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Leveraging Artificial Intelligence to Boost Academic Performance: A Personalized Learning Framework for Struggling Students

George Kalowa[1], Jameson Mbale[2]
Copperbelt University
1. george.kalowa1@gmail.com; 2. jameson.mbale@quantumkazi.com

Abstract

The challenge of under performance in schools necessitates the need to for sustainable educational solutions. Currently, many interventions have been made. Despite that, some students continue having difficulties academically due to inadequate personalised learning. This systematic paper delves into the application of Artificial Intelligence (AI) to change learning and teaching practices thereby, improve learner performance. Through the use of Artificial intelligence Applications, Our paper proposes a framework that is designed to offer tailored educational support to pupils in schools particularly, the underperforming pupils. This AI-driven framework will aid teachers in identifying individual knowledge gaps, monitoring student progress, and possibly customizing instructional strategies to address specific learning needs. Through practical applications, we demonstrate how this framework not only enhances the learning experience but helps to foster measurable improvements in academic performance for under-performing pupils. Our discoveries highlight the potential AI has to create a more responsive educational environment which can help to better overall student performance. AI-driven personalized learning will definitively bridge the knowledge gap for underperforming students by providing tailored instruction, real-time feedback, and adaptive assessments.

Keywords: Artificial Intelligence, Personalised Learning, Adaptive Instruction, Data-driven Insights and Real-time feedback

I. INTRODUCTION

The challenge of poor results in secondary and primary schools calls for various sustainable educational initiatives. In many schools, underperforming pupils usually fail to keep pace with their performing schoolmates and this leads to widening knowledge gap which results from inadequate personalized learning. To solve the problem of poor results in both primary and secondary schools, AI-driven personalized learning seems to be a promising solution in many ways. In [1] theydefined Artificial intelligence (AI) as computer systems that can perform tasks that typically require human intelligence, such as learning, problem-solving and natural language understanding.Another researcher [2] statesthat personalized learning, enabled by AI algorithms, tailors educational experiences to the unique needs, preferences, and pace of each learner.AI-driven personalized learning can help address the challenge of poor academic results through real-time feedback, adaptive instruction and data-driven insights.

This research paper delves into the application of Artificial Intelligence (AI) to change the available educational practices and thereby to a greater extent, improve learner academic performance through AI personalised learning. Below are Research Objectives and Research Questions for this study:
Research Objective:

- To investigate the positive effect of AI-driven personalized learning on pupils' academic success.
- To examine the value of AI-driven personalized learning in encouraging student participation.
  - To analyze the function of adaptive assessments in AI-driven personalized learning environments
  - To explore the teacher's responsibility in instigating and facilitating AI-driven personalized learning especially for underperforming students.

Research Questions:

- How does AI-driven personalized learning positively affect the academic success of pupils?
- What factors contribute to increased student participation in AI-driven personalized learning environments?
- What is the impact of adaptive assessments on the learning outcomes of learners in AI-driven personalized learning?

- What sustainable systems do our teachers need to instigate and facilitate AI-driven personalized learning especially for underperforming students?

II. Literature Review

The inclusion of (AI) into education has been a subject of interest among many different researchers and scholars. To be precisely, the introduction of personalized learning through AI has triggered research, targeted to employ AI's capability in customizing education to the needs of learners in various learning institutions. This chapter covers the various related literature on personalized learning powered by Artificial Intelligence. As a consequence of poor academic results in primary and secondary schools, the use of AI-driven personalized learning to better academic achievement especially for underperforming students has been investigated in various studies by different writers.

One fundamental study by [3]highlighted the manifestation of AI-driven virtual tutors. In his research, he highlighted the usefulness of the various AI tutors in increasing student comprehension and performance. By using numerous AI algorithms, the virtual entities could emulate human tutor responses, thereby giving feedback which is customized to the pupil's level of intellectual capacity and the rate of learning.

A study by [4] showcased the significance of various adaptive learning systems that are powered by AI algorithms which were modeled to modify content delivery on the basis of personal academic learner profiles, highlighting the adaptability of e-learning environments.
In his results, he stressed the advantages of adaptability, from increased learner participation to enhanced retention rates.

In [5]he did a study on the incorporation of AI into Learning Management System. He highlighted the functions of AI in customizing academic content and also predicting leaner academic performance. The various predictive investigations provide teachers close insights into possible learner dropouts or those in need of educational assistance.

In another study investigated by [6], discussed AI-driven gamified platforms, underscores the function of AI in personalizing game scenarios to improve learning outcomes. Such platforms can indeed make learning more individualized and engaging.

Another study is called the Drug Abuse Resistance Education (DARE) framework created by Darryl Gates(1983): This framework looks at providing learners with various skills and knowledge need to avoid drug abuse and violence. Though this program is not directly connected to AI-driven personalized learning, the framework can still be adapted to help support the social and emotional learning needs of the learners.

While these various researches focus on AI being utilized by all learners, our research focuses on the specific application of AI-driven personalized learning especially for underperforming students in primary and secondary schools in Zambia, discovering its impact on academic achievement, student participation and teacher support. Our study also examines the scalability and sustainability of AI-driven personalized learning in different academic environments, a gap not addressed in previous research.

In view of the above, in [7] they pointed out that the introduction of technology offered enormous benefits to the educational institutions, particularly those in the sub-Saharan region. Furthermore, in [8] he paid much attention on the utilization of the improved hardware infrastructure in improving the learning standards.
While the aforementioned studies focus on the general application of AI across all learners, our research narrowly targets underperforming students in primary and secondary schools in Zambia, providing a much-needed focus on this specific group of learners. The unique contributions of this study are:

- Focus on Underperforming Students: Unlike existing literature, which primarily explores AI in the context of broad student populations, this study investigates how AI-driven personalized learning specifically enhances the academic outcomes, participation, and engagement of underperforming students.
- This work goes beyond general claims about AI's effectiveness by providing quantitative evidence of how AI-driven personalized learning improves academic outcomes for underperforming students, contributing directly to the existing gap in understanding its specific effects in this context.

III. Methodology

This study investigates the impact of Artificial Intelligence (AI)-driven personalized learning on academic achievement for underperforming students in all subjects. In this study, a mixed-method approach was used to appreciate the positive effect of AI on personalized learning. The mixed approach involved a quantitative analysis of student performance and participation metricfor both pre and post AI introduction coupled with qualitative interviews to obtain pupils views.

A. Quantitative Analysis

The research was conducted at Maiteneke Secondary School in Chingola district of Zambia. A sample of 60 pupils was selected, all of whom are exposed to the traditional learning method were no AI is used. These pupils were now then exposed to AI-driven personalized learning. Key performance indicators such as end of term test results were analyzed. Meta AI was used to carry out the task. Statistical tools, such as end

of term test questions, were employed to ascertain significant differences between both the tradition method and AI-driven method.

The students were divided into two groups:

- Pre-AI Group: 30 students were used as a baseline, participating in traditional learning methods.
- Post-AI Group: 30 students were exposed to the AI-driven personalized learning system over the course of the study.

The key performance indicators for the quantitative analysis included:

- End-of-Term Test Results: Test scores were collected before and after the introduction of AI to measure any significant improvement in academic achievement.
- Participation Metrics: Data were also collected regarding the level of student participation in both traditional and AI-enhanced lessons, including the frequency of interaction with AI tools and their engagement in AI-based learning activities.

B. Qualitative Analysis

In addition to the 60 students involved in the quantitative analysis, **6 teachers** who were responsible for implementing AI tools in the classroom were selected for participation in the qualitative component. The students and teachers were purposefully selected to represent a range of experiences and perspectives.

To enhance the **trustworthiness** of the qualitative analysis, triangulation was employed, meaning the findings from both students and teachers were compared and cross-checked to identify common themes and discrepancies.

Group discussions were conducted after the pupils were being exposed to the AI-driven learning environment and teachers who utilized AI tools. Questions revolved around:

- The perceived benefits,
- The challenges, and
- Suggestions for improvement.

IV. STUDY FINDINGS

A. Quantitative findings

After the 60 learners were exposed to AI-driven personalized learning, they showed some improvement in their test results compared to the time before AI was introduced. In addition, participation levels also increased. The 60 learners became more efficient in carrying out their tasks effectively on their own. During the research in class with the 60 learners, the teacher became a mere facilitator while the learners used AI-driven application to teach themselves. Generally, the learners results were far much better than the ones they had prior to AI learning tool being introduced to them. This can suggest that the AI tool provided them a more steady individualized learning experience.

B. Qualitative analysis

After being exposed to learning through the use of AI Learning tool, a majority of students felt the AI tool made the AI-based learning experience more exiting, engaging and catered to their individual learning needs. Learners appreciated the real-time feedback, the tailored content, the additional information and accuracy of answers which can help them understand and retain concepts far much better that the traditional way of learning.

The real time feedback, tailored content and additional information were some of the advantages discovered during the research. The diagram below shows the other benefits of AI-driven personalised learning.

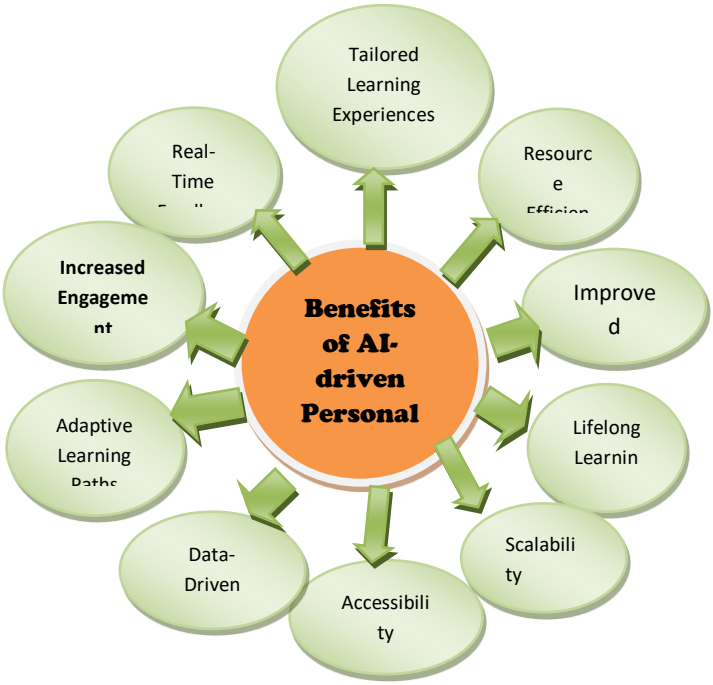

Fig. 1. benefits of AI driven Personalised Learning

V. DISCUSSION

A. Explanation of findings.

Teachers that were exposed to AI valued the insights provided by AI-driven analytics, which can help them meet students' academic needs. However, the researcher expressed reservation regarding over-reliance on AI, citing concerns about reducing the human touch in teaching. Despite that reservation, AI-driven personalized learning looks very to be beneficial. The

table below shows the benefits of some areas of AI learning, the AI implementation involved and the benefits.

TABLE 1: Benefits of AI learning

Area	AI Implementation	Benefits
Elearning Models	Data analysis of student interaction	Tailored instructional content
Adaptive Assessments	AI-driven quizzes and test	Personalized assessment based on student pace
Resource recommendation	Algorithm-based content suggestion	Suggests supplementary resources for individual needs

B. Acknowledgment of research limitations.

The current study was confined to less than a term. Long term studies that span over a year can provide more insights into the long-term impacts of AI-driven personalized learning on learner performance and well-being more especially the underperforming learners.

C. Challenges of implementing AI-driven learning tools

The inclusion of AI into education offers numerous benefits such as real time feedback, increased engagement and improved outcomes. On the other hand, there are challenges to consider while thinking of implementing AD-driven personalised. In [9] they wrote a seminal paper highlighting the potential ethical concerns related to AI. In his paper, it is a clear fact that the data required for AI algorithms to effectively personalize learning can bring concerns about teacher and learner data security. Another challenge is that AI algorithms might be difficult for teachers and learners to understand. Other challenges include:

- Implementation may involve significant costs.
- Teachers and Learners need to be trained to use these tools.
- Over-dependence on AI might reduce human interaction.

D. Future Work:

The initial findings from this study underscore the potential benefits of integrating AI in personalized learning. However, the research also brings to light areas needing improvement and further exploration:

- Integration with Curriculum: with many advantages AI has, future research can consider looking at how AI-driven tools can be integrated into the Zambian academic curriculum. Of course, this would involve carrying out studies on how different modules can best leverage AI for enhanced personalized learning to improve academic performance.
- Ethical Considerations: As AI continues to penetrate different sectors, ethical concerns around data security become paramount. Future research should delve into creating frameworks that ensure pupils and teachers and learners data remain protected.
- Long-term Studies: The current study was confined to less than a term. Longterm studies spanning over a year can provide more comprehensive insights into the long-term impacts of AI-driven personalized learning on student performance and well-being especially the underperforming students.
- Increasing the research sample: To achieve more generalizable results, future research should include a more diverse and larger sample size, encompassing different age groups, educational levels, and cultural backgrounds.
- AI and Educator Training: An area that warrants attention is the training of educators to effectively use and implement AI tools. Studies could focus on what kind of training is most beneficial and how it impacts the overall teaching-learning dynamic.
- Apart from AI, in [10] they pointed other areas that need improvements such as the transformation of the traditional Information Technology (IT) systems to Cloud infrastructure. However, other areas that need improvement are stated by [11] who highlighted that a conducive platform for sharing of technological tools could bring enormous development. Whilst in [12] they emphasized on the increasing the quality of the institution's infrastructure by enhancing online and digital systems.

VII CONCLUSION

Artificial Intelligence (AI) has potential change educational practices and to a greater extent, improve learner academic results through personalised learning. By taking advantage of AI, academic institutions can provide more effective and engaging learning environments that would change how education is delivered. Teachers can improve learner performance and automate administrative tasks.

In conclusion, while AI holds immense promise in revolutionizing personalized learning, it's essential to approach this integration with a balanced perspective. It's not about replacing the traditional teaching methods but enhancing them with AI's capabilities. As the adage goes, it's not either-or; it's and.

Recommendations

With the coming of AI, we recommend that it should be integrated into learning and teaching practices. There are many AI applications that can be used to enhance student performance in schools. Below is a list of the recommended AI-driven tools that can transform educational practices:

Table 2: AI-driven tools

AI-driven tools	Specific examples of AI-driven tools	
1. *Intelligent Tutoring System*	• Socratic by Google: this helps students comprehend their homework problems by providing explanations.	
2. *Personalized Learning Platforms* , by enhancing	• DreamBox: Offers adaptive math instruction that adjusts to each student's needs. • *Khan Academy's Khanmigo: Provides personalized tutoring and feedback tailored to each student's learning pace and style.*	
3. *Language Learning Apps*	• Rosetta Stone: used for interactive language learning and provides speech recognition for practice. • Duolingo: leverages AI to create adaptive language learning experiences and also track learner progress.	
4. AI-Powered Assessment Tool	• Gradescope: this system automates grading and provides detailed feedback, helping teachers and students understand performance better.	
5. *Study Aids and Flashcard Apps*	• Anki: Uses spaced repetition algorithms to help students memorize information more effectively.	
6. Writing and Grammar Tools	• Grammarly: Assists with grammar, punctuation, and style suggestions, improving writing skills. • ProWritingAid: Offers comprehensive feedback on writing, including style and structure improvements.	
7. Speech and Reading Assistance	• NaturalReader: Converts text to speech, helping students with reading difficulties.	
8. *AI Chatbots for Support*	• IBM Watson: Provides AI-driven chatbots for answering common student questions and offering support. • ChatGPT for Education: Assists with answering questions, providing explanations, and supporting learning.	
9. Administrative and	• AI-based Timetabling Systems:	

Scheduling Tools	Optimize scheduling to improve resource allocation and reduce conflicts. • Schoology: Integrates AI to help manage coursework, grades, and communication between students and teachers.	
10. Data Analytics for Learning Insights	• Edmodo Insights: Uses data analytics to provide insights into student performance and learning trends.	

Implementing these AI applications can help create a more personalized, engaging, and effective learning environment, catering to the diverse needs of students and supporting educators in their
teaching efforts. Below are other recommendations provided after the research:

- Implement AI-driven personalized learning in schools to support underperforming students.
- Provide teachers with professional development on AI-driven personalized learning tools.
- Allow AI-driven tool help teachers monitor student progress and adjust personalized learning plans accordingly.
- Conduct further research on the long-term effects of AI-driven personalized learning.
- Explore the use of AI-driven personalized learning in all grade levels.
- Develop guidelines for the ethical use of AI-driven personalized learning in education.
- Create a framework to guide teachers implement and use AI-driven personalised learning tools.

By implementing these recommendations, educators and policymakers can harness the potential of AI-driven personalized learning to improve academic results especially for underperforming students and promote more equitable learning opportunities.

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