Digital Innovations & Contemporary Research in SCIENCE, ENGINEERING & TECHNOLOGY
Vol. 11. No. 1, 2023

Article Citation Format
Omorogiuwa O., Ohiagu K & Lawal K. H. (2023):
Towards The Review of Artificial Intelligence Programme Curricullum
and Effective Collaborations Among Academia for AI Programme Development in
Africa.. Journal of Digital Innovations & Contemporary Research in Science,
Engineering & Technology.
Vol. 11, No. 1. Pp 1-16
DOI: dx.doi.org/10.22624/AIMS/DIGITAL/V11N1P1x

Article Progress Time Stamps

Article Type: Research Article
Manuscript Received:15th Dec, 2022
Review Type: Blind Peer
Final Acceptance: 9th February, 2023

Towards The Review of Artificial Intelligence Programme Curriculum and Effective Collaborations Among Academia for AI Programme Development in Africa

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ABSTRACT

Artificial Intelligence (AI) is an area of Computer Science that emphasizes the creation of intelligent systems that work, reasons and react like humans. In recent times information and computing solutions are leveraged on the concept of Artificial Intelligence with regard to Artificial Neural Network, Machine Learning, Fuzzy logic, Deep learning and Robotic Science. Applications of AI solutions have being highly effective in all sectors of human endeavors. During the Covid 19 pandemic, AI applications resulted in the rapid development and implementation of solutions which ordinarily would have taken years to achieve especially in the area of vaccine. Despite the gains of AI, we realized that less emphasis is placed in this trending area of computer science by the educational systems in Africa especially at university level. This research seeks to demand for an urgent need for a review of our educational curriculum to include AI and other trending disciplines in the frontiers of Information Technology. A multidisciplinary cloud based research model was also formulated which can be adopted in our educational system to foster multidisciplinary research. This will improve quality and efficient research outputs from universities in Africa.

Keywords: Artificial Intelligence, Machine learning, academic-collaboration-models, Curriculum Review, AI Applications

1. INTRODUCTION

Artificial Intelligence (AI) is a branch of Computer Science that aims to create intelligent machines. It has become an essential part of the technology industry. research associated with Artificial Intelligence is highly technical and specialized. The core problems of Artificial Intelligence include programming computers for certain traits such as: knowledge, reasoning, problem solving, perception, learning, planning, and ability to manipulate and move objects.

The basic elements that a system can possess to qualify it as an intelligent system are reasoning, communication and learning (see Fig. 1). Reasoning is the ability of a machine to apply knowledge based on contextual information in making decisions which could be fuzzy, but the results can be dependable. Communication is the ability of the computing system to be able to express itself using natural languages that can be understandable and dependable. Learning is the ability of a computing system to be able to improve on its existing knowledge-base from new contextual information. It can also be seen as the situation whereby the system becomes autonomous and continuously improve on itself based on contextual information. A computer system that has the ability to reason, communicate and learn just like humans can be regarded as Artificial Intelligence (AI).

Fig. 1: Basic Elements of Artificial Intelligent Systems

Artificial Intelligence consists basically of Fuzzy Logic, Deep Learning, Artificial Neural Network, Expert Systems and Machine Learning as depicted in Fig. 2. Machines can often act and react like humans only if they have abundant information relating to the world. Artificial Intelligence must have access to objects, categories, properties and relations between all of them to implement knowledge engineering. Initiating common sense, reasoning and problem-solving power in machines is a difficult and tedious approach.

Machine learning is another core part of AI. Learning without any kind of supervision requires an ability to identify patterns in streams of inputs, whereas learning with adequate supervision involves classification and numerical regressions. Classification determines the category an object belongs to and regression deals with obtaining a set of numerical input or output examples, thereby discovering functions enabling the generation of suitable outputs from respective inputs. Mathematical analysis of machine learning algorithms and their performance is a well-defined branch of theoretical computer science often referred to as computational learning theory. Machine perception deals with the capability to use sensory inputs to deduce the different aspects of the world, while computer vision is the power to analyze visual inputs with a few sub- problems such as facial, object and gesture recognition. Robotics is also a major field related to AI. Robots require intelligence to handle tasks such as object manipulation and navigation, along with sub-problems of localization, motion planning and mapping.

Deep Learning (DL) or more commonly known as deep structured learning or hierarchical learning is a division of Machine Learning (ML) which is based on a set of algorithms that attempt to model high-level abstractions in data, [1]. Such algorithms develop a layered, hierarchical architecture of learning and representing data. This hierarchical learning architecture is inspired by artificial intelligence emulating the deep, layered learning process of the primary sensorial areas of the neocortex in human brain, which automatically extracts features and abstractions from underlying data [2] and [3].

DL algorithms are useful when it comes to dealing with large amounts of unsupervised data and naturally learn data representations in a greedy layer-wise method. In recent years, a number of researchers have applied DL algorithms to various different fields. Machine learning came directly from minds of the early Artificial Intelligence, and the algorithmic approaches over the years included decision tree learning, inductive logic programming. Clustering, reinforcement learning, and Bayesian networks among others. As we know, none achieved the ultimate goal of Artificial Intelligence, and even Narrow AI was mostly out of reach with early machine learning approaches. One of the very best application areas for machine learning for many years was computer vision, though it still required a great deal of hand-coding to get the job done. People would go in and write hand-coded classifiers like edge detection filters so the program could identify where an object started and stopped; shape detection to determine if it had eight sides; a classifier to recognize the letters "S-T-O-P." From all those hand-coded classifiers they would develop algorithms to make sense of the image and "learn" to determine whether it was a stop sign.

Fuzzy logic is an extension of Boolean logic by Lotfi Zadeh in 1965 based on the mathematical theory of fuzzy sets, which is a generalization of the classical set theory. By introducing the notion of degree in the verification of a condition, thus enabling a condition to be in a state other than true or false, fuzzy logic provides a very valuable flexibility for reasoning, which makes it possible to take into account inaccuracies and uncertainties. One advantage of fuzzy logic in order to formalize human reasoning is that the rules are set in natural language. Fuzzy logic is a method of reasoning that resembles human reasoning. It is a form of many-valued logic in which the truth value of variables may be any real number between 0 and 1 both inclusive. It is employed to handle the concept of partial truth, where the truth value may range between completely true and completely false.

Artificial Neural Networks (ANN), usually called Neural Networks, is computing systems vaguely inspired by the biological neural networks that constitute animal brains. An ANN is based on a collection of connected units or nodes called artificial neurons, which loosely model the neurons in a biological brain.

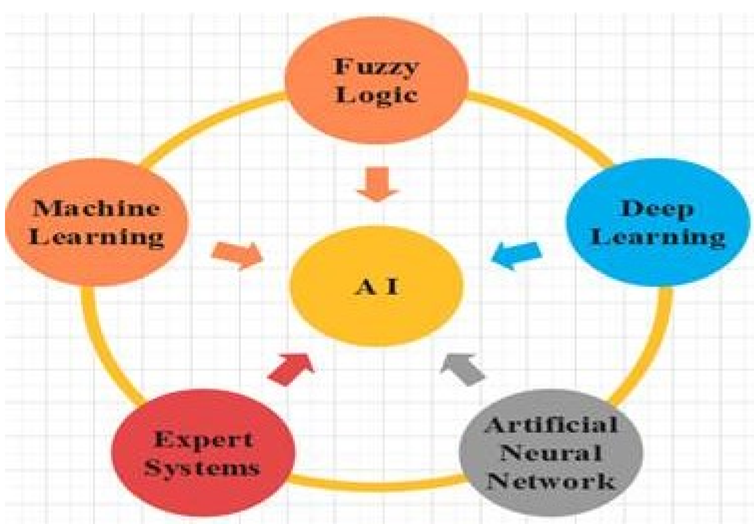

Fig. 2: Branches of Artificial Intelligence

The term "Artificial Neural Network" is derived from Biological neural networks that develop the structure of a human brain. Similar to the human brain that has neurons interconnected to one another; artificial neural networks also have neurons that are interconnected to one another in various layers of the networks. These neurons are known as nodes. An Artificial Neural Network in the field of Artificial intelligence where it attempts to mimic the network of neurons makes up a human brain so that computers will have an option to understand things and make decisions in a human-like manner. The artificial neural network is designed by programming computers to behave simply like interconnected brain cells. There are around 1000 billion neurons in the human brain. Each neuron has an association point somewhere in the range of 1,000 and 100,000. In the human brain, data is stored in such a manner as to be distributed, and we can extract more than one piece of this data when necessary from our memory parallelly. We can say that the human brain is made up of incredibly amazing parallel processors.

1.1 Some Applications of Artificial Intelligence

Automatic Speech Recognition (ASR)

According to [4], Google announced that Google voice search had taken a new turn by adopting Deep Neural Networks (DNN) as the core technology used to model the sounds of a language in 2012. DNN replaced Gaussian Mixture Model which has been in the industry for 30 years. DNN also has proved that it is better able to measure which sound a user is fabricating at every instant in time and with this they delivered prominently increased speech recognition accuracy. In 2019, DL has gained full momentum in both ASR and ML. DL is basically linked to the use of multiple layers of nonlinear transformations to derive speech features, while learning with shallow layers comprises the use of exemplar-based representations for speech features which have high dimensionality but typically vacant entries.

Image Recognition

Deep max-pooling convolutional neural networks are used to detect mitosis in breast histology images as presented in [5]. Mitosis detection is very hard. In fact, mitosis is a complex process during which a cell nucleus undergoes various transformations. In this approach, DNN was used as powerful pixel classifier which operates on raw pixel values and no human input was needed. The DNN automatically learns a set of visual features from the training data. DNN is tested on a publicly available dataset and significantly outperforms all competing techniques, with manageable computational effort: processing a 4MPixel image requires few minutes on a standard laptop. Large and deep convolutional neural network is trained to classify the 1.2 million high resolution images in the ImageNet LSVRC-2010 contest into 1000 different classes [6].

Drug Discovery and Toxicology

Quantitative Structure Analysis/Prediction Studies (QSAR/QSPR) attempt to build mathematical models relating physical and chemical properties of compounds to their chemical structure. In [8] multi-task learning is applied to QSAR using various neural network models. They used an artificial neural network to learn a function that predicts activities of compounds for multiple assays at the same time. The method is compared with alternative methods and reported that the neural nets with multi-tasking can lead to significantly improved results over baselines generated with random forests. AtomNet has been introduced as first structure-based, deep convolutional neural network which was designed to predict the bioactivity of small molecules for drug discovery applications [9].

Natural Language Processing

Deep Learning methods have been successfully applied to a variety of language and information retrieval applications. By exploiting deep architectures, deep learning techniques are able to discover from training data the hidden structures and features at different levels of abstractions useful for any tasks. [7] proposed a series of Deep Structured Semantic Models (DSSM) for Web search. More specifically, they use a DNN to rank a set of documents for a given query as follows. First, a non-linear projection is performed to map the query and the documents to a common semantic space. Then, the relevance of each document given the query is calculated as the cosine similarity between their vectors in that semantic space. The neural network models are discriminatively trained using the click-through data such that the conditional likelihood of the clicked document given the query is maximized. The new models are evaluated on a Web document ranking task using a real-world data set.

Customer Relationship Management

A framework for autonomous control of a customer relationship management system been charted by [10]. First, a modified version of the widely accepted Recency-Frequency-Monetary Value system of metrics can be used to define the state space of clients or donors was explored. Second, a procedure to determine the optimal direct marketing action in discrete and continuous action space for the given individual, based on his position in the state space was described. The procedure involved the use of model-free Q-learning to train a deep neural network that relates a client's position in the state space to rewards associated with possible marketing activities. The estimated value function over the client state space can be interpreted as Customer Lifetime Value (CLV), and thus allows for a quick plug-in estimation of CLV for a given client.

Applications of Artificial Intelligence in Education

Gone are the days we used to line up inside the vicinity of the school library to get to photocopy a couple of Encyclopedia pages, to use as a reference for our school projects. With this generation having grown up with the privilege of having access to technology at their fingertips, the arena of education has massively revolutionized and overturned in this digitally driven world. Basically, all you need now is an Internet connection and access to online resources. Chalkboards have been replaced by Interactive whiteboards. In the times of the COVID19 crisis, quarantined to your home and not able to physically attend classes, online classes and tutorials became a medium for effective academic delivery. One such technology that has gradually paved its way inside the world of education is Artificial Intelligence.

While the Academic sector is still assumed to be a largely human sector, yet that does not really reduce the involvement of AI in this sphere. There are still multitudes of ways that teachers and educational staff can gain from employing this technology. Slowly yet consistently seeping into this sphere, AI has gradually begun making its place in the academic sphere, making it more accessible and personalized. The technology has overturned the world of learning as educational materials become more accessible to all with the use of smart devices and computers while also automating all complicated administrative tasks, allowing faculties to invest more time in focusing on their students.

According to [11], Artificial Intelligence is being employed for personalizing learning for each student. With the employment of the hyper-personalization concept which is enabled through Machine Learning, the AI technology is incorporated to design a customized learning profile for each individual student and to tailor-make their training materials, taking into consideration the mode of learning preferred by the student, the student's ability and experience on an individual basis.

Teachers can break down their lessons into smaller study guides, smart notes or flashcards in order to help the student in comprehending. With AI assisting in generating digital content, learning is proposed to become more digital and less reliant on papers and hard copies.

Various AI-powered apps and systems help the students in accessing instant and customized responses as well as in getting their doubts cleared from their teachers. AI is also playing a role in augmenting tutoring and designing personal conversational, education assistants who can offer them aid in education or assignment tasks. For instance smart tutoring systems such as Carnegie Learning offers instant feedback and works directly with students. These education assistants are also attempting to improve their feature of adaptive learning so that all the students are allowed to learn at their own pace and at their own suitable time.

Yet another AI component being fruitfully employed by educators in learning is voice assistants. These include Amazon's Alexa, Apple Siri, Microsoft Cortana, etc. These voice assistants allow the students to converse with educational materials without the involvement of the teacher. They can be employed in home and non-educational environments for facilitating interaction with educational material or to access any extra learning assistance.

Traditional methods of learning are slowly being discarded in the case of higher education environments, with various universities and colleges offering students voice assistants rather than the traditionally printed student handbooks or complicated websites for assistance with their campus-related informational needs. The aim behind these voice assistants is to supply answers for all common questions regarding campus needs as well as for it to be customized for the particular schedule and courses of each student. This helps in reducing the requirement for internal support as well as cuts down the expense of printing college handbooks which are only temporarily used. The employment of these voice assistant systems breaks the monotony and fetches an exciting prospect for the students. The employment of this technology is expected to escalate in the coming years.

Teachers don't just battle the work of education-oriented duties but are also handed the responsibility of handling the classroom environment and dealing with a variety of organizational tasks. They are handed a variety of non-teaching duties which include evaluation of essays, exam papers grading, dealing with the necessary paperwork, handling HR and personnel-related issues, arranging and managing classroom materials, handling the duties relating to booking and managing of field trips, interacting and responding with parents, aiding with interaction and issues relating to the second language, keeping track of sick or absentees, as well as providing a learning environment.

Since half the time of the educators is invested in non-educational activities, AI systems have been a crucial aid at dealing with back-office and task-related duties such as grading tasks as well as facilitating personalized responses for students. Alongside they can also deal with the routine and monotonous paperwork, matters related to logistics as well as personnel issues. These AI systems can also arrange personal interactions with guardians and parents facilitate feedback relating to routine issues as well as resource access thus offering more time to teachers to invest in students. **A**longside educators, the administrations have also been enjoying the AI benefits by employing intelligent assistants to aid in various complicated admin tasks such as budgeting, arranging student applications and enrollments, managing courses, HR-related topics, expenses as well as facilities.

The AI-powered systems add to the efficiency of educational institutes, reducing their operating costs and offer, and facilities management. Using intelligent AI-powered systems can greatly improve the efficiency of many educational institutions, lower their operating costs, give them greater visibility into income and expenses, and improve the overall responsiveness of the educational institutions. In the case of higher education, AI-powered systems are being used to reduce human bias during the process of admission and enhance the credibility of the process since these systems use given specific criteria to select applications in admissions. Hence these systems have helped enhance oversight in the process of admissions.

Artificial intelligence tools and devices have been aiding in making global classrooms accessible to all irrespective of their language or disabilities. These programs are all-inclusive. For instance Presentation Translator is a free PowerPoint plug-in that develops subtitles in real-time of what the teacher is saying. This also helps aid the sick absentees as well as students requiring a different pace or level when it comes to learning or even in case they wish to understand a particular subject that is unavailable in their own school. Barriers are being torn down like never before.

Recommender Systems

Automatic music recommendation has become an increasingly relevant problem in recent years, since a lot of music is now sold and consumed digitally. Most recommender systems rely on collaborative filtering. [12], proposed to use a latent factor model for recommendation, and predict the latent factors from music audio when they cannot be obtained from usage data. Traditional approach is compared using a bag-of-words representation of the audio signals with deep convolutional neural networks, and the prediction is evaluated quantitatively and qualitatively on the Million Song Dataset. The result shows that the recent advances in DL translate very well to the music recommendation setting, with deep convolutional neural networks significantly outperforming the traditional approach. Recent online services rely heavily on automatic personalization to recommend relevant content to a large number of users. This requires systems to scale promptly to accommodate the stream of new users visiting the online services for the first time.

Some researchers [13], proposed a content-based recommendation system to address both the recommendation quality and the system scalability. They also proposed to use a rich feature set to represent users, according to their web browsing history and search queries. They use a DL approach to map users and items to a latent space where the similarity between users and their preferred items is maximized. Scalability analysis shows that the multi-view DNN model can easily scale to encompass millions of users and billions of item entries.

Bioinformatics

The annotation of genomic information is a major challenge in biology and bioinformatics. Existing databases of known gene functions are incomplete and prone to errors, and the bimolecular experiments needed to improve these databases are slow and costly. While computational methods are not a substitute for experimental verification, they can help in two ways: algorithms can aid in the curation of gene annotations by automatically suggesting inaccuracies, and they can predict previously-unidentified gene functions, accelerating the rate of gene function discovery. In [14], an algorithm that achieves both goals using deep auto encoder neural networks was developed. With experiments on gene annotation data from the Gene Ontology project, it shows that deep auto encoder networks achieve better performance than other standard machine learning methods, including the popular truncated singular value decomposition.

In recent times, Artificial Intelligence (AI) has increased the chances of physicians with little or no statistically experience to apply the benefits of Artificial Intelligence-based diagnostic approaches to enhance service improvements, by providing techniques that uncover complex associations which cannot be reduced to an equation. Artificial Intelligence (AI) approaches provide reasoning capability, which consists of inferences from facts and rules using heuristics, pattern matching or other search approaches and has contributed significantly to the evolution of biomedicine and medical informatics. Recent areas of development in AI in relationship to medical diagnostics which are the leading methods with which physicians are assisted in this demanding task include the expert system, fuzzy logic, Artificial Neural Networks and neuro-fuzzy expert system.

Artificial Intelligence in Agriculture

AI is becoming pervasive very rapidly because of its robust applicability in the problems particularly that cannot be solved well by humans as well as traditional computing structures. Such an area of extreme importance is agriculture where about 30.7% of the world population is directly engaged on 2781 million hectares of agricultural land. Such a venture is not so smooth running; it faces several challenges from sowing to harvest. The major issues are pest and disease infestation, inadequate application of chemicals, improper drainage and irrigation, weed control, yield prediction, etc. The application of computers in agriculture was first reported in 1983. Three major AI techniques; Expert Systems, Artificial Neural Networks and Fuzzy systems are considered as the focused areas. Different approaches have been suggested to solve the existing problems in the agriculture starting from the database to decision support systems. Out of these solutions, systems that apply AI have been found to be the most excellent performers as far as the accuracy and robustness are concerned.

Application of Artificial Intelligence in Combating Covid 19

Lots of research work is ongoing in the use of various AI tools in combating Covid 19. [15], spotted various areas AI can help to mitigate and manage Covid 19 pandemic. Firstly with big data available in various repositories, the application of AI will facilitate the research on this deadly virus. [16], stipulates AI as upcoming and useful tool to identify early infections due to coronavirus and also helps in monitoring the condition of the infected patients. The use of AI can track the crisis of Covid 19 at different scales such as medical, molecular and epidemiological applications. [17] stipulates that "AI can be harnessed for forecasting the spread of virus and developing early warning systems by extracting information from social media platforms, calls and news sites and provide useful information about the vulnerable regions and for prediction of morbidity and mortality". Unprecedented pace of efforts to address the COVID-19 pandemic situation is leveraged by big data and artificial intelligence (AI). Various offshoots of AI have been used in several disease outbreaks earlier. AI can play a vital role in the fight against COVID-19. AI is being successfully used in the identification of disease clusters, monitoring of cases, prediction of the future outbreaks, mortality risk, diagnosis of COVID-19, disease management by resource allocation, facilitating training, record maintenance and pattern recognition for studying the disease trend.

Never before has mankind witnessed such a race for the development of a vaccine against a pathogen. The pace of the discovery can be accelerated manifold by harnessing the power of AI. [18], predicted possible vaccine candidates for COVID-19 using the Vaxign reverse vaccinology-machine learning platform that relied on supervised classification models. [19] devised a method for fast and accurate classification of available SARS-CoV-2 genomes by applying machine learning on identified genomic signatures. [20], used ontology-based side effect prediction framework and Artificial Neural Network to evaluate the side effects of Traditional Chinese Medicines for the treatment of SARS-CoV-2.

3. THE NEED TO INCLUDE ARTIFICIAL INTELLIGENCE COURSES IN THE EDUCATION CURRICULUMS IN AFRICA

As technology shapes our future and becomes more advanced, it's important that students understand the world of Artificial Intelligence from all strata in Nigeria educational system and Africa at large. Sadly, a quick investigation online shows that most African Universities need to give attention to the inclusion of AI in their curriculums. In Nigeria, we have forty three (43) Federal Universities, fifty two (52) State Universities and seventy-nine (79) Private Universities. Amongst these 173 Universities in Nigeria, not a single one offers Artificial Intelligence at undergraduate level with few offering Artificial Intelligence and Cyber Security at Masters Degree Levels. Other African countries also have such deficiencies in there approved Universities curriculum. For example, In South Africa with about twenty six (26) Public Universities, thirty five (35) private Universities, hardly will you find Artificial Intelligence at undergraduate level. Sparingly, about seven (7) Universities offer AI at Postgraduate level.

In Ghana, with about nine (9) National Universities, nine (9) additional professional instructions, none offers Artificial Intelligence at undergraduate level. In Kenya with thirty (30) public Universities, thirty (30) chartered private universities and thirty (30) universities with letter of Interim Authority, hardly will you find Artificial Intelligence as an undergraduate discipline. This is not so in other aspect of the world, presently about ninety eight (98) universities across Europe, North America, South America, Asia, Antarctica and Oceania offers undergraduate degree program in Artificial Intelligence.

There is the urgent need for African countries to begin to see the need to review their curriculum and include undergraduate disciplines like Artificial Intelligence, Cloud Computing, Cyber Security, Robotic Science etc which are trending and relevant to present day needs and challenges. In Nigeria; for example, the entire educational curriculum needs to be reviewed to include early courses in Artificial Intelligence, software development from primary, secondary and tertiary level. Teaching; Introduction to Computers and its applications courses at the primary and secondary level is not enough.

Every young Nigerian and African needs to be properly introduced to the concept of programming, Robotic Science and Artificial Intelligence at the early stages of their education. The inadequate inclusion of such subjects in our curriculum will greatly affect our state of preparedness towards meeting Information Technology problems in the nearest future. Artificial Intelligence which is presently playing a domineering role as a result of its applications across all spheres of life is missing as a standalone undergraduate discipline in African Universities.

Most countries in the world now have Artificial Intelligence and some programming languages included in their curriculum starting from primary through secondary level. It is generally believed that kids think smartly while they are young; exposing this kids to programming, software development, artificial intelligence and robotic science will not only help build the thinking ability of our children, but preparing them into the much evolving fields of information and computing technologies in African universities. As a matter of urgency, Ministries of education also needs to task their various education bodies to meaningfully include subjects that will include programming, Artificial Intelligence in their curriculum and put some caveat that will encourage students to participate in the subjects actively.

Cloud Collaboration in Academia

Due to the growth of virtual technology options, it is possible for colleagues to work remotely on academic projects in ways that were not possible in the past [21]. Such collaboration can facilitate improved knowledge and outcomes, assist in solving complex issues, encourage different ways of thinking, and stimulate novel solutions to problems [22] and [23]. Thus, collaboration can now occur virtually, facilitating working groups across geographical distances and different institutions. Such virtual collaborations allows researchers to work with others who may not otherwise have been able to form these collegial relationships. This opportunity brings together individuals with diverse strengths and experience [24], promoting innovation and creativity [25].

In online learning, collaboration utilizes instructional tools such as discussion boards, drop boxes, white boards, e-mails, and synchronous meetings [24], and virtual collegial collaboration can operate using similar tools. Educators can find many examples of such successful collaboration. Using web-based resources has supported successful research by medical students [26]; outside the classroom, faculty students have collaborated internationally using web-based platforms, facilitating an awareness of culture and global Information Technology issues [27]. Opportunities to work as departmentally based virtual teams is becoming more common in academia [28]. Despite the interest in such scholarly collaboration [29], working virtually creates potential challenges for managers/mentors. Virtual collaboration can lead to conflicts related to cultural, geographical, and time differences [29]. Fewer opportunities for in-person interactions may lead to inaccurate assumptions about team members, related to both functional (i.e., level of experience/expertise) and social (i.e., age, race, cultural differences) diversity. If not managed successfully, this can negatively affect trust and performance [30], [31].

In mentoring virtual departments, limitations of virtual teams require leaders dedicated to mentoring with creative strategies that support diplomacy, collaboration, goal obtainment, and performance [30]. To support the culture, buy-in, and performance of a virtual team, it is important that the mentor considers individual needs. Getting to know team members as individuals can be time-consuming [32], but is an important first step in creating a dynamic and successful team. This can be accomplished through numerous technology-based methods, but diversity of team member preferences may result in varying responses to each strategy. To optimize effectiveness of communication methods, these response differences should be managed by the mentor, as a means to facilitate productive mentee engagement. A second crucial capability for a mentor of virtual departmental teams is the effective and transparent communication of specific objectives and goals. Virtual teams can be employed to contribute a vast array of ideas that can support organizational goals [30]. Successful dissemination of ideas increases buy-in and supports performance outcomes [30], [32]. Mentors should be mindful that these ideas are of indispensable value to the organization. Additionally, mentors of virtual teams must be authentic.

Virtual collaboration can be an effective strategy in academia. Suitability of colleagues for remote collaboration is crucial, and characteristics of successful groups include the motivation to produce quality work, meet agreed-upon goals, and have commitment to the success of the project. In addition, all team members must feel empowered to provide honest, constructive feedback to each other, regardless of faculty rank, experience, publication/research background, or discipline. Peer accountability is essential, as is providing rapid response to communications. Implications for educators include understanding how to structure teams for successful virtual collaboration. It is also essential to be aware of the barriers to effective virtual team interactions, and implement strategies to support the process throughout the project life cycle.

In addition to utilizing this approach for academic scholarly endeavors, educators can also employ similar techniques when working on institutional initiatives with remote faculty. In an increasingly global academic world, using technology to bridge the physical gap of distance is important to promote the sharing of ideas, research, and improved outcomes. Virtual collaborations can easily be facilitated by individual academia belonging to academic communities in LinkedIn, the Academia, ResearchGate etc.

4. MODELING RESEARCH COLLABORATIONS IN ACADEMIA

The term "Research Collaboration" in academic is usually thought to mean partnership between two or more academic faculty members who are pursuing mutually interesting and beneficial research. During research collaboration, the following should be outlined.

- ✓ Discuss mutual expectations from the research
- ✓ Clearly state and establish who is responsible for each task
- ✓ Determine who should be the corresponding author
- ✓ Take minutes of meetings and then distribute to everyone in the research
- ✓ Everyone in the research team should have access to data/information
- ✓ Discuss the research expectations from the data/information even before the research begins.

Team members in a collaborative research team must be open minded, have a good communication skills, have a good organization skills, long term thinking, adaptability and able to discuss on research focus elaborately. Academic Collaborations could be individual, team, community, network and cloud forms. The benefits of research collaborations cannot be over-emphasized. Academic Collaboration leads to more innovation, efficient processes, increased success and improved communication. Through listening and learning from team members, you can help each other reach optimal goals. The present manner in which collaborations is done with regard to Information and Communication Technology in our Universities is quite worrisome and calls for re-modeling.

In Nigeria, for example, MTN Nigeria, Global com Nig, Airtel and others are the major players in IT services, however they have minimal collaboration with higher institutions in Nigeria and most investment made by these organizations have no direct linkage with the academia. Same goes for other IT firms in the country. Investment made by some of the tech giants are majorly in the training of youths in the acquisition of IT Skills but research innovations ongoing in some of our higher institution are getting no form of support. Other organizations currently supporting academia in IT research and development include World Bank, NITDA, ACETEL (Africa Center on Technology, Enhanced Learning. One major beneficiary of such support is the National Open University of Nigeria (NOUN).

Some public institutions have been able to attract industry collaboration but at a very minimal level because;

i. Most of the multinational companies get their technology from their source country and not really concerned about developing our own local technology. However, SME's are the country's prospect for basic technological implementation.
ii. The industrial managers of multinational companies' distrust academics whom they believe only want to experiment at their expense. They claim that the Nigerian universities do not have the required facilities.
iii. Lack of utilization of local raw materials and inappropriate government policies have resulted in making Nigerian industries to be import dependent.

iv. Academics claim that there are inadequate facilities, and where they exist such facilities are obsolete and inefficient to conduct or correlate research / curricula to suit the industrial needs of the country. It is evident to say that, most academics and industrialists are not dedicated to technology transfer or linkages. On the contrary, the driving force for academics is towards publishing basic research findings in journals which is necessary for their academic career. This characteristic behavior seems to be recycled year after year. The current state of technology transfer is basically a result of informal collaboration between individual lecturers or groups of lecturers and industry.

There is the ultimate need to model research collaborations in academia that will encourage industry - academic Collaborations in Africa. We represent two schematic diagrams using Venn diagrams to show the most frequent kind of collaborations currently in academia and the proposed schematic diagram to stimulate industry-academic collaborations in our Universities.

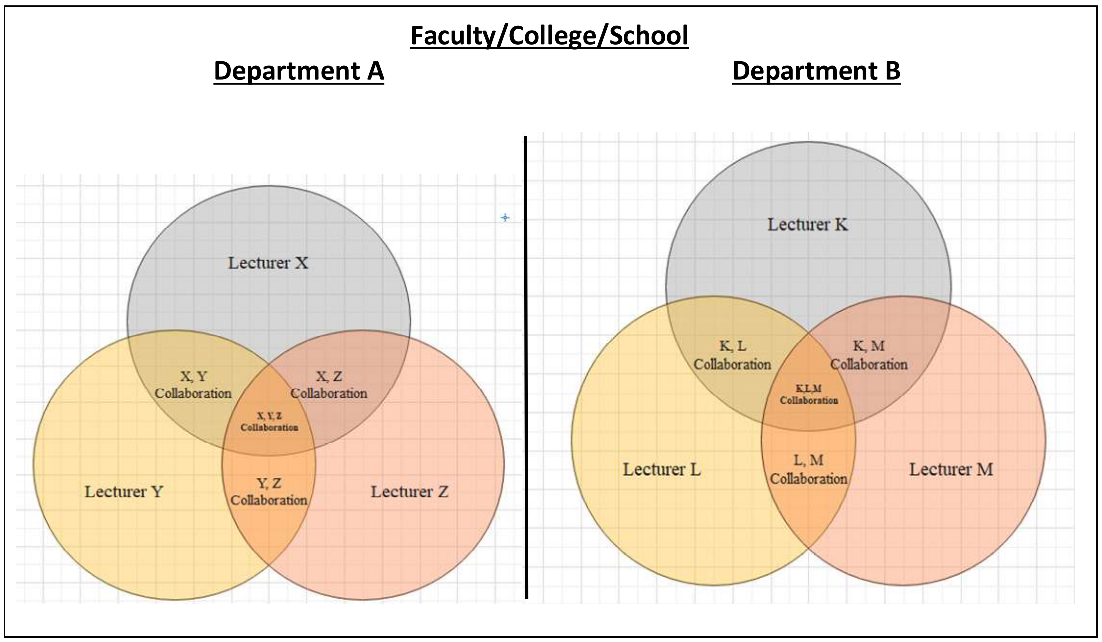

Fig. 3: A Schematic Model for Research Collaboration in Academia

Fig. 3 depicts the current collaborative efforts that are most prevalent in our Universities. Lecturers tend to only see the need to collaborate only among colleagues within their domain (i.e. their discipline). They often tend to localize their knowledge and limit only their research efforts within their domain. Present day solutions support multidisciplinary collaboration. This is not to play down on domain expertise, but to ensure that we actually concentrate on our domain knowledge while others do likewise in solving a particular defined problem. Let us take a hypothetical topic: ***Artificial Intelligence Based Covid 19 Mortality Rate Predictive Model in Nigeria.*** This topic will need collaboration for domain experts in College of Health Science, Life Sciences, and Physical Sciences etc. Sadly, the reverse is the case in our academic environment. Such a research topic may end up just having only co-authors from the Department of Computer Science. Although, the topic is relevant to modern day challenges, but such will not attract industry collaboration because it lacks domain experts' collaboration across disciplines from other Universities.

It's high time; we in academic and Africa begin to collaborate across disciplines and across borders by applying the concept of community, team and cloud collaborations while carrying out our research. It is only when we start doing that; industries can be attracted to our research findings and recommendations.

A Proposed Schematic Model to Support Industry-Academia Collaboration Among Domain Experts in Our Universities

Fig. 4 depicts the Schematic Model that supports industry academic collaboration in our Universities. It depicts multidisciplinary approach to research. It allows the various domain experts to contribute their domain knowledge in a particular defined problem. It helps to eradicate the local champion mentality as seen in Figure 1.0. If Universities in Africa most call for Industrial Academic collaboration, it most first begin to ensure multidisciplinary research; charity begins at home. If we continue to dwell on Fig. 3 model, we will only end up having theoretical and limited knowledge based research findings, which will ultimately not attract the industries. Although, identified factors that hinders collaboration range from perceptions of both the industry and academia, lack of confidence, poor or weak policies, limited financial capability among other things observed. The industrialist sees himself as an expert in his field and is not interested in attending academic conference. We are adding to the fact that if we support multidisciplinary research in academia, it will attract the industries more into collaboration.

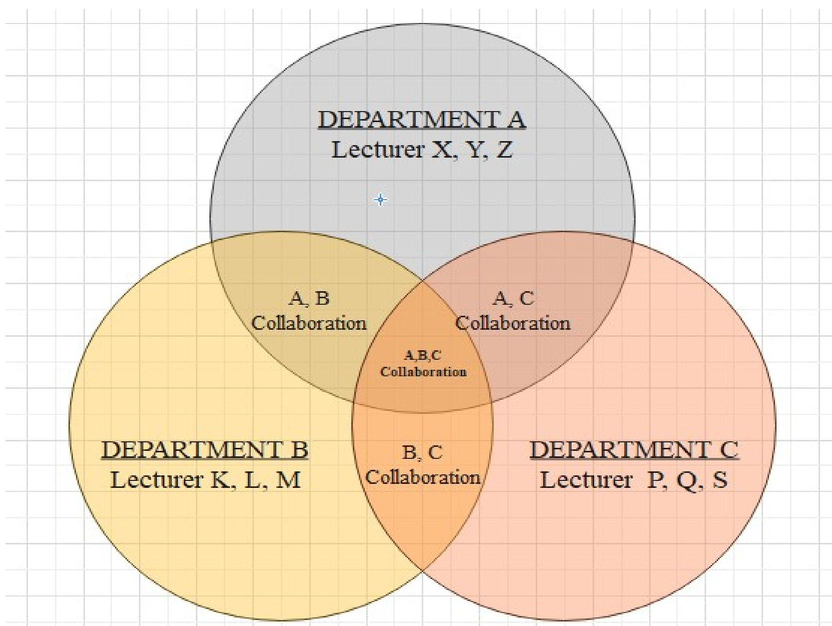

Fig. 4: A Schematic Multidisciplinary Schematic Model for Research Collaboration

5. RECOMMENDATIONS

Based on our research, the following are our recommendations.

i. The urgent need for a review of educational curriculum across all strata of educational sectors in Africa to include Artificial Intelligence and all other frontiers of modern Information Technologies courses.
ii. The need for academic staff in our universities to support multidisciplinary collaboration. This will greatly improve research quality and acceptance.
iii. The need for academia to foster academic collaboration across academic borders through cloud collaboration.
iv. The need for industries to establish more Tech-Hubs in our Universities across Africa. This will stimulate more industry academic collaborations and linkages.

5. CONCLUSION

The use of Artificial Intelligence cannot be overemphasized as its relevance and applications has been shown across all sectors of human endeavor. Artificial Intelligence is the technology for the now and future. Artificial Intelligence needs to be given prompt attention by Africa educational sectors and government. If we must remain relevant in this 21st century, our undergraduates most be well equipped in the field of Artificial Intelligence by quickly reviewing our curriculum to support its inclusion. The academia needs to embrace multidisciplinary collaboration in their research to foster cultural, quality and robust research findings. This definitely will prompt industry academic collaboration.

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