

## A model to integrate Generative Artificial Intelligence to improve student academic performance in South African universities

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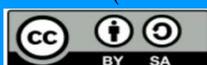
**Abstract:** This paper explores the use of GenAI on university students in pursuit of academic excellence, with reference to South Africa. This study will embrace some of these salient issues: issues of high dropout rates occasioned by resource scarcity and meeting diverse learning needs by proposing a model that assists an individual learning experience using GenAI. This would be useful in highlighting recommendations toward effective adoption with reduced inequity in education and improvement of student achievement based on current literature and empirical investigations. Moreover, the paradigm proposed, named GAIA-SAU, would strongly focus on the development of personalized learning plans, continuous feedback mechanisms, and involvement of stakeholder engagement in delivering adaptive learning environments. This will lighten the burden for the country's path toward achieving high-quality and innovative learning, with further alignment to the goals of the National Education Strategy. Finally, the findings from this study will provide insight into educators, other stakeholders, and policymakers on ways in which best to capitalize on the use of GenAI in improving performance and equity in pursuing all students toward university education. This essay looks at how structurally advanced AI can solve these issues that stand in the way of realizing students' potential fully.

**Keywords:** Academic performance, Transformation, Generative artificial intelligence, South African universities

### Introduction

With colleges facing high challenges, such as high dropout rates and underfunding, Generative Artificial Intelligence has immense potential for improving academic performance within educational frameworks. It supports learners at crucial junctures in highly individualized ways. This paper therefore attempts to conceptualize a model that will give in detail how GenAI would apply in the real world toward enhancing academic performance. The study addresses the call made by Cloete and Maassen (2019) for personalized learning strategies and increased access to learning materials. This model attempts to enhance the retention and academic performance of students by fostering adaptive learning environments. Against this background, the general research question that guided this study was thus: How does the integration of GenAI into academic performance create or enhance academic performance in South African universities? The form this paper shall take is that of a critical literature review, drawing on recent research concerning the use of GenAI in education, followed by a theorization of ideas informing this study. This section outlines information on

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research design and procedures for data collection in the methodology part, followed by the consequences and implications for education practice. In the end, practical recommendations of the usage of GenAI in Colleges of South Africa for consideration by educators and legislation to conclude the paper.

### **Literature review**

Utilization of Generative Artificial Intelligence systems is one of the innovative approaches to improved student performance in the Universities of South Africa. The concept of genetic algorithms combined with artificial intelligence facilitates personalized and adaptive learning environments. Eden et al. (2024) agrees that high dropout rates and diversity in the needs of all students indeed call for innovative approaches to GenAI to bring improvement in academic achievement. The AI systems can create personalized learning content available, and curate personalized content based on metrics relevant to the success of each student. Whereas intelligent tutoring systems provide personalized feedback, congruent with the individual learning needs of learners, adaptive learning technologies continuously adjust on-the-fly content delivery to continuous assessments of students' performance. Other examples of such technologies that would fall into this category are things like specialized applications and personalized learning tools, which adapt instructional materials to diverse learning styles. While the learning management systems ease the administration, tracking, and reporting of educational courses, data analytics systems analyze performance data about students for trends and areas of improvement.

The integration of GenAI together with associated technologies has been used in a number of academic settings. For instance, in the study by Anis (2023), it is clear how much adaptive environments with personalized feedback have increased the rates at which students engage and complete their work. In a similar vein, Eden et al. (2024) pointed out that intelligent tutoring systems, while meeting the demands of each student, go a long way in improving academic results. These studies bring out the ways in which GenAI has the potential to reduce educational challenges and enable people to achieve their fullest potential. This work relies on the Diffusion of Innovation Theory, first proposed by Everett Rogers, which has been applied in describing the process of communication of innovative ideas or technological processes in social systems.

The relative advantage of the idea, its compatibility with prevailing practices, its intricateness, trial-ability, and observability are some of the critical characteristics that according to this concept ensure the forward motion of the adoption process. This framework stipulates ways in which Universities in South Africa would successfully integrate advanced technologies into their function to enhance academic achievement in the face of challenges of resource constraints and diverse student populations.

### **Methodology**

This study adopts a qualitative systematic review approach, analyzing secondary data from academic publications, institutional reports, and relevant literature. The focus is on understanding how Generative Artificial Intelligence (GenAI) tools can improve academic performance in South African universities. Studies were selected based on relevance to personalized learning, adaptive assessments, and stakeholder engagement, ensuring alignment with educational challenges such as resource constraints and diverse learning needs. Thematic analysis was used to identify trends, critical factors for successful integration, and gaps in existing research. This approach ensures a comprehensive foundation for the proposed GAIA-SAU model, offering practical recommendations for GenAI adoption in higher education. This qualitative review of generative artificial intelligence in improving academic achievement amongst students in South African universities is based on secondary data emanating from the literature. It is against this background that qualitative approaches are better suited to explain the intricate relationships that exist between technology, teaching strategies, and the educational experiences of students. Thus, they are chosen. An interpretative methodology would indicate the proposed study reviewing subjective views, attitudes, and experiences of students, teachers, and administrative personnel regarding how GenAI affects the attained academic achievement. The backbone would be from Cloete and Maassen and Davis et al. (Cloete & Maassen, 2019; Davis et al., 2022). The secondary sources of data for this study are primarily extracted from various research papers, publications,

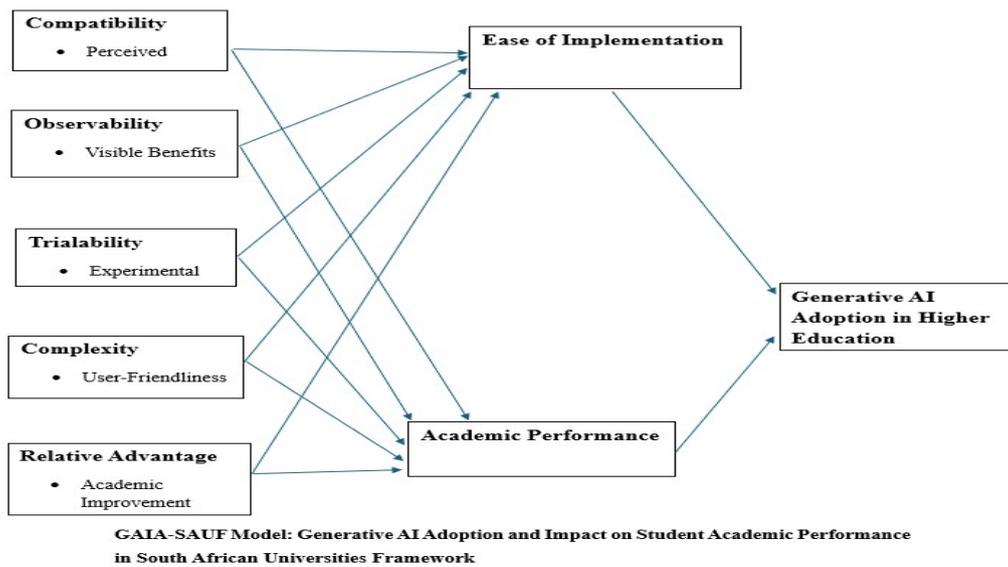
and scholarly literature. The data will highlight current practices and challenges that exist in the integration of GenAI. These findings offer empirical evidence of how effective GenAI is in ensuring improved student performance and recommend a model for successful implementation across South African universities based on some researchers (Makhanya & Zibane, 2020; Ismail, 2023). These findings form the basis for informing people about what he does and how GenAI can be used to enhance academic performance.

*The GAIA-SAU Model: Revolutionizing Student Academic Performance through Generative AI Integration in South African Universities*

The GAIA-SAU model proposed here thus addresses the most persistent challenges that students in South African universities face through the strategic integration of generative artificial intelligence into the education system. This will be achieved by improving students' academic performance through personalized learning experiences, adaptive assessments, and targeted support mechanisms. Using the power of GenAI, the framework would investigate data for each student, including academic tracking records, learning styles, and performance measures, to develop targeted learning plans that address the needs of each student. According to Eden et al. (2024), this will help instil a sense of ownership in each student. The research issue provides the rationale for the model underachieved by students, especially in South African universities. Contributory factors include inadequacy of resources, conventional approaches to teaching, and individualized application of an attitude towards learning. The GAIA-SAU model faces and oversees the same challenges since it is a structured framework through which Gen I is integrated. The model's core components are personalized learning plans, which include data-informed design to create learning experiences that cater effectively to the strengths and weaknesses of all students.

Adaptive learning environments: Through a real-time monitoring system of students' progress, learning materials would be adapted to ensure timely Support and intervention. Improved stakeholder engagement: Involving educators, administrators, and students in the process of GenAI adoption to align the technology with the mission and goals of the institution, promote more meaningful engagement with it, and foster broader adoption. This comprehensive approach addresses improvement in academic performance and helps build an inclusive environment to meet the diverse needs of the students. This is an excellent contribution that this study makes: its zeros in on integrating GenAI into the higher education context in South Africa, a perspective that only some studies have considered in the present literature. In this respect, the penchant of GenAI's model for personalized learning may fire up some discourses within the educational technology conference and spur further research on how advanced technologies could best be leveraged to overcome systemic educational challenges, especially in developing nations. These results stimulate further investments in the quest for technology-driven innovation to improve educational outcomes.

Introduction of Generative AI in South African Universities and Academic Performance of Students The model provides a template to solve the various academic problems faced by students in South African universities with the incorporation of generative artificial intelligence that works toward enhancing the performance of the students through personalized learning, adaptive assessments, and targeted support mechanisms. It analyses students' academic records, learning styles, and performance indicators to produce an individual learning plan best fitted to their needs and opportunities. The model underlines the involvement of stakeholders, organizational alignment, and an assurance of a hostile-free learning environment.



Perceived Educational Fit refers to the degree of congruence between the technology and prevailing teaching methods, curricula, and educational objectives, an issue that becomes crucial in adopting GenAI at South African universities. When GenAI could be perceived as an iterative development from existing practice, it would result in easy acceptance both by educators and students. The adoption of GenAI technologies will proceed more smoothly, for example, if they can be readily included in the workflow that lecturers have already created or used to augment conventional teaching methods without creating major disturbance. Furthermore, their acceptance hinges on how evident the benefits of GenAI are. Additionally, it supports successful results anytime they are demonstrated since using GenAI to support larger deployment across departments and courses can be linked to better skill development, increased student engagement, or higher grades. The focus on user-friendly experimental implementation is another important aspect of this methodology. Prior to widespread implementation, universities might assess the efficacy of small pilot projects in specific circumstances. In this way, some challenges can be foreseen, with the product being tinkered with best to meet the needs of educators and students alike.

Moreover, the success of GenAI depends a lot on how user-friendly it will be. The more user-friendly the technology is, the less significant the training or changes in current practice, and the more likely it will be accepted. Interest in adopting GenAI alone will be driven by the perceived potential to promote critical thinking skills and improve academic performance. When educators are convinced that GenAI can make a meaningful contribution to their teaching goals, they become more likely to adopt this kind of innovation; gradual yet sure integration of the technology within the educational landscape follows.

#### *Policy and Educational Practices*

Integration of GenAI in South African universities have important implications for educational policy and practice. The findings of this study may be helpful to policymakers in making pertinent steps towards innovative technologies that improve their education outcomes, a factor underlined in the National Development Plan 2030. According to the present research, GenAI can improve students' academic performance in schools; hence, policies supporting the integration of digital technologies in pedagogical uses should be promoted. This study helps to develop a framework for ways in which GenAI could be applied in educational contexts from an ethical perspective. Other ethical concerns in integrating technology into education involve data privacy and algorithmic bias.

#### *Contribution to Personalized Learning and Adaptive Assessments*

The proposed model can serve as a roadmap for universities to address those challenges while realizing the utmost benefits of GenAI. Personalized learning pathways and adaptive assessments have been highlighted in a model for integrating GenAI into South African universities. Through data analysis by GenAI, the model will infer students' unique needs, preferences, and learning styles to design customized learning experiences. Evidence has shown that GenAI can raise student engagement and motivation to continuously improve academic performance (Ellikkal & Rajamohan, 2024). Adaptive assessment features will, moreover, enable continuous monitoring of progress. GenAI algorithms can adapt learning materials and resources allocated to students regarding their performance, thus giving them the necessary support to pass through the challenges they have experienced in their academic endeavours. In this view, Zawacki-Richter et al. (2019) present that such adaptive approaches alleviate resource challenges facing universities in South Africa.

#### *Bridging the Digital Divide*

Adaptive learning platforms have customized learning materials and resources that GenAI can rely on while bridging existing digital gaps at universities. With the incorporation of technology, the learners would be guaranteed the necessary support and resources irrespective of their geographical and socio-economic status. This becomes important in helping those students who come from a very remote area or deprived region that has poor access to quality educational resources. This also mentions investment needs of computer labs and high-speed internet infrastructure that may integrate this new wave brought by GenAI. Continuous efforts have been made in support of infrastructural development processes at universities to ascertain equal opportunities of digital learning. The study now looks at the key drivers of access and availability of technology resources.

#### *Ethical Implementation of GenAI*

It therefore develops a framework in which GenAI could be implemented within the South African universities, with considerations toward the ethical implications that should precede such implementation. This therefore set up a policy framework and a set of ethical principles that became necessary in the construction of an actionable plan toward the mitigation of various risks and challenges associated with the GenAI applications touching on privacy, data security, and algorithmic biases. Results by Suliman et al. (2024) further bring out the issue of data security and privacy being paramount in every step of colleges in implementing such technologies of GenAI. Recommendations on standards for user consent procedures about data governance will ensure a well-protected collection of student data for moral use in the pursuit of improvement in academic achievement. It also deals with algorithmic bias viewed as algorithms, if left to themselves, exacerbate inequality. The study integrates methods or ways bias detection, and mitigation techniques can be established into processes supporting GenAI implementation to advance more equitable and inclusive educational environments.

#### *Development and Support*

Integration of GenAI in South African universities brings serious faculty development and Support considerations into focus. The model presented in the paper emphasizes that educators must be empowered to master the various technologies related to GenAI in teaching. The current research supports their professional advancement through comprehensive training programs and resources so that faculty can employ GenAI for pedagogies toward improvement in student learning. Indeed, Moodley et al. (2023) add that These findings suggest that GenAI can relieve some of the pressures on faculty by automating part of the learning process—for example, real-time feedback and guidance for learners using intelligent tutoring systems. Already, this speaks to the resource constraints of the universities in South Africa, which enables faculty to focus on what they are uniquely able to do: more individualized interactions and directed Support.

### *Future Research Directions*

The results of this study and the model suggested to position GenAI within South African universities call for new research directions. The study contributes to the literature by documenting how GenAI can be leveraged within educational settings, thus laying a foundation for further research and refinement of the model. Future research can thus assess empirically the level at which the suggested model can effectively improve student academic performance in the South African university. Through longitudinal studies and data gatherings on student outcomes, it can be confirmed whether the model is efficient and can identify the areas where improvements need improvement. Further research may also establish that the model suits other educational environments within and outside the borders. The comparative study may provide insight into the model's flexibility within different educational systems and highlight best practices for successful implementation.

### *Application of Innovation Diffusion Theory in the Gaia-Sau Model for South African Universities*

Innovation diffusion Theory applies to the very core of the GAIA-SAU Model since it provides a framework for understanding how the integration of GenAI into South African universities can be used to enhance student academic performance. The theory, first proposed by Everett Rogers, describes how innovative ideas, products, or practices diffuse over time within a given social system. The GAIA-SAU Model allows for identifying factors that influence the adoption of GenAI technologies in educational environments. It describes how adoption patterns go from innovator to laggard in a step-like manner. This structured approach can help in the strategic implementation of GenAI at universities. The stages listed herein will help the stakeholders devise strategies that enhance the speed at which GenAI technologies are accepted and used by teachers and students. The theory also investigates various influence factors, such as perceived relative advantages, compatibility with existing systems, complexity, trialability, and observability, which could support creating the most effective and efficient GAIA-SAU Model addressing such issues. An effective communication channel is always helpful in spreading the advantages and functionalities of GenAI technologies. The theory outlines that clear communications help to distribute information relating to innovations. Thus, the GAIA-SAU Model can apply different communication techniques to inform stakeholders how GenAI can help shape better educational practices.

Moreover, the theory identifies that social systems influence the rate at which innovation is adopted. The differentials that need to go into the GAIA-SAU Model should incorporate diverse students and technological readiness, amongst others, in South African universities. Understand social dynamics, allowing the model to meet specific needs in South African higher education. Based on this understanding of Innovation Diffusion Theory, appropriate strategies to encourage the adoption of GenAI by the GAIA-SAU Model can be suitably informed. These pilot programs make the trial of GenAI technologies possible for educators and students, observable, and compatible with current educational practices. But this is also a very valued framework from which to evaluate the impact of GenAI on academic performance output. It provides all stakeholders with critical choices for future investments in technology using the student's engagement and retention rate as key performance indicators. Innovation Diffusion Theory provides a strategic framework that allows the adoption and assessment to innovatively incorporate GenAI into the circumstances at South African institutions in the best possible manner to support the road of raising student academic achievement.

### **Findings**

South African universities experience challenges that tremendously impact students' academic performance. Some of these are socioeconomic disparities, poor educational infrastructure, a shortage of technology, and a lack of sufficient academic support systems necessary for learning and development, as Mhlanga et al. (2020) addressed. It was stated in the study that disparities in accessing quality education, along with disparities in accessing resources, serve to exacerbate the already existing qualities in academic achievement among students emanating from poor backgrounds. On the other hand, integrating GenAI presents several advantages for tackling the challenges. GenAI can create personalized learning experiences tailored to individual students' needs, increasing engagement and motivation. This is because GenAI can process large volumes of data,

enabling better identification of at-risk students and providing interventions to enhance academics. Critical success factors for effective integration include institutional readiness, technological infrastructure, faculty training, and stakeholder involvement. This study again points out that universities' investments in improving their technological capabilities and providing educators with such training will lead to a capacity to maximize the full benefit of the functionality of GenAI-applied actions.

## Conclusion

The introduction of Generative Artificial Intelligence is promoted in this research article to ensure academic improvement at South African universities. It seeks to answer one of the most important questions, "How does GenAI embed student academic performance at South African universities?" through the introduction of the GAIA-SAU Model. It addresses issues related to high dropout rates and different learning needs through a focus on personalized learning opportunities and flexible forms of assessments along with continuous feedback mechanisms. These findings are based on the use of GenAI in developing a more inclusive and productive learning platform to improve the student's academic performances. However, there are a couple of limitations. This investigation has focused on one South African university; thus, generalization on other places outside its context is highly limited. The latter, while drawing, to the extent that this relies on currently existing literature, only some developments concerning recent improvements in the development of GenAI technologies could be captured. Thirdly, other issues in the practical implementation of this model are likely to experience resource availability and readiness problems in the institutions. More empirical research should be done to establish the validity of this model for educational purposes. Integration Influence on Future Perspective The influence of integration on the long-term achievements of students is likely to fall within the limits of a number of disciplines and levels of education. It would also be essential to study further how the scalability of the GAIA-SAU Model works across different educational contexts. Indeed, considering the increasing digital transformation within educational institutions, continuous research is needed to develop strategies for embedding technologies such as GenAI into university systems.

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