



How AI could transform Uganda's Eduscape

Paving the Path for Blended Learning

Africa Policy Centre
Uganda Christian University

July 2020

PB003



Author: Ms. Cadreen Barungi Kabahizi

Editor: Mr. Twesiime Jordan McGurran



How AI could Transform Uganda's Eduscape
Cadreen Barungi Kabahizi
APC PB003

Published by Africa Policy Centre in August 2020
© Africa Policy Centre 2020

Copyright© Africa Policy Centre (APC)

The Africa Policy Centre at Uganda Christian University is a Christian-inspired Policy Think Tank established in 2016. The goal of the Africa Policy Centre is to build a community of policy researchers and political thinkers who are wisely engaging public policy and political thought within two broad frameworks: the Christian and biblical framework emerging from the broad and multifaceted Christian tradition as well as indigenous and local perspectives, especially from the multiple ethnic and civilizational traditions and communities in our particular context on the Africa continent. Through our work, we investigate policy issues, political thought and theory, and theological understanding on a wide range of questions, issues, and topics. Our work rests on the foundations of dignity for all people, the necessity of virtue for a flourishing society, and the aim for the common good. We seek to serve the nations in Uganda, the communities in East Africa, the African continent, and the rest of the world.

Disclaimer: The views expressed in this publication are those of the authors and do not necessarily represent the views of Africa Policy Centre or its management.

Any inquiries can be addressed in writing to the Executive Director on the following address:

Africa Policy Centre
Uganda Christian University
P.O Box 04, Mukono, Uganda
Tel: +256787061826
Email: africapolicycentre.ucu@gmail.com / apc@ucu.ac.ug
Web: <https://africapolicycentre.org/>

The Africa Policy Centre at Uganda Christian University is a Policy Think Tank established in 2016

Executive Summary

As the world enters the fourth industrial revolution, artificial intelligence (AI), an emerging technology, is subtly becoming part of our lives. In many ways, we are becoming increasingly dependent on AI-powered tools and devices. In the education sectors of several countries, we see some cases in which AI has been integrated into students' personal and school lives. Because Sub-Saharan Africa has not yet fully launched the use of AI in schools, it is of paramount importance that Uganda's education system looks into this proposition as a means to bridge the historic literacy gaps within the country. Educating students with AI and about AI is also a means to prepare Ugandan students to be competitive in the world market. This is especially important to consider now that Uganda's education sector is recalibrating the education system as a response to the COVID-19 driven school closures. AI offers the chance for faster recovery of the learning losses that students are currently suffering. It would empower educators, increasing their reach in the number of students taught and thus increasing their efficiency.

This, however, does not come without challenges. The biggest of which are ethical concerns and lack of necessary infrastructure. This paper explores ways in which these challenges can be mitigated to bring about the necessary advancement. We encourage the Government of Uganda to run trials to find the best-suited ways to apply AI in the education system. AI application has to be safe, ensuring secure data and privacy of users and it has to be helpful and beneficial, producing positive learning outcomes and increasing the teachers' efficiency. All this is in hope that AI can provide the avenue to reach through which many uneducated people get access to world-class education closing the historical learning gaps of illiteracy and greatly enriching the Human Capital of Uganda.

Introduction

When the COVID-19 pandemic struck the world, no one would have known what was to come. With so much uncertainty about the future, rethinking and restructuring of systems are one of the key mechanisms of managing the continuation of many of life's activities. One way or another, societies are changing how they do things in a bid to achieve a form of normalcy - this new way of doing things is now called the 'new normal'.

This means there will be impacts expected, big and small, positive and negative, on people's lives. Although the short run psycho-social-economic effects are already visible, the long-run effects can only be anticipated for now.

The COVID-19 pandemic has not only disrupted our personal lives but it is affecting the way we are going about our normal lives. Social distancing now characterizes many permitted social gatherings, and gathering in crowds may soon be a thing of the past. Uganda's education sector, too, has suffered its toll of the coronavirus pandemic. A great byproduct of which is the remote learning policy recently given by the Ministry of Education and Sports (MoES) [1]. As a result of this policy, for the first time, the masses have free access to high-quality study material. UPE students have a chance to fill in any learning gaps, matching up their peers in good quality schools. This chance, although slim because of the unavailability of capable teachers to teach this material, is better than these pupils have ever had. Previous school dropouts and uneducated people also now have access to good quality learning material. These learning provisions have been well laid out by the National Curriculum Development Centre (NCDC) [2] and schools through email, newspapers, radios, televisions, and websites [3].



©Yolk Studio

Many teachers have consequentially risen to the task of harnessing whatever avenues they can to continue teaching their students [3], [4], [5]. The teaching process is therefore now shifting from being teacher-centered¹ to being learner-centered². It is this learner-centered approach in education that opens us to the role Artificial Intelligence (AI) could play in this arrangement as AI's main role in education is to enhance learner-centered approaches [6]. This has opened up discussions on the way forward, and the word 'blended learning' has continuously shown up on the radar of new strategies to implement in Uganda's classroom setting.

It is within this concept of blended learning that we explore the role AI would have in harnessing the best of our abilities within the confines of our resources to yield great results. AI could transform the whole eduscape in Uganda as it has in many other countries [7].

The term 'scape' was coined by Appadurai in his five scapes of globalization along with the idea of global cultural flow [8] in which scapes are likened to the characteristics and general makeup of something for example landscapes, and the global cultural flow characterizes the fluidity of these characteristics across borders. In essence, no one place would be homogenous in any one characteristic, instead, each place has characteristics influenced by other locations' characteristics. With that background, we take the definition given by Madsen [9, p.7],

“An eduscape is constituted by the ideological visions and political structures that take place in local schools as the daily administration of time, activity and place, the practices of teaching and learning in classrooms, the construction of social relations and of agents' (i.e. teachers' parents' children and young people's) imaginations of the optional worlds that are seen as consequences of schooling”

Encyclopedia Britannica defines AI as the ability of a digital computer or a computer-controlled robot [Category]to perform tasks commonly associated with intelligent beings [10]. Whereas automation to-date has means computer hardware, industrial robots, and software designed to do repetitive and predictable tasks for example calculators, AI can take on more complex and less predictable tasks that were previously handled by humans. These include problem-solving, decision making, and interaction. Good examples of these are self-driving cars and diagnosing disease [11].

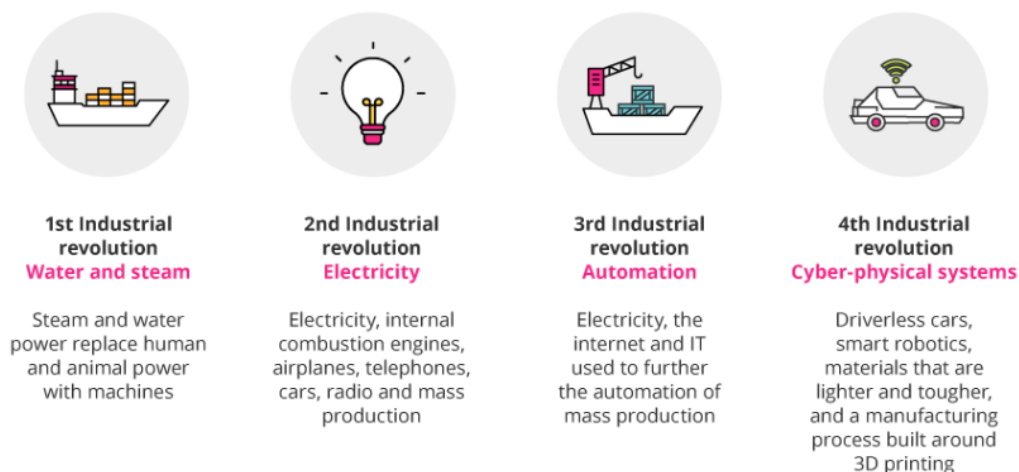
In the education setting, AI can be used to provide smarter ways to transfer knowledge from teachers to students. This can be done through learning software applications for all levels of learning, through online tests, marking scripts, making self-designed curricula, and several other things.

The great need for Uganda to be aware of AI and its implications in our lives is quite urgent because the World Economic Forum has acknowledged that the world is entering the fourth Industrial revolution which is characterized by the use and integration of AI in daily human life [12].

¹ Teacher-centered learning is where the teacher does the instructing/teaching while students listen and learn. Focus here is on the teacher.

² Learner-centered education is where both students and teachers share the focus. Here feedback, ideas and group work are encouraged, and students share their perspectives with the teachers.

THE FUTURE OF WORK



Source: World Economic Forum, 2016.

Although AI seems like a far-fetched idea because Uganda is not yet well invested in technological infrastructure, it sure is part of the solution to educating Uganda, integrating it into the teaching process could reshape Uganda's education structure making it possible for all Ugandan children to have access to quality education raising the literacy levels to unprecedented levels. If considered and invested in, it could truly turn things around for Uganda because it would greatly raise the quality of human life in Uganda.

Examples of AI in Education

- **Langbot**-teaching language
- **Immersive reader**-can help students with dyslexia to build confidence in reading.
- **Azure's Machine Learning Software**-for analyzing student data. This points teachers to students learning challenges
- **ChatBot** helps students design personal curricula
- **Microsoft Office 365**(Word, OneNote, PowerPoint)
- **e-rater** for giving scores and feedback on writing proficiency
- Content Technologies, Inc: **Palitt** allows students to design personal curricula, **NursingEd101**helps nurses with sorting out and memorizing information, **Cram101** disseminates information in textbooks to make study guides. **JustTheFact 101** highlights and creates summaries of long texts and textbooks which are archived in a digital collection
- Carnegie Learning: **Mika** Software. **MATHia** for math learning
- **Netex Learning**: Allows educators to design digital curriculum and content. Also provides a personal learning platform
- Pearson: e.g. **iTalk2Learn** system¹⁶: Provides feedback to the teacher about the student's knowledge level, cognitive needs, and emotional state.
- At Georgia Tech University: **Jill Watson**. An AI teaching assistant is used for answering student queries
- In China: Marking/grading software for essays have been used in more than 6000 schools.

In the classroom setting, AI can play several roles: Aiding the teacher in tasks like grading tests and monitoring the concentration of students as has been experimented in China, but also it can help students by offering personalized learning, personalized group projects, and several other services [13].



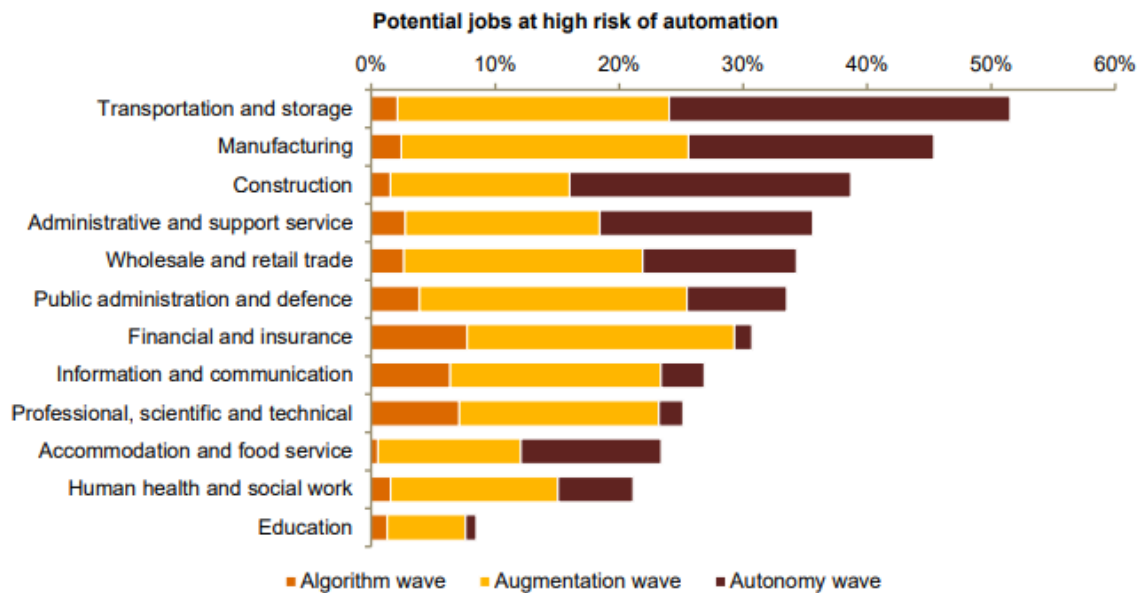
© Can't Wait to Learn

For AI to function well, it requires large scale data [7]. AI uses data to analyze information, sifting through piles of information to produce the necessary results, therefore the more the data available, the more efficient AI will be in delivering the required services. This also brings to light the need for organized and consistent data collection in Uganda. This brings us to the concept of Big Data which means huge volumes of data that grows exponentially and cannot be processed by traditional data processing tools [14]. Big Data is a necessity for the functioning of AI. With big data, educational data mining would then be possible, analyzing all the data collected during teaching and learning to attain all kinds of information relevant to inform teaching practices, lesson designs, and personalization of the learning experiences [15]. The assessment of students to understand their individual learning styles, strengths, preferences, and speed is called Learning Analytics [13]. This is the main goal of AI in learner centered-education.

Our current education system must prepare students for AI in four ways:

- Learning how to use AI, including how to use the available functions for maximum effectiveness and productivity.
- Learning the technical aspects of AI, including how to develop AI systems, how to use AI infrastructure, and how to create and moderate the necessary functions for the AI to be able to serve humanity.

- Because education is designed to prepare learners to live wholesomely, serving humanity and the economy, now and in the future, we must understand the future of work if our education system is to be competitive and if Uganda's learners are to be adequately trained with the right foundation for effectiveness in the fourth industrial revolution.
- Our education system should also train and prepare learners to be problem solvers, as this is the niche that will not be easily replaced by AI [16]. It is predicted that AI will replace several mundane jobs in the degrees shown in the figure below.



Source: PwC, 2018

There is a great fear among people that artificial intelligence will at some point surpass human intelligence after reaching a point of 'Singularity'. This point of the singularity is a hypothetical future scenario in which AI development would have advanced so much that it would become more intelligent than humans and decisive enough to overthrow human decisions [17]. However, according to BBC Future, the real risk regarding the use of AI is in the wrong decisions it would make having been fed wrong data [18]. For AI to operate efficiently it needs correct data.

The issue of data is another contentious one. Data, the very lifeblood of AI tools, is always at risk of being stolen, manipulated, and hacked into for selfish gains. These possibilities of privacy breaches render users wary of engaging with AI. Because humans already live in a heavily interconnected world- thanks to the internet - the need for privacy is even more paramount. The importance of data protection and data privacy can therefore not be overstated.

To protect humanity - given that AI has the potential to be humankind's worst nightmare if designed for that purpose- AI must be designed and used to serve humanity. OpenAI was created by tech giants like Elon Musk, to provide altruistic AI that could serve and not threaten humanity [19]. This is a very

attribute for AI developers to put into consideration. Altruistic AI would allow humans to enjoy the benefits of meaningful work without feeling insecure about being overtaken by AI.

Given all these considerations, it is of paramount importance that Uganda prepares and enforces ethical considerations to be used in the integration of AI in our education system [20], [21].

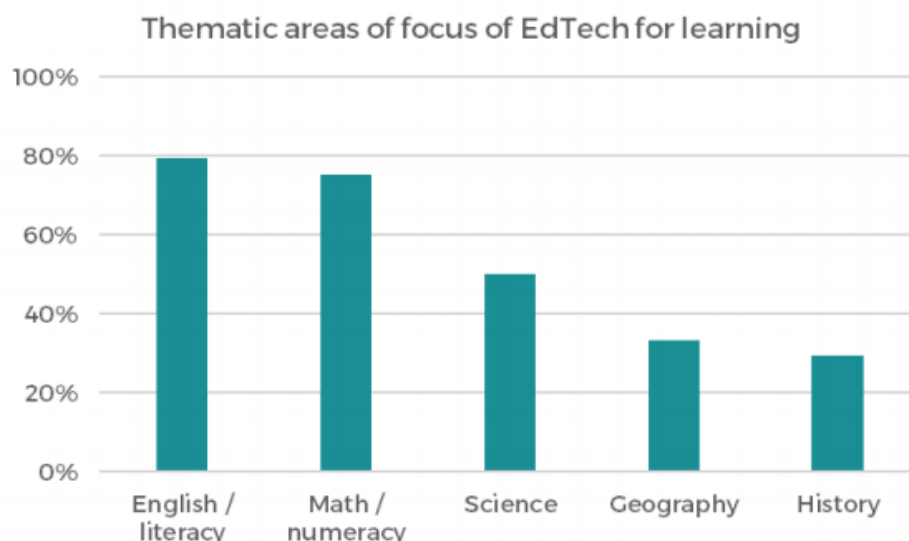
How Uganda is Currently Using AI

Uganda already enjoys the benefits of AI through using search engines such as Google and Yahoo, through applications that are interactive like Safe Boda, Uber, Google maps and, learning applications such as checheza, BSOL, EduTab, Hadithi Hadithi!, Can't Wait to Learn, TutorSasa, VirtualSasa and in many other ways. Uganda, like the rest of the world, has been actively engaged with AI for over two decades.

Although an assessment of Uganda's e-Government readiness in 2012/2013 found a low level of e-government capacity and implementation [20], Uganda's Ministry of Education and Sports (MoES) has been progressively implementing Information Technology (IT) solutions to increase efficiency and simplify data collection. The implementation of the Education Management Information System (EMIS) was one such initiative that aims to integrate people, practices, and technology in Uganda's education sector [22]. Private and Public initiatives can now be encouraged to determine how best AI can be introduced and assimilated into the daily teaching activities.

Uganda already has EdTech programs in several capacities. The NCDC already has an e-learning platform that can be freely used by any student who has access to the internet [2]. The NCDC even created software called Virtual Learn that teachers can use to design lessons for students [23]. It uses animations and has several interactive tools. Other programs like Skool Desk from Blue Node Media which helps teachers do the grading of tests and provides an e-learning platform for learners [24]. An organization called Checheza has also used an offline educative application called Checheza is helping children in Bududa learn literacy and mathematics [25]. Several other initiatives are used for the following categories: 1. Learning - games and applications for learners, etc., 2. School management - helping schools manage their systems, 3. Teacher development - training teachers on how to use these tools and more.

Research done by Save the Children in 2019 shows that the 22 EdTech solutions being currently implemented in Uganda take 3 main forms: games/applications (50%); digital libraries with books and other learning resources (38%); and tech-enabled education of jobs with hands-on components for learners (18%). The main thematic areas that the ed-tech solutions cover are shown in the figure below.



Source: Save the Children, 2019

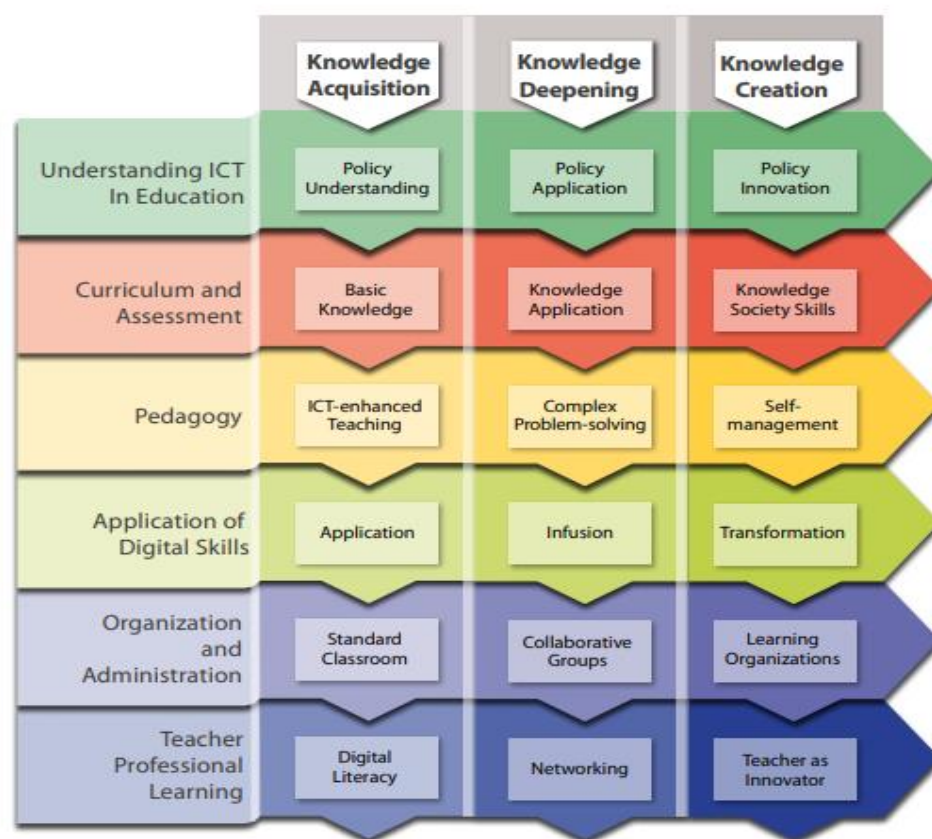
With AI, the future of technology is quite unpredictable. No one can say for certain what AI will look like a few decades from now. Futuristic impressions predict machines being like humans and even better than humans and the doom of humans being overtaken by AI. The future could surely go in any direction but one thing researchers have found is that AI is not capable of having human intelligence, at least for now. Machine learning is capable of and limited to knowledge accumulation which is basically from data accumulation and with this, through data mining, AI can answer questions and solve problems.

In a study of the evolution and revolution of AI in education, it was concluded that AI should be integrated not only in the learning experiences of students in the classroom but also in their non-formal learning experiences and their normal life experiences [26]. This would lead to the further familiarity of the AI and would free up space for teachers to do more in developing the human intelligence of learners as opposed to just delivering knowledge to them. Teachers would rise to the role of mentors in addition to their traditional teaching roles [26].

UNESCO recommends a new curriculum for a digital and AI-powered world [7]. Based on a given set of competency areas that learners should attain to equip them for the use of AI in everyday life:

- Fundamentals of hardware and software;
- Information and data literacy;
- Communication and collaboration;
- Digital content creation;
- Safety;
- Problem-solving;
- Career-related-competencies.

This goes hand in hand with a framework for teacher training that UNESCO recommends [27], to train and equip teachers with the skills required to use AI to aid them in the teaching process and teach their students how to use it. The framework can be summarized in the figure below:



Source: UNESCO, 2013

The education sector in Uganda has not yet fully embraced and implemented the use of AI for several reasons:

- Uganda's AI sector is not yet well advanced.
- AI trials are expensive to run.
- Uganda is not yet fully equipped with adequate technological infrastructure
- Uganda is not yet heavily invested in research and development. This greatly lags the transformation of an economy because R&D is vital for the growth and development of any society [28].

What AI can do for Uganda's Education System

AI can make the learning process much more interesting and interactive for students. Learning applications are really attractive and engaging and would emphasize the understanding of concepts through meaningful and active learning techniques. This is in contrast to rote learning- the currently predominant style of learning in Uganda³.

Learning programs and applications designed by teachers can be made possible through AI technology. This would make the teaching experience easier for teachers. They may be able to teach more students through the content they create. This way, AI has the potential to make the studying experience for each student more personalized. Because some children understand things faster than others and because children have varying interests, AI-powered study tools can enable each student to enjoy their learning experience growing better and better in the knowledge of their interests. For example, for students with dyslexia, an AI-powered tool called Immersive Learning helps pupils gain confidence in reading [29].

The software makes it possible for the teacher to design their learners' content which is vital because then the teacher can guide the learning direction of the students. These lessons can even be designed to suit learners' needs and learning styles-this is especially important for students with learning/physical disability. Teachers can use AI to design and prepare lessons, prepare tests, and monitor the progress, concentration, interests, and performance of their students. AI also helps teachers with grading tests and exams done either physically (offline) and online.

As opposed to being a threat to educators and teachers, AI is harnessed only to aid teachers with their tasks making their work easier and more efficient [13], [16], [30]. AI is in no way able to replace teachers in the classroom, as an all-round education of the human goes beyond academic knowledge. A wholesome education experience also targets to nourish the human intelligence of the students. Human intelligence mainly involves reasoning capacity, problem-solving, and learning [31]. These abilities, as well as others like social intelligence, are best taught by human teachers. Even within the lesson delivery by AI, e.g. through applications, teachers have to be present to clarify, explain concepts' and guide the learning process of the students [7].

There is a global shortage of 68.8 million teachers as of 2016 if the world is to achieve the SDG4 by 2030 [32], a problem that AI can facilitate in solving. AI can help the current teachers close that gap by enabling the effective teaching of more students. This would give more evidence to 'ephemeralization' [33]. This is a term coined by Buckminster Fuller, a futurist and theorist, meaning the ability to do more and more with less and less until one can do everything with nothing because of technological advancement. This is something we already see happening in our societies.

³ Rote learning techniques involve memorization of learning material based on repetition

The future of education

Concerning education, teaching with smart-solutions may face more and more technological enhancement, with innovations coming up every year. AI is already moving from computer boxes to taking robot shapes. Several trials of different aspects and forms of AI are being carried out around the world. In the majority of cases, AI has been shown to improve the learning outcomes of the students [7], [34]. In some cases, however, AI was not as successfully used. Teachers found that the gadgets students were using got increasingly distracting to the students' attention [35]. This means as much as AI has benefits to the teaching system, each teacher must find out what works for them and their students depending on the age. AI should be used as a tool to aid and enhance, it should not by any means take over the classroom or the teaching.

Current and Anticipated Challenges

The mere thought of AI seems to raise many contradictory reactions among people. Many still see AI as an abstract concept that is a threat to the human race. The scanty research available does not make this matter any easier. The thin body of research of the AI use in education in Uganda indicates that AI is in several places still under trial. Although several pilot studies have come to a conclusion, there is still so much to be done. The following are some challenges Uganda is already facing and may continue to face during the implementation of AI in the education system.

Low access of the necessary devices: Ugandans still have low coverage of devices like smartphones, computers, and laptops. The 2017/2018 National IT Survey shows that only 10.8% of households had a household telephone and only 5.9% of households had access to a computer at home[20]. These statistics portray the grim reality of device coverage in Uganda. This is by far, the biggest challenge in Uganda. It is important to note, though, that the device coverage shown in these statistics represents mainly adults. Children below the age of 18 years generally expectedly have a very low device coverage. Then IHE students expectedly have the largest device coverage in the students' category.

Ethical concerns: The very thought of AI usually leaves unsettled feelings among potential users and benefactors. Already we live in a world in which the combination of technology and the internet leave us with little privacy. The constant gathering of data by cookies on the internet is already something that powerful tools like Google use to predict what information and advertisements are brought our way every time we go online [36]. Users are constantly willingly or begrudgingly uploading their personal information online. It is no wonder that the thought of even more data gathering is very unsettling. Users are constantly worried about the capabilities of AI to be very intrusive. More so, very powerful users would be able to use personal data wrongfully for crime, blackmail, and many other things that breach personal privacy. In this regard, powerful data privacy protection regulations are paramount [37].

High costs of internet: Because the notion of 'high costs' is relative, the solution to this challenge could go two ways: Firstly, an overall improved standard of living could mean that the people

everywhere would be able to afford the current internet costs. This condition, however, may require a much longer time to achieve. Secondly, reducing the current internet costs to make internet use within the reach of the poor in Uganda. This is a solution that could be within easier.

Requirements for the Establishment of AI in the Uganda Education System

The requirements stated below are by no means comprehensive. Embarking on this journey will provide firsthand insights about the requirements for the establishment of AI in Ugandan schools. However, below are some of the preliminary requirements for a good head-start:

The role of good governance cannot be overstated in matters concerning development. **Good and progressive leaders and a conducive political climate** are the pillars by which societies are built. And the development of human capital is one very key area for the development of a society. Good leaders would provide the necessary foundation for the transformation of Uganda's educational scape.

The **installation of the required technological infrastructure** is the most expensive aspect of AI integration in education. Installing the basic infrastructure and having enough of the right devices for students and teachers to use.

Training of teachers on how to operate the infrastructure necessary to integrate Artificial Intelligence in everyday learning. Teachers need to learn how to design classes and monitor their students' performance.

A very vital aspect of preparation is putting is **pilot testing** to understand what AI tools are best applicable for education in the Ugandan setting. As many tools as possible can be tried and tested until those most suitable to the tasks of improving learning outcomes, increasing teaching efficiency, and reaching as many people as possible can be taken on.

Regulations are very important because they define the much-needed boundaries about which AI can be safely used in our study environments. The use of data must be well controlled and data must be protected to ascertain the safety of users' privacy [37].

Policy Recommendations

Some of the policy recommendations given below are already underway because the NCDC has taken steps to embrace EdTech in Uganda. This suggests that the MoES would be open to suggestions especially now that COVID-19 has thrust the MoES into reorganizing and planning for the education system in Uganda. This, hereby, presents an opportunity to make changes that will strengthen Ugandan schools by leaps and bounds. The following are some policy recommendations in this vein:

Research and Development

Because there is a huge gap in research on the use of AI in Uganda, pilot studies should be done first to test which AI tools are most appropriate and effective in improving the learning outcomes. This will inform policymakers on the best direction to take in the implementation of AI in Uganda's education system. Some pilot tests are still running but more and more research is needed in this area.

Bringing Public-Private-Partnerships on Board

Public-Private Partnerships (PPPs) should be welcomed to run trials and handle the implementation of AI in schools as it is expensive and technology-intensive. PPPs are organizations led and run collaboratively between the Government and private investors⁴. It is vital that these implementing organs be PPPs because government regulation and involvement is vital. This will ensure that no propaganda contrary to the Government's policies and education framework is implemented. The private aspect is vital because it would make it possible to bypass the Government's bureaucracy and ensure more efficiency in implementation. The private investors would also have sufficient resources to install the necessary infrastructure and run the necessary programs. They would also be able to furnish classrooms with the necessary devices, a feat that would require lots of financial resources.

Putting the necessary Laws and Regulations in place

Uganda currently has the Data Protection and Privacy Act, 2019, which seeks to regulate the collection and use of personal data in Uganda. This is a strong signal showing that Uganda is aware of and has taken steps to mitigate the risks that come with data collection, its storage, and its control. Laws and regulations regarding all the ethical concerns that would arise as a result of AI in daily life and education should be passed to secure the data privacy protection of users. This is a vital aspect of the process. Effort should be made to ensure flexibility in the adjustment of these regulations to suit users' needs and to continue managing AI in an effective way given that innovations in the technological world are fast changing and some potential challenges may not be foreseen.

Creating a Framework for the use of AI

The MoES, schools, and educators would do well to embrace the use of AI, the aspects of it that would serve the greater vision of Uganda's education system. The MoES has already shown how progressive it is by designing software and putting up an e-learning platform on the NCDC website.

⁴ There are several different arrangements that a PPP could take with either the Government or private investors taking the upper hand in the partnership.

The use of these tools, however, needs to be greatly up-scaled. The MoES should design a framework for the use of AI in schools. This would allow for the use of AI in schools in ways that preserve Uganda's sociocultural norms and moral fabric. Uganda, being a culturally conservative society, would enjoy using the aspects of AI that would enrich, and not diminish, the cultural values in Ugandan societies. It would be the responsibility of the MoES to draft the guidelines necessary for the implementation of AI.

Training Teachers on how to use AI

With the MoES guidelines in place, teachers would have to be trained in how to use AI technology to design lessons, applications, tests and anything else for which they would need to use AI. The uses of AI can and should be customized to meet teachers' and learner's needs.

Training Specialists

Higher education institutions should commence with the training of AI specialists who would develop, manage and run the AI infrastructure and participate in the research and development necessary to cultivate creativity and innovation in the AI sector. Uganda has an established Information Technology (IT) sector. This is a good foundation for the training of AI specialists.

Provision of Internet Subsidies

Although the cost of internet in Uganda has dropped considerably since the early 2000s, it remains high-too high for the poor. This probably because the internet users need to grow further before the costs can be reduced [38].

A solution to this could be in offering subsidized internet bundles to students for study purposes. The GoU could partner with internet service providers to provide very affordable internet bundles to students. This is vital not only for the use of AI in education but also for access to other learning aids like videos.

Furthermore, it is possible to design learning applications that do not need internet to run. Such applications would greatly reduce the need for internet, making the use of AI more sustainable in the near future.

References

- [1] “FULL ADDRESS: MoE Janet Museveni Lays Out Education Plan For Schools After Lockdown - No End Of Term One Exams, Online Examinations Stopped, Holidays Will Be Shorter.... - Grapevine News.” [Online]. Available: <https://www.thegrapevine.co.ug/full-address-moe-janet-museveni-lays-out-education-plan-for-schools-after-lockdown-no-end-of-term-one-exams-online-examinations-stopped-holidays-will-be-shorter/>. [Accessed: 23-Jun-2020].
- [2] “Home Schooling Materials | National Curriculum Development Centre.” [Online]. Available: <http://ncdc.go.ug/content/home-schooling-materials>. [Accessed: 13-Jul-2020].
- [3] Ministry of Education and Sports Uganda, “Framework for Provision of Continued Learning During the COVID-19 Lockdown in Uganda,” p. 55, 2020.
- [4] “Radio Teaching Is Uganda’s New Covid 19 Gem.” [Online]. Available: <https://www.newvision.co.ug/news/1521446/radio-teaching-uganda-covid-19-gem>. [Accessed: 13-Jul-2020].
- [5] “Uganda National Media play a stronger role in education during COVID-19 | International Bureau of Education.” [Online]. Available: <http://www.ibe.unesco.org/en/news/uganda-national-media-play-stronger-role-education-during-covid-19>. [Accessed: 13-Jul-2020].
- [6] D. McArthur, M. Lewis, and M. Bishary, “The roles of artificial intelligence in education: current progress and future prospects,” *J. Educ. Technol.*, vol. 1, no. 4, pp. 42–80, 2005.
- [7] UNESCO, “Artificial intelligence in education: challenges and opportunities for sustainable development,” *Work. Pap. Educ. policy*, 7, p. 46, 2019.
- [8] “Appadurai’s 5 Scapes of Globalization Explained (2020).” [Online]. Available: <https://helpfulprofessor.com/appadurai-scapes/>. [Accessed: 07-Aug-2020].
- [9] U. Ambrosius, “Roskilde,” 2006.
- [10] “artificial intelligence | Definition, Examples, and Applications | Britannica.” [Online]. Available: <https://www.britannica.com/technology/artificial-intelligence>. [Accessed: 13-Jul-2020].
- [11] “The Question with AI Isn’t Whether We’ll Lose Our Jobs — It’s How Much We’ll Get Paid.” [Online]. Available: <https://hbr.org/2018/01/the-question-with-ai-isnt-whether-well-lose-our-jobs-its-how-much-well-get-paid>. [Accessed: 10-Aug-2020].
- [12] “The Fourth Industrial Revolution: what it means and how to respond | World Economic Forum.” [Online]. Available: <https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/>. [Accessed: 13-Jul-2020].
- [13] “The challenges and opportunities of Artificial Intelligence in education.” [Online]. Available: <https://en.unesco.org/news/challenges-and-opportunities-artificial-intelligence-education>. [Accessed: 07-Jul-2020].
- [14] “Big Data: What it is and why it matters | SAS.” [Online]. Available: https://www.sas.com/en_us/insights/big-data/what-is-big-data.html. [Accessed: 10-Aug-2020].

- [15] M. J. Baker, “The roles of models in Artificial Intelligence and Education research: a prospective view,” 2000.
- [16] PwC, “Will robots really steal our jobs ? An international analysis of the potential long term impact of automation,” 2018.
- [17] “What is Singularity (the)? - Definition from WhatIs.com.” [Online]. Available: <https://searchenterpriseai.techtarget.com/definition/Singularity-the>. [Accessed: 10-Aug-2020].
- [18] “The real risks of artificial intelligence - BBC Future.” [Online]. Available: <https://www.bbc.com/future/article/20161110-the-real-risks-of-artificial-intelligence>. [Accessed: 07-Aug-2020].
- [19] “AI Open Letter - Future of Life Institute.” [Online]. Available: <https://futureoflife.org/ai-open-letter/?cn-reloaded=1>. [Accessed: 10-Aug-2020].
- [20] NITA, “National Information Technology Council,” *Natl. Inf. Technol. Surv.* 2017/18, no. March, pp. 1–151, 2017.
- [21] “The Institute for Ethical AI in Education | University of Buckingham.” [Online]. Available: <https://www.buckingham.ac.uk/research-the-institute-for-ethical-ai-in-education/>. [Accessed: 07-Jul-2020].
- [22] “EMIS - Ministry of Education And Sports.” [Online]. Available: <http://www.education.go.ug/emis/>. [Accessed: 14-Jul-2020].
- [23] “NCDC develops digital learning platform for schools – SautiTech.” [Online]. Available: <https://www.sautitech.com/digital/ncdc-develops-digital-learning-platform-for-schools/>. [Accessed: 04-Aug-2020].
- [24] “SkoolDesk - Blue Node Media | Digital Innovation.” [Online]. Available: <https://bluenodemedia.com/skooldesk/>. [Accessed: 09-Jul-2020].
- [25] “Checheza - Educational app.” [Online]. Available: <http://www.checheza.com/>. [Accessed: 04-Aug-2020].
- [26] I. Roll and R. Wylie, “Evolution and revolution in artificial intelligence in education,” *Int. J. Artif. Intell. Educ.*, vol. 26, no. 2, pp. 582–599, 2016.
- [27] A. . Fallis, *Unesco Ict Competency Framework for Teachers*, vol. 53, no. 9. 2013.
- [28] “How important is R&D for economic growth? - Research & Development World.” [Online]. Available: <https://www.rdworldonline.com/how-important-is-rd-for-economic-growth/>. [Accessed: 14-Jul-2020].
- [29] “Everything You Need To Know About Immersive Learning.” [Online]. Available: <https://elearningindustry.com/everything-need-know-about-immersive-learning>. [Accessed: 10-Aug-2020].
- [30] E. T. Team and E. W. Group, “Mapping EdTech in Uganda,” 2019.
- [31] R. Colom, S. Karama, R. E. Jung, and R. Haier, “Human intelligence and brain networks,” no. December, 2010.

- [32] UNESCO, “The world needs almost 69 million new teachers to reach the 2030 education goals,” *UNESCO Inst. Stat.*, no. 39, pp. 1–16, 2016.
- [33] “Ephemerization - Wikipedia.” [Online]. Available: <https://en.wikipedia.org/wiki/Ephemerization>. [Accessed: 07-Jul-2020].
- [34] “Africa: AI Could Be the Boost Education in Africa Needs - allAfrica.com.” [Online]. Available: <https://allafrica.com/stories/201912021010.html>. [Accessed: 07-Aug-2020].
- [35] “Is Screen Time at School Bad for Kids? - The Atlantic.” [Online]. Available: <https://www.theatlantic.com/education/archive/2018/11/screen-time-backlash/567934/>. [Accessed: 27-Jul-2020].
- [36] “What Is Data Privacy and Why Is it Important?” [Online]. Available: <https://www.lifelock.com/learn-identity-theft-resources-what-is-data-privacy-and-why-is-it-important.html>. [Accessed: 27-Jul-2020].
- [37] The Republic of Uganda, “The data protection and privacy act, 2019,” p. ACT Supplements No. 9, Vol. CXXI No. 21, 2019.
- [38] “42% Of Uganda’s Population Now Connected To Internet.” [Online]. Available: <https://www.newvision.co.ug/news/1517233/-uganda-population-connected-internet>. [Accessed: 04-Aug-2020].

Photo Credits: Can’t Wait to Learn, Yolk Studio, SautiTech