ChatGPT or other conversational AI applications to explore academic concepts, generate practice questions or obtain alternative explanations. However, such activities should also require them to verify generated information against credible academic publications and other authoritative learning resources. Through this approach, students learn not only how to use GenAI but also how to judge when its outputs are appropriate and when independent investigation is necessary.

The contribution of this pillar is to establish the knowledge and technological competence required for informed GenAI utilisation. It provides the foundation upon which critical evaluation, independent reasoning and ethical use can be developed. In the context of Zambian higher education, its implementation should take account of differences in students' previous digital experiences, access to devices and opportunities for technology-related training.

9.3.2 Pillar two: critical evaluation of AI-generated information

The second pillar emphasises the ability of students to critically examine AI-generated information before accepting, applying or incorporating it into academic work. Although GenAI systems can produce detailed explanations, coherent arguments and convincing responses, the apparent fluency of generated content does not guarantee factual accuracy, academic validity or completeness. Outputs may contain unsupported claims, fabricated references, biased interpretations or omissions that are not immediately apparent to inexperienced users. Students must therefore develop the ability to assess the credibility, relevance, consistency and accuracy of information generated by these systems.

Critical evaluation requires students to move beyond simply receiving AI-generated answers towards actively questioning and examining them. This includes comparing generated information with scholarly literature, checking references, identifying unsupported assumptions, recognising inconsistencies and considering alternative explanations. It also involves distinguishing between an explanation that appears convincing and one that is supported by reliable academic evidence. This process is important because students remain responsible for the academic arguments, interpretations and conclusions presented in their work, even when AI tools have assisted in producing them.

Lecturers can operationalise this pillar through learning

activities that position AI-generated content as material for academic examination. For example, students may be provided with an AI-generated explanation of a theoretical concept and asked to compare it with established academic literature. They would then identify areas of agreement, inaccuracies, omissions and unsupported claims before developing their own evidence-based explanation. Such an activity requires students to engage with both the AI-generated response and authoritative academic sources rather than treating the technology as an unquestioned source of knowledge.

This pillar is particularly important for developing critical thinking, analytical reasoning and academic judgement. It also strengthens the connection between AI literacy and higher-order thinking by ensuring that students use their technological knowledge to make informed intellectual decisions. Within the proposed framework, GenAI is consequently positioned not as an unquestionable academic authority but as a resource whose outputs must be examined, verified and interpreted critically.

9.3.3 Pillar three: Independent reasoning and problem-solving

The third pillar seeks to preserve students' ability to undertake intellectual activities independently, even when AI assistance is readily available. A central purpose of higher education is to develop graduates who can analyse problems, formulate arguments, evaluate alternatives, make informed decisions and generate appropriate solutions. These capabilities require sustained cognitive engagement and opportunities for students to practise reasoning independently. The availability of GenAI should therefore complement these processes rather than replace them.

Under this pillar, students should be encouraged to attempt academic problems independently before requesting AI assistance. They may subsequently use GenAI to compare possible approaches, obtain feedback, identify errors or explore alternative solutions. This sequence allows students to benefit from technological assistance while retaining responsibility for understanding the problem and evaluating the suitability of proposed solutions. It also reduces the possibility that students will routinely delegate essential reasoning activities to AI systems without developing the competencies required to perform those activities themselves.

For example, a computer science student may first attempt to develop a programming solution independently before using GenAI to examine possible improvements, understand error messages or compare alternative algorithms. The student should then be able to explain the underlying programming principles, justify the selected approach and demonstrate how the solution works. In this situation, AI functions as a supplementary learning resource, while the student remains responsible for the intellectual decisions involved in solving the problem.

Lecturers can reinforce this pillar through practical exercises, independent assignments, problem-based learning, oral explanations and activities requiring students to justify their decisions. Assessment activities should also provide opportunities for students to demonstrate that they can transfer acquired knowledge to unfamiliar situations without depending entirely on generated responses. The intended contribution is to ensure that AI assistance does not eliminate the intellectual practice necessary for developing higher-order thinking, problem-solving competence and independent academic judgement.

9.3.4 Pillar four: ethical AI use and academic integrity

The fourth pillar establishes the ethical responsibilities associated with the use of GenAI in academic environments. Although AI applications can assist students in generating ideas, organising information, preparing drafts and exploring academic concepts, their use does not remove students' responsibility for the accuracy, originality and integrity of submitted academic work. Students must understand that technological assistance does not transfer academic accountability from the individual to the AI system.

This pillar promotes transparency, accountability, appropriate acknowledgement of AI assistance and compliance with institutional academic integrity requirements. It also addresses the responsible handling of information, including the protection of personal data, confidential research materials and unpublished academic work. Students should understand the risks associated with submitting sensitive information to external AI platforms and should avoid uploading confidential materials without appropriate authorisation.

At institutional level, universities should establish clear guidelines explaining acceptable and unacceptable uses of GenAI across different academic activities. Such guidelines should distinguish between activities where AI assistance is permitted, activities where disclosure is required and assessments in which independent student performance is expected. They should also provide clear expectations regarding authorship, acknowledgement, verification of AI-generated references and accountability for submitted work. Because acceptable use may differ across academic disciplines and assessment contexts, institutional guidance should allow for appropriate discipline-specific requirements while maintaining consistent principles of academic integrity.

The contribution of this pillar is to develop responsible AI practices while maintaining academic honesty, accountability and institutional trust. It recognises that responsible GenAI integration is not simply a matter of technological competence but also involves ethical judgement and compliance with established academic standards.

9.3.5 Pillar five: Assessment strategies that measure genuine understanding

The fifth pillar addresses the need to ensure that academic assessment continues to provide meaningful evidence of student learning in environments where AI-generated content is readily available. Assessment is expected to establish the extent to which students have acquired knowledge, developed relevant competencies and can apply what they have learned. However, assessment approaches that depend heavily on unsupervised written assignments may face limitations in demonstrating individual understanding when students can obtain substantial assistance from generative AI systems.

The framework therefore proposes assessment strategies that examine students' ability to explain concepts, defend arguments, apply knowledge and demonstrate practical competence. These may include oral examinations, academic presentations, supervised practical demonstrations, individual problem-solving exercises, reflective learning reports, project demonstrations and follow-up questioning. Such approaches should complement

rather than necessarily replace conventional written assessments. Their purpose is to provide additional evidence of students' intellectual contribution and their ability to demonstrate knowledge independently.

For example, a student submitting an AI-assisted research assignment may also be required to explain the research methodology, justify the arguments presented, identify the limitations of the work and respond to questions about its findings. Similarly, a programming student may submit a completed project and subsequently demonstrate its operation, explain important sections of the code and respond to questions requiring modifications or further application. These activities enable lecturers to examine whether the submitted work reflects meaningful understanding and whether students can independently apply the knowledge presented.

Assessment redesign should also recognise that different disciplines require different forms of evidence of learning. Practical programmes may place greater emphasis on demonstrations and performance-based assessments, while theoretical disciplines may incorporate oral defence, critical analysis and evidence-based argumentation. The important consideration is that assessment methods should remain aligned with intended learning outcomes and provide reasonable opportunities to establish students' individual understanding.

The contribution of this pillar is to strengthen the relationship between academic assessment and genuine learning. Rather than focusing exclusively on the quality, presentation or completion of submitted outputs, assessment should establish whether students can explain, evaluate, apply and independently demonstrate the knowledge and competencies expected of them.

9.4 Institutional enabling conditions

Although the five pillars describe the competencies and practices required for responsible GenAI integration, their implementation depends on an enabling institutional environment. Students cannot be expected to use AI responsibly without appropriate academic guidance, institutional standards and access to relevant technological resources. The proposed framework therefore identifies three interconnected institutional enabling conditions: lecturer guidance and pedagogical support, institutional policies and governance, and digital infrastructure and equitable access. These conditions are intended to support the implementation of all five pillars rather than operate as separate educational outcomes.

9.4.1 Lecturer guidance and pedagogical support

Lecturers play a central role in determining how GenAI is incorporated into teaching and learning. Their responsibility extends beyond introducing students to AI applications to establishing appropriate learning expectations, guiding students in evaluating generated information and designing academic activities that preserve independent intellectual engagement. The educational contribution of GenAI is likely to depend partly on whether lecturers can integrate the technology into learning activities that promote questioning, critical evaluation, reflection and problem-solving rather than simply encourage faster task completion.

Lecturer preparedness should therefore encompass AI literacy, an understanding of the limitations of generative systems, assessment redesign and the ability to develop discipline-specific applications of AI. Professional development programmes should enable lecturers to identify appropriate uses of GenAI within their subjects, establish clear expectations for student participation and distinguish between productive technological assistance and excessive dependence. For example, lecturers may design activities in which students use AI to generate an initial explanation or solution and subsequently evaluate its accuracy, identify weaknesses and defend an independently developed response.

Universities should provide continuous professional development, practical training and opportunities for lecturers to share effective teaching practices. Such support is particularly important because AI technologies and their educational applications continue to evolve. Through appropriate pedagogical guidance, lecturers can help ensure that GenAI contributes to active learning while students retain responsibility for their academic decisions and intellectual development.

9.4.2 Institutional policies and governance

Institutional policies and governance provide the organisational foundation for responsible GenAI integration. While individual students and lecturers make decisions about AI use in particular learning situations, universities must establish consistent expectations governing its application across teaching, learning, research and assessment. Without clear institutional guidance, students may receive inconsistent instructions regarding acceptable AI assistance, disclosure requirements and academic accountability. This may create uncertainty and contribute to differences in how academic integrity requirements are interpreted and implemented.

The proposed framework therefore emphasises the development of institutional guidelines addressing acceptable AI use, academic integrity, disclosure of AI assistance, data protection, research ethics and accountability for submitted academic work. Such policies should distinguish between different academic contexts and recognise that the appropriate level of AI assistance may vary according to course objectives, assessment requirements and professional expectations. They should also provide guidance on the verification of AI-generated references, protection of confidential information and the responsible use of external AI platforms.

Effective governance requires participation from relevant university stakeholders, including academic departments, information technology units, research offices, quality assurance offices, student representatives and university management. This collaborative approach can help ensure that institutional policies address both technological and educational considerations. Policies should also be reviewed periodically to accommodate changes in AI capabilities, emerging risks and developments in national and international guidance. In the Zambian context, institutional governance should be informed by relevant national policy priorities, including the National Artificial Intelligence Strategy 2024–2026 [2].

9.4.3 Digital infrastructure and equitable access

Digital infrastructure and equitable access constitute the third enabling condition because students' ability to benefit from GenAI is influenced by the availability, affordability and reliability of technological resources. Access to appropriate devices, internet connectivity, digital platforms and technical support may differ across universities and among students within the same institution. These

differences can influence the extent to which learners participate in AI-supported academic activities and benefit from the opportunities provided by generative technologies.

The framework therefore recognises that responsible GenAI integration should not assume that all students have equal access to technological resources. Universities should consider the availability of reliable internet connectivity, appropriate computer facilities, digital learning resources and institutional technical support when developing AI integration initiatives. Particular attention should be given to students who experience financial, geographical or technological constraints that limit their participation in digital learning environments.

Equitable access also involves ensuring that AI integration does not create additional disadvantages for students who cannot afford paid AI subscriptions or consistently access reliable internet services. Institutions should explore appropriate access arrangements, provide alternative learning resources where necessary and ensure that students are not unfairly disadvantaged because of differences in technological access. In this respect, digital infrastructure is not merely a technical requirement but an important condition for inclusive educational participation.

For Zambian universities, implementation of this enabling condition should take account of institutional differences in technological readiness, available resources and student needs. Strengthening digital infrastructure and equitable access would provide a more supportive environment for implementing the five pillars and reducing the possibility that GenAI-related educational opportunities are concentrated among students with greater technological and financial resources.

9.5 Intended educational outcomes of the framework

The proposed RGAI Framework is directed towards three interconnected educational outcomes: higher-order thinking, learner autonomy and meaningful academic achievement. These outcomes represent the educational competencies and forms of learning that responsible GenAI integration is intended to support. They are not assumed to emerge automatically from the adoption of AI technologies. Rather, their development is expected to depend on the quality of implementation of the five pillars and the effectiveness of the institutional enabling conditions.

9.5.1 Higher-order thinking

The first intended outcome is the development of higher-order thinking, particularly students' abilities to analyse information, evaluate arguments, formulate independent conclusions, solve problems and generate appropriate solutions. The framework seeks to achieve this by combining AI literacy with critical evaluation and independent reasoning. Students should be able to use GenAI to explore different perspectives and obtain explanations while retaining the responsibility to question generated information, examine evidence and justify their conclusions.

The framework therefore positions higher-order thinking as an outcome of active intellectual engagement rather than the mere ability to generate or reproduce information. Its educational contribution should be reflected in students' capacity to evaluate AI-generated responses, identify weaknesses in arguments, apply knowledge to unfamiliar problems and develop reasoned solutions. These capabilities are particularly important in higher education because graduates are expected to demonstrate independent judgement in academic, professional and social environments.

9.5.2 Learner autonomy

The second intended outcome is strengthened learner autonomy. This refers to students' capacity to take responsibility for their educational development by identifying learning needs, establishing objectives, selecting appropriate resources, monitoring progress and evaluating their understanding. The framework seeks to ensure that GenAI supports these processes without replacing students' responsibility for directing their own learning.

Through AI literacy, critical evaluation and responsible use, students should become better equipped to make informed decisions about when and how to use AI assistance. Lecturer guidance and appropriate learning activities should further encourage students to engage in independent study, reflect on their learning and assess the usefulness of AI-generated feedback. The intended outcome is not the elimination of technological assistance but the development of learners who can use available resources while maintaining control over their academic decisions and intellectual responsibilities.

9.5.3 Meaningful academic achievement

The third intended outcome is meaningful academic achievement. Within the proposed framework, academic achievement is understood beyond the completion of assignments or the production of well-presented academic work. It also encompasses conceptual understanding, knowledge application, problem-solving competence and the ability to demonstrate acquired learning independently.

The assessment pillar is particularly important in achieving this outcome because it encourages institutions to evaluate whether students understand and can apply the knowledge presented in their academic work. When combined with independent reasoning and critical evaluation, appropriate assessment strategies can provide stronger evidence of students' academic competence. The framework therefore seeks to promote an understanding of academic achievement that recognises both the quality of academic performance and the learning processes and competencies underlying that performance.

The three outcomes are interconnected. Higher-order thinking supports students in evaluating information and applying knowledge, while learner autonomy encourages sustained engagement and responsibility for learning. Together, these capabilities can contribute to meaningful academic achievement. However, the framework does not assume that the outcomes will necessarily improve whenever its pillars are introduced. Their development will depend on implementation quality, student engagement, institutional support and the characteristics of the learning environment.

9.6 Conceptual operation of the proposed framework

The proposed framework conceptualises responsible GenAI integration as a relationship between student competencies and practices, institutional enabling conditions and educational outcomes. The five pillars represent the principal dimensions through which responsible GenAI utilisation is expected to be promoted. The three enabling conditions provide the pedagogical, governance and technological environment within which these dimensions can be implemented. The intended outcomes represent the

educational competencies and achievements that the framework seeks to strengthen.

The framework proposes that AI literacy, critical evaluation, independent reasoning, ethical use and assessment practices operate collectively to influence the educational value of GenAI utilisation. Their effectiveness is supported by lecturer guidance, institutional governance and equitable digital access. For example, students may possess the technical ability to use GenAI, but without critical evaluation skills they may accept inaccurate information. Similarly, students may understand the importance of independent reasoning, but assessment practices that reward only completed outputs may provide insufficient opportunities to demonstrate that competence. The framework therefore emphasises the importance of aligning student practices, teaching approaches and institutional arrangements.

For conceptual clarity, GenAI integration represents the broad area of technological utilisation being examined, while the five pillars describe the dimensions of responsible integration proposed by this article. The institutional enabling conditions describe the environment within which those dimensions operate. Higher-order thinking, learner autonomy and academic achievement constitute the intended educational outcomes. These relationships are conceptual propositions rather than statistically established causal relationships. The review does not claim to have empirically tested the framework or established the magnitude of influence of one component on another.

9.7 Application of the framework in Zambian universities

The framework is proposed as a conceptual guide for universities seeking to integrate GenAI into teaching, learning and academic assessment in Zambia. Its application should begin with an institutional assessment of existing AI awareness, student digital competencies, lecturer preparedness, technological infrastructure and access to AI-supported learning resources. Such an assessment would help universities identify their levels of readiness and determine which areas require attention before expanding AI-supported educational initiatives.

Following the institutional assessment, universities should establish or strengthen policies governing the use of generative AI and provide appropriate training for lecturers and students. These initiatives should communicate expectations concerning acceptable AI use, academic integrity, disclosure of AI assistance, information verification and data protection. Institutional guidelines should also provide sufficient flexibility for academic departments to determine how GenAI can be appropriately incorporated into different disciplines and assessment contexts.

Academic departments could then translate the five pillars into discipline-specific learning activities. For example, computer science departments may emphasise independent programming, code evaluation and the verification of AI-generated solutions. Research-oriented programmes may focus on source verification, argument development, research ethics and the responsible use of AI in academic writing. Similarly, programmes involving practical or professional competencies may incorporate activities requiring students to demonstrate their understanding and independently justify decisions made with the assistance of AI tools.

Assessment practices should be reviewed to ensure that students have opportunities to demonstrate independent understanding, practical competence and the ability to apply knowledge to unfamiliar situations. This may involve combining written assignments with oral explanations, supervised practical activities, project demonstrations and reflective assessments. Such approaches should be aligned with course learning outcomes and should not be treated as identical requirements for every discipline.

Implementation should be monitored through student feedback, lecturer experiences, institutional reviews, assessment practices and available evidence of learning outcomes. This monitoring would enable universities to identify effective approaches, recognise implementation challenges and make appropriate adjustments. However, claims about the framework's effectiveness should be based on subsequent empirical evaluation rather than assumed from its adoption.

The framework should not be interpreted as a rigid or universally applicable model. Universities may adapt its implementation according to their institutional resources, academic disciplines, student populations and technological environments while maintaining its central commitment to responsible AI use, academic integrity and independent learning.

9.8 Theoretical contribution and practical significance

The proposed framework contributes conceptually by bringing together three theoretical perspectives to explain the conditions under which GenAI may support or potentially undermine learning. Constructivist Learning Theory informs the emphasis on active knowledge construction, learner engagement and critical interaction with AI-generated information. It supports the argument that meaningful learning requires students to participate actively in interpreting information and developing their own understanding rather than simply receiving completed responses.

Self-Regulated Learning Theory provides the theoretical basis for the framework's emphasis on learner autonomy, planning, monitoring and academic responsibility. It explains why students should remain actively involved in directing their learning even when AI systems provide personalised explanations and feedback. The framework therefore positions GenAI as a resource that can support self-regulated learning without taking over the decisions and reflective activities that learners need to develop independently.

Cognitive Offloading Theory explains the need to distinguish between productive technological assistance and the delegation of essential intellectual activities. Although external tools can reduce the effort required to complete certain tasks, excessive dependence may reduce opportunities for students to practise the cognitive processes that higher education seeks to develop. This perspective informs the framework's emphasis on independent reasoning, critical evaluation and assessment of genuine understanding.

For Zambian higher education, the framework contributes a contextually relevant perspective that recognises the growing adoption of GenAI while emphasising the need to

preserve students' intellectual independence. It also provides a basis for future institutional discussions and empirical investigations concerning the relationship between responsible AI integration and educational development.

9.9 Limitations of the proposed framework

The proposed RGAI Framework is conceptual and has not yet been empirically validated in Zambian universities. Its pillars, enabling conditions and proposed relationships have been developed through the synthesis of theoretical perspectives, scholarly literature and policy considerations examined in this article. They should therefore be interpreted as a conceptual proposition rather than an empirically established model of educational effectiveness.

The framework also recognises that higher education institutions differ in their technological resources, institutional policies, academic disciplines, student populations and levels of preparedness. Consequently, its implementation may require adaptation to specific institutional circumstances. The framework does not assume that identical interventions will produce the same outcomes across all universities or academic programmes.

Future research should operationalise the framework's components and examine their applicability across different Zambian higher education institutions. Empirical studies could investigate how the five pillars relate to higher-order thinking, learner autonomy and academic achievement, while also examining how lecturer guidance, institutional governance and equitable digital access influence implementation. Such research would provide opportunities to refine the framework and assess its practical usefulness in different educational settings.

Accordingly, the principal contribution of the RGAI Framework at this stage is to provide an integrated conceptual guide for responsible GenAI utilisation in higher education. Its value lies in identifying the student competencies, pedagogical practices and institutional conditions that warrant attention when universities seek to use generative AI to support meaningful learning without compromising independent intellectual development.

10. Implications of generative artificial intelligence for higher education

The integration of generative artificial intelligence into higher education has implications that extend beyond the adoption of new technological tools. It requires universities to reconsider teaching approaches, assessment practices, student support systems and institutional governance. As discussed in the preceding sections, the educational value of GenAI depends not simply on whether students use these technologies, but on how their use is guided, monitored and incorporated into learning activities. The proposed Responsible Generative AI Integration Framework therefore provides a basis for identifying practical responsibilities among the key stakeholders in higher education.

10.1 Implications for university management and institutional leadership

University management has an important responsibility in establishing an institutional environment that supports the responsible integration of GenAI. Institutions need clear policies that define acceptable and unacceptable uses of AI tools in teaching, learning, research and assessment. Such policies should address academic integrity, transparency, privacy, accountability and the appropriate disclosure of AI-assisted work.

Institutional leadership should also invest in AI literacy programmes for both academic staff and students. These programmes should move beyond introducing users to AI applications and develop their ability to evaluate AI-generated information, recognise limitations and make responsible decisions when using these technologies.

Furthermore, universities should consider the availability of reliable internet connectivity, appropriate digital devices and institutional technical support. Unequal access to these resources may create differences in students' ability to benefit from AI-supported learning. Consequently, institutional strategies should promote equitable access rather than assuming that all students have the same technological opportunities.

10.2 Implications for lecturers and teaching practice

The emergence of GenAI requires lecturers to reconsider their instructional roles. Rather than treating AI solely as a threat to academic integrity or as a substitute for teaching, lecturers can incorporate it into structured learning activities that encourage questioning, evaluation, reflection and independent reasoning.

For example, students may be asked to generate an initial response using an AI tool and subsequently identify factual errors, evaluate the quality of the arguments and compare the generated response with credible academic sources. Such activities can encourage students to engage critically with AI-generated information instead of accepting it without examination.

Lecturers should also provide guidance on appropriate AI use and design learning activities that require students to demonstrate their own understanding. This may include oral presentations, practical demonstrations, reflective reports, problem-based assignments and supervised assessments. These approaches can help distinguish genuine learning from the ability to produce polished AI-generated responses.

Professional development is equally important. Lecturers require opportunities to develop AI literacy, understand the limitations of generative tools and explore pedagogical approaches that preserve meaningful student participation.

10.3 Implications for students

Students must remain active participants in the learning process and retain responsibility for their academic development. Although GenAI can provide explanations, examples, feedback and learning support, students should not transfer their entire reasoning and decision-making responsibilities to these systems.

Responsible use requires students to evaluate AI-generated responses, verify information using credible sources and acknowledge AI assistance where institutional requirements demand disclosure. They should also develop the ability to distinguish between using AI to support understanding and using it to complete academic tasks without meaningful intellectual engagement.

The development of self-regulated learning skills is particularly important. Students should be encouraged to establish learning goals, plan their study activities, monitor their understanding and reflect on their progress. GenAI can support these processes, but it should not replace the student's responsibility for planning, evaluating and directing their own learning.

10.4 Implications for assessment and curriculum design

Traditional assessment methods may become less effective when assignments can be completed substantially through generative AI tools. This does not mean that written assignments are no longer useful; rather, it highlights the importance of designing assessments that evaluate understanding, reasoning, application and intellectual contribution.

Universities should consider assessment approaches that require students to explain their reasoning, defend conclusions, demonstrate practical competencies and apply knowledge to unfamiliar situations. Oral examinations, project demonstrations, supervised practical tasks, reflective activities and staged assignments may provide additional evidence of student understanding.

Curriculum design should also incorporate AI literacy as a relevant academic competency. Students should understand how GenAI systems generate responses, the possibility of inaccurate or biased outputs, the importance of information verification and the ethical implications of AI use. These competencies should be integrated into relevant subject areas rather than treated only as isolated technical topics.

10.5 Implications for educational policymakers

At the national level, policymakers have an important role in creating an enabling environment for responsible AI integration in higher education. This includes developing guidance that supports institutional policy development, promotes digital inclusion and encourages appropriate AI literacy across educational institutions.

In the Zambian context, the National Artificial Intelligence Strategy 2024–2026 provides a relevant policy context for considering the role of AI in national development and education [2]. However, the translation of national AI ambitions into higher education practice requires institutional implementation, adequate resources and coordination among relevant stakeholders.

Policymakers and higher education stakeholders should therefore encourage universities to develop contextually appropriate approaches to AI governance, staff development, student protection and equitable access. Such approaches should recognise the differences in institutional resources and technological readiness across universities.

10.6 Practical implementation priorities for Zambian universities

The proposed Responsible Generative AI Integration Framework suggests several practical priorities for universities seeking to incorporate GenAI into teaching and learning.

First, institutions should establish clear guidelines that communicate acceptable AI use, academic integrity expectations and disclosure requirements. Second, AI literacy programmes should be introduced for students and lecturers, with emphasis on critical evaluation and responsible application. Third, lecturers should receive professional development that supports the integration of GenAI into learning activities without undermining independent student reasoning.

Fourth, universities should review their assessment practices to ensure that learning outcomes are evaluated through evidence of understanding, critical thinking and practical application. Finally, institutions should strengthen digital infrastructure and consider equitable access to AI-supported learning resources, particularly for students who experience technological and connectivity constraints.

These priorities should be implemented progressively, taking account of institutional capacity, available resources and the needs of different academic programmes.

10.7 Integrative analysis

The implications discussed demonstrate that responsible GenAI integration is a shared institutional and educational responsibility. University management provides the policy and infrastructure environment, lecturers establish pedagogical direction, and students retain responsibility for meaningful intellectual engagement. Policymakers contribute through national guidance and support for digital development.

The central implication is that successful GenAI integration should not be measured solely by the frequency of technology use or improvements in assignment completion. Greater attention should be given to whether students develop stronger reasoning abilities, become more independent learners and demonstrate genuine academic understanding.

For Zambian higher education institutions, the challenge is therefore to move beyond technology adoption towards purposeful educational integration. This requires an approach that balances the opportunities offered by GenAI with the need to preserve human reasoning, academic responsibility and equitable participation in higher education.

11. Research gaps and future research directions

Despite the growing adoption of generative artificial intelligence in higher education, important gaps remain in understanding its implications for students' cognitive development, independent learning and academic performance. Existing literature has increasingly examined students' awareness, perceptions, acceptance and patterns of AI use. However, evidence concerning the extent to which these technologies contribute to meaningful learning outcomes remains developing. This is particularly relevant in Zambia, where the adoption of GenAI is occurring within a higher education environment characterised by differences in institutional capacity, digital infrastructure and technological access.

11.1 Limited evidence on higher-order thinking development

Although existing studies have investigated the educational potential of GenAI, further research is required to establish whether regular interaction with these tools strengthens or weakens students' higher-order thinking abilities. In particular, there is a need for studies that examine changes in critical thinking, analytical reasoning, evaluation, problem-solving and creativity over time.

A key gap concerns the distinction between students using AI-generated explanations to improve their understanding and students relying on AI systems to perform intellectual tasks on their behalf. Research should therefore investigate not only whether students use GenAI, but also whether their use results in improved independent reasoning and the

ability to solve unfamiliar problems without AI assistance.

11.2 Insufficient understanding of the relationship between GenAI and learner autonomy

Another important research gap concerns the relationship between GenAI use and learner autonomy. Although AI tools can support self-directed learning through personalised explanations, immediate feedback and learning assistance, their influence on students' ability to plan, monitor and evaluate their own learning requires further examination.

Future studies should investigate whether students who frequently use GenAI demonstrate stronger self-regulated learning behaviours or become increasingly dependent on automated assistance. Particular attention should be given to goal setting, independent study, learning motivation, self-monitoring and academic responsibility.

Longitudinal research would be valuable in determining whether the relationship between AI use and learner autonomy changes as students become more familiar with these technologies.

11.3 Uncertainty regarding the effect of GenAI on academic achievement

The relationship between GenAI use and academic achievement also requires further investigation. Improved assignment quality, faster completion of academic tasks and increased access to learning resources do not necessarily demonstrate improved knowledge retention or conceptual understanding.

Future research should distinguish between immediate academic performance and sustained learning outcomes. This may involve examining examination performance, coursework results, knowledge retention, practical application and students' ability to independently demonstrate competencies acquired through AI-supported learning.

Comparative studies could also examine differences between students who use GenAI as a learning support mechanism and those who rely on it primarily to generate academic responses.

11.4 Limited context-specific research in Zambian higher education

Although the study by Mudenda *et al.* [9] provides important evidence concerning students' awareness, attitudes and use of ChatGPT across five Zambian universities, further investigation is needed into the relationship between GenAI use and measurable educational outcomes.

The available evidence on awareness and adoption does not, by itself, establish whether GenAI improves higher-order thinking, learner autonomy or academic achievement. This creates a need for context-specific studies that examine the educational consequences of AI use among students in Zambian universities.

Future research should consider institutional differences, academic disciplines, students' levels of study, access to digital resources and variations in AI literacy. Such investigations would help establish whether the educational implications of GenAI are consistent across different higher education environments in Zambia.

11.5 Limited evaluation of pedagogical and institutional interventions

A further gap concerns the effectiveness of institutional strategies for promoting responsible GenAI integration. While AI literacy, lecturer guidance, institutional policies and assessment reforms are frequently identified as important conditions, more empirical evidence is required to establish which interventions produce meaningful improvements in student learning.

Future studies could examine the effects of lecturer-led AI literacy programmes, structured AI-supported learning activities, responsible-use policies and redesigned assessment methods. This would help determine how universities can integrate GenAI while preserving independent intellectual engagement and academic integrity.

11.6 Need for longitudinal and mixed-methods research

Much of the emerging literature provides evidence from cross-sectional surveys, student perceptions and short-term educational interventions. Although these approaches offer useful insights, they may not adequately capture changes in cognitive development, learner autonomy and academic achievement over extended periods.

Longitudinal studies could examine how students' learning behaviours and academic outcomes change as they interact with GenAI throughout their university education. Mixed-methods research could complement quantitative measurements with interviews, focus groups and classroom observations to explain how and why particular patterns of AI use influence learning.

11.7 Future validation of the proposed responsible GenAI integration framework

The Responsible Generative AI Integration Framework proposed in this review provides a conceptual basis for understanding the relationship between GenAI integration, institutional and pedagogical enabling conditions and student learning outcomes. However, the framework has not yet been empirically validated.

Future research should operationalise its key components and examine the relationships among the independent, intermediary and dependent variables. In particular, researchers should investigate how AI literacy, critical evaluation, independent reasoning and responsible AI use relate to higher-order thinking, learner autonomy and academic achievement.

The institutional and pedagogical enabling conditions, including pedagogical guidance, institutional governance and equitable digital access, should also be examined to determine whether and how they influence the relationship between GenAI integration and student learning outcomes. Empirical testing across different Zambian higher education institutions could help refine the framework and establish its practical applicability.

11.8 Integrative analysis

The identified research gaps demonstrate that the central issue in GenAI and higher education is shifting from technology adoption towards understanding educational effectiveness. Awareness, accessibility and frequency of use provide useful indicators of adoption, but they are insufficient measures of meaningful learning.

In Zambia, the findings of existing research provide an important foundation for further investigation, but more evidence is required on the cognitive, behavioural and academic consequences of GenAI use. Future research should therefore move beyond students' perceptions and

examine measurable learning outcomes, changes in independent learning behaviour and the institutional conditions that shape responsible AI integration.

Addressing these gaps would contribute to a stronger evidence base for higher education policy and practice. It would also provide an opportunity to evaluate and refine the proposed Responsible Generative AI Integration Framework, ensuring that its recommendations are informed by the realities of Zambian universities.

12. Conclusion and recommendations

12.1 Conclusion

The rapid development of generative artificial intelligence is reshaping higher education by introducing new ways through which students access information, engage with academic content and undertake learning activities. Although these technologies offer opportunities for personalised learning, immediate feedback, information exploration and academic support, their educational implications remain complex. Their influence on student learning depends largely on how they are used and the pedagogical and institutional conditions within which they are introduced.

This review examined the implications of GenAI for three important dimensions of higher education: Higher-order thinking, learner autonomy and academic achievement. The discussion suggests that GenAI can function as a cognitive support mechanism by assisting students to explore ideas, compare arguments, obtain explanations and receive feedback. However, when students rely excessively on AI-generated responses, these technologies may also become substitutes for independent reasoning, critical evaluation and problem-solving.

The review further highlighted that the relationship between GenAI and learner autonomy is not straightforward. While AI tools can support self-directed learning, their inappropriate use may weaken students' responsibility for planning, monitoring and evaluating their own academic progress. Similarly, improved assignment completion and academic productivity should not automatically be interpreted as evidence of improved conceptual understanding, knowledge retention or independent academic competence.

In the Zambian higher education context, existing research provides evidence of growing student awareness and adoption of generative AI. However, further investigation is necessary to establish its actual influence on students' cognitive development, independent learning behaviours and academic achievement. Institutional readiness, lecturer preparedness, digital infrastructure, equitable access and appropriate governance are important considerations in this process.

In response to these challenges, the review proposed the Responsible Generative AI Integration Framework, which emphasises AI literacy and technological competence, critical evaluation of AI-generated information, independent reasoning and problem-solving, ethical AI use and assessment strategies that measure genuine understanding. The framework also recognises pedagogical guidance, institutional governance and equitable digital access as important institutional and pedagogical enabling conditions shaping the relationship between GenAI integration and student learning outcomes.

12.2 Recommendations

Based on the review, the following recommendations are proposed for higher education institutions, lecturers, students and educational policymakers.

1. Develop institutional generative AI policies.

- Universities should establish clear institutional guidelines governing the use of GenAI in teaching, learning, research and assessment. These guidelines should address academic integrity, disclosure of AI assistance, responsible use, data privacy and accountability.

2. Strengthen AI literacy among students and lecturers.

- Higher education institutions should introduce structured AI literacy programmes that equip students and academic staff with the knowledge and skills required to use GenAI effectively, evaluate AI-generated information and recognise the limitations of these technologies.

3. Promote independent reasoning and critical engagement.

- Lecturers should design learning activities that require students to question, verify, compare and critically evaluate AI-generated responses. GenAI should be used to support intellectual engagement rather than replace independent thinking and problem-solving.

4. Integrate responsible AI use into teaching and curriculum design.

- Universities should incorporate responsible AI use into relevant academic programmes and teaching practices. Students should develop an understanding of AI capabilities, limitations, ethical considerations and the importance of maintaining academic responsibility.

5. Review assessment strategies to measure genuine learning.

- Institutions should strengthen assessment approaches that evaluate conceptual understanding, critical thinking, knowledge application and independent academic competence. Oral examinations, supervised practical assessments, project demonstrations and reflective activities should complement conventional assessment methods where appropriate.

6. Improve digital infrastructure and equitable access.

- Universities and relevant educational stakeholders should invest in reliable internet connectivity, digital learning resources and institutional support systems. Particular attention should be given to students who experience limitations in accessing digital devices and AI-supported learning technologies.

7. Strengthen lecturer capacity and pedagogical support.

- Academic staff should receive continuous professional development to support the effective integration of GenAI into teaching and learning. Training should focus on pedagogical application, assessment redesign,

responsible AI use and strategies for maintaining student intellectual engagement.

12.3 Contribution of the review

The main contribution of this article is the development of a Responsible Generative AI Integration Framework that connects the integration of GenAI in higher education with three important student learning outcomes: Higher-order thinking, learner autonomy and academic achievement. By incorporating pedagogical, institutional and access-related institutional and pedagogical enabling conditions, the framework provides a structured perspective for understanding why the educational consequences of GenAI may differ across learning environments.

The review also contributes to the discussion of GenAI in African higher education by highlighting the need to move beyond technology adoption and examine its implications for meaningful learning within specific national and institutional contexts. In particular, it identifies research priorities relevant to Zambian universities and provides a conceptual foundation for future empirical investigations.

The framework is proposed as a basis for further scholarly discussion and testing rather than as an empirically established model. Its validation through future research will be necessary to determine the strength and nature of the relationships among its variables and its applicability across different higher education settings.

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