# AI Acceptance and Usage in Sub-Saharan African Education: A Systematic Review of Literature

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**Abstract**

The purpose of this review was to map the state of AI in sub-Saharan African (SSA) education based on published literature. The studies analysed comprised 96 AI-related studies over a decade (2013 to 2023). The findings revealed a concentration of AI-related studies in 2023, primarily originating from the western part of sub-Saharan Africa, specifically Ghana (26 studies) and Nigeria (26 studies). The reviewed studies primarily focused on students (35 studies) and teaching staff (28 studies) as users of AI. In terms of approach, 32 studies were quantitative, and 26 studies were qualitative. Key factors influencing AI adoption and usage in the SSA education landscape included global perspectives on AI usage, training and skill development, and readiness of institutions to integrate AI into education. The main benefits of AI usage in education, as reported in the reviewed studies, included promoting global collaboration, enhancing efficiency in learning and research, and the ability of AI to analyse vast amounts of data. Despite the increasing acceptance and usage of AI technologies within educational institutions in the sub-region, emerging challenges such as risks of AI discouraging learning and scepticism among students, and the potential of AI causing long-term unemployment were discussed by the authors. The review provides recommendations to address these challenges and enhance AI adoption and usage within the SSA educational landscape.

**Keywords:** AI, adoption, acceptance, usage, sub-Saharan Africa, education, systematic review.

## 1. Introduction

In sub-Saharan African (SSA) countries, Artificial Intelligence (AI) has become an integral component of the region's education system, permeating various facets of academic and administrative functions (Butcher et al., 2021; Okoruwa et al., 2022; Sarfo et al., 2024). Research indicates that the majority of SSA educational institutions are leveraging AI-driven tools to streamline administrative tasks related to academic resource management (Tapo et al., 2024). Furthermore, studies have highlighted additional benefits of AI usage in the SSA educational delivery system. For instance, AI-driven educational tools have been observed to have a transformative impact by offering tailored learning experiences to students and effectively addressing their deeper learning engagement outside of normal instructional hours (Dandachi, 2024). Additionally, AI technologies were noted for facilitating personalised feedback and

providing a more adaptive and inclusive learning environment at various levels of education in the SSA region (Tapo et al., 2024). These observations undoubtedly support the argument that the introduction of AI into the sub-Saharan education system indicates a commitment of the region to promoting innovative teaching methodologies and preparing students for the increasingly technology-driven market demand (Nolan, 2024). It appears that the integration of AI is currently aligning with broader efforts by the region's educational institutions to address employers' demands and preferences for long-term human capital development, crucial for SSA's growth and development (Barakabitze et al., 2019; Kulkov et al., 2023). Although there are some oppositions to the integration of AI into the region's education system, there is already a growing reliance on AI technologies, demonstrating the region's strategic response to be at the forefront of harnessing AI's benefits for tackling contemporary challenges that block its development agenda (Daniels et al., 2022).

In light of the foregoing discussions, we support the stands of contemporary researchers who argue that the rapid proliferation of AI technologies and usage within SSA's educational institutions must be given some level of attention (Engstrom et al., 2020), to understand the depth of issues that surround it. However, a thorough understanding of the depth of issues concerning AI adoption and usage in academia certainly requires a synthesis of existing literature (Reiger, 2022), as done for some regions. For instance, while systematic literature reviews exist for AI integration in education in developed regions such as Australia in Yigitcanlar et al.'s study (2020) about developing tertiary students' capacity to use AI for building smarter cities; in Europe, by Recht et al. (2020) who studied the use of AI in students' clinical exercises; and in Asia, by Su et al. (2022) in a study about the effective use of AI at K-12 level of teaching, no comparable synthesis exists for SSA. Given the cultural and contextual institutional acceptance and usage differences and nuances in AI integration in these diverse teaching and learning environments, it is imperative to approach this topic distinctively rather than adopting one-size-fits-all recommendations. That is, it will be inappropriate for SSA to tow or implement the unified views or suggestions expressed about AI usage from regions outside SSA.

Indeed, the above provides a clear viewpoint that AI adoption in SSA necessitates a literature review study to provide a comprehensive overview of, for example, trends in yearly publications, country distributions, authorship contributions, AI adoption and usage patterns, as well as benefits and threats emanating from usage within SSA education delivery. In view of this, the primary objective of this study aligns with the following specific research questions:

1. What are the yearly publication trends in AI-related studies?
2. Which countries have contributed to studies on the use of AI technologies in teaching, learning and research within the SSA education landscape?
3. What are the methodological characteristics of the AI-related studies about the SSA education delivery?
4. What factors have contributed to the acceptance/adoption and usage of AI technologies in SSA education?
5. What benefits do students, instructors, and researchers in SSA get from using AI technologies?
6. What challenges are associated with the integration of AI technologies in teaching and learning within the SSA education landscape?

### *Operational Definition of Methodological Terminologies*

Before the analysis was performed for this study, the studies were categorised on the following basis:

– Country Representations of adoption, acceptance, benefits, and threats of AI usage-related Studies: Studies were grouped according to the countries within which the AI-related research was carried out. They were afterward grouped according to countries and into major parts (Northern, Southern, Eastern, Western, and Central) of the sub-Saharan Africa region.

– Study Approach: These are the broad research approaches, namely Quantitative, Qualitative, and Mixed Methods, prescribed by Creswell (2013) for categorising research approaches, designs or paradigms.

– Sample Size: Study sample sizes of subjects were also grouped into small, medium, and large. They were coded as follows: ≤ 150 (small),>150≤ 250 (medium), and> 250 (large), based on the recommendation by Bervell and Umar (2017) for sample size categorisation.

– AI usage by academic subject Area: The various academic disciplines where AI technologies are employed and integrated to improve processes, research, and outcomes within those specific fields.

– AI Usage by level of Education: This explains the different educational stages or levels where artificial intelligence (AI) technologies have been applied and integrated.

– Categories of AI users: These are the various groups or types of individuals and entities that utilise artificial intelligence (AI) technologies for different purposes.

– AI Adoption and Acceptance Factors: Factors considered when integrating artificial intelligence for production, research, or learning.

– Factors influencing AI usage: These are the factors that collectively or individually determine the integration or application of AI in various contexts.

– Benefits from AI usage: This refers to the opportunities, advantages, or help that AI usage offers to society. It may encompass improved efficiency, enhanced decision-making, automation of repetitive tasks, and the potential for innovative solutions, thereby fostering advancements across a diverse range of occupations or fields.

–Threats and Risks of AI Use: This involves the future dangers or unexpected contingencies that AI may cause in societies after continuous usage.

## 2. Methods and Materials
### *Article search procedures and processes*
To conduct this systematic review, the process began with the identification and retrieval of relevant studies on the adoption, acceptance, benefits, and threats of Artificial Intelligence (AI) usage within the education research landscape of sub-Saharan Africa. A structured and rigorous methodology was employed, guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines as outlined by Moher et al. (2009). The PRISMA protocol provided a step-by-step framework for the systematic identification, selection, analysis, and synthesis of eligible studies.

Searches were conducted across four major electronic databases: Scopus, African Journals Online, Africa Digital Library, and PubMed. The search strategy was carefully designed to locate studies that examined key themes, such as AI adoption and acceptance in educational delivery, the benefits of AI usage, and the potential risks or threats associated with integrating AI technologies into SSA education systems. To ensure the comprehensiveness and relevance of the review, a set of inclusion and exclusion criteria was developed. Studies were included if they were published between 2013 and 2023 and focused specifically on AI-related issues within educational contexts in sub-Saharan Africa. Studies were excluded if they were duplicates, non-empirical, or fell outside the defined regional and thematic scope of the review.

**Table 1.** Criteria for Inclusion and Exclusion of AI Adoption and Usage Related Articles

| |
|---|
| **Inclusion Criteria** |
| – Studies in the English language. |
| – Research studies related to AI adoption and acceptance, benefits and threats, and risks of AI usage in the higher education context of SSA. |
| – Studies within the period of 2013-2023. |
| – Studies that emphasised a country of study. |
| **Exclusion Criteria** |
| – Studies outside the sub-Saharan region. |
| – Studies that solely concentrated on reports on only training programmes, policies and strategies limited in scope and depth of discussions on AI adoption, acceptance, benefits and threats of AI usage, and technical reports. |
| – Studies that focused on AI adoption, acceptance, benefits and threats of AI usage, written in a language other than English. |

Search terms were constructed to reflect the core focus of the review, with keyword combinations such as: TITLE-ABS-KEY ("AI Adoption and Acceptance" AND "education" AND "factors influencing AI usage" AND "institutions" AND "sub-Saharan Africa" AND "West Africa" AND "East Africa" AND "Central Africa" AND "Southern Africa") AND PUBYEAR >= 2013. This general search was complemented by a country-specific search strategy designed to capture AI research outputs focused on individual countries within the region. Countries included in the search string were: "Angola" OR "Benin" OR "Botswana" OR "Burkina Faso" OR "Burundi" OR "Cape Verde" OR "Cameroon" OR "Central African Republic" OR "Chad" OR "Comoros" OR "Congo" OR "DR Congo" OR "Cote d'Ivoire" OR "Equatorial Guinea" OR "Eritrea" OR "Eswatini" OR "Ethiopia" OR "Gabon" OR "Gambia" OR "Ghana" OR "Guinea" OR "Guinea Bissau" OR "Kenya" OR "Lesotho" OR "Liberia" OR "Madagascar" OR "Malawi" OR "Mali" OR "Mauritania" OR "Mauritius" OR "Mozambique" OR "Namibia" OR "Niger" OR "Nigeria" OR "Rwanda" OR "Sao Tome & Principe" OR "Senegal" OR "Seychelles" OR "Sierra Leone" OR "Somalia" OR "South Africa" OR "South Sudan" OR "Sudan" OR "Tanzania" OR "Togo" OR "Uganda" OR "Zambia" OR "Zimbabwe.

Boolean functions were also used in the database searches. The reference pages of retrieved articles were chain searched (through the snowballing technique) for relevant articles. The articles were then sorted and organised based on the predetermined criteria. During the selection of articles for the study, several steps were followed. Table 1 outlines the criteria for article inclusion and exclusion, while Figure 1 illustrates the article selection process. At the end of the search from the above-listed database sources (i.e., Scopus, African Journals Online, Africa Digital Library, and PubMed), 96 articles were identified for review (Appendix A).
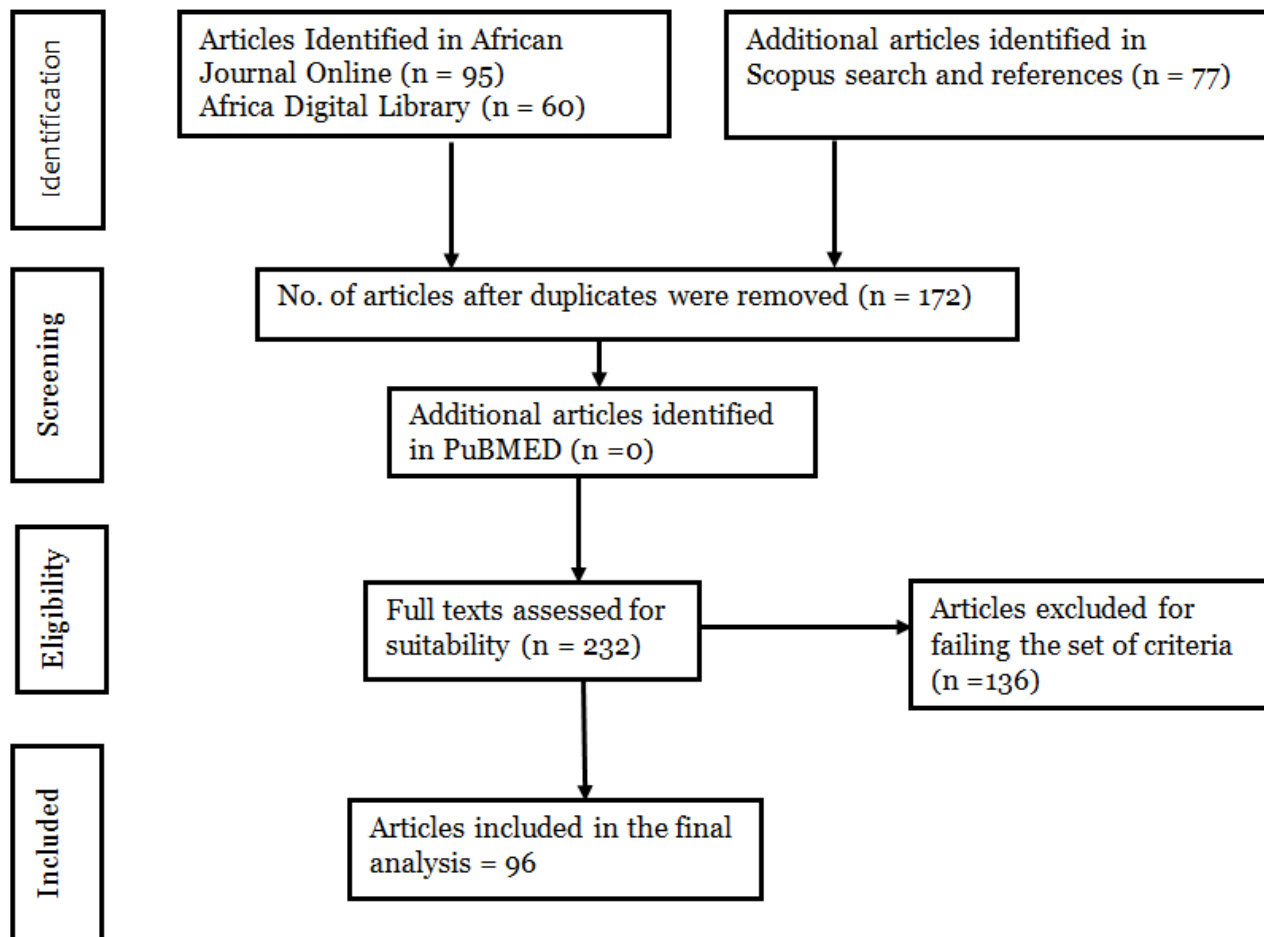


**Fig. 1.** Number of AI-related Studies about the SSA Education Concern

### 3. Findings: Empirical Results

This section presents the categorisations of AI adoption or acceptance and usage within the SSA educational institutions context, following Jiang et al.'s (2020) recommendation. According to

the authors, the patterns of growth and distribution of phenomena define the trends in yearly occurrences, forms, authorship, and geographical distributions. Therefore, we present the patterns in AI acceptance and usage within the SSA educational context, based on the recommendations of Jiang et al. (2020).

### Yearly Trends in AI-related Studies

Significant details from Figure 2 provided insights into the evolving landscape of AI research in the region. Between 2013 and 2016, there was only one publication, representing 1.04 % of the 96 studies reviewed. However, in 2017, there was a slight increase, with two publications, constituting 2.08 %. The subsequent years exhibit variations in publication counts, with a notable increase in 2023, when 55 publications were recorded, representing the majority at 57.29 %.
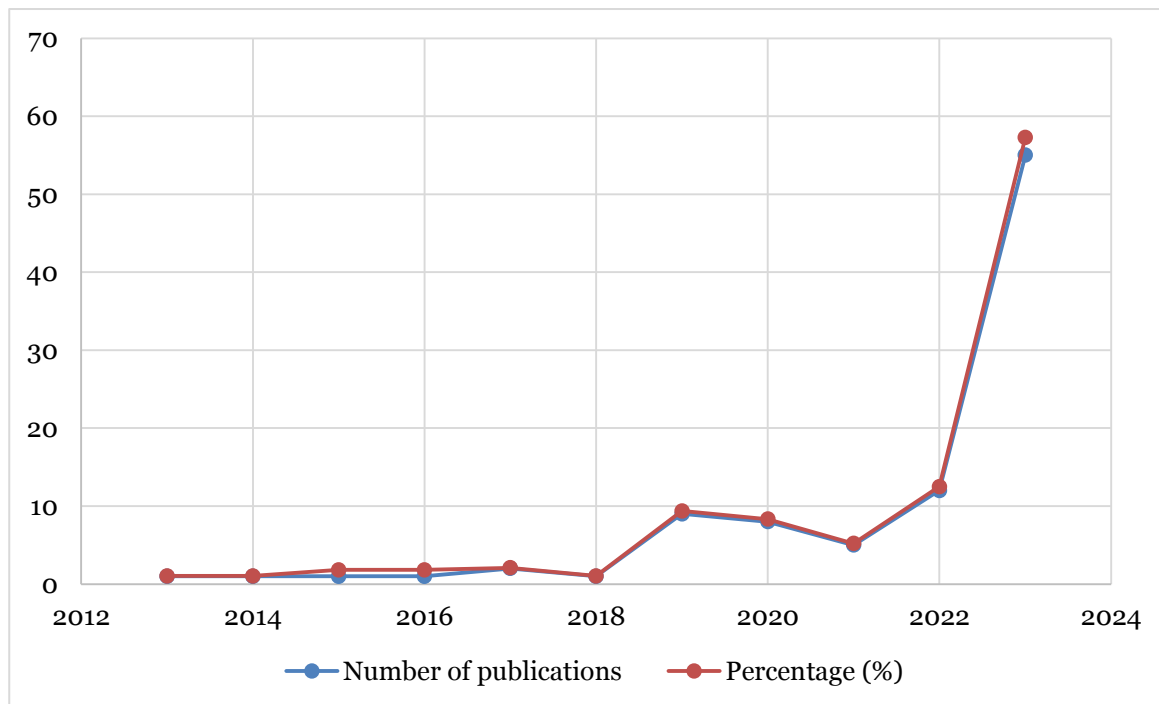


**Fig. 2**. Yearly Article Publication Trends in AI-related Studies about SSA Education Delivery

### Countries and Parts of Sub-Saharan Africa that Contributed to AI Research

This section focuses on the geographical distribution of AI research contributions across Sub-Saharan Africa (SSA). It aims to identify the countries and regions within SSA that have actively contributed to AI research initiatives. The results are in Figure 3 as well as Table 2.

From Table 2, the AI-related studies spanned twenty-three SSA countries. Out of this number, seven of them were from the Western, eight from the Southern and five from the Eastern parts. Additionally, two countries are situated in the Central part, and a country is located in the Northern part of SSA. For the number of studies, Ghana and Nigeria had 26, being the highest number of studies, representing 27.09 % respectively out of the total number of 96 studies. This was followed by Togo, Kenya, Namibia and South Africa with 4 studies per country representing 4.16 %. Both Tanzania and Zambia produced three studies, each representing 3.14 %. Six countries, namely Botswana, Burundi, Cameroon, Mauritius, Rwanda, and Sierra Leone, published two AI-related articles each, representing 2.08 %. Central African Republic, Ethiopia, Mauritania, Niger Senegal, Sudan and Zimbabwe contributed only one study and the least, representing 1.04 %. Examining Table 1, more broadly, it became evident that the Western part of SSA had the highest number of studies 61 (63.54 %). However, the Southern part produced 19 (19.79 %) of studies, the Eastern and Central parts contributed 12 % and 4 % of studies, respectively.
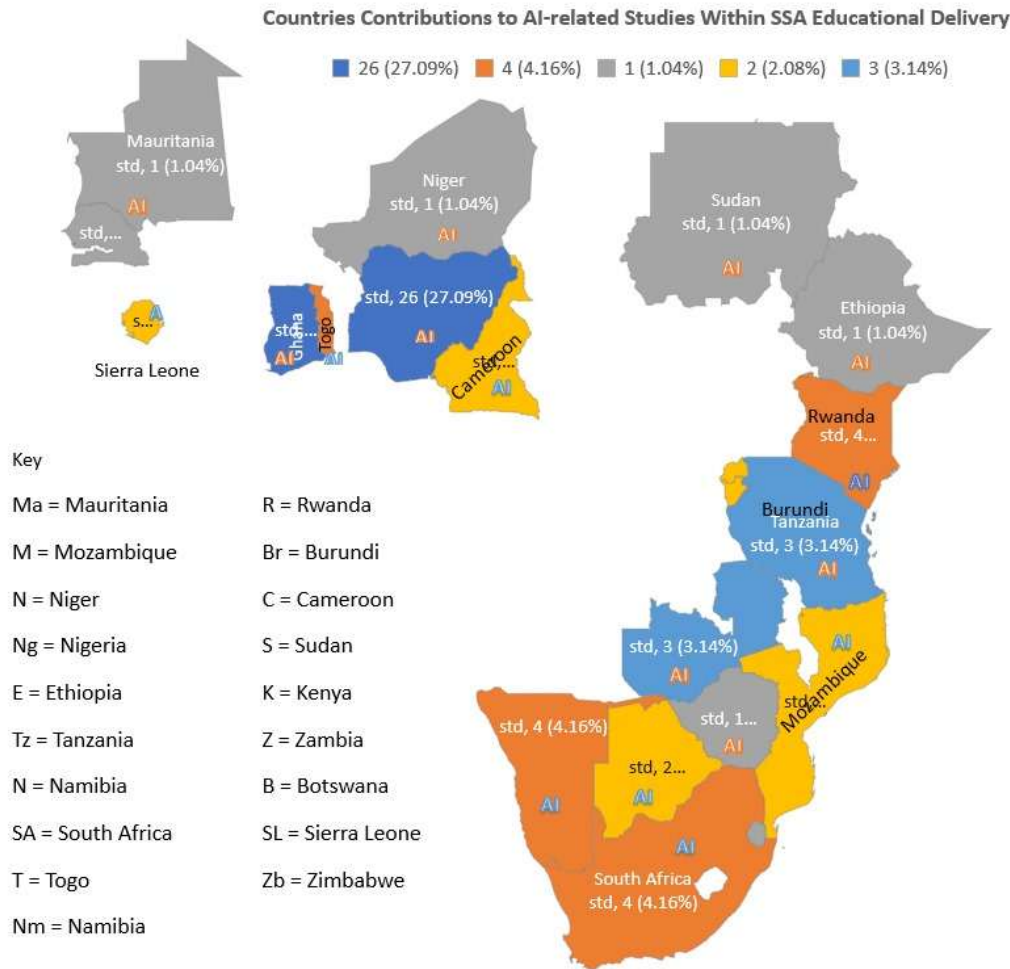
**Fig. 3**. Country contributions to AI-related studies within SSA educational delivery.
Source: Pew Forum…, 2025

**Table 2.** Country and Part of Sub-Saharan Africa with a number of Studies

| Country | Part of SSA | No. of Studies | Percentage (%) | No. of Studies by Part of SSA | Percentage (%) |
|---------|-------------|----------------|----------------|-------------------------------|----------------|
| Ghana | Western | 26 | 27.09 | 61 | 63.54 |
| Nigeria | Western | 26 | 27.09 | | |
| Togo | Western | 4 | 4.16 | | |
| Mauritania | Western | 1 | 1.04 | | |
| Niger | Western | 1 | 1.04 | | |
| Senegal | Western | 1 | 1.04 | | |
| Sierra Leone | Western | 2 | 2.08 | | |
| Burundi | Eastern | 2 | 2.08 | 12 | 12.50 |
| Tanzania | Eastern | 3 | 3.14 | | |
| Ethiopia | Eastern | 1 | 1.04 | | |
| Kenya | Eastern | 4 | 4.16 | | |
| Rwanda | Eastern | 2 | 2.08 | | |
| Sudan | North Eastern | 1 | 1.04 | 1 | 1.04 |
| Cameroon | Central | 2 | 2.08 | 3 | 3.12 |
| Central AR | Central | 1 | 1.04 | | |
| Botswana | Southern | 2 | 2.08 | 19 | 19.79 |
| Mauritius | Southern | 2 | 2.08 | | |
| Mozambique | Southern | 2 | 2.08 | | |
| Namibia | Southern | 4 | 4.16 | | |

| Country | Part of SSA | No. of Studies | Percentage (%) | No. of Studies by Part of SSA | Percentage (%) |
|---|---|---|---|---|---|
| South Africa | Southern | 4 | 4.16 | | |
| Swaziland | Southern | 1 | 1.04 | | |
| Zambia | Southern | 3 | 3.14 | | |
| Zimbabwe | Southern | 1 | 1.04 | | |
| Total | | 96 | 100 | 96 | |

### *Methodological Characteristics of the AI-related Studies about the SSA Education Delivery*

This section delves into the methodological characteristics of Artificial Intelligence (AI)-related studies within the context of Sub-Saharan Africa's (SSA) educational landscape. By examining the research design, data collection instruments, subjects, sample size and statistical tools used for analysis employed in these studies

### *Design and Instruments*

The first aspects of the methodology assessed were the research design and instruments adopted for the various studies. Details on the research design and instruments are provided in Table 3.

**Table 3.** Research Design and Instruments

| Design | No. of Stds. | Per (%) | Instruments | | | |
|---|---|---|---|---|---|---|
| | | | Questionnaire | Interview | Questionnaire & Interview | Literature Study |
| Quantitative | 34 | 35.42 | 34(35.42 %) | | | |
| Qualitative | 27 | 28.13 | | 27(28.13 %) | | |
| Mixed Method | 12 | 12.5 | | | 12(12.5 %) | |
| Desktop Review | 23 | 23.95 | | | | 23(23.95 %) |
| Total | 96 | 100 % | | | | |

Table 3 shows that the quantitative research design dominated most of the studies. This is underpinned by the fact that 34 out of the total studies, accounting for 35.42 %, employed this research design. This was followed by the qualitative approach, which recorded 27 (28.13 %) studies. Next is the Desktop review approach, which records 23 studies, presenting 23.95 %, with the mixed-method approach being the least used. In terms of the instruments utilised for data collection, the questionnaire was the most used instrument by 34 studies, representing 35.42 % followed by an interview, 27 (28.13 %). Next, the literature review comprised 23 (23.23%) studies, and both questionnaires and interviews were used in 12 (12.5%) cases, being the least employed instruments for collecting data.

### *Subjects and Sample Size*

The subjects selected for study, along with their corresponding sample sizes, are presented in Table 4.

**Table 4**. Subjects and Sample Size

| Subject | No of Studies | Percentage (%) | Sample Size | | |
|---|---|---|---|---|---|
| | | | | | |
| | | | <= 150 Small | >150 <=250 Medium | >250 Large |

| | | | | | |
|---|---|---|---|---|---|
| Students | 30 | 31.25 | 8 (30.77 %) | 5 (21.74 %) | 17 (36.17 %) |
| Teaching Staff | 23 | 23.95 | 3 (11.54 %) | 13 (56.52 %) | 7 (14.89 %) |
| Both students & Teaching Staff | 17 | 17.71 | 5 (19.23 %) | 2 (8.70 %) | 10 (21.28 %) |
| Administrative Staff | 9 | 9.38 | 1 (3.85 %) | - | 8 (17.02 %) |
| Both Teaching & Administrative staff | 5 | 5.21 | 4 (15.38 %) | 1 (4.35 %) | - |
| Researchers | 8 | 8.33 | 3 (11.34 %) | 2(8.70 %) | 3 (6.38 %) |
| Librarians | 4 | 4.17 | 2 (7.69 %) | - | 2 (4.26 %) |
| Total | 96 | 100 | 26 (26.8 %) | 23(23.71 %) | 48(49.48 %) |

Details from Table 4 indicate that out of the 96 articles reviewed, 30, constituting 31.25 %, used university students as their subjects of study. This was followed by 23 (23.95 %) studies that used teaching staff as their subject. Of the remaining studies, 17 (17.71 %) of them made use of both students and teaching staff as subjects, and 9 (9.38 %) of the studies utilised administrative staff as subjects. Five (5.21 %) studies utilised both teaching and administrative staff, while 8 (8.33 %) and 4 (4.17 %) of the 96 studies considered researchers and librarians, respectively, for their studies. For sample sizes, the range was between small for 26 studies, medium size for 23 studies and large size for 48 research constituting 48.48 %. Overall, 48 out of the 96 articles published used large sample sizes for their studies.

### Statistical Instruments/Tools Employed for Analysis
The quality and dependability of research findings significantly depend on the statistical instruments or tools adopted for analysis. Taking this into account, the study sought to explore the various statistical tools employed in analysing research about AI in SSA, as illustrated in Table 5.

**Table 5**. Statistical Instruments/Tools

| Statistical Instruments/Tools | No. of Studies | Percentage (%) |
|---|---|---|
| Thematic Desktop Analysis | 24 | 25.0 |
| Descriptive Analysis | 37 | 38.54 |
| Correlation Analysis | 8 | 8.33 |
| Regression/Chi-square/GLM's/MANOVA | 2 | 2.08 |
| Structural Equation Modelling (SEM) | 6 | 6.25 |
| ANOVA | 1 | 1.04 |
| Content Analysis | 14 | 14.6 |
| Kolmogorov-Smirnov test | 1 | 1.04 |
| Univariate analysis | 1 | 1.04 |
| Mann-Whitney U test | 1 | 1.04 |
| Meta-Analysis | 1 | 1.04 |
| **Total** | 96 | 100 |

From Table 5, the majority of the authors employed descriptive analysis, constituting 37 (38.5 %) of the studies. This was followed closely by thematic desktop analysis, with 24 studies representing (25.0 %) of the 96 studies reviewed. Content analysis, Correlation Analysis, SEM and Regression/Chi-square/GLM/MANOVA constituted the next set of tools the studies utilised, recording 14 (14.58 %), 8 (8.33 %), 6 (6.25 %), and 2 (2.08 %) respectively. Kolmogorov-Smirnov

test, ANOVA Univariate analysis, Mann-Whitney U test, and Meta-Analysis were less frequently utilised, each study representing 1 (1.04 %) of the studies reviewed.

### *Distribution of AI Users in AI-related Research*

Table 6 presents the dispersion of users within the scope of education examined in AI-related studies. Substantially, 35 studies, constituting approximately 36.46 % of the 96, focus on AI usage among students. Another significant portion of the studies, 28 (29.17 %) illustrate the use of AI by teaching staff. A noteworthy 9 studies, accounting for about 9.38 %, research into the involvement of administrative staff in utilising AI for educational purposes. The remaining 18 studies, representing 18.75 %, and 6 studies accounting for 6.25 %, concentrate on the use of AI among researchers and librarians, respectively. Moreover, the 96 studies reviewed offer a holistic perspective on the different users of AI in education.

**Table 6**. Users of AI in the SSA higher education delivery

| Users of AI | No. of Studies | Percentage (%) |
|---|---|---|
| Students | 35 | 36.46 |
| Teaching Staff | 28 | 29.17 |
| Administrative Staff | 9 | 9.38 |
| Researchers | 18 | 18.75 |
| Librarians | 6 | 6.25 |
| Total | 96 | 100 |

### *Factors influencing AI Adoption within the SSA educational institutions context*

Table 2 categorises and quantifies the factors contributing to the adoption of AI within SSA education. Among the identified factors, "global perspectives on AI in education" with 11 studies emerges as the most prevalent theme, comprising 10 studies and constituting 38.5 % of the total. Following this, "training and skill development for adoption" accounts for 19.2 %. In contrast "the readiness of educational institutions to integrate AI" and "ethical considerations, training, professional development, and the cultural impact of AI in education" each with five studies representing 17.2 % follows in the order—cultural impact of AI in education, albeit to a lesser extent, with two studies.
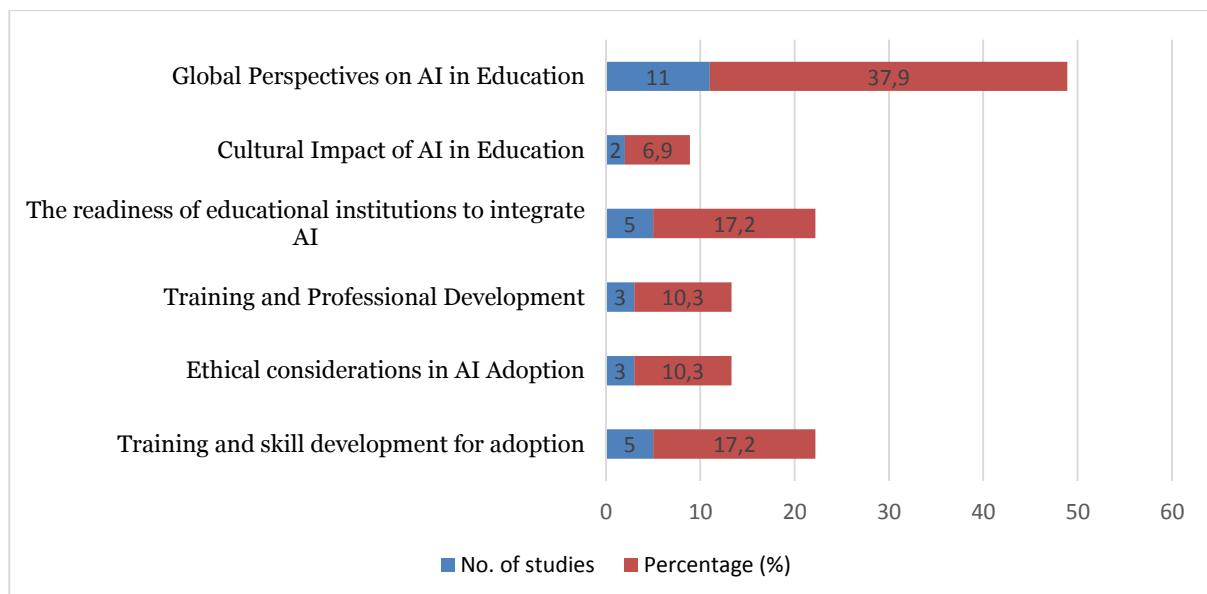


**Fig. 3.** Factors Influencing AI Adoption, Acceptance and Usage within SSA Education

Figure 3 depicts the factors influencing AI adoption and usage within SSA higher education. *Enhancement of global collaboration* emerges as the most prominent factor, accounting for

33.3 %, with 11 studies focusing on this aspect. *Student perspectives about AI usage* and *human-centric concerns* are significant contributors, representing 21.2 % and 24.7 %, contributing 7 and 8 studies, respectively. The ability of AI to support automated administrative and marketing processes with 3 studies (9.1 %), facilitate research with 1 study (3.0 %), support language learning and enhance accessibility with 1 study also with 1 study (3.0 %) were other factors noted to influence AI usage within the SSA higher education system.
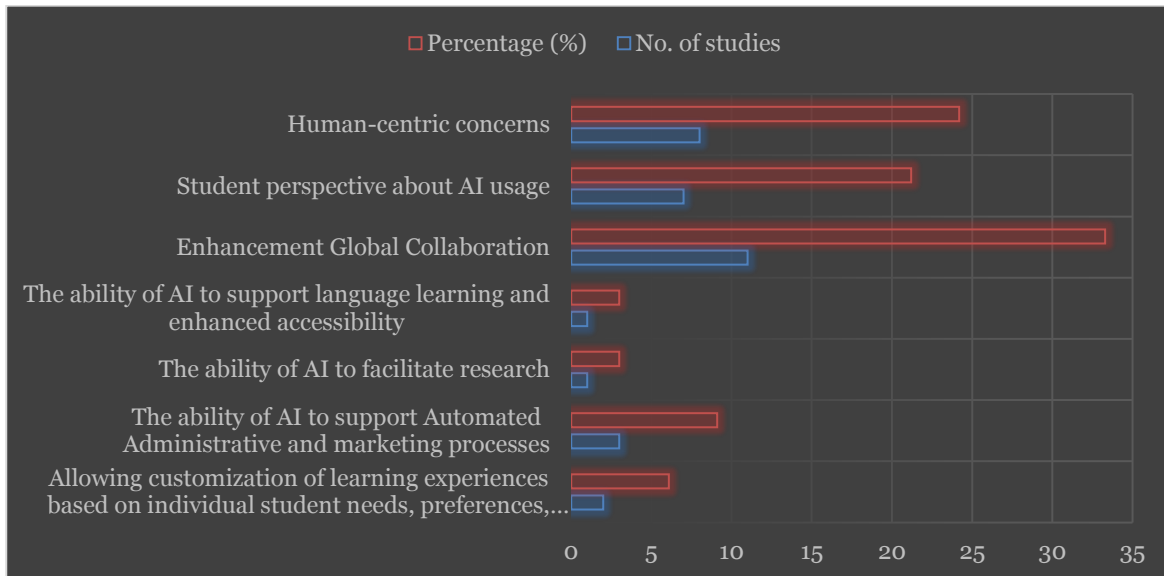


**Fig. 4**. Threat and risk of using AI within SSA education

### *Threats and risks of using AI discussed in related studies*
Table 4 concisely presents the threats and risks of using AI within SSA education. Optimism and scepticism, harboured by some people who fear drawbacks, such as a loss of human connection in learning, constitute the majority, representing 77.8% in 7 studies. Additionally, the potential of AI causing AI-induced unemployment in the future is identified as a concern by the authors in 2 studies (22.2 %). These were the only two categorisation of the perceived threats and risks authors found with the integration of AI into SSA higher education delivery.
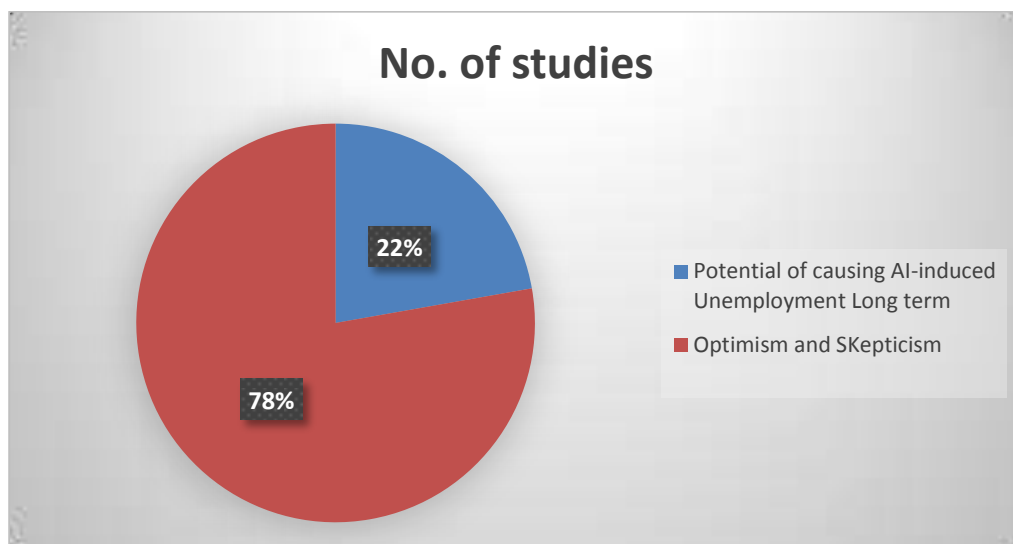


**Fig. 5.** Threat and risk of using AI

### *Beneficial uses of AI discussed in AI-related studies*

Figure 6 provides an overview of the beneficial uses of AI within SSA education, showcasing its multifaceted positive impacts. 'Promotion of global collaboration' emerges as a predominant theme, constituting 44 % with 11 studies emphasising the role of AI in fostering international collaboration in project management, research and publications. Additionally, AI being recognised as a *beacon of innovation and efficiency in learning and research,* was found in 28.0 % of the studies representing 7 studies. Other benefits such as AI enhancing engagement and understanding to improve learning outcomes was in a study (4.0 %), More so, AI's ability to analyse vast amounts of data was discussed in 3 studies (12.0 %), and AI's support in the acceleration of research processes was mentioned in 2 studies (8.0 %). Furthermore, there is an acknowledgement of AI's support in language learning (4.3 %) in one of the studies reviewed.
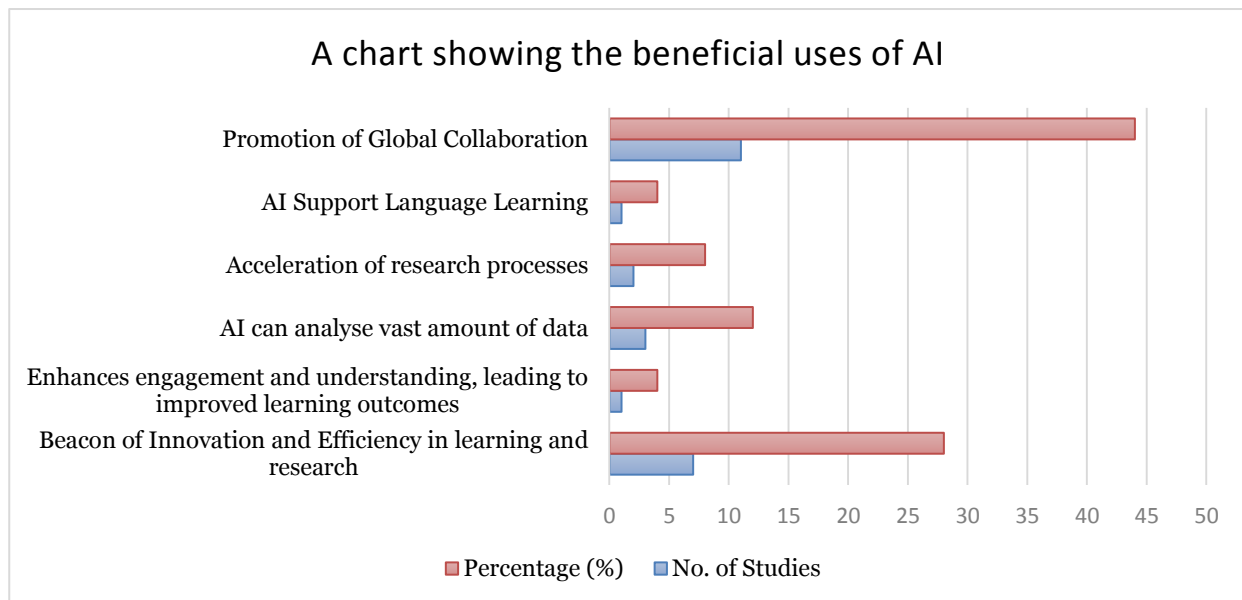
**Fig. 6.** Beneficial uses of AI

## 4. Discussion

Concerning country contributions to published studies related to AI adoption and usage within the SSA educational delivery, it was observed that Ghana and Nigeria had the highest number of studies on AI in education, followed by South Africa, Kenya, Namibia, and Togo. Sequentially, the countries with the fewest studies included Mauritania, Niger, Senegal, Sudan, Swaziland, the Central African Republic, Ethiopia, and Zimbabwe. This distribution seems to correlate with the AI readiness rankings of SSA countries, with Kenya, South Africa, Ghana, Cote d'Ivoire, and Nigeria being the top five AI-ready nations. Despite these variations, the popularity of AI studies in SSA began to surge in 2019 and reached its peak in 2023, aligning with global trends.

After the literature review, it was noted that investigations into AI adoption and acceptance in educational institutions in SSA gained popularity in 2019 and skyrocketed in 2023. Between 2013 and 2018, AI-themed studies received little scholarly and research attention. The observations regarding the popularity of AI studies in 2019 and its subsequent surge in 2023 are consistent with global trends, as discussed by the authors. To substantiate these findings, Adamopoulou and Moussiades (2020) demonstrated an astronomical increase in publications on chatbots since 2016. Moreover, as a region that often plays catch-up, especially in technology, it is understandable why studies on AI started to peak in 2019. This shift coincided, certainly with the increased attention to chatbots in education, especially after the release of ChatGPT in November 2022, as emphasised by the authors in the reviewed studies.

The findings from the review revealed that the authors consistently employed quantitative methods to explore the role of AI in SSA's education landscape. This preference for quantitative approaches indicated a commitment to rigorous and systematic analysis, allowing the researchers to employ statistical tools for the analysis of the results of the studies discovered. In addition to quantitative methods, desktop reviews and qualitative research were commonly employed by the

authors, providing complementary perspectives for a holistic understanding of AI adoption and acceptance within the SSA educational concern. It was observed that the qualitative methods facilitated in-depth exploration of the nuances and contextual factors influencing the adoption and effectiveness of AI technologies. Although less common, the mixed methods approach was utilised in approximately half of the quantitative studies, signifying a recognition of the need for a comprehensive examination of AI-related issues in the SSA educational concern.

The users of AI constituted another notable observation derived from the reviewed studies. It was observed that the authors highlighted the primary internal stakeholders in the education environment as the users of AI in SSA, encompassing students, researchers, teaching staff, administrative staff, and librarians. This underscores the widespread integration of AI in SSA's educational landscape, involving all major groups. Regarding the frequency of AI usage among these groups, students emerged as the most frequent users, followed by teaching staff. Librarians were identified as the stakeholder group with the least utilisation of AI, and administrative staff ranked just above librarians in terms of AI usage according to the reviewed studies.

Concerning the factors contributing to the acceptance and adoption of AI in educational institutions in SSA, the reviewed studies revealed that a prominent factor is the global considerations about AI usage in education. Given the above circumstance, the authors emphasised the necessity for academic institutions to align their curricula with evolving AI technological trends and advancements, ensuring students are equipped with essential skills for using AI in teaching and learning. Fomunyam (2020) proposed machine learning as an alternative pathway for education in Africa, while Qin et al. (2022) demonstrated positive attitudes toward integrating chatbots in education, particularly in regions with high student-teacher ratios. Essentially, most authors suggested that educational authorities in the SSA region should demonstrate a commitment to embracing technological advancements in AI usage, as witnessed in other parts of the world.

The review extracted the threats and risks associated with AI usage in SSA educational concerns, with a particular focus on the potential for long-term unemployment and employee scepticism. While Ikedinachi et al. (2018) discussed the impact of AI advancements on jobs, suggesting that increased use and rapid progress could lead to competition with human workers and job insecurity, there was limited commentary on these findings. Authors noted instances where AI outperformed humans in tasks, contributing to scepticism and a cautious approach to AI adoption in educational institutions across the SSA region. This highlights the need for thoughtful consideration and strategic planning to address potential negative consequences while embracing AI in education.

The benefits of integrating AI technologies in SSA's educational landscape, as highlighted in the reviewed studies, emphasise the transformative potential of AI in various aspects of learning and academic performance. Specifically, AI's role in supporting language learning through immediate feedback on pronunciation, grammar, and vocabulary usage, as demonstrated by Dos Santos et al. (2021), signifies its contribution to enhancing language skills. Moreover, the recognition of AI as a beacon of innovation and efficiency in learning and research suggests its positive impact on entrepreneurial performance among university students. The consistent emphasis on the positive learning experience during virtual teaching, especially when students engage with AI technologies, aligns with the studies by Essel et al. (2022), Amegadzie et al. (2021), Khalid (2020), and Imhanyehor (2022). This collective evidence highlights the potential of AI to enhance engagement, understanding, and overall learning outcomes in SSA's educational context.

### Implications for Practice in SSA Education

Educational institutions in sub-Saharan Africa should prioritise training and development programmes for students, lecturers, administrators, and librarians to build the necessary skills for effective AI usage. Such initiatives will ensure that key stakeholders are adequately equipped to integrate AI tools into teaching, learning, and administrative operations. Beyond technical skills, users must be made aware of ethical considerations and responsible usage to reduce the risk of academic dishonesty and misuse. Training students and faculty on acceptable academic conduct when using AI tools will help improve learning outcomes while maintaining academic integrity. Institutions are also encouraged to invest in AI-supportive infrastructure and digital platforms to facilitate seamless adoption. Furthermore, educators and academic staff should be encouraged to view AI as a supportive tool rather than a replacement, which can result in cognitive processing redundancy. Structured

dialogue, workshops, and peer-led adoption strategies could help reduce scepticism and promote a more collaborative, open-minded approach to AI integration in education.

### *Implications for Research in SSA Education*

In terms of research, the findings of the review suggest a need for broader geographical representation. While Ghana and Nigeria dominate the literature, underrepresented regions in Eastern, Central and Southern SSA must receive increased scholarly attention. Future studies should also employ mixed methods approaches, combining both quantitative and qualitative techniques to capture a more comprehensive view of AI adoption, acceptance, and usage in higher educational contexts. This blended approach offers richer insights into both numerical trends and contextual factors that influence AI implementation. Additionally, researchers should expand their focus beyond students and teachers to include other stakeholders such as school administrators, librarians, and technical staff whose roles are integral to the success of AI adoption. To enhance the generalisability and reliability of findings, it is recommended that researchers apply more robust analytical tools, including inferential statistics such as Partial Least Squares-Structural Equation Modelling (PLS-SEM), Generalised Structured Component Analysis (GSCA), Analysis of Moment Structures (AMOS) structural equation modelling, Correlation Analysis, Regression/Chi-square/GLM's/MANOVA, ANOVA, Kolmogorov-Smirnov test, Univariate analysis, Mann-Whitney U test and Meta-Analysis. This will enable researchers to shift from heavy reliance on desktop or thematic analysis and engage in more empirical research that documents real-world experiences and contributes to the global discourse on AI in education in SSA. Lastly, research in SSA should focus on specific AI tools (ChatBot, Image Generation, Content Writing, Project Management, Natural Language Processing, Computer Vision, Machine Learning, and Deep Learning) to unearth their affordances, challenges, and limitations based on their functionalities and usage.

### *Implications for Policy in SSA Education*

At the policy level, it is evident that there is a need to formulate and promote policy on equity in AI research support across the region. National and regional policies should include funding provisions specifically targeted at AI research and capacity building within the education sector. These funds can support infrastructure, training, and collaborative research initiatives aimed at enhancing the use of AI in teaching and learning. Moreover, AI adoption must be embedded in broader national education policies and reform agendas. This alignment ensures that AI integration is not treated as an isolated innovation but rather as a core driver of educational transformation. Policymakers should also develop ethical frameworks for the use of AI in educational settings, with a focus on issues such as data privacy, academic integrity, and equitable access. Finally, creating policies that create environments for international research collaborations will position SSA institutions to contribute meaningfully to the global AI education landscape and benefit from shared knowledge and innovations.

### 6. Conclusion

This paper has provided significant insights into research on AI adoption and usage in general education in SSA from 2013 to 2023. Data mining from databases such as Scopus, Google Scholar, and PubMed was employed to obtain 96 articles on the topic, adhering to the authors' set criteria. The review period (2013–2023) represents when authors began publishing on AI technologies in educational institutions. The review examined AI adoption, acceptance, and usage, as well as threats and risks, and the benefits of AI within the SSA educational landscape.

Building upon the findings, this study offers insights into yearly publication trends, countries' contributions, methodological characteristics, and core thematic issues, namely factors influencing adoption, acceptance, and usage, as well as the benefits associated with AI usage in education within SSA. AI integration in education in SSA is progressing steadily, and more studies on the subject are required to contribute to the global discourse on AI adoption and usage in education. Specifically, more empirical studies are needed on AI integration in the Eastern, Central, Northern, and Southern parts of SSA, as most existing studies focused on Ghana and Nigeria in the Western part of the region.

It can be concluded that AI adoption and usage in education in SSA have primarily focused on students or teachers, relying on either quantitative or qualitative approaches, with few studies underpinned by a mixed-method approach. Another revelation from the review is that the thematic

desktop analysis and descriptive analysis used in most studies failed to unearth findings that could be generalised for the population in the study contexts. Although the integration of AI technologies in educational institutions in SSA is on the rise due to its associated benefits, the review also highlighted risks and threats. The study concludes that skepticism and potentially induced long-term unemployment were identified as some of the associated risks and threats as challenges in the review for AI integration in education in SSA, and requires more investigations.

## 7. Declarations

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## Appendix A

**Table 7**. Summary of included studies

| Author(s)/ Date | Country | Subjects (Agric, Edu, etc.) | Methods (qual, quant, mixed) | Sample size | Users (students, lecturers, administrators, researchers, etc.) | Level of Edu (e.g., undergraduate, postgraduate, and post-doctoral study) |
|---|---|---|---|---|---|---|
| D Vernon, 2019 | Ghana | healthcare, agriculture, education, manufacturing, and industrial development. | | | general population in Africa, students, and the workforce | |
| HB Essel, D Vlachopoulos, 2022 | Ghana | Education | mixed | 68 | undergraduate students | Undergraduate |
| A Endurance, N Onah Eunice, 2021 | Nigeria | Education | Quantitative | 301 | lecturers | Doctorate |
| E Okewu, P Adewole, S Misra, 2021 | Nigeria | Education | Desktop review | 190 | researchers | |
| EM Onyema, 2019 | Nigeria | Education | Quantitative | 200 | lecturers and students | Undergraduate and Doctorate |
| IT Sanusi, SA Olaleye, SS Oyelere, RA Dixon, 2019 | Nigeria | Education | Quantitative | 605 | students | Undergraduate |
| RO Okunlaya, N Syed Abdullah, RA Alias, 2022 | Nigeria | Education | Desktops review | | librarians | |
| A Alam, 2022 | Togo | Education | | | lecturers and students | Undergraduate |
| A Hamoud, AS Hashim, WA Awadh, 2018 | Togo | Education | Quantitative | 161 | students | Undergraduate |
| SAD Popenici, S Kerr, 2017 | Togo | Educational | Not Stated | Not Stated | teachers and students. | |
| AS Oladele, V Vokolkova, JA Egwurube, 2014 | Botswana | Engineering | Quantitative | | transportation planners, researchers | |
| Shonhe, L., Jain, P., Akakandelwa, A. (2023) | Botswana | education | quantitative | 354 | students | undergraduate |
| KO Dalton, 2019 | Burundi | Education | Quantitative | 133 | lecturers and students | |
| WJ Shyr, FC Yang, PW Liu, YM Hsieh, 2019 | Burundi | Education | Quantitative | 10 | students | |
| Jeremie Ning (2023) | Cameroon | education | quantitative | 500 | academic staff | postgraduate |
| S Fosso Wamba, MM Queiroz, 2022 | Cameroon | It is not specific to any particular industry but instead addresses the | Content analysis and discussions | | | |

| Author(s)/ Date | Country | Subjects (Agric, Edu, etc.) | Methods (qual, quant, mixed) | Sample size | Users (students, lecturers, administrators, researchers, etc.) | Level of Edu (e.g., undergraduate, postgraduate, and post-doctoral study) |
|---|---|---|---|---|---|---|
| | | broader context of digital transformation. | | | | |
| F Pedro, M Subosa, A Rivas, P Valverde, 2019 | Central African Republic | Education, Technology, and Sustainable Development | | | students and teachers | |
| F Machaba, TB Bedada, 2022 | Ethiopia | Education | Quantitative | | mathematics teachers | |
| C Tastimur, M Karakose, E Akin, 2016 | Kenya | Education | | | | |
| T Eli, 2021 | Mauritania | Education | Quantitative | 101 | students | Undergraduate |
| sengupta, E.and Blessinger, P.(Ed.), 2022 | Mauritius | Education | Literature review | | educators, administrators, policy makers and anyone interested in the use of technology in higher education. | |
| S Panchoo, 2015 | Sieus | EDUCATION | Mixed | | policymakers, researchers, educators and stakeholders in education. | |
| R Manhiça, A Santos, J Cravino, 2022 | Mozambique | Education | | | educators and researchers | |
| A Shipepe, L Uwu-Khaeb, E Kolog, M Apiola, K Mufeti... | Namibia | Education | Qualitative | | undergraduate students | Undergraduate |
| MM Ujakpa, JO Osakwe, GE Iyawa, 2020 | Namibia | Educational | Quantitative | 24 | students | |
| IT Sanusi, SA Olaleye, SS Oyelere, RA Dixon, 2022 | Niger | Education | Quantitative | 605 | students | -K-12 Students. |
| KJ Mwilongo, R Mwageni, G Matto, 2022 | Rwanda | Education | | | students and facilitators | |
| SZ Salas-Pilco, K Xiao, X Hu, 2022 | Rwanda | Education | Content analysis | 30 | teachers | |
| B Gueye, AD Gueye, A Gueye, O Kasse..., 2021 | Senegal | Education | | | students | |
| H Wandera, 2020 | Sierra Leone | Education | | | students | |
| H Wandera, V Marivate, D Sengeh, 2020 | Sierra Leone | Education | | | students | High School |
| F Pedro, M Subosa, A Rivas, P Valverde, 2019 | South Africa | Education | Literature Review | | students, teachers and policy makers | From K-12 to higher education |
| MA Goralski, TK Tan, 2020 | South Africa | Business | Conceptual Analysis | | | |
| X Chen, H Xie, D Zou, GJ Hwang, 2020 | South Africa | Education | Content Analysis | | | |
| ZM Sedahmed, NA Noureldien, 2019 | Sudan | Education | | 800 | students | |
| K Madzima, EL Dube, PM Mashwama, 2013 | Swaziland | Education | | | students and teachers | Secondary school |
| JS Kamaghe, ET Luhanga, K Michael, 2020 | Tanzania | Education | | | students | Higher Education |
| M Maphosa, V Maphosa,2 020 | Tanzania | Education | Literature review | 811 | student, lecturers , administrators and researchers | |
| F Pedro, M Subosa, A Rivas, P Valverde, 2019 | Togo | Education | Not Stated | Not Stated | students and teachers | |

| Author(s)/ Date | Country | Subjects (Agric, Edu, etc.) | Methods (qual, quant, mixed) | Sample size | Users (students, lecturers, administrators, researchers, etc.) | Level of Edu (e.g., undergraduate, postgraduate, and post-doctoral study) |
|---|---|---|---|---|---|---|
| KJ Mwilongo, R Mwageni, G Matto, 2022 | Zambia | Education | | | students and teachers | |
| OS Madumo, JR Kimaro, 2021 | Zambia | Education and Technology | Qualitative | | students | |
| F Chigora, C Katsande, P Zvavahera..., 2022 | Zimbabwe | Educational | Literature Review | | students | |
| Adarkwah, M.A., Amponsah, S., van Wyk, M.M., Huang, R., Tlili, A., Shehata, B., Metwally, A.H.S. and Wang, H., 2023 | Ghana | Education | Mixed | 34 academics - Qualitative; 50 academics - Quantitative | academics | Higher Education |
| Mohammed, A. S. (2023 | Ghana | Education | Qualitative | 8 Educators | academics | |
| Nyaaba, M. (2023). | Ghana | Education | Not stated | Not stated | academics | Pre-tertiary level (K-12) and the teacher education programs |
| Nyaaba Akanzire, B., Nyaaba, M., Nabang, M. (2023). | Ghana | Education | Qualitative | 50 | academics | Colleges of education |
| Zhai, X., Nyaaba, M. (2023). | Ghana | Education | Quantitative | 307 | teacher educators, administrators, and in-service teachers | Teacher education |
| Butakor, P. K. (2023). | Ghana | Education | Quantitative | 231 pre-service teachers | academics | Higher education |
| Ofosu-Ampong, K., Acheampong, B., Kevor, M. O. (2023). | Ghana | Education | Quantitative | 146 students | academics | Higher education |
| Bonsu, E. M., Baffour-Koduah, D. (2023) | Ghana | Education | Mixed-method approach | 107 | academics | Higher education |
| Boateng, J. K., Osei-Tutu, E. M., Kwapong, O. A. T. (2023) | Ghana | Education | Not stated | Not stated | academics | Higher education |
| Boateng, G., Mensah, J. A., Yeboah, K. T., Edor, W., Mensah-Onumah, A. K., Ibrahim, N. D., Yeboah, N. S. (2023) | Ghana | Education, Technology | Qualitative | 60 | academics, researchers | Senior High School |
| Inusah, F., Missah, Y. M., Najim, U., Twum, F. (2023) | Ghana | Education | Mixed | 648 | academics, administrators | Basic education |
| Attah, A. P. K., Tahiru, A. M. 2023) | Ghana | Technology | Qualitative | 55 | special education teachers | All levels of education |
| Ampofo, J. W., Emery, C. V., Ofori, I. N. (2023). | Ghana | healthcare, Technology | Quantitative | 225 | students, health institutions, | Higher education |
| Esseku, J. F., Teye, V. Q. N., Agyemfra, K.A., Musa, M. (2023) | Ghana | Education | Not stated | Not stated | healthcare, financial, industrial, and transportation sectors | |
| Baidoo-Anu, D., Ansah, L. O. (2023) | Ghana | Education | Not stated | Not stated | policy makers, researchers, educators and technology experts | Higher education |

| Author(s)/ Date | Country | Subjects (Agric, Edu, etc.) | Methods (qual, quant, mixed) | Sample size | Users (students, lecturers, administrators, researchers, etc.) | Level of Edu (e.g., undergraduate, postgraduate, and post-doctoral study) |
|---|---|---|---|---|---|---|
| Boateng, J. K. (2023). | Ghana | Education | Mixed(Quantitative = 230 respondents and Qualitative = 10 respondents from the 230) | 230 | academics | Higher education |
| Nemorin, S., Vlachidis, A., Ayerakwa, H. M., Andriotis, P. (2023). | Ghana | Education | Quantitative | 143 | academics | Higher Education |
| Segbenya, M., Bervell, B., Frimpong-Manso, E., Otoo, I. C., Andzie, T. A., Achina, S. (2023) | Ghana | Education | Mixed | 294 | academics | Higher Education |
| Dake, D. K., Bada, G. K., Dadzie, A. E. (2023) | Ghana | Education | Quantitative | 200 | academics, researchers | Higher Education |
| Edzie, E. K. M., Dzefi-Tettey, K., Asemah, A. R., Brakohiapa, E. K., Asiamah, S., Quarshie, F., … Kusodzi, H. (2023) | Ghana | Education | Qualitative | 77 | academics | Higher Education |
| Ismail, F., Tan, E., Rudolph, J., Crawford, J., Tan, S. (2023) | Ghana | Education | Mixed | — | academics | Higher Education |
| Tlili, A., Ofosu, S., Zhang, J. (2023) | Ghana | Education | Mixed | 110 | academics | Higher Education |
| Boateng, G., Kumbol, V., Kaufmann, E. E. (2023). | Ghana | Education | Qualitative(Literature review) | Not stated | researchers, administrators | Secondary Schools |
| Huang, R., Tlili, A., Xu, L., Chen, Y., Zheng, L., Metwally, A. H. S., … , Bonk, C. J. (2023). | Ghana | Education | Qualitative(Literature review) | Not stated | designers, developers, educators, policymakers | Higher Education |
| Ogunode, N. J., Ejike, C. N. (2023). | Nigeria | Education | Qualitative | Not stated | educators, students | Post-Basic Education |
| Samuel, O. O. (2023) | Nigeria | Education | Qualitative(Literature re | Not stated | teachers, researchers, students | Primary Schools |
| Ogunode, N. J., Olofu, P. A., Bassey, U. O. (2023) | Nigeria | Education | Mixed | 150 | academics, students | Higher Education |
| Nwile, C. B., Edo, B. L. (2023) | Nigeria | Education | Quantitative | 154 administrators | administrators | Higher Education |
| Okagbue, E. F., Ezeachikulo, U. P., Akintunde, T. Y., Tsakuwa, M. B., Ilokanulo, S. N., Obiasoanya, K. M., … , Ouattara, C. A. T. (2023) | Nigeria | Education | Qualitative | 1138 articles | extracted articles | Higher Education |
| Onyejegbu, L. N. (2023) | Nigeria | Education | Qualitative | 12 Faculties | senior faculty, research lab heads and researchers | Higher Education |
| Timothy, K. N., Onyeukwu, H. C. (2023) | Nigeria | Education | Quantitative | 104 | primary and secondary schools | Primary and Secondary Education |
| Adejoro, C. O., Arn, L., Schwartz, L., Yeh, T. (2023, June) | Nigeria | Education | Qualitative | 11 | secondary school students | Secondary school |
| Ananyi, S. O., Nwosu, L. K. (2023). | Nigeria | Education | Quantitative | 25 | university public relation officers | Higher Education |
| Jibrin, H. S., Idris, M. K., | Nigeria | Education | | | tertiary institution | Higher Education |

| Author(s)/ Date | Country | Subjects (Agric, Edu, etc.) | Methods (qual, quant, mixed) | Sample size | Users (students, lecturers, administrators, researchers, etc.) | Level of Edu (e.g., undergraduate, postgraduate, and post-doctoral study) |
|---|---|---|---|---|---|---|
| Usman, B., Alhassan, I. M., Ahmed, A. A. (2023) | | | | | | |
| Ananyi, S. O., Nwosu, L. K. (2023) | Nigeria | Education | Quantitative | 25 | admin | Higher Education |
| Olatunde-Aiyedun, T. G., Hamma, H. (2023) | Nigeria | Education | Quantitative | 301 | university lecturers | Higher Education |
| Iyinolakan, O. (2023) | Nigeria | education | Mixed method | 271 | teachers, journalist (students) | Higher Education |
| Cleopas, B. C. (2023) | Nigeria | | | | | |
| Ogunlade, B. O., Babatunde, R. A., Fakuade, O. V. | Nigeria | Education | Qualitative | 40 | students | Junior secondary |
| Ogwo, U., Ibegbulem, F. | Nigeria | Education | Qualitative | Not stated | academic libraries | |
| Moustapha, A. A., Mr, I. O. Y. (2023) | Nigeria | Education | Quantitative | 450 | librarians | HIgher education |
| Akinola, S. (2023, December) | Nigeria | Education | Literature review | Not stated | academic libraries | |
| Eiriemiokhale, K. A., Sulyman, A. S. (2023) | Nigeria | Education | Quantitative | 37 | librarians | HIgher education |
| Anana, M., Alugbin, M., Chinaguh, E. C. | Nigeria | Education | Quantitative | | students | higher education |
| Cln, O. T. E. (2023) | Nigeria | Education | Quantitative | 704 | librarians | Higher education |
| Wachira, K., Wachira, L. N., Mwangi, E., Absaloms, H. O., Jeon, G. (2023, September) | Kenya | Education | Quantitative | 572 | students | Undergraduate |
| Ondiek, B., Waruguru, L., Njenga, S. (2023). | Kenya | Education | Quantitative | 384 | students | Higher education |
| Oranga, J. (2023) | Kenya | Education | Literature review | | academics | All levels of education |
| Manhiça, R., Santos, A., Cravino, J. (2023) | Mozambique | Education | Qualitative | | academics | Higher education |
| Jatileni, C. N., Sanusi, I. T., Olaleye, S. A., Ayanwale, M. A., Agbo, F. J., Oyelere, P. B. (2023) | Namibia | Education | Qualitative | 159 | students | Basi education secondary education |
| Solís, M. W. M. V., Ríos, C. A. G., Hermida, C. E. C., Alencastre, J. L. A., Tovalin-Ahumada, J. H. (2023) | Namibia | Education | Qualitative | Not stated | professors, students and administrative staff | Higher Education |
| Nwosu, L. I., Bereng, M. C., Segotso, T., Enebe, N. B. (2023) | South Africa | Education | Qualitative | 54 | researchers | Higher education |
| Lashayo, D. M., Mhina, J. R. A. (2023) | Tanzania | Education | Qualitative | 10 | students | Higher education |
| Mumba, B. (2023) | Zambia | Education | Qualitative | Not stated | students, administration staff | |
| Essel, H. B., Vlachopoulos, D., Tachie-Menson, A., Johnson, E. E., Baah, P. K. (2022) | Ghana | Education | Quantitative | 68 | undergraduate students | |