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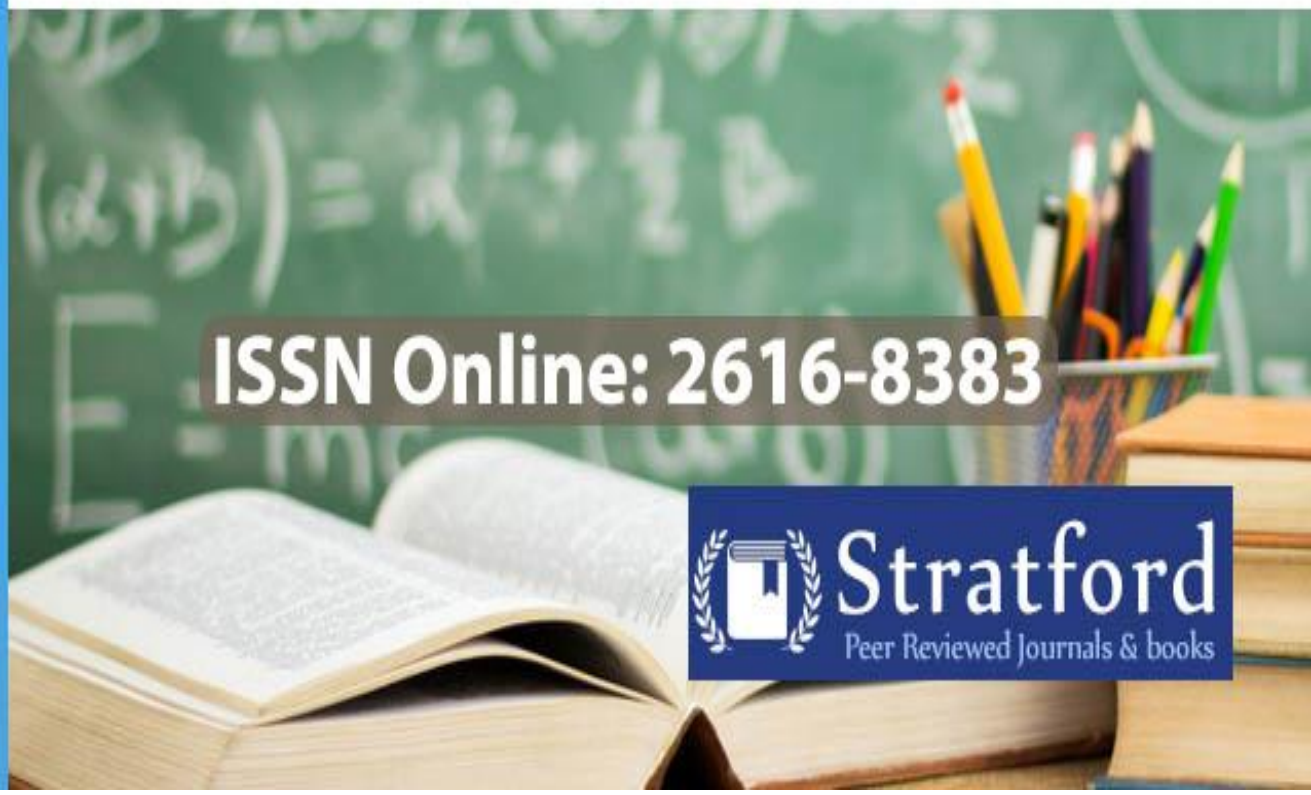

The Prospects, Challenges and Ethical Aspects of Artificial Intelligence in Education

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The Prospects, Challenges and Ethical Aspects of Artificial Intelligence in Education

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Abstract

Implication of Artificial intelligence in education brought significant improvement on traditional models of teaching and learning process. This paper was aiming at bringing to the right prospects, challenges and ethical aspects of Artificial Intelligence in Education (AIED). Purposive non probability sampling technique was used to select study participants. Descriptive statistics and thematic approach were used to analyse collected quantitative and qualitative data Effective creation and implementation of AIED various adaptive learning platforms (Liushuo in China, NLP in USA, PAM in Germany, EdTech company Greekie in Brazil and M-shule in Kenya), Advanced data analytic platforms, the introduction of AI as major course in universities, and Investment for AI research were established as prospects of AI at the level of 26.80%, 24.10%, 26%, and 23.10% respectively. Other potential prospects like Multi-source of data analysis and audio-Visio teaching and learning materials were revealed as key prospects of AIED. Fragile technological infrastructure, inadequate government expenditure in education, achievement gap in education, resistance to implement AIED, and unprepared teacher for AIED implementation were found as challenges of AIED at 85%, 75%, 65%, 60%, 40% respectively. In addition, curriculum transition, culture and religion of some countries, resistance to change mindset were suggested as other challenges of AIED. Cultural integration; accountability; fairness, equity and affordability; security, and privacy were found out as the main ethical aspects of AIED at 33.3%, 28.6%, 14.3%, 14.3% 9.5% respectively. Increasingly Humanity, singularity, authentication and profitability, personal interest's investment, humanitarianism, and solitary were suggested as ethical aspects of AIED. The paper recommends AIED theorists to mitigate carefully the impacts of AI on human kinds.

Keywords: *Artificial Intelligence in Education (AIED), Prospects, challenges, ethical aspects, Adaptive learning platform, Algorithm, 21st century skills.*

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Introduction

Recently, several research studies were carried out to establish the prospects of artificial intelligence in education worldwide, the findings of such studies presented contradictory views concerning the incorporation of AIED its challenges and ethical aspects. In one hand, researchers undoubtedly argue that artificial intelligence has started and by at least 2030, it will be plying a significant assistance in education in line of achieving the 21st century skills [1]in a personalised AI system.

Evidence provided for this assertion were found in different AIED adaptive learning platforms already developed and made use for one teacher to teach hundred thousands of students at once and provide individual feedback, marking close or open tests against a humanlike precision of 92%, providing a customised learning experience over thousand schools like Liushuo in China, NLP in USA, PAM in Germany, EdTech company Greekie in Brazil M-shule in Kenya respectively UNESCO (2019); Perera & Aboal, (2018); WISE (2011); Rundle, (2015); Rigby, (2016).

In the same line, are advanced data analytic platforms designed and already incorporated in education system which have capacity of containing all kinds of educational data, tracking and analysing students' performance like an AI advanced information management system in United Arab Emirates; M-Shule in Kenya; Daptio in south Africa (Leading Countries of the World (2018; UNESCO, 2019).

Subsequently, introduction of AI major courses in high level of universities (master's and doctoral) and technical and vocational education and training (TVET) in China and France plus introduction of AI in other existing courses (biology, psychology, sociology etc.); launch of national initiative of producing thousands of graduates in AI and even specialists in Republic of Korea and big investment (€1.5 billion, 2 billion, 5 million RMB (≈726,427 USD)) provided by governments of states like France, Korea and China respectively (Government of the People's Republic of China (2017); China Daily (2018); Villani (2018); Campus France (2018); Sharma, (2018).

On the other hand, some of the scientific community worry that the integration of AI in education is like a Pandora's Box [2]with dangerous consequences. To take a case in point, AIED was claimed as the end of human era due to the fact that it exceeds the human intelligence (Hawking, 2014; Vinge, 1993). While Gray Scott denied that "There is no reason and no way that a human mind can keep up with an artificial intelligence machine by 2035" (Marr, 2020).

After all, the Economist Intelligence Unit (2018) refuses that no country in the world is ready for intelligent automation in a genuine manner and insisted that those considered as leaders in AI

[1] **21st century skills** refer to Literacy, Numeracy, Scientific literacy, Information communication, Critical thinking and problem-solving, Curiosity, Initiative, Persistence/grit, and Adaptability (Luckin, Holmes, Griffiths & Forcier 2016).

[2] **Pandora's Box** refers to A present which seems valuable but which in reality is a curse (Brewer's Concise Dictionary of Phrase and Fable, 1992)

to have intelligent automation response it's only nascence. The point hereunder discusses the challenges encountered by AI in education system. The existing literature has been highlighting several challenges hindering the implementation and success of AIED system worldwide. Inadequate funding, infrastructure, ICT skills, internet connectivity, language and culture were found most hindrances of AIED (Nye, 2015).

Normally, government of the country worldwide is the prime funder of education system through Government grants in education system. However low-income countries recorded low amount of money devoted to education from GDP or government expenditure (budget) (UNESCO, 2000; Samarrai, Cerdan-Infantes & Lebe, 2019). It was then found spending in education from GDP for most of the low- and middle-income countries[3] remained relatively unchanged, at about 4.5 percent despite the fact that global spending on education has risen significantly over the past two decades (Samarrai, Cerdan-Infantes & Lebe, 2019).

Even though the governments of low and middle-income countries face a challenge of scarce educational infrastructure, it becomes worse when it comes to technological infrastructure. As a matter of fact, US Internet council (2000) reported that from 2001 considered 818 million African population, it was noted that only: 1/4 has a radio, 1/13 has a television, 1/35 has a mobile phone, 1/40 has a fixed line phone, 1/130 has a personal computer (PC), 1/160 uses internet, 1/400 has a pay TV.

Associated with this, was the prevalence of telephone, personal computers, and internet host out of 1000 per economic groups, world Bank (2001) indicate that the number of people having telephone in sub-Saharan Africa, low income, middle income, high middle income and high income were [18, 26.3, 121.3, 582.8]/1000 respectively, computer [8.4, 4.4, 27.1, 345.7]/1000 respectively, for internet host [2.3, 0.3, 7.6, 603.1]/1000 respectively. Without doubt, UNESCO (2017) confirmed that fragile infrastructure and connectivity hindered the progress of digital literacy in education.

AIED is hindered by unprepared teachers to facilitate learners in interaction of this new education initiative. This should further be see in teacher's digital illiteracy[4]. For example, insufficiency level of digital literacy among Iran language teachers, Japanese University teachers, Indonesian English teachers, Ugandan teachers (Dashtestani, 2014; Son et al., 2011; Andama, 2014; Madan, 2018; UNESCO, 2011). Abdul (2010) elucidated that African teachers are not only ICT and digital illiterate but also technophobic. The crux of the matter is resistance to technology in both teachers and community found in Cameroon, where teachers often see digital tools as an additional burden for their daily work UNESCO (2018).

One of the existing biggest unsolved issues in education is shortage of teachers to the extent that 33 countries currently have insufficient teachers to provide every child with primary education

[3] **Low-income countries**: countries earning $1,025 or less from their gross national income (GNI) per capita.

Middle-income countries: countries earning between $1,026-$12,475 from their GNI per capita

High-income countries: countries earning $12,476 and above from their GNI per capita. (World Bank, 2017)

[4] **Digital literacy**: ability to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital devices and networked technologies for participation in economics and social life (UNESCO, 2019).

even without a hope of solution by 2030 (UNESCO, 2015). To solve this issue, at least 25.8 million school across the world are in need in order to achieve this goal. Since this seems impossible another suggested solution was AIED where an AI adaptive learning platform can be used for one teacher to effectively teach thousands of students at once. Even though this may be true, there is fear of losing job for many teachers despite the view of UNESCO (2019) and Luckin, Holmes, Griffiths and Forcier, (2016) of assistance not replacement. Due to this speculation of losing job, resistance to implement AIED can rain a big barrier.

According to Conroy and Rothstein (2013) students from poorer backgrounds perform worse than students from richer backgrounds. One of the proposed solutions by AIED for this gap is the reduction in cost of AIED leading to its affordability to schools and school system. Yet, Low-income parents may also have had limited education opportunities, meaning they may face serious challenges in providing at-home learning support to their children (Paton, 2014).

As the proposed solution in tackling achievement gap is to make AIED assistants available to all parents to ensure that they are well informed, supported, and engaged in their child's education (Luckin, Holmes, Griffiths & Forcier, 2016). Initiation of AIED remains critical with these questions remains: will AI be provided to both students and parents in low and middle income countries out of affordable price? Will AI simultaneously teach both students, teachers and parents to the extent of handling social economic gap leading to achievement gap?

Human and societal behaviour are being quantified objectively due to the influence of this age of big data resulting in tracking, modelling and predicting people easily (Mayer-Schönberger & Cukier, 2014). There is no question that, this can also affect education sector once AIED is incorporated in When treating this issue of datafication in education such problems are raised: who can use AIED data, who owns the data, who can use it, for what purpose, and who is held accountable?

So far as **ethical aspects** of AIED is concerned, privacy, transparency, accountability, security, fairness, equity and affordability, cultural integration are briefly discussed.

In the first place, considering the ways in which algorithms[5] are designed, there is a worry concerning teachers, students' data **privacy** as such a large data from algorithms might be targeted by cyber criminals. It was also revealed that people are not sure of usage of their data even if informed consents have been offered, which create worries in teachers about AIED as a classroom spy to record and report their suboptimal performance (UNCTAD, 2016; Luckin, Holmes, Griffiths & Forcier, 2016). Legal framework therefore has to ensure a strong protection of personal data against cyber-attacks and ensure citizens that their data will no longer be used for unwanted surveillance (world wide web foundation, 2017; Wright, 2018).

Immediately following is **transparency** in AIED where the users wonder problems like, how can we make AI as transparent as possible? How can we explain how an AI-based decision was made, what that decision was based on, and why it was taken the way it was taken? Leslie (2019)

[5] **Algorithm**: A defined list of steps for solving a problem.

explained transparency as interpretability (opening the black box[6]) of a certain AI. For instance a student solving a mathematical problem using AI model and it can give outcome that the answer is either right or wrong. In case it says wrong, a student wants to know at which stage s/he was wrong, and what s/he needs to change in order to get the right answer. In these case the school has therefore to have a necessary understanding of how such a decision has been drawn and be able to explain it the students in a an understandable language.

On the next occasion, is **accountability** which actually comes in when negative consequences or impact appeared or when recognizing who or what causes errors, failures or harm. It is therefore a difficult matter to identify whether owner, the assigned teacher, the algorithm or technician team should held accountable in case one of those negative impact happens. Several debates and discussions failed to solve this matter, due to the complexity of AIED production process involving multi agent character of the development and use of this systems (Leslie, 2019)

Following the accountability is **security** refers cyber-security and defensive capacity. According to Leslie (2019) the aim of security in AI in education system is protecting several operational dimensions of an AI system while confronted with adversarial attacks. Associated with this was a view of Kose (2018) who adds that even AI itself might be targeted by threat actors for the intention of damaging or subverting an organisation effort. As an example, adversarial data can be used to challenge, confuse or redirect an AI model. So threat actors need to be prevented from educational AI model access so as for them not to manipulate social dynamics or cause misinformation in the system.

Subsequently, **fairness, equity and affordability** are a matter of ethics in AI in education, as the educational personnels wonder how fair AI will it be, to what extent will it be equitable, and how affordable will it be in terms of cost. Since this AIED technology has been created by a human being who is subjected to bias, this kind of bias, misjudgement, or errors committed in the AI design life cycle, it is undoubtedly believed that such a type of unfairness will affect the input, process and the output produced at a given level. Furthermore, a question whether the cost of AI system in education will be equal in all countries which are not in the same economic group, if yes, will it be affordable for all schools? What will happen to the schools which will fail to afford to price set? This keeps worry that the least developed countries will be at risk of suffering new technological, economic and social divides with the development of AI, hence lack of equity and affordability which can lead to school apartheid (Santry, 2018).

As far as **cultural integration** is concerned, since the issue of building cultural norms into AIED has already started, worries were raised that AIED models might be a tool for dominant cultures such as Chinese culture or American culture to influence subcultures or vice versa depending on the country which developed AIED (Hadfield-Menell, Andrus, & Hadfield, 2019; Malle, Bello, & Scheutz, 2019). More emphatically, Zgrzebnicki (2017) elucidated that countries developing or designing AIED may use it to serve as a colonial agent by advancing and spreading their social cultural norms.

[6] **Opening the black box** refers to not only observe input and output but also how the internal part (black box) works transparently.

To this end, from the aforementioned existing literature, there is no question that same steps have been made in line of introducing AIED system as a new educational reform which will serve as advantageous in learning. yet, only high and some few middle-income countries were found to make a substantial progress, under which prospects of AIED were indeed remarkable while less or nearly nothing has been done in low and most of middle income countries. By contrast, some worries have been raised claiming that AI is an idea which currently seems to be valuable but really a curse plus various challenges which might hinder the success of AIED. What's more, it was noted that less has been done about AI ethical aspects.

Basing on this inconsistency, a conclusion that AIED will have significantly assisted in achieving an educational SDG, 21st century skills and in eradication of existing biggest unsolved issues in education by at least 2030 should not be drawn. Afterwards, it has also been noted that the study addressing the prospects, challenges and ethical aspects of AIED at once, has never been conducted. This current study therefore intends to explore the prospects, challenges, and ethical aspects of AIED.

Methods

The data that forms the basis for the conclusions of this paper was collected from educationists and technologist respondents. Data was collected all-over the world by using google forms, majority of them were from East Africa (Rwanda, Kenya and Tanzania). Purposive non-probability sampling technique was used to select participants of this study. Structured questionnaire was used as data collection tool. Descriptive statistics and thematic approach were used to analyse both quantitative and qualitative data collected.

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Results

Prospects of AIED

The first objective of this paper was to find out prospects of AIED. To achieve this objective respondent were asked select whether they agree to the following prospects and suggest what else they think. its findings are summarised in figure 1.

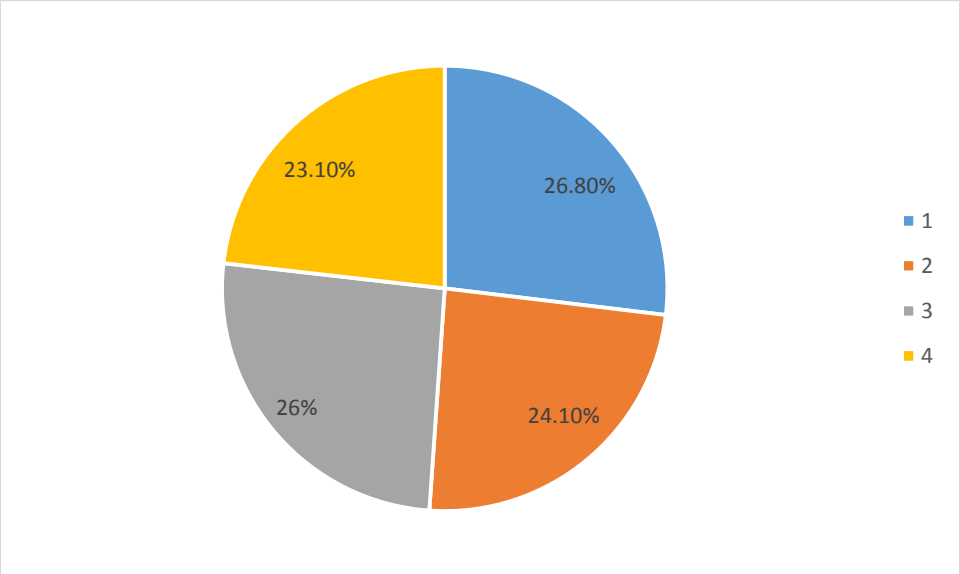

Figure 1 the prospects of AIED

The results in figure 1 suggests that adaptive learning platforms, advanced data analytic platforms, introduction of AI major courses in high levels of University (doctoral and masters) and in TVET and introduction of AI in the existing courses (Biology, Mathematics, Sociology etc.), and Investment for AI research were considered as prospects of AI at the level of 26.80%, 24.10%, 26%, and 23.10% respectively. When asked to provide other potential prospects, Multi-source of data analysis and audio-Visio teaching and learning materials were suggested.

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Challenges of AIED

The 2nd objective was to indicate the challenges of AIED. To achieve this, the respondents were asked to select the greatest among these challenges. The results are summarised in figure 2.

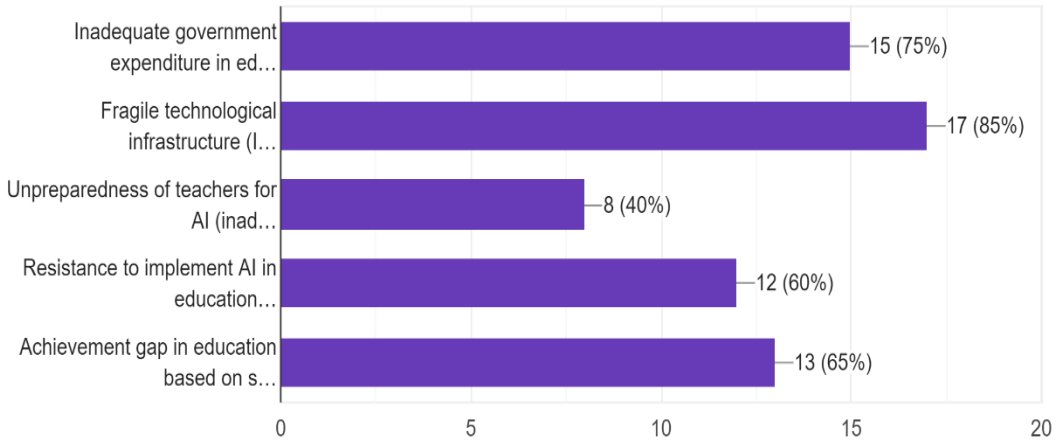

Figure 2 the challenges of AIED

The results in figure 2 suggests that fragile technological infrastructures, inadequate government expenditure in education, achievement gap in education based on social economic group, resistance to implement AIED because of fear to be replaced by AIED, and unprepared teacher for AIED implementation were found as challenges of AIED at 85%, 75%, 65%, 60%, 40% respectively. In addition curriculum transition, culture and religion of some countries, resistance to change mindset were suggested as other challenges of AIED.

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Ethical aspects of AIED

The 3rd objective of this paper was to identify the ethical aspects of AIED. To achieve this objective, the respondents were asked to express their perception about the ethical aspects listed. Results are summarised in the figure 3.

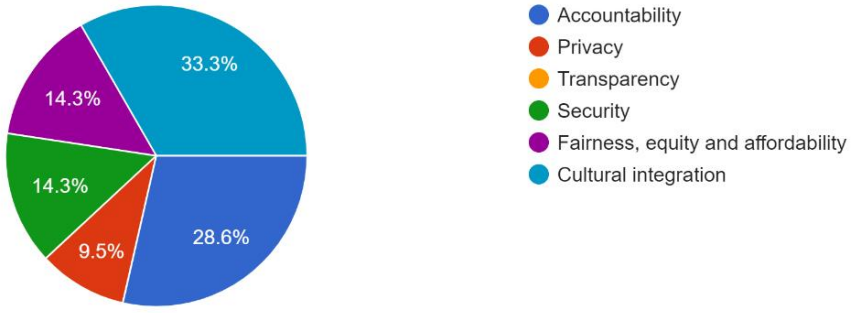

Figure 3 the ethical aspects of AIED

The results in figure 3 showed cultural integration; accountability; fairness, equity and affordability; security, and privacy as the main ethical aspects of AIED at 33.3%, 28.6%, 14.3%, 14.3% 9.5% respectively. From the views of respondents, Humanity, singularity, authentication and profitability, personal interest's investment, humanitarianism, and solitary were suggested as ethical aspects of AIED.

Discussions

The data was analysed using descriptive statistics to identify the prospects, challenges, and ethical aspects. For the possibility of AIED to happen in future, The results of figure 1 indicated at 26.8% that various adaptive learning platforms (Liushuo in China, NLP in USA, PAM in Germany, EdTech company Greekie in Brazil and M-shule in Kenya) and at 26% the introduction of AI major courses in universities (Doctoral and masters) & TVET plus introduction of AI in existing courses (biology, psychology, sociology, law etc.) are a great evidence that AIED will happen in future. These findings were against the views of Hawking (2014) and Vinge (1993). Who argued that implementation of AI could put an end upon humankind due to the fact that 50% of respondents rejected the idea of AIED failure because of worries that it could end a humankind? Moreover, a contrarians' view of AIED failure due to lack of readiness for any country for intelligence automation in a genuine manner was also rejected by the majority of respondents at 45% / 10% who accepted.

Despite these prospects, the results of figure 2 indicated at 85% fragile technological infrastructure, and at 75% inadequate government expenditure in education as the main challenges of AIED which requires enough and sustainable technological infrastructure to serve the purpose. These findings were in line of the assertion articulated in a report of the Economist

Intelligence Unit (2018) refuses that no country in the world is ready for intelligent automation in a genuine manner and insisted that those considered as leaders in AI to have intelligent automation response it's only nascence.

Furthermore, as indicated in figure 3, the majority of respondents expressed their worries that AIED could be a tool for culture integration which seems as colonial agents for the countries developed AIED. This finding corroborated with the worry raised by Zgrzebnicki (2017) that countries developing or designing AIED may use it to serve as a colonial agent by advancing and spreading their social cultural norms. Increasingly was lack of accountability as main ethical aspects. This indicated that community worry about drawbacks of AIED like errors, failures, or harm with no one to be held accountable about mistakes caused whether program owners, assigned teachers, or technician team. This finding was in line of the view of Leslie (2019) that the issue of accountability in AIED remained unsolved because of complexity of production process involving multi-agent character of both development and use of this system.

Conclusion

The study investigated the prospects, challenges, and ethical aspects of AIED. The study established that various adaptive learning platforms, the introduction of AI major courses in universities (Doctoral and Masters) & TVET plus introduction of AI in existing courses (Mathematics, sociology, psychology, law etc.), Investment for AIED research, data analytic platforms were the prospects of AIED; fragile technological infrastructure, inadequate government expenditure in education, achievement gap in education based on social economic group, resistance to implement AIED because of fear to be replaced by AIED, and unprepared teacher for AIED implementation were the main challenges of AIED and Culture integration, accountability, fairness, equity and affordability; security, and privacy were ethical aspects of AIED. In view of this findings, the study concludes that adaptive learning platforms, the introduction of AI major courses in universities & TVET plus introduction of AI in existing courses are the main prospects of AIED and that fragile technological infrastructure, inadequate government expenditure in education are the main challenges of AIED whereas Culture integration and accountability are the major ethical aspects of AIED.

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