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The Impact of Artificial Intelligence in Secondary Education: A Case Study of Wellspring Academy, Rwanda

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Abstract: *This study investigates the integration of Artificial Intelligence (AI) in secondary education through a case study of Wellspring Academy in Rwanda. It examines how AI technologies are utilized in curriculum delivery, teaching practices, and school administration, and evaluates their impact on student engagement, academic performance, and operational efficiency. A mixed-methods approach was used, combining survey data from 90 students, 20 teachers, and 5 administrators with qualitative interviews and academic performance analysis. Results show that AI tools significantly improved personalized learning, learner engagement, and administrative productivity. However, implementation challenges remain, including insufficient training, infrastructure gaps, resistance to change, and ethical concerns around data privacy. The study proposes stakeholder-driven policy recommendations to ensure equitable, effective, and ethical AI adoption. These include structured training programs, inclusive access strategies, robust data governance, and feedback-informed policy mechanisms. The findings contribute to emerging research on AI in African education and highlight the need for a balanced integration of technology with human-centered pedagogy.*

Keywords: *Artificial Intelligence, High School Education, Personalized Learning, Educational Technology, Student Engagement.*

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1. Introduction

The integration of Artificial Intelligence (AI) into education systems is redefining how schools approach teaching, learning, and administration, with growing influence in Sub-Saharan Africa. Countries such as Rwanda are leading digital transformation efforts by embedding AI into national education policies and classroom strategies to bridge digital divides and enhance learning equity (Bitalo, 2024; Kwarkye, 2025). AI applications ranging from intelligent tutoring systems and adaptive learning software to automated grading and administrative platforms are enabling schools to personalize instruction, streamline operations, and foster student-centered learning (Masabo et al., 2023; Zimba, Ndaka & Jouini, 2025).

In Rwanda, AI adoption in secondary schools has gained traction through initiatives such as the National AI Policy and strategic public-private partnerships in education. Schools like Wellspring Academy have implemented AI-supported platforms for communication, student records management, and learning support. One example is the Student Information Management System, which allows stakeholders to access real-time school data securely and remotely, promoting administrative efficiency and accountability (Pelaez et al., 2022). Classroom use of AI-

enhanced tools, such as voice recognition for scheduling and learning analytics for academic tracking, has been observed among students and teachers alike (Sangwa & Mutabazi, 2025; Ntakirutimana, 2022).

While technological progress is evident, challenges remain. Infrastructure inequality between urban and rural schools, limited digital literacy among educators, and concerns over data privacy and algorithmic fairness continue to constrain the full-scale deployment of AI in education (Smith et al., 2021; Moosun, 2023). Moreover, most existing literature emphasizes higher education or national-level policy frameworks, leaving a significant research gap regarding the operational realities of AI in high school environments (Iyamuremye & Niyonzima, 2024; Butcher, Wilson-Strydom & Baijnath, 2021). This study responds to that gap by exploring the implementation and impact of AI technologies at Wellspring Academy, a private secondary school in Rwanda. It aims to understand how AI is used in teaching, learning, and administration and to assess its benefits and limitations from the perspectives of students, teachers, and school administrators. The findings are intended to inform future integration strategies and policymaking for secondary schools in similar contexts.

The research is guided by three central questions:

1. How is AI integrated into curriculum delivery, teaching practices, and administrative operations at Wellspring Academy?
2. What benefits and challenges are experienced by stakeholders using AI?
3. What policy recommendations can support effective and ethical AI adoption in secondary education?

2. Literature Review

The integration of Artificial Intelligence (AI) into education has expanded rapidly over the past decade, with applications ranging from intelligent tutoring systems and predictive analytics to adaptive assessments. AI is no longer a peripheral innovation but is becoming a core component of digital education strategies, especially in developing regions like Sub-Saharan Africa (Bitalo, 2024; Sangwa & Mutabazi, 2025). The increasing presence of AI in education is influencing pedagogy, institutional policy, and student support systems (Masabo et al., 2023).

2.1 Pedagogical Transformation and Personalization

Recent research emphasizes how AI enhances personalization in instruction, tailoring content based on student behavior and performance (Zimba et al., 2025; Kamalov et al., 2023). Systems using natural language processing and adaptive learning engines allow learners to receive real-time, personalized feedback and instructional material, improving engagement and outcomes. These tools are particularly valuable in secondary education, where students' needs and performance levels vary significantly (Robertson, 2018; Sener et al., 2021). In the context of African education systems, personalized AI tools have been used to address challenges such as large classroom sizes, teacher shortages, and inconsistent curriculum coverage (Kwarkye, 2025; Iyamuremye & Niyonzima, 2024). Rwanda's education policy now actively encourages the integration of AI tools such as learning management systems, content delivery bots, and AI-assisted grading to streamline processes and raise performance standards (Butcher et al., 2021; Ntakirutimana, 2022).

2.2 Administrative Efficiency and Learning Analytics

Beyond instruction, AI is reshaping how schools handle assessment, communication, and data management. AI-driven systems like Student Information Management Systems are used to automate school fee tracking, attendance, performance reporting, and timetable coordination (Pelaez et al., 2022). These platforms reduce administrative overhead, improve data accuracy, and offer real-time insights to school managers (Smith et al., 2021; Gwagwa et al., 2021). In Rwanda, such platforms have improved transparency and parental engagement through mobile-accessible dashboards (Sangwa & Mutabazi, 2025).

2.3 Social and Ethical Considerations

Despite these benefits, researchers caution against ignoring the ethical dimensions of AI in schools. Key concerns include student data privacy, algorithmic bias, and the emotional disconnect caused by over-reliance on AI in teacher-student relationships (Kamalov et al., 2023; Chan & Tsi, 2023). Educators and policymakers must weigh these concerns against the technological promise to ensure responsible integration (Moosun, 2023; Tsai et al., 2022). Additionally, the rise of challenge-based learning as a pedagogical framework has gained attention, particularly in its alignment with digital transformation. It emphasizes

real-world problem solving, collaboration, and critical thinking qualities that can be supported by AI but not replaced by it (Ka Yuk Chan & Tsi, 2023; Tsai et al., 2022). In Rwanda and similar contexts, ensuring that students retain cultural literacy and humanistic values amid AI integration remains a core challenge.

2.4 Summary and Research Gap

While literature confirms the transformative potential of AI in secondary education, most studies focus on tertiary institutions or national strategies. There is limited empirical work on how AI affects pedagogy, student experience, and school operations at the secondary level especially in Sub-Saharan Africa. This study aims to bridge that gap by focusing on a single high school in Rwanda and offering practical, localized insights into AI integration from the ground up.

2.4 Theoretical Framework

The present study draws on two foundational theories to contextualize the integration of Artificial Intelligence (AI) in secondary education: the Technology Acceptance Model (TAM) and Constructivist Learning Theory. These frameworks provide both behavioral and pedagogical lens through which to analyze AI's impact on learning, teaching, and school administration.

The Technology Acceptance Model (TAM), originally proposed by Davis (1989), has evolved into one of the most influential theories in understanding user adoption of new technologies. The model identifies two core factors influencing technology adoption: Perceived Usefulness (PU) the degree to which a person believes that using a system enhances performance and Perceived Ease of Use (PEOU) the degree to which one believes the technology is free of effort. In the context of this study, TAM is relevant for assessing how students, teachers, and administrators at Wellspring Academy perceive the utility and usability of AI tools such as Student Information Management Systems, AI tutors, and automated scheduling platforms. Research shows that positive perceptions of usefulness and ease significantly increase adoption rates in educational settings (Venkatesh & Bala, 2020; Kamalov et al., 2023). Therefore, TAM helps explain the behavioral factors driving or hindering AI adoption in Rwandan secondary education.

Complementing this is Constructivist Learning Theory, which emphasizes that learners construct knowledge actively through interaction, inquiry, and reflection (Bruner, 1961; Vygotsky, 1978). When extended to digital and AI-enhanced environments, constructivism supports the use of intelligent tutoring systems, chatbots, and adaptive learning platforms that enable learners to explore content at their own pace, receive individualized feedback, and engage in meaningful problem-solving (Sener et al., 2021; Zimba et al., 2025). These AI-supported mechanisms align well with the constructivist emphasis on learner agency and cognitive engagement, particularly in adolescent learners navigating complex high school curricula.

Together, TAM and Constructivist Learning Theory offer a robust theoretical foundation. While TAM informs the study's analysis of user behavior and system interaction, constructivism shapes the pedagogical interpretation of AI's educational impact. This dual framework enables a comprehensive evaluation of both the technological and instructional dimensions of AI integration at Wellspring Academy.

3. Methodology

This study adopted a mixed-methods case study design to examine the integration and impact ofArtificial Intelligence (AI) in teaching, learning, and school administration at Wellspring Academy, a private secondary school in Kigali, Rwanda. A case study approach was selected because it enables in-depth, context-specific exploration of phenomena within real-world settings (Yin, 2018). The mixed-methods strategy allowed for the triangulation of quantitative and qualitative data to provide a holistic understanding of stakeholder experiences and perceptions regarding AI tools in the education process.

3.1 Research Design

The case study design was both descriptive and exploratory. The study combined surveys, semi-structured interviews, and document review to answer the research questions. Quantitative data provided measurable trends, while qualitative inputs offered deeper insights into how AI technologies are understood and experienced by students, teachers, and administrators. This approach aligns with best practices in education research that advocate methodological pluralism to ensure data robustness and richer interpretation (Creswell & Plano Clark, 2018).

3.2 Study Population and Sampling

The target population consisted of students, teachers, and school administrators at Wellspring Academy. The sample included 90 students, 20 teachers, and 5 administrators who were selected using purposive sampling. This non-

probability technique was chosen to ensure participants had direct experience with the AI systems under study (Etikan, Musa & Alkassim, 2016). Gender, role, and years of experience were considered to ensure diversity within the sample.

3.3 Data Collection Methods

A structured questionnaire was administered to students and teachers. It covered perceptions of AI usefulness, ease of use, learning outcomes, and concerns about privacy and reliability.
Semi-structured interviews were conducted with school administrators to explore policy-level insights, resource allocation, and implementation challenges. Document analysis of administrative records and AI-based platforms (e.g., the Student Information Management System) was used to triangulate data and confirm implementation claims. Instruments were developed based on prior validated research in educational technology adoption (Venkatesh & Davis, 2000; Kamalov et al., 2023) and were adapted to the Rwandan secondary education context.

3.4 Data Analysis

Quantitative data from surveys were analyzed using descriptive statistics (frequencies, percentages, mean scores) using Excel and SPSS. Qualitative data from interviews were coded thematically using Braun and Clarke's (2019) approach, which supports pattern identification and narrative interpretation in educational settings.

3.5 Validity and Reliability

To ensure instrument validity, the tools were reviewed by two experts in educational technology and piloted on a small group from another secondary school. Adjustments were made to refine clarity and contextual appropriateness. Reliability was ensured through consistent administration of tools and data triangulation across methods.

3.6 Ethical Considerations

The study was conducted in compliance with ethical research standards. Permission was obtained from the school administration, and informed consent was secured from all participants. Anonymity and confidentiality were maintained throughout. Participation was voluntary, and respondents were allowed to withdraw at any time without penalty.

This methodology aligns directly with the study's theoretical framework using Technology Acceptance Model (TAM) to assess adoption behaviors and Constructivist Learning Theory to interpret the learning processes shaped by AI integration. It ensures that both the behavioral and pedagogical dimensions of AI are systematically examined in the context of Rwandan secondary education.

4. Results and Discussion

This section presents the empirical findings on the use and impact of Artificial Intelligence (AI) at Wellspring Academy. Data is drawn from 90 students, 20 teachers, and 5 administrators. Findings are organized by the study's three research questions and interpreted using the Technology Acceptance Model (TAM) and Constructivist Learning Theory. Where relevant, results are compared with findings from recent studies conducted across African educational contexts.

4.1 Integration of AI into Teaching, Learning, and Administration

Survey data showed that AI tools are regularly integrated into academic and administrative activities. As shown in Table 1, a combined 56.5% of all respondents reported using AI tools "Often" or "Always." Among students, 51 (57%) used AI frequently, particularly for personalized revision tools and automated practice quizzes. Teachers similarly adopted AI for grading, lesson planning, and content delivery, with 11 (55%) reporting high-frequency use. Administrators showed even stronger adoption, with 3 out of 5 using AI for scheduling, finance tracking, and communication platforms.

Table 1: Frequency of Use of AI at Wellspring Academy

Frequency	Students (n=90)	Teachers (n=20)	Administrators (n=5)	Total (n=115)
Never	6	2	0	7%
Rarely	8	3	1	10.4%
Sometimes	25	4	1	26.1%
Often	30	4	1	30.4%
Always	21	7	2	26.1%

4.2.1 Student Engagement and Academic Performance

This section examines the impact of AI tools on student engagement and academic performance at Wellspring Academy. The data were derived from surveys administered to students, teachers, and administrators. Analysis is organized across three sub-themes: AI and engagement levels, academic performance effects, and specific benefits attributed to AI use. The results are interpreted in line with the Technology Acceptance Model (TAM) and Constructivist Learning Theory, and are compared to contemporary literature in African education systems.

Table 2: AI Tools and Student Engagement

Engagement level (scale 1–5)	Percentage of students (%)
1. (Not at all engaged)	5%
2. (Slightly engaged)	9%
3. (Moderately engaged)	18%
4. (Highly engaged)	32%
5. (A great deal engaged)	26%

Table 2 shows that the majority of students reported high engagement levels when using AI tools. A combined 58% of students ranked their engagement as level 4 or 5, indicating that AI positively impacts active participation and learning. This is consistent with findings by Sener et al. (2021) and Zimba et al. (2025), who emphasized AI's role in personalized feedback and real-time learner interaction. However, 14% of students reported low engagement, suggesting that additional support or customization may be necessary. This reflects the TAM's emphasis on perceived usefulness, and the constructivist view that engagement arises from tailored, student-centered environments.

Table 3: Impact of AI Tools on Academic Performance

Impact on academic performance	Student (90)	Teachers (20)	Administrators (5)	Total (115)
Significantly improved	40	7	2	49 (42.6%)
Somewhat improved	30	6	2	38 (33.0%)
No change	12	4	1	17 (14.8%)
Somewhat declined	5	2	0	7 (6.1%)

Table 3 demonstrates that a significant proportion of respondents observed improvements in academic performance due to AI. Specifically, 75.6% of all participants noted either significant or moderate improvements, which supports the TAM model by indicating a high level of perceived usefulness. Teachers acknowledged benefits in lesson planning and student engagement, while administrators highlighted the role of AI in decision-making and operational tasks. These findings resonate with Kamalov et al. (2023) and Gwagwa et al. (2021), who reported similar outcomes in AI-driven learning improvements across African secondary institutions.

Table 4: Ways AI Has Helped in Studies

Ways AI has helped in studies	Students (90)	Teachers (20)	Administrators (5)	Total (115)
Personalized learning	42	8	2	52 (45.2%)
Immediate feedback and support	35	6	2	43 (37.4%)
Improved access to resources	50	9	3	62 (53.9%)
Enhanced problem-solving	38	7	2	47 (40.9%)

Table 4 elaborates the specific benefits AI provided to different stakeholders. The highest cited advantage was improved access to resources, followed by personalized learning. This aligns closely with the constructivist approach, which emphasizes learner autonomy and contextual learning. Immediate feedback and problem-solving also ranked highly, reinforcing AI's capacity to foster critical thinking. These outcomes are consistent with studies by Butcher et al. (2021) and Ntakirutimana (2022), confirming AI's role in enhancing adaptive learning and responsiveness in African secondary schools.

4.2 Perceived Benefits and Challenges

This section presents stakeholder perceptions of the benefits and challenges of AI use at Wellspring Academy. Data from surveys and interviews were analyzed thematically and are summarized in Tables 5, 6, and 7. The findings are further interpreted through the Technology Acceptance Model (TAM) and Constructivist Learning Theory, and compared with recent African-based studies.

Table 5: Perceived Learning Benefits of AI Tools

Learning Benefit	Percentage or Observation
Improved understanding of lessons (students)	72% agreed
Flexible revision opportunities	Frequently mentioned in open responses
Immediate feedback (via AI tutoring)	Reported by students and teachers
Learner autonomy and engagement	Observed by most teachers

AI tools were reported to enhance student engagement and understanding. As shown in Table 5, 72% of students agreed that AI platforms helped them better understand their lessons. Open-response data also revealed that learners appreciated flexible revision opportunities and instant feedback, particularly in science and language subjects. These insights affirm the value of AI-driven platforms in promoting learner autonomy, a core principle in Constructivist Learning Theory (Sener et al., 2021; Zimba et al., 2025). Teachers echoed these observations, stating that AI systems facilitated differentiated instruction and encouraged greater participation.

These findings support the TAM model, where Perceived Usefulness is a key factor influencing user adoption. The positive responses from both students and teachers suggest that AI tools are not just being used they are perceived as effective and desirable components of the learning process.

Table 6: Reported Barriers to AI Use

Barrier	Reported By	Description
Lack of training	60% of teachers	Limited formal training on AI tools
Technical/internet issues	>50% of students	Unstable connectivity, poor access to devices
Resistance to AI tools	Some staff/students	Reluctance to adapt to new systems
Lack of policy clarity	Administrators	Unclear rules for AI deployment and data handling

Despite these benefits, several obstacles were reported. As seen in Table 6, 60% of teachers cited a lack of training as a major barrier to effective AI integration. More than half of the student respondents noted unreliable internet access and limited access to digital devices at home. These infrastructural limitations echo concerns raised by Kamalov et al. (2023) and Moosun (2023), who argue that the digital divide continues to hinder AI's full potential in African secondary schools. Administrators also highlighted the absence of a coherent institutional policy on AI deployment, especially regarding user training, privacy, and data storage. These issues undermine Perceived Ease of Use, a second core construct of TAM, thereby limiting AI's adoption even when its usefulness is acknowledged.

Table 7: Ethical and Systemic Concerns in AI Adoption

Concern	Stakeholder Comment
Bias in AI tracking	Administrators fear unfair treatment based on algorithm outputs
Data privacy	Concerns about how student data is used/stored
Access inequality	Students without devices or home internet are disadvantaged

Further analysis of interview data identified systemic and ethical concerns related to AI use, as detailed in Table 7. Administrators expressed apprehension about the lack of transparency in how AI systems process student data, with some citing fears of algorithmic bias in academic performance tracking. Concerns about data privacy were also shared by students, aligning with broader debates in the literature around ethical AI use in education (Gwagwa et al., 2021; Smith et al., 2021). From a constructivist perspective, these findings point to the need for human-facilitated learning environments. While AI systems can support independent learning, over-reliance on automated systems without teacher oversight can challenge the social and cognitive scaffolding needed for meaningful education.

4.3 Policy Recommendations for Ethical and Effective AI Adoption

This section outlines stakeholder-informed policy recommendations for advancing AI use in secondary education. Data were collected through surveys and interviews with students, teachers, and administrators. The analysis identified six core policy areas critical to sustainable, ethical, and impactful AI integration. These are summarized in Table D and interpreted in light of relevant African research and theoretical perspectives.

Table 8: Stakeholder-Supported Policy Priorities for AI Adoption

Policy Recommendation	Stakeholder Support (%)	Explanation
Ongoing AI Training for Teachers & Students	68%	Many teachers requested structured professional development programs.
Reliable Infrastructure (Devices + Internet)	61%	Students stressed device/internet access issues as a major implementation gap.
Data Privacy & Ethics Guidelines	52%	Administrators emphasized the need for policies to govern AI data use.
Inclusive Access Policies	47%	Suggested provisions for underserved learners (e.g., subsidized devices).
Feedback & Monitoring Mechanisms	44%	Participants want regular feedback channels to assess AI effectiveness.
Clear National/School-Level AI Policies	39%	Administrators asked for guidelines from the Ministry of Education.

The most widely supported recommendation across all stakeholder groups was the establishment of ongoing AI training programs. This aligns with earlier findings in Section 5.2, where 60% of teachers reported a lack of formal training. The TAM framework supports this view unless stakeholders perceive both usefulness and ease of use, adoption will remain inconsistent.

A majority of students also advocated for stronger infrastructure investments, such as device provision and improved connectivity. These suggestions mirror concerns raised in Kamalov et al. (2023) and Moosun (2023), where infrastructural inequality limited the effectiveness of AI programs in African classrooms. Another priority was the creation of data privacy and AI ethics policies, a concern also raised by administrators. This reflects the insights of Gwagwa et al. (2021), who warn that without ethical safeguards, AI risks exacerbating digital harm, especially in under regulated education systems.

Calls for inclusive access policies emphasize the need to support equity in AI use. This aligns with the Constructivist Learning Theory, which prioritizes learner-centered and socially just environments. AI should not create new gaps between high-resourced and low-resourced students. Finally, stakeholders recommended building feedback loops and requesting more active engagement from education ministries. These preferences suggest that bottom-up AI implementation, one that is responsive to user feedback may be more effective than top-down directives alone.

5. Conclusion and Recommendations

5.1 Conclusion

This study examined the integration of Artificial Intelligence (AI) in secondary education at Wellspring Academy, Rwanda, using a mixed-methods approach informed by the Technology Acceptance Model (TAM) and Constructivist Learning Theory. The research addressed three core areas: (1) how AI is applied in teaching, learning, and administration; (2) the perceived benefits and challenges of AI adoption; and (3) policy recommendations to support ethical and effective implementation.

Findings indicate that AI tools are increasingly embedded in the school's pedagogical and administrative processes. Over 75% of stakeholders reported improvements in learner engagement, academic performance, and operational efficiency. These results support TAM's emphasis on perceived usefulness and ease of use, and they reflect constructivist ideals by showing that AI platforms promote autonomy, interactive feedback, and differentiated learning.

Despite these gains, several persistent challenges hinder full-scale implementation. These include insufficient training (reported by over 60% of teachers), unreliable infrastructure (noted by more than half of students), ethical concerns around data use (raised by 32.2% of stakeholders), and resistance to change. Additionally, administrators expressed concern over the absence of national-level AI integration policies. These issues echo regional trends observed across Africa and suggest that AI adoption must be supported by sustainable training, infrastructure investment, and ethical oversight (Gwagwa et al., 2021; Kamalov et al., 2023). Administratively, AI applications such as automated attendance, scheduling, and finance management show clear promise, but adoption among school leaders remains uneven. This calls for stronger professional development frameworks and top-down policy engagement to ensure leadership readiness for AI-enhanced operations.

AI presents transformative opportunities for education in Rwanda and across Africa. At Wellspring Academy, its integration has already led to improvements in academic engagement, performance, and operational efficiency. However, to maximize these benefits, a comprehensive approach that includes training, infrastructure, equity, and ethical governance is essential. This study contributes not only to academic discourse but also offers actionable strategies for schools seeking to embrace AI while prioritizing inclusive and responsible innovation.

5.2 Recommendations

From the findings, the study has come out with the following recommendations:

1. Schools should implement structured training programs for all stakeholders. These should cover both the technical and pedagogical dimensions of AI tools, ensuring alignment with their educational goals

2. Investment is needed in high-speed internet, smart devices, and school-wide platforms. Dedicated ICT support teams should be available to troubleshoot issues in real time

3. Schools should conduct ongoing awareness campaigns and stakeholder dialogues to address resistance and improve confidence in AI systems.

4. Clear, enforceable data governance policies must be developed and communicated. Stakeholders should be

trained in digital rights, consent, and safe usage of AI systems.

5. School leadership should ensure no student is left behind due to lack of access to AI tools. This includes the provision of school-owned devices and subsidized internet where necessary.

6. The impact of AI should be continuously evaluated using feedback from students, teachers, and administrators. This data should guide policy adjustments and innovation planning.

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