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A Critical Analysis of the Use of Artificial Intelligence (AI) Tools in the 21st Century Teaching and Learning in Zimbabwean Tertiary Education Institutions (TEIs)

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Abstract

The study sought to analyse the use of Artificial Intelligence (AI) phenomenon in the teaching and learning process in Zimbabwean Tertiary Education Institutions (TEIs). The study explored the state of AI-tools adoption in Zimbabwean Tertiary Education Institutions, highlighting lecturers and students' perceptions, AI benefits and ethical considerations. Related literature reviewed highlighted global and national key AI developmental and application milestones from the early 1960s to the 21st century. The study used the Mixed Methods Approach (MMA) in which quantitative and qualitative data were generated, presented, analysed and interpreted numerically and descriptively. A sample population of 10 Information and Communication Technology (ICT) lecturers, and five librarians were purposively selected, while 300 students specialising in ICT were randomly selected. The research instruments used to gather qualitative data were in-depth interview guides, while questionnaires were used to collect quantitative data. The study revealed that students were optimistic, cautious and appreciative of the positive impact of AI on learning processes, while lecturers showed optimistic caution but highlighted opportunities and concerns on the phenomenon. It also emerged that AI can improve tertiary education, enhance student outcomes, and promote inclusive education. Further, it was established that for effective use of AI tools, the users should prioritise ethics such as transparency, accountability, and data protection. The study also confirmed AI benefits which include student-centric learning, language, audio and visual services. Based on the major findings and insights, an AI-policy formulation model was developed for use by lecturers, and administrators to ensure that AI tools are used responsibly. The model is anchored on the development of AI policies by institutions, aligning to global and national guidelines. The study recommends the formulation of institutional AI policies and the adoption of the use of AI in the teaching and learning process in TEIs, in order to enhance quality of education as well as production of goods and services.

Keywords: Artificial Intelligence, teacher education, ethics, inclusivity, Information Communication and Technology.

1. Introduction

The study explores the effectiveness of AI-tools in the teaching and learning process in Tertiary Education Institutions (TEIs) in Zimbabwe, in support of academic excellence and production of goods and services. Artificial Intelligence (AI) refers to computer systems that can perform tasks and generate information mimicking human cognitive functions such as processing possible solutions to problems, decision making and, to some extent interpreting data (Kulik and Kulik, 2019). In this study, Artificial Intelligence (AI) refers to the use of technologies, such as machine learning, automated language processing, and computer vision, to enhance teaching, learning, and processing of goods and services in Tertiary Education Institutions. Thus, the primary objective of the study was to explore and unpack the ethical considerations, and application when both, lecturers and students use AI systems in order to ensure transparency, fairness and unbiased assessment and grading of students. The complexity of application of AI tools. With related attributes such as perceptions, understanding and level of acceptance in view of academic integrity, prompted this study. Further, the 21st century ways of doing things by lecturers and students in maintaining the validity and integrity of AI generated solutions along with mitigating risks of AI-cheating and plagiarism were interrogated.

The study also aimed to come up with an AI-policy formulation model that supports and enhances the harnessing of AI's potential to create effective, efficient, and engaging teaching and learning environments, preparing both lecturers and students for success in an increasingly AI-driven world in a quest to produce quality graduates, goods and services. It is this background that ignited this study to explore AI's application and ethical considerations in selected TEIs in Zimbabwe.

1.1. Statement of the Problem

The application of Artificial Intelligence (AI) to teaching and learning in Zimbabwean TEIs is still in its infancy, hence the

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need to explore its potential to enhance teaching, learning, and research. Despite the growing application of AI in various sectors, Zimbabwean TEIs still face challenges in harnessing its benefits due to limited resources, infrastructure, expertise and a clear policy that gives direction. This study aims to explore the opportunities of AI adoption in Zimbabwean TEIs in an effort to leverage the technologies to also enhance the production of goods and services.

1.2. Research Questions

The study was guided by the following questions:

i). What are the perceptions of students and lecturers in using Artificial Intelligence in teaching and learning processes in Zimbabwean Tertiary Education Institutions?
ii). What ethical considerations should be made when using Artificial Intelligence in teaching and learning in Zimbabwean Tertiary Education Institutions?
iii). What are the benefits of using Artificial Intelligence in teaching and learning in Tertiary Education Institutions in Zimbabwe?
iv). To what extent does AI enhance teaching and learning, including the production of goods and services by TEIs in Zimbabwe?

2. Literature Review

2.1. Introduction

Artificial Intelligence (AI) is fast transforming tertiary education by enhancing teaching, learning, and administrative processes. This section reviews related literature on the global historical development of AI in education, the scope of AI application in education, advantages of using AI in the teaching and learning process, limitations of using AI in education and use of AI in education gaps.

2.2. The Global Historical Development of AI in Education

The birth of Artificial Intelligence (AI) in education dates back to the 1950s and 1960s, when researchers like Alan Turing began exploring the possibility of machine intelligence. The term "Artificial Intelligence" was officially coined in 1956 at the Dartmouth Conference, marking the beginning of AI as a field of study in developed countries (UNESCO, 2023). Further, in education, AI started gaining traction in the 1970s with the development of Intelligent Tutoring Systems (ITS), which aimed to replicate one-on-one tutoring. These early systems were rule-based and focused on logic and student responses (Ross, 2022). Some selected key milestones in AI's evolution in education are discussed in the proceeding subsections.

i). **The 1960s Era: Computer-based Instruction Systems:** According to Anderson, Boyle and Reiser, (2021), the 1960s saw the emergence of Computer-Based Instruction (CBI) systems, which revolutionalised the education sector. The pioneers of AI developed and gave birth to a machine programme coded Programmed Logic for Automated Teaching Operations (PLATO) in 1960. The PLATO programme permitted students to access interactive tools, simulations, and participation in tutorials via terminals anchored to a computer mainframe (Autor, 2020).

Further, the PLATO system used programmed logical activities rather than human physical interaction, making it a ground breaking innovation that was later developed to match the everchanging global demands.

ii). **The 1970s-1980s Era: Intelligent Tutoring Systems (ITSs) Adaption for Classroom Instruction:** The 1970s-980s era had a significant advancement in Intelligent Tutoring Systems (ITSs) for both classroom instruction and learner operations (Ross, 1987). In the same vein, Graesser, Hug, and Sottilare, (2018), contend that, this period witnessed the integration of microcomputers, AI and cognitive psychology that created more effective and interactive learning systems that were later upgraded in the 1990s. Thus, these advancements laid a foundation for modern educational technology, paving way for AI-powered learning systems and adaptive instruction, currently used on e-boards globally.

iii). **The 1990s Era: The Adaptive Learning Systems:** The 1990s period witnessed significant development and advancements in adaptive electronic learning systems, leveraging AI and Computer Science that promoted personalised learning (Anderson, Boyle, and Reiser, 1985). The developed systems used algorithms to adjust and support learning experiences based on individual students' needs, abilities and learning modes. In a nutshell, the systems were inclusive in nature.

Further, researchers who include Hubbard, (2023); Autor, (2020) and Maher, (2018) highlighted key AI developments as indicated below:

- **Adaptive Hypermedia System:** It combined hypertext and hypermedia with the user modelling to tailor learning experiences adaptive to the contexts;
- **Machine Learning:** It enabled the systems to learn from student interactions and was improved overtime and
- **Student Modelling:** The technique uses platforms networked to understand students' knowledge and behaviour in their day-to-day class work performance.

These AI advancements laid the ground work for modern adaptive learning technologies which continue to transform tertiary education in the 21st century.

iv). **The 2020s Era: Development of AI Integration in Education Guidelines and Policies**

The 2020s have seen significant formulation of guidelines and policy frameworks for the smooth integration of AI in education (Chan, 2023). The author, further contends that institutions of higher education should work towards establishing policy frameworks that ensure responsible AI adoption, as well as addressing concerns around ethics, academic integrity and information privacy.

Kim and Wug, (2024) highlighted three policy framework focus areas which guide AI policy formulators for higher education institutions. These are:

- **Academic Integrity Policy:** Should address plagiarism, proper citation, acknowledgement of other people's work and authorship;
- **Data Privacy Policy:** Should ensure, secure data handling and protection; and
- **Ethics and Bias Policy:** Should promote the mitigation of AI-related biases and ensure fairness in assessment of students.

In summary, the AI guidelines and policy frameworks aim to support the effective and responsible use of AI in higher education, thereby promoting innovation, while maintaining academic integrity and values.

v). The Educationists' View on the Use of AI in Tertiary Education

According to Chui, Manyika and Miremadi (2017), 21st century educationists' perceptions of the use of AI tools in tertiary education contributes significantly, anchored on its use to promote accessibility, equity, quality and contextual relevance to teaching and learning. In brief the scholars highlighted that 21st century educationists view AI have a set of powerful tools that have the following factors:

- **Enhanced Instant Teaching Support System:** AI is viewed as a teaching assistant tool rather than a lecturer replacement (Stefik, 2021). Further, the author argues that AI supports and assists in generating learning materials, analysing students' performance and supporting class and classroom management, while giving lecturers some space to focus on creativity and students' emotional support.
- **Individual Learning Process:** Earlier studies by Kulik and Kulik (2020), established that educationists have a strong perception that AI can transform lecture room learning from a *'one-size-fits-all'* model to a '*student-centred'* approach. In the same vein, Chan, (2023), asserts that AI adapts concepts to a student's ability, supports those with special needs and gives instant feedback.
- **Expanded Access to Education:** AI tools are viewed as inclusive, and contribute significantly to online learning platforms, virtual tutoring, language translation and promotes flexible learning systems (Luckin, Holmes, Griffiths and Forcier, 2019).
- **Development of 21st Century Compliant Skills:** The use of AI tools in the teaching and learning process helps in developing critical skills that go beyond traditional literacy and numeracy which include creativity, critical thinking, communication and digital competence (Ross, 2021). Further, scholars who include Jobin, Ienca and Vayena (2020), contend that the use of AI is essential and critical in developing adaptable, innovative and productive graduates.

In a nutshell, both 21st century researchers and scholars concur that as AI continues to evolve, educators, students and TEIs administrators, should prioritise responsible and ethical AI use, thereby ensuring that benefits for both lecturers and students are maximised.

2.3. The Historic Developments of Artificial Intelligence (AI) in TEIs in Zimbabwe

Zimbabwe's journey with Artificial Intelligence (AI) in TEIs is still in its infant stages, but it is progressing and gaining momentum. The TEIs are fast integrating AI into their curricula, offering capacitation programmes focusing on equipping both lecturers and students with necessary skills. The key milestones are briefly highlighted as this sub-section unfolds.

i). Historical Journey of AI in TEIs in Zimbabwe

- **The Early 2000s Period:** AI research began with a focus on Computer Science and Information Technology being introduced in TEIs with limited Information and Communication Technology (ICT) hardware and software (Chui, Manyika and Miremadi (2019). Thus, the introduction of Computer Science studies ignited the beginning of AI use in TEIs in Zimbabwe.
- **The 2010s Period:** AI applications emerged and were integrated in various curriculum clusters that include Mathematics, Physics, Chemistry, Natural Sciences, Arts, Languages and Humanities (UNESCO, 2023). It is during this era when digital gadgets like computers and scientific calculators began to be commonly used to access information from internet service providers.
- **The 2018 to 2025 Period:** The Zimbabwean government developed and launched the National ICT Policy in 2022, which focused on AI as a key area focussing on its use in research and applications in producing goods and services in support of the country's vision 2030. In the same vein, some TEIs developed their AI policies with the primary goal of regulating the responsible use of AI in teaching and learning process.

Overall, TEIs are making significant progress in integrating AI into their curricula, with a focus on capacity building, commercialisation, and for the growth of the socio-economy of the country.

2.4. Advantages of Using AI in the Teaching and Learning Process

According to Kim and Wu (2024), AI is revolutionising teaching and learning processes in TEIs, anchored on the following advantages:

i). Individualised Learning: AI tools tailor content according to the individual student needs and preferred learning styles or pace. Further, it provides instant information and opportunities for students to select what they want to learn; it addresses diverse learning abilities and supplies immediate feedback (Ross, 2021).

ii). Efficient Grading: The AI tools have the capability of automating assessment and grade students' coursework and examinations marks, hence freeing lecturers' time for more impactful physical interactions (Ross, 2021). Researchers who include Taddeo and Floridi (2018), established that AI technologies have the capability of automatically evaluate, score and provide instant feedback on students' academic work in a quick, accurate, more consistent and data-driven manner.

iii). Enhanced Virtual Student Engagement: Jobin, Ienca and Vayena (2020), assert that AI-powered tools promote virtual learning, interaction and fun, boosting student motivation to continue making enquiries on the subject under investigation. The AI system provides step-by-step explanations and suggestions for the next step of enquiry, hence improving virtual participation and increasing attention, and retention in students.

iv). Data-driven Insights: It has also been established that AI technologies have the capacity to generate, present, process and analyse students' data, giving meaningful insights, thereby, assisting lecturers to quickly identify areas that need remediation, and improve students' performance (Suppes and Atkinson, 2019). In fact, AI data-driven insights provide more relevant patterns, trends and predictions. Further, it is able to discover hidden data relationships and provide actionable recommendations to both lecturers and students.

v). Lecturer and Student 24/7 Support: The AI-powered tools enable continuous virtual teaching, learning and academic support beyond normal timetabled lecture hours. Kuss and Griffiths (2021) contend that, throughout the year, 24/7, AI acts as a digital assistant, lecturer and partner available everywhere for both lecturers and students.

In a nutshell, AI enhances teaching effectiveness, student

engagement, and learning outcomes, making 21st century tertiary education more efficient and enjoyable.

2.5. AI Grey Areas in Tertiary Education

Based on Kulik and Kulik (2020), Hubbard, (2021) and Chan (2023), the three major grey areas that hinder the use of AI quick acceptance and integration into teaching and learning in TEIs are hinged on the following gaps:

- Limited digital literacy and preparedness among lecturers and students to use AI responsibly and meaningfully;
- Institutional lack of readiness to develop AI policies fast aligning them to the global and national ICT policy frameworks in order to regulate the use of AI in Tertiary Education Institutions; and
- Limited scope in the development of AI related infrastructure.

The study explored the grey areas and came up with a Spheric AI-policy formulation model that enhances the institutional formulation of Artificial Intelligence policies that regulate AI use in teaching and learning processes in TEIs.

Further, the results of this study sought to address these grey areas and challenges, in order for Zimbabwe's Tertiary Education Institutions to be able to harness the potential of AI to enhance teaching, learning, and student outcomes, thereby improving the production of goods and services.

3. Methodology

The study adopted the multi-case design, which involves more than one case in a study (Katiyo, 2021). In this study, two tertiary education institutions participated as case studies, in order to establish the impact of AI on teaching and learning processes. Further, the Mixed Method Approach (MMA) was adopted in which qualitative and quantitative data were generated using descriptive and numeric methods. The target population of this study was 98 librarians, 54 ICT lecturers and 900 students specialising in ICT.

3.1. Sampling Procedure

In line with Lewis and Thorn (2019) as cited in Katiyo (2023:45), a sample size format at 95% confidence level and 5% margin error was used to randomly select a sample of students who provided quantitative data. The sample size of 300 students is shown in Table.

Table 1: Sample size of students specialising in ICT from two TEIs

Case Code	Frequency	% Age Sample
A	145	48.3%
B	155	51.7%
Total	300	100%

3.2. Sample Size of ICT Lecturers and Librarians

A sample of ICT lecturers and librarians was purposively selected from possible participants with knowledge and skills in the AI area. The sample size is shown in Table 2.

Table 2: Sample size of ICT lecturers and librarians

Category	ICT Lecturers	Librarians	Total
TEI A	5	2	7
TEI B	5	3	8
Total	10	5	15

Key: TEI: *Tertiary Education Institution*
ICT: *Information and Communication Technology*

3.3. Research Instruments

The study used semi-structured in-depth interview questions administered to ICT lecturers and librarians through face-to-face interaction. A questionnaire with a closed-Likert scale of 1 to 5, with provided responses, was used to collect quantitative data from students specialising in ICT. The qualitative data were analysed using the thematic approach, while quantitative data was analysed using IBM SPPSS version 21. The two sets of results were presented and discussed concurrently in the proceeding section.

4. Results

The numeric and descriptive data are concurrently presented, analysed and interpreted as the section unfolds.

4.1. Perceptions of Students and ICT Lecturers in Using AI Tools in Teaching and Learning in Tertiary Education Institutions

The participants' perceptions on using AI tools in teaching and learning in TEIs were categorised in two sets as presented below.

i). Students' Perceptions

The students' perceptions on the use of AI tools were synthesised into three sub-themes based on their response similarities as follows:

a) Optimistic

Most of the student participants, (on average 96%) were confident in that the use of AI boosts their creativity and information accessibility. They optimistically indicated that AI provides them with instant feedback, assistance whenever is needed (24/7). Further, they highlighted that AI provides a virtual environment that allows them ask questions without fear of interrogation and judgement. Three of the participants had this to say,

Participant A: *"I perceive AI as a tool that boosts my autonomy and creativity in my whole learning."*
Participant C: *"In my view, AI is always available than the lecturer. I appreciate AI tool because I get instant feedback. Further, I can research and get responses instantly."*
Participant E: *"I view AI as a user-friendly tool because I can ask questions and get help without fear and judgement."*

The participants responses imply that most of the students are optimistic about the use of AI platforms in that AI-powered teaching and learning increases student engagement and motivation, providing instant feedback that helps them to track their progress in every second (24/7) as they wish.

b) Positive Impact in the Learning Process

Further, about 84% of the student participants highlighted that AI had a positive impact in their learning process. They contended that AI has high potential to support their learning as a virtual teacher and, improves their academic and practical tasks performances.

Two of the participants highlighted the following,

Participant D: *"In my opinion, AI is more than a lecturer because it assists students get current information."*
Participant F: *"I think, AI platforms, support students improve their understanding of concepts, how to answer some assignments and perform tasks, and enhance critical thinking."*

The responses imply that AI can assist students to comprehend complex concepts better, and also provides

personalised teaching and learning experiences. The results also suggest that AI tools guide students and enable them to work on their practical tasks, leading to the production of goods and services.

c) Cautious Perceptions

An insignificant percentage (10%) of the participants perceived AI's use on teaching and learning as unfavourable. They expressed concerns about ethics, privacy and over-dependence. Two of the participants had this to say,

Participant G: *"I think, the use of AI in teaching and learning is unfavourable because the tool compromises student's originality, thinking and physical lecturer-student interaction."*

Participant J: *"In my view, students may use AI unethically and over-dependence of it reduces their originally and critical thinking."*

The results imply that overreliance on AI-tools can compromise students' critical thinking skills, perpetuate unethical practices, and to some extent generate inaccurate information.

ii). ICT Lecturer Perceptions

The ICT lecturer participants responses were divided into three sub-themes which are presented in proceeding sub-sections.

a) Cautious Optimistic

The participants expressed cautious optimistic positive acknowledgement that AI has significant potential to promote personalised teaching and learning platforms efficiently, but were also sceptical that to some extent, it reduces lecturer–student physical interaction. Seventy-five percent of the participants perceived AI as a tool that can provide access to additional learning resources. Three of the participants had this to say,

Participant K: *"In my view, the use of AI in teaching and learning in TEIs provides well-tailored and personalised learning experiences. On the other hand, AI reduces the physical lecturer – student interaction."*

Participant M: *"I think, AI tools to a greater extent provide students with platforms to access current additional information on spot."*

Participant N: *"In my opinion, AI in the 21st century is the way to go, and should be embraced in TEIs because information is readily available, enhances student engagement and gives quick feedback."*

The responses imply that the use of AI tools in the teaching and learning process promotes personalised pedagogical methods, provides current information and enhances student engagement and motivation. On the other hand, the results imply that the use of AI reduces physical lecturer student interaction.

b) 4.1.2.2 AI Opportunities

Results indicate that most of the lecturer–participants perceived AI as having significant opportunities in the teaching and learning process. They cited opportunities, which include real-time feedback, enhanced student engagement, improved teaching efficiency and support of virtual interaction.

Two of the participants had this to say,

Participant L: *"I think, AI has several opportunities in teaching and learning process that include efficiency in accessing information, instant feedback and can be accessed any time."*

Participant K: *"In my view, AI provides the opportunity to; access information 24 / 7, promote critical thinking and provide student engagement."*

The responses imply that the use of AI in the teaching and learning process creates opportunities that include prompt feedback, promotion of students' motivation, improving critical thinking and making learning accessible and can be done in the comfort of students' homes without physical human interaction.

c) Lecturers' Use of AI Concerns

Results indicate that some lecturer–participants raised several concerns over the use of AI in teaching and learning, which include reduced physical lecturer-student interaction and depersonalisation of learning, lack of emotional intelligence and empathy. Further, they questioned the unethical use of AI as well as the biased and inaccurate AI generated content. Three participants highlighted the following;

Participant P: *"My major concern over the use of AI in teaching and learning is that it is gradually replacing core teaching function with a human touch."* (January, 2026).

Participant Q: *"In my view, AI may mislead and misinform students because not all generated content is accurate."* (January, 2026).

Participant R: *"I think, my concern is that the lecturer's job is being slowly being replaced by AI. In fact, lecturers are going to be irrelevant in the near future."* (January, 2026).

The responses imply that the participants' major concerns over the use of AI include data privacy, inaccuracy in AI generated content and academic dishonesty. The results further suggest that there is gradual possibility of replacing core human teaching functions in TEIs.

In summary, the students were more receptive and confident that embracing AI in tertiary education creates significant opportunities to enhance and support the production of goods and services, while some lecturers were more reserved and sceptical about AI reducing human physical interaction and levels of originality. Thus, this study highlights varied levels of readiness to embrace AI in TEIs in Zimbabwe. Hence, the need to tailor training programmes and formulate policies on the use of AI in teaching and learning in TEIs so that it is legally regulated.

In summary, the students were more receptive and confident that by embracing AI in tertiary education, it has significant opportunities to enhance and support the production of goods and services, while some lecturers were more reserved and sceptical about AI reducing human physical interaction and levels of originality. Thus, this study highlights varied levels of readiness to embrace AI in TEIs in Zimbabwe. Hence the need to tailor training programmes and formulate policies on the use of AI in teaching and learning in TEIs so that it is legally regulated.

4.2. Ethical Considerations When Using AI Tools in the Teaching and Learning Process

Student participants were asked about their level of agreement on the possible ethical considerations which should be made when using AI tools in the teaching and learning process in TEIs in Zimbabwe. Results are presented in Table 3, based on six selected ethical consideration aspects rated on the 5-point scale.

Table 3: Level of agreement on selected ethical consideration aspects when using AI tools in teaching and learning in TEIs

Ethical Consideration Aspects	N	1	2	3	4	5		
		Strongly disagree	Disagree	Neutral	Agree	Strongly agree	CM	SD
Privacy and data protection	300	15 (5%)	30(10%)	45 (15%)	148 (49.3%)	62 (20.7%)	3.82	1.1261
Bias and fairness	300	10 (3.3%)	27 (9%)	33 (11%)	156 (52%)	74(24.7%)	3.73	1.1121
Transparency	300	6 (20%)	20 (6.6%)	29 (9.7%)	177 (59%)	68 (22.7%)	3.41	1.1211
Accountability	300	3 (1%)	11 (3.7%)	32(10.7%)	166 (55.3%)	88(29.3%)	3.15	1.114
Student autonomy	300	2(0.7%)	12 (4%)	16 (5.3%)	178(59.3%)	92 (30.7%)	3.33	1.1310
Academic integrity	300	0 (0%)	5 (1.7%)	5 (1.7%)	189(63%)	101 (33.6.%)	3.42	1.133

Key:
N = Number of sample population;
CM = Criterion Mean of 3 and above indicates level of agreement on ethical consideration aspects in this study;
SD = Standard Deviation measures the decision dispersion from the mean score in the study.

The study involved 300 student-participants specialising in ICT, who were randomly selected. The results presented in Table 3 are based on six selected key ethical consideration aspects rated on a 5-point Likert scale. The results are presented numerically and descriptively, aspect by aspect below.

i). **Privacy and Data Protection:** Firstly, students were asked on their level of agreement on whether it is essential to consider privacy and data protection in AI-supported teaching and learning. Results in Table 3 indicate that 49.3% agreed and 20.7% strongly agreed on the importance of privacy and data protection in AI-generated teaching and learning, with a mean score of 3,82 and SD of 1.1261. On average, 70% of the participants highly agreed that it is necessary to consider privacy and data protection in order to promote responsible and sustainable use of AI in TEIs.

ii). **Bias and Fairness:** Secondly, participants were asked on whether they were in agreement that AI-generated content should be treated with caution to detect bias and ensure fairness in teaching and learning processes. The results in Table 3, indicate that 52% agreed and 24.7% strongly agreed with the assertion, with a mean score of 3.73 and SD was 1.1121. Thus, on average, 76.7% had a strong affirmation that strict consideration for bias detection and fairness in teaching and learning helps in maintaining academic integrity in TEIs.

iii). **Transparency:** Thirdly, participants were asked on their level of agreement on the aspect that transparency should be considered when AI-generated content is presented for academic assessment and ratification. Results in Table 3, show that 59% agreed and 22.7% strongly agreed on the aspect of transparency, with a mean score of 3.41 and SD of 1.1211. On average, 81.7% uphold the aspect of transparency as an AI-ethical consideration factor in the teaching and learning process in order to sustain professional practices.

iv). **Accountability:** Fourthly, student participants were asked on their level of agreement on whether AI-generated teaching and learning should consider accountability from content developers, students and institutions. Results in Table 3, indicate that 55.3% agreed and 29.3% strongly agreed with the assertion that AI-facilitated teaching and learning should remain accountable to content originators and users (lecturers and students), with a mean score of 3.15 and SD of 1.1140. On average, 84.6% ascertained that accountability when using AI builds trust among students, lecturers and content developers.

v). **Student Autonomy:** The fifth aspect sought participants' level of agreement on whether the students should remain autonomous when teaching and learning is supported by AI. Results in Table 3, show that 59.3% agreed and 30.7% strongly agreed, with a mean score of 3.33 and SD of 1.1310. On average 90% indicated that the participants agreed that AI should augment teaching and learning, while students should be autonomous on decision-making about their research and learning.

vi). **Academic Integrity:** On the sixth aspect, participants were asked on their level of agreement on the extent of academic integrity when using AI in the teaching and learning process. Results in Table 3, indicate that 63% agreed and 33.7% strongly agreed, with a mean score of 3.42 and SD of 1.1333, that the use of AI tool should be regulated in order to maintain academic integrity in teaching and learning. On average, 96.7% agreed that in order to maintain academic integrity, the use of AI to generate content and assignment responses, students should be provided with an ethical consideration policy which minimises plagiarism and cheating in order to uphold academic integrity in TEIs.

In a nutshell, the results in this section revealed that aspects on ethical considerations when using AI tools in teaching and learning are not optional. They are essential for upholding ethical consideration in teaching and learning practices, complying with AI legal frameworks and ensuring fairness in tertiary education programmes.

4.3. Benefits of Using AI in Teaching and Learning in Tertiary Education Institutions

The responses from ICT lecturers and librarians highlight the transformative role and benefits of Artificial Intelligence. Further, both groups of participants acknowledged the potential benefit of supporting the production of goods and provision of several services in the teaching and learning process.

Results presented in Table 5 below show five categories of benefits which are promoted by Artificial Intelligence generated teaching and learning in TEIs.

Table 5: Responses by ICT lecturers and librarians on benefits of AI in teaching and learning

Benefit 1: AI supported student-centric teaching and learning
ICTL3: "In fact, Artificial Intelligence-student centric support system includes personalised learning, intelligent teaching and improved student assessment and automated grading." **ICTL1:** "In my view, AI provides systems that support data-driven analysis and selection for learning contexts." **LB 3:** "I think another benefit of AI is that, it powers gamification and stimulations that enhances Student engagement and participation." **LB5:** "From my experience, another core benefit is that AI provides access to quality teaching and learning services in remote areas or under serviced areas."
Benefit 2: AI-generated language services
ICTL1: "It is a fact that students and lecturers benefit from AI-generated language services, which include human-like texts such as emails, messages and articles." **ICTL4:** "Also, we benefit from an inclusive language service AI provides in language translation and speech recognition." **LB 3:** "A profound benefit from AI is its capabilities to transcribe oral speech into text."
Benefit 3: AI-generated visual services
ICTL9: "In my view on of the major benefit of Artificial Intelligence is that it can generate a variety of images which include photos, artwork and other graphics that aide teaching and learning." **LB2:** "In fact, AI can be used to detect faces, objects and scenes in video form that assist in understanding concepts." **ICTL8:** "Also, AI has the capacity to classify images like vehicles, buildings, maps and a variety of infrastructure."
Benefit 4: AI-generated audio services
LB4: "It is factual that AI benefits in teaching and learning as it can generate meaningful sounds, music and songs backgrounds that aide learning." **ICTL7:** "In fact, students can be supported when composing music using AI tools." **ICTL10:** "From my experience, AI can generate and synthesise voices to human-like speech and into audiobooks."
Benefit 5:AI-supported production of goods
ICTL10: "I have witnessed AI-robot systems producing goods like furniture, textiles and packaging among other products." **ICTL5:** "In summary, AI tools can design Art work and generate paintings and sculpture." **LB3:** "In fact, AI-programmed systems have the capabilities to design clothing accessories and textiles."

Key:
ICTL = Information and Communication Technology Lecturer.
LB = Librarian Results in Table 5, indicate four categories of AI benefits in teaching and learning in TEIs as presented below, category by category.

i). **Ai Supported Student-Centric Teaching and Learning:** Interviewees *ICTL3* and *LB5* highlighted a common understanding that an AI-generated teaching and learning process promotes personalised, enhanced student assessment and automated grading. Further, participants *ICTL1* and *LB3* indicated that AI tools provide data-driven analysis and selection of specified learning context. Thus, the results imply that AI supports student-centric teaching and learning.

ii). **Ai-Generated Language Services:** Results in Table 5, also indicate that interviewees *ICTL1, ICTL4* and *LB3* highlighted that there are AI-generated language services that aid teaching and learning. The language services highlighted include AI-generated texts, language translation, speech recognition and transcription of oral speech into readable texts.

iii). **Ai-Generated Visual Services:** Results in Table 5, show that participants *ICTL9, LB 2* and *ICTL8* concurred that AI can generate and provide visual services which include a variety of images, classification of images, detection of objects and scenes in video form, that assist students in comprehending concepts during the teaching and learning process.

iv). **Ai-Generated Audio Services:** Further, results in Table 5, indicate that interviewees *LB4, ICTL7* and *ICTL10* highlighted that another benefit of AI is its capacity to generate audio services that enhance teaching and learning. The participants articulated that AI-generated audio services include composing music, song backgrounds and audio textbooks that aid learning.

v). **Ai-Supported Production of Goods:** Results in Table 5, show that participants *ICTL3, LB5* and *ICTL10* highlighted that AI-robot systems can generate and produce goods like furniture, sculpture, labels, and to some extent, packaging of beverages, among other tangible products.

4.4. Attributes that indicate effectiveness of AI in teaching and learning in TEIs

Through a questionnaire the ICT lecturer and student participants were asked to indicate whether they agree *(YES)* or disagree *(NO)* on selected AI attributes in teaching and learning in TEIs. The results obtained are shown in Table 6 below.

Table 6: AI attributes that augment the quality of teaching and learning in TEIs

Selected AI Attributes in Teaching and Learning	**Yes**		**No**	
	ICT Lecturers	**Students**	**ICT Lecturers**	**Students**
Efficiency: • Quick content creation • Real-time data analysis • Contextualise concepts	98%	99%	2%	1%
Personalised Learning: • Adaptive content to students' ability • Provides personalised instant feedback • Individualise content	95.5%	88%	4.5%	12%
Quality Education: • Improved digital learning • promotes virtual learning • Supports individualised learning	94.6%	90.3%	5.4%	9.7%
Expanded Access: • Supports inclusivity • Limitless access • Students can learn virtually	97.2%	98.8%	2.8%	1.2%

Table 6, shows that 98% of ICT lecturer-participants and 99% of student-participants agreed that AI tools were attributed to efficiency. The results imply that AI tools improve efficiency through quick content creation, real-time data analysis and instant feedback. Further, 95.5% of ICT lecturer-participants

and 88% of student-participants confirmed that AI tools institute and support personalised learning. It implies that AI tools have the capabilities to create adaptive content to students' ability. Also, 94.6% of the ICT lecturer-participants and 90.3% of student-participants agreed that AI tools enhance quality teaching and learning. Thus, AI tools enhance quality education through improved and contextualised learning materials. Hence, it supports better teaching practices. The results further show that, 97.2% of ICT lecturer-participants and 98.8% of students confirmed that AI tools provide expanded access to learning in the comfort of their homes.

In summary, the participants' numeric responses were percentages indicative to which AI attributes enhance the teaching and learning process is illustrated in *Figure 1* below.

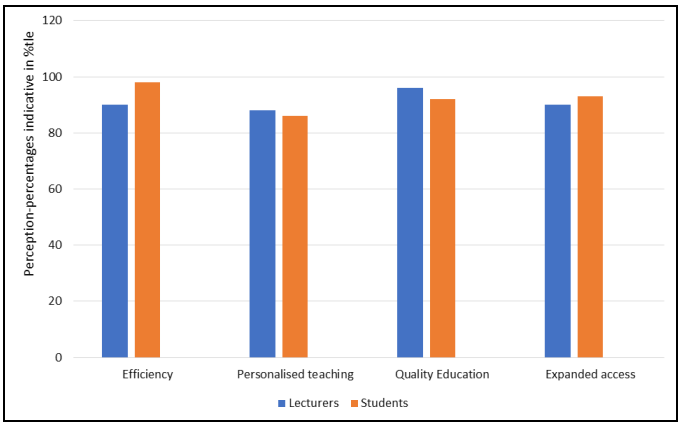

Fig 1: Bar graph showing Lecturers and Students perceptions, indicative to which AI attributes enhance teaching and learning in TEIs

The results presented in *Figure 1,* above is a bar graph indicating perceptions of lecturers and students, as a confirmation by the participants that AI attributes support the teaching and learning process significantly. Further, the results imply that AI tools generate attributes that include efficiency, personalised teaching, provision of quality education and expanded access to tertiary education to all students with their diverse needs. Further, the results imply that AI tools generate attributes that include efficiency, personalised teaching, provision of quality education and expanded access to tertiary education to students with diverse needs.

5. Discussion of Findings

The findings of the study established perceptions of ICT lecturer and student participants on the use of AI, key ethical considerations when using AI, benefits of AI and attributes that enhance teaching and learning when using AI tools in TEIs.

5.1. Perceptions of ICT Lecturers and Students on the Impact of AI in the Teaching and Learning Process in TEIs in Zimbabwe

The study established that both, the ICT lecturers and students had varied perceptions regarding the effectiveness, opportunities and challenges associated with the use of AI in the teaching and learning process in TEIs as discussed below.

Firstly, ICT lecturers perceive AI as a transformative tool with opportunities of improving teaching efficiency. The study further, revealed that participants were continuously optimistic that AI had significant capabilities to promote efficient, personalised teaching and learning platforms. The findings concur with Mutanga, Jugoo and Adefemi, (2024), who established that AI technologies, which include Chatbots and Intelligent Tutoring Systems, support personalised learning and provide real-time feedback. In the same vein, this study confirms that over 90% of the 21st century lecturers in TEIs frequently use AI tools like ChatGPT for research, academic content generation and, in the teaching and learning process.

Secondly, the student participants perceive AI as a useful learning support tool. The study also established that AI technologies assist students and lecturers with brainstorming ideas, academic writing, and production of goods and services. The findings were in concurrence with Suppers and Atkinson (2023), who found out that both lecturers and students confirmed that their acceptance of AI is influenced by factors such as perceived usefulness, ease of use, and automative generation of goods and services.

Thirdly, the study also revealed that the lecturer participants had concerns related to ethical AI usage, academic integrity and overreliance on AI tools, thereby weakening creativity and critical thinking among the students. The findings concur with Ross (2021), who pointed out that lecturers were cautious about the use of AI because of concerns about reduced student engagement, academic dishonest and potential threats to the traditional lecturer-student academic relationship.

Overall, the study established that perceptions of both ICT lecturers and students are evolving on the drive for responsible AI integration in teaching and learning, prioritising student-centred learning, while leveraging AI benefits.

5.2. Ethical Considerations When Using AI in the teaching and learning processes in TEIs

i). **Privacy and Data Protection:** The study established that AI tools often generate and analyse large amounts of data, raising concerns about privacy and data protection. Thus, the study resonates with Borenstein and Pearson (2020)'s assertion that institutions should ensure that content is generated, stored, and used in accordance with relevant laws, regulations and ethical considerations, such as those enshrined in Zimbabwe's Data Protection Act.

ii). **Bias and Fairness:** The study confirms earlier studies by Gotz and Slobodova (2021); and Taddeo and Floridi (2018), who established that AI algorithms have the potential to perpetuate and amplify content biases when tagged on biased data. Further, the results of the study imply that TEIs should come up with policies that ensure that AI systems are regulated, designed and used in a way that promotes fairness and equity for all students.

iii). **Transparency:** The study concurs with Maher (2018) who also established that AI-generation of content, assessment and decision-making processes should be transparent and explainable to lecturers, students, internal assessors and external assessors. Thus, the TEIs should provide clear transparency policy frameworks on how AI – generated content is used in teaching and learning and, assessment processes.

iv). **Accountability:** The study revealed that TEIs should establish clear accountability mechanisms for AI-related teaching and learning procedures, decisions and actions. Further, the findings concur with Autor, (2020); Chan, (2023) and Zhang, (2023), who argue that, students,

educators and AI developers should be held accountable for ensuring that AI systems are used ethically.

v). **Students' Autonomy:** The findings resonate with Jobin, Ience and Vayema, (2019) who argue that AI tools should augment human thinking, interaction and decision-making in teaching and learning processes. The study also revealed that students should have control over their AI-generated content and be informed on ethical considerations about how AI is used in their learning.

vi). **Academic Integrity:** The study findings established that AI-generated content may raise concerns about plagiarism and cheating if not procedurally presented and scholarly acknowledged. Further, the results echo the assertion by Chui, Manyika and Miremadi, (2019) which postulate that TEIs should develop policies and guidelines for the use of AI in academic work. Thus, AI-ethical considerations require a nuanced approach which anchor the benefits of AI-generated content with the need to protect students' rights and promote ethical practices.

5.3. Benefits of Artificial Intelligence Generated Service Programmes in TEIs

The study confirmed earlier research findings by Brynjolfsson and McAfee (2024) who established that Artificial Intelligence promotes student-centred learning by personalising teaching and learning processes in order to meet individual student needs, abilities, and learning styles, to be discussed as this sub-section unfolds.

i). **AI-generated Student-centric Learning Services:** The study confirms that AI tools can analyse and establish students' performance, learning pace, and preferences to provide personalised content, gives immediate feedback, and adaptive assessments. Thus, AI allows students to progress at their own pace, improving understanding and retention. Further, the findings of the study concur with earlier findings established by Kuss and Griffiths (2021), that AI-generated services also support inclusive education by identifying learning gaps and suggesting intervention strategies for students with special educational needs. Thus, AI enables learners to become more engaged, motivated, and responsible for their own learning, while lecturers are supported with content-driven insights to enhance their tuition and assessment techniques.

ii). **AI-audio Generated Services:** The findings of the study concur with Gozt and Slobodova (2021), who established that AI-generated audio services which support teaching and learning processes include the transcription of text-to-speech, speech recognition, and voice-assisted learning tools that enhance accessibility and comprehension. Thus, the findings imply that AI-generated audio services are significantly beneficial to visually impaired students, students with reading difficulties, and second-language learners, as content can be delivered audibly in clear and adjustable formats. Further, the study also confirmed the findings of Taddeo and Floridi (2018), who assert that AI-generated audio services provide instant feedback through voice-based tutoring systems, improving pronunciation, listening skills, and student confidence.

iii). **AI-Generated Video Services:** The findings of the study resonate well with the study by Venezky (2019); and UNESCO (2023), which revealed that AI-generated video services transform learning by producing interactive, visual, and engaging instructional content. This study, showed that AI can generate explainer videos, simulations, virtual demonstrations, and animated lectures that simplify complex concepts and improve comprehension of concepts and skills. Thus, the AI-generated video services support self-paced learning, as students can pause and replay, giving them the chance to reflect on content needed.

iv). **AI-Generated Language Services:** The study echoed Ross (2021)'s findings that AI-generated language services transform teaching and language through Natural Language Processing (NPL) computer system. This study confirms that AI-language service types include language translation, speech recognition, content automated creation, grammar checking and editing. Thus, AI-generated language services increase access to information across languages, and improves efficiency in communication and inclusivity in teaching and learning in TEIs.

v). **AI-Supported Production of Goods in TEIs:** The study also confirms other findings by Maher (2018); Kulik and Kulik (2019), and Stefik, (2021), who established that AI plays a significant role in the 21st century in the creation and optimisation of goods. This study further ascertained that AI-computerised tools can produce the following:

- Modern furniture;
- Clothes and vehicle hardware;
- Smart devices like phones, wearables, laptops etc;
- Digital Goods Which Include Music And Art Software; And
- Agricultural inputs like stock feed, pesticides and fertilisers.

The findings further ascertained that AI-supports production of goods and enhances research, innovation and industrialisation in TEIs by customising goods to user preferences and increase production.

In a nutshell, AI–generated services that include student-centric learning, audio and video systems significantly enhance teaching and learning by improving personalisation, accessibility, engagement, and efficiency.

5.4. Attributes of AI that Enhance in Teaching and Learning in TEIs

The findings of the study on attributes that enhance teaching and learning in TEIs are in descriptive discussion-style to which AI supports key areas in tertiary education programmes. The discussion is anchored on four selected aspects, which are, improved efficiency, personalised learning, enhanced quality education and expanded access to education as highlighted below.

i). **Improved Efficiency in the Teaching and Learning Process:** The study revealed that AI has the ability to improve efficiency by automating routine teaching and learning tasks. It was also confirmed that, AI can handle activities such as grading assignments, tracking student progress, and providing information sources. The findings are in tandem with Hubbard (2021), who established that AI-driven tools enable lecturers to streamline repetitive teaching and learning processes such as marking objective tests and analysing student data, thereby saving time and improving productivity.

In a nutshell, an AI-powered teaching and learning process can quickly create content, contextualise concepts and provide instant feedback to the students. Thus, these capabilities enhance institutional efficiency and ensure that teaching and learning activities run

smoothly.

ii). **Personalised Learning:** The study also revealed that a significant attribute of AI is its ability to support personalised learning experiences by generating and analysing individual learning content, providing virtual learning pace and adapting educational content to meet each student's needs.

Further, the study confirms, Katiyo (2024), who contends that AI supports personalised instruction by recommending learning resources and exercises tailored to individual learners. Thus, the approach improves student motivation, engagement, and academic performance, as learners receive support suited to their unique learning pace and styles.

iii). **Enhanced Quality of Education:** The study confirms findings by Graesser and Sottilare (2018), who established that AI enhances the quality of teaching and learning in TEIs through intelligent tutoring systems, virtual assistants, and automated feedback mechanisms. Thus, students can receive instant responses to their research and academic queries.

Further, the findings of the study concur with Kim and Wu (2024), who established that, AI technologies can simulate expert tutoring by providing explanations, hints, and practice questions that support a deeper understanding of complex concepts. Thus, AI tools complement the work of lecturers by providing continuous academic assistance beyond the lecture room.

In brief, AI contributes to improved learning outcomes and overall performance in academic and practical assessment.

iv). **Expanded Access to Education:** The study established that AI-powered online learning platforms and digital tutors expand access to tertiary education by allowing students from different geographical places and socio-economic backgrounds to access quality education in the comfort of their homes. The study validates findings by UNESCO, (2023), who argue that AI technologies bridge educational gaps by supporting remote learning and providing multilingual educational resources.

Furthermore, the study confirms that AI can support students with disabilities through assistive technologies such as speech recognition, text-to-speech tools, and automated translation systems. Thus, AI tools create more inclusive learning environments and ensure that tertiary education opportunities are accessible to all learners regardless of their location.

All in all, AI possesses several attributes that enhance teaching and learning processes in tertiary education institutions, which include improved efficiency and personalised learning experiences.

6. Conclusions

Grounded on the findings of the study, the following conclusions were made, evolving on the extent to which AI can be utilised in the teaching and learning process in TEIs:

i). ***Firstly***, it supports personalised learning, where students receive learning materials tailored to their pace and ability in the comfort of their preferred environments. Further, it improves efficiency by assisting lecturers in content creation, student feedback and performance grading.

ii). ***Secondly,*** it was concluded that AI ethical:

- Considerations are critical when integrating Artificial Intelligence into the teaching and learning process;
- Concerns which include academic integrity, data privacy, transparency, and fairness should be regulated by institutional policies; and
- Policies should be formulated in order to regulate the responsible use of AI in academic fields in TEIs.

iii). ***Thirdly,*** it has several benefits in TEIs which include AI-generated services such as student-centric learning, videos, audios and language translations. Further, it supports students in developing and producing educational materials.

iv). ***Fourthly,*** AI-attributes that indicate the effectiveness of teaching and learning include improved efficiency, personalised learning, enhanced quality of tertiary education, expanded access to tertiary education and support to students with diverse needs.

Anchored on the study's major findings and insights deduced from the forgoing conclusions, *a Spheric AI-policy formulation model* was developed as illustrated in *Figure 2* below.

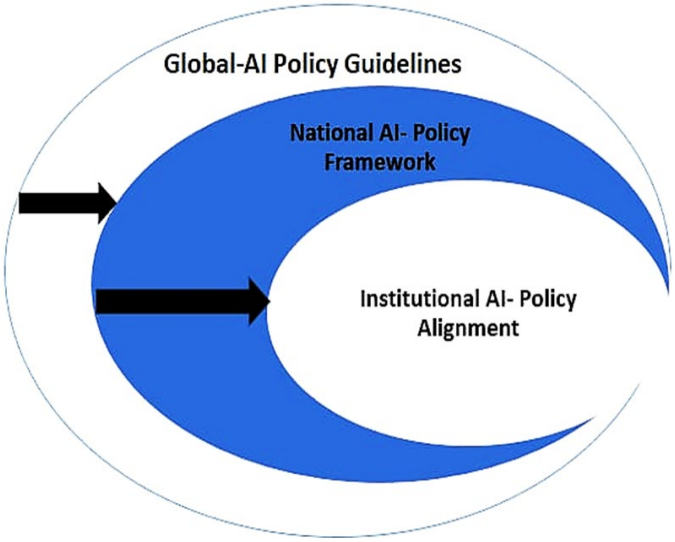

Fig 2: Spheric AI-policy formulation model

7. The Spheric AI Policy Formulation Model Considerations

The Spheric AI-policy formulation model is a holistic, continuous and interconnected approach designed to regulate the use of AI in teaching and learning. Each sphere continuously informs and improves the other level, creating a dynamic and adaptive system as briefly outlined below.

i). **Global AI-policy Guidelines:** Provide international standards and general expectations on the ethical use of AI, in order to ensure consistency, responsible use and cooperation across the continents.

ii). **National AI-policy Framework:** Provides a framework for AI governance, addressing national concerns and regulatory requirements in TEIs.

iii). **Institutional AI-policy Alignment:** Institutions formulate their AI-policies aligning to global and national guidelines and frameworks, tailoring the AI policy ethics specific to institutional contexts, ensuring accountability and responsible AI practices.

In summary, the model allows for flexibility, adaptability, and scalability, while addressing AI ethics in a comprehensive manner.

8. Recommendations

Based on the major findings, the study recommends the following to TEIs:

i). Formulation of institutional AI-policies aligned to global and national guidelines in order to domesticate responsible AI use in the teaching and learning.

ii). Adoption of the AI use in TEIs in order to enhance teaching and learning as well as production of goods and services.

References

1. Anderson JR, Boyle CF, Reiser BJ. *Intelligent Tutoring Systems*. Science. 2021;228(4698):456-462.
2. Autor DH. Why are there still so many jobs? The history and future of workplace automation. *Journal of Economic Perspectives*. 2020;29(3):3-30.
3. Borenstein J, Pearson YE. Robot caregivers: Harbingers of hope, or machines of malice? *Gerontologist*. 2020;50(4):539-543.
4. Brynjolfsson E, McAfee A. *The second machine age: Work, progress, and prosperity in a time of brilliant technologies*. W.W. Norton & Company; 2024.
5. Chan B. *A Comprehensive AI Policy Education Framework for University Teaching and Learning*. Routledge; 2023.
6. Chui M, Manyika J, Miremadi M. *A future that works: Automation, employment, and productivity*. McKinsey Global Institute; 2019.
7. Graesser AC, Hu X, Sottilare R. *Intelligent Tutoring Systems*. International Handbook of the Learning Sciences. 2018;24.
8. Götz M, Slobodova K. How AI can enhance teaching and learning. In: López C, Moreira AC, editors. *2015 International Symposium on Computers in Education (SIIE)*. IEEE; 2021. p. 1-6.
9. Hubbard P. *Computer assisted language learning*. Routledge; 2021.
10. Jobin A, Ienca M, Vayena E. The global landscape of AI ethics guidelines. *Nature Machine Intelligence*. 2019;1(9):389-399.
11. Katiyo A. Exploring College-Based Policy Formulation Processes in Teachers' Colleges in Zimbabwe for the Promotion of Student Friendly Environments. *International Journal of Research in Academic World*. 2023;2(9):43-52.
12. Katiyo A. Exploring the Implementation of Heritage-Based Education 5.0 Curriculum in Tertiary Institutions, in Zimbabwe. *International Journal of Research in Academic World*. 2024;3(8):167-178.
13. Kim LM, Wu T. *Artificial Intelligence in Higher Education: Examining the AI Policy Landscape at US Institutions*. PAGE; 2024.
14. Kulik CC, Kulik JA. Effectiveness of computer-based instruction: An updated analysis. *Computers in Human Behaviour*. 1991;7(1-2):75-94.
15. Kuss DJ, Griffiths MD. Online social networking and addiction—a review of the psychological literature. *International Journal of Environmental Research and Public Health*. 2021;8(9):3528-3552.
16. Luckin R, Holmes W, Griffiths M, Forcier LB. *Intelligence unleashed: An argument for AI in education*. Pearson; 2019.
17. Maher ML. *Intelligent tutoring systems*. Artificial Intelligence in Engineering. 2018;2(1):50.
18. Suppes P, Atkinson RC. *Computer-assisted instruction*. Science. 2023;139(3556):849-855.
19. Ross P. *Intelligent tutoring systems*. Journal of Computer Assisted Learning. 2021;3(4):194-203.
20. Stefik M. *Intelligent tutoring systems*. Artificial Intelligence. 2021;26(2):238-245.
21. Taddeo M, Floridi L. How AI can be a force for good. *Science*. 2018;361(6404):751-752.
22. U.S. Department of Education. *Reimagining the Role of Technology in Education: 2017 National Education Technology Plan Update*. 2017.
23. UNESCO. *Guidance for Generative AI in Education and Research*. Pearson; 2023.
24. Venezky RL. *The intelligent design of computer-assisted instruction*. Longman; 2019.
25. Zhang E. *Ethical Considerations and Policy Implications for Large Language Models*. PAGE; 2023.