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E-learning and m-learning: Africa's Search for a Suitable Concept in the Era of Cloud Computing?

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Abstract**—**This paper is an exploration of the conceptual confusion between E-learning and M-learning particularly in Africa. Section I provides a background to the development of E-learning and M-learning. Section II focuses on the conceptual analysis as it applies to Africa. It is with an investigative and expansive mind that this paper is elaborated to respond to a profound question of the suitability of the concepts in a particular era in Africa. The aim of this paper is therefore to shed light on which concept best suits the unique situation of Africa in the era of cloud computing.

Keywords**—**African Concept, Cloud computing, E-learning, M-learning

I. Introduction

THERE is an Information and Communication Technologies (ICT) revolution going on in the world at the moment. This has spread to Africa and it is also being applied in facilitating learning in higher education. The two dominant concepts in this field include E-learning and M-learning. There is however a confusion in the appropriate conceptual framework most suitable to Africa in the era of Cloud computing. E-learning refers to using electronic applications and processes to learn. E-learning applications and processes include Web-based learning, computer-based learning, virtual classrooms and digital collaboration. On the other side, the term M-Learning, or "mobile learning", has different meanings for different communities. Although related to E-learning, there are a lot of debates around the term and M-learning is defined as a type of learning that occurs through the use of portable electronic devices or wireless devices like cell phones, Tablets, and laptop computers. Cloud computing, new wave as it is called is gaining traction globally and Africa is not left behind. The practice refers to data access and storage services that do not require end-user knowledge of the physical location and configuration of the system delivering a particular service. This paper defines cloud computing as a storage of content and services that will be wirelessly pushed to the devices upon demand. With the excitement surrounding the era of cloud computing in Africa and elsewhere globally, the fast expansion of ICT has many points of contact with Education and Training. As the potential for technology to enhance learning grows, everything including Teaching and learning environment grows with it. In the African continent, among the prospects brought by the arrival of undersea cables in Sub-Saharan Africa, the prospects of the smartphone revolution in bringing mobile connectivity as well as the gigantic prospect that E-learning provides for students, contribute to the elevating of teaching and learning in the new learning environment which is in line with technology breakthroughs.

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Simone Brunozzi a technological evangelist for Amazon and more specifically cloud computing, believes that Africa is, "on the verge of something just about to happen" and cloud computing is making a lot of that possible [1].

It is in contradiction of this experience that the need arose to find out, which one of the concepts born from learning or Education suit the African context. It is also time to see how Education and training in Africa is linked to the vision of an education society overflowing with Technology.

II. Is Cloud Computing A New Or An Old Age Fashion?

Cloud computing is not a new technology at all; the concept refers to a phase of delivering hosting business solutions as a service over the internet. It is also an internet based computing that enables users to access and share information (be that documents, video, software, etc.) from any computer, anywhere in the world; and the term cloud is used as a metaphor for the Internet. Is the concept new or old? To answer this question, one has to look at the review of related literature around the concept to find out.

Reference [2] argues that from the 1970s to the 1990s, productivity grew threefold in sectors that invested heavily in Information Technologies (IT) compared to those that did not. Now with the new approach that is placing new demands on expertise, IT is playing a central role in almost all future planning of Education and training. Cloud computing has developed from a catchphrase to an active infrastructure used today by several organizations, and many technology experts have different views about what it means to the IT background and what cloud computing can do for Education as well as to any others businesses.

The term "cloud computing" according to many authors is still a developing prototype everywhere not only in Africa. Reference [3] underscores the fact that the use of the Internet and ICT to deliver educational resources is considered mainstream in the 21st century, lectures and students will no longer have to physically carry their documents and data around with them. Instead they will be able to access them in the "cloud" anywhere from any connected device. According to [3], "this blending of traditional teaching and learning with online applications and tools for collaborated learning via internet is thus a fundamental concept of cloud computing". It is true, as I share the same view because the theories around cloud are that: cloud is an internet based facility.

Reference [4] published an article titled: "Twenty-one Experts define Cloud Computing", and among the definitions listed by the experts are the following- Damon Edwards states that - "the –Cloud- concept is finally wrapping people's mind around what is possible when you leverage web-scale infrastructure(application and physical) in an on-demand way". But Paul Wallis argues that: "in order to discuss the issue surrounding the cloud concept, I think it is important to place it in historical context. Looking at the Cloud's forerunners, and the problems they encountered, give us the

reference points to guide us through the challenges it needs to overcome before it is adopted".

For [5], the cloud computing industry represents a large ecosystem of many models, vendors and market niches. As ICT represents a high interest of many in the continent, it is therefore inevitable that the functions of cloud computing would be applied towards education through its three services models. Reference [6] to whom the official definition of the term is attribute, define the term as follows: " Cloud Computing is a model for enabling ubiquitous, convenient, on demand network access to a shared pool configurable computing resources(e.g., networks, servers, storage, applications, and services) that can rapidly provision and release with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four deployment applications."

The concept of Cloud Computing is becoming reputable among organizations that have fast and reliable access to the internet (which is perhaps the most crucial requirement for cloud computing) as indicated by [3]. Africa is not that far, as mobility and wireless connectivity are part of the beauty of Cloud computing. I firmly believe that this prototype alteration offers the strong possibility of accelerating social and economic development, even in this time of limited resources in Africa.

III. The African Concept

The author is aware that the African context, irrespective of the field of research, may bring up several issues for debate , but the argument in this paper focuses on the culture of adoption and use of ICT in Education and Training while there are a number of push and pull dynamics which influence ICT use in and from Africa. It is true that ICT continue to shape the continent's social structure, economy and development intentions. This paper is in agreement with [6] who described the spread of the use of technology as follows: "first come innovators, then the early adopters, the early majority, the slow majority and finally those who are opposed".

It is in line with the adoption of technology that this paper underscores the African context, despite some breaches that show the problems that arise when ICT is marketed in Africa. The reason is not because, the technology may be new or appears new to Africans, but because the dynamics push and pull mentioned later on, have economic and social roots. The paper must emphasize, among other things, the political factors that the continent is often subject to. In line with Moore's quote -"first come Innovators"- I don't see many innovations in Africa when dealing with ICT; but in a very small and significant percentage, Africa is innovative. I see Africa in the early category, the reason being that, Because of the remarkable outcomes accomplished or brought by innovators, Africa comes with vision of how to use technology and what benefits it may offer; but Moore's Chasm is between the early adopters and the early majority.

Africa is in the chasm of Moore because the risk is not taken with uncertain or non-functional technology. However, the real frame markets start with this category and many new inventions never cross this chasm. The African context that I am arguing is the early adopters where the use of ICT in Education is now emerging from the chasm and getting closer to the early majority stage. The slow majority start using technology unenthusiastically in some part of the continent in integrating ICT within the framework of Education's field while the last group is not starting anything at all. The African context underlined here, is based on the enthusiasm that the paradigm shift of ICT use has impacted the continent in adopting new technology according to the era; meaning as new wave comes, new pressures are required.

IV. Is Africa Up To The Challenge?

In debates on the challenges to competence of education and training, the solution most often offered is the principle of lifelong learning, and ICT as a most important dynamic in economic growth is exposing more developing countries to trail strategies that open up their country to mobile, internet, and broadband penetration. On the African continent only mobile technology has seen significant growth thus far, and the increasing coverage of and developments in mobile information and communication technology in the continent establish the foundation of M- learning. However, Africa is the world's least connected continent and tremendous effort is required from private and public sector to reverse this authenticity, it must also be noted that cloud computing may require more than just mobile penetration to a certain extend. Reference [3], underlines that "while some cloud services may not require users to have fast internet connections or use large amounts of bandwidth to access web applications such as text messages through Facebook or Gmail, others, such as downloading a streaming video file through YouTube or uploading large quantities of data to Amazon for storage (S3) or processing (EC2) do". The reality on the ground makes the environment incredibly tough for Africa with the lower level of internet access, as the goal of traditional education has been pressurized by the fast changing working life and collective practice. This presents a considerate confront in Education and training not only in Africa but everywhere globally. - However, the challenge has been taken in Africa; as a result the digital civilization drives the continent to be the social network's fastest growing part of the globe. Cloud computing is still in its early stages, but Africa like any other part of the globe is already beginning to involve all parties. The fact in this case is: every user of a cellular phone is experiencing cloud computing and there is no doubt about it. The era matters in term of learning in Africa because of the tremendous increase in the use of ICT in education in the last decade. The interest and development in the sum of institutions using mobile devices to support learning and teaching is worth noting. In fact, as [1] quoting, Chinery Hesse adds: the reason cloud computing matters to Africa and the reason it has made his gamut of business successful is that it avoids common power outages and overcomes limits to bandwidth. The key role that ICT plays in transforming learning and teaching into anytime and anywhere education says [8], becomes a life-threatening success feature. It is within this context that Africa must clarify its concept of adoption in order to contribute to quality education because of the rich atmosphere that cloud computing is providing. On the other hand, express change and the increasing difficulties of working life have raised the idea that organizations should

also be viewed as learning and information producing communities argues [9]. The African context in which ICT is being used in learning and teaching environment are typical of those found elsewhere globally in the adoption and use of new technology.

However, Africa is challenging itself with the paradigm shift of ICT use as an adopter of technology and cloud computing is already evolving technology in Africa more than ever before. To be clear, cloud computing is a reality in Africa today and every level of the African society is taking part.

V. E-learning And M-learning: Background And Development

This paper refers to [10] where he states that the evolution in education and training at a distance can be characterized as a move from D-Learning (distance learning) to E-Learning (electronic learning) to M-Learning (mobile learning). These three stages of development correspond to the influence on society of the Industrial Revolution of the 18th to 19th centuries, the Electronics Revolution of the 1980s and the Wireless Revolution of the last years of the 20th century. Reference [11] underlines that: "by nature the M-learning is a form of existing D-learning and E-learning". Historically the distance education has more than one hundred years of experience and traditions. Its main characteristics are the distance and time separation between lecture and students.

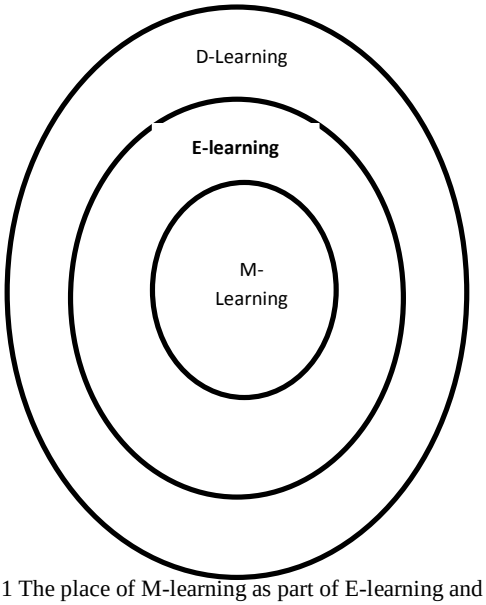

Diagram. 1 The place of M-learning as part of E-learning and D-learning

Reference [12] argues that E-learning is the macro concept that includes online and mobile learning environments. He supports his argument with this definition: "M-learning is E-learning through mobile computational devices: Palms, Windows CE machines, even the digital cell phone". Reference [12] further joined [11] at some point in his argument, as can be deduced from the following: "Thus M-learning is a subset of E-learning. E-learning is in turn a subset of distance learning, which is in turn a subset of flexible learning".

Moving from Diagram I, which portrays the place of M-learning as part of E-learning and D-learning as per [11], I must agree with everyone at this stage but must also accentuate my argument with [12]'s approach on flexible learning , which is in fact the global approach of Education and training. The following diagram is from [12] that illustrate the subnets of flexible learning as distinct delivery modes, and he underlines the fact that these delivery modes are in practice very integrated or blended.

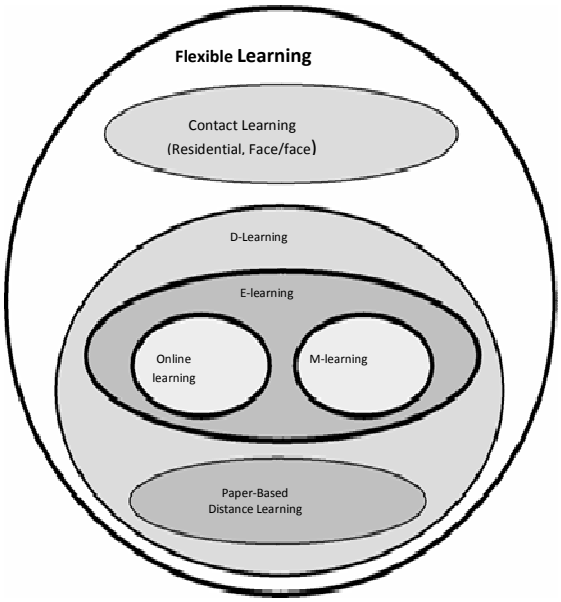

Diagram. 2 The subsets of flexible learning

From the two diagrams, it is clear that M-learning is a subset of E-learning and the two concepts derive from distance learning.

My understanding is that, the origin of the two concepts is from learning; that is when the traditional classroom-based education or learning was evolving with the use of ICT in transforming the learning and teaching environment into anytime and anywhere education, argues [8]. The concepts go far beyond this, as the future of learning is dynamic, engaging and interactive and includes technologies; in fact, the traditional education's transformation in the cloud is anytime, anywhere with any mobile devices.

While the future of education system was questioned prior to the last decade, experience and expertise in the development and delivery of learning using ICT have flourished. E-learning has finally given birth to M-learning in the cloud, which is why I join [10], in supporting the future learning: from E-learning to M-learning. The impact of the two concepts is to fully transform the traditional classroom-based education from face to face to anywhere and anytime education. From what is mentioned earlier in this paper and the different diagrams, it is without any doubt that M-learning is the fruition of E-learning, which concludes the absent constituent of an E-learning solution.

VI. E-learning And M-learning: Differences

E-Learning is a subset of Distance Learning -- Mobile Learning is a Subset of E-Learning. Basically, one of the differences is in the technologies that are used. In many cases,

M-learning is used to support E-learning, for example when learners may not have quick access to non-movable technical devices such as desktop computers, [13]. M-learning is used for learning that can be provided and sustained completely by mobile technology and has less restrictions in the transformation of traditional education while E-learning can be limited to mobility.

TABLE I
E-LEARNING VS M-LEARNING

E-Learning	M-learning
Lecture in Classroom or Internet Lab	Learning anywhere, anytime
E-mail to Email	Instantaneous messaging
Private Location	No geographic Boundaries
Travel time to reach the internet site	No travel time with wireless internet connectivity

Reference [14], observes that: sources disagree on the status of laptop and notebook computers as mobile devices. While they are capable of working without plugging into a power source and can utilize wireless networks, they are not devices that people can carry everywhere and quickly access at any time due to their size, configuration, and the time required to boot up and shut down. This paper supports [14] in reiterating this fact and argues that M-learning is any activity that allows individuals to be more productive when consuming, interacting with, or creating information, mediated through a compact digital portable device that the individual carries on a regular basis, has reliable connectivity, and fits in a pocket or purse. [12] argues that E-learning environments can be divided into networked and stand-alone environments and that networked environments in turn can be divided into online (wired) and mobile (wireless) environments.

From a definition point of view, [14] underlines the fact that there is much debate as to whether M-learning is the next progressive step from E-learning or if it is simply an advanced tool that integrates with E-learning. For [14], in either case, M-learning is a new and unique component of distance learning. Reference [8], defines E-learning as "learning supported by digital electronic tools and media", and M-learning as "E-learning using mobile devices and wireless transmission. I have defined E-learning elsewhere as a transmission of learning and service content through ICT facilities in order to improve knowledge acquisition and delivery [15]. Further, [16] defines M-learning as follows "M-learning is the use of mobile technology to aid in the learning, reference or exploration of information useful to an individual at that moment or in a specific use context." Reference [14] defined M-learning as any E-learning application delivered on-demand via mobile digital device.

Through all interpretations, mobile learning, termed "M-learning", is on intensity as a new technique of gaining access to learning. As additional mobile devices go conventional, such as Amazon's Kindle e-book reader, tablets and others, consumers will become comfortable to reading content on a mobile device.

The move is taking place while the adoption is been measured through accessibility, quality, metrics, retention and relative cost in the cloud.

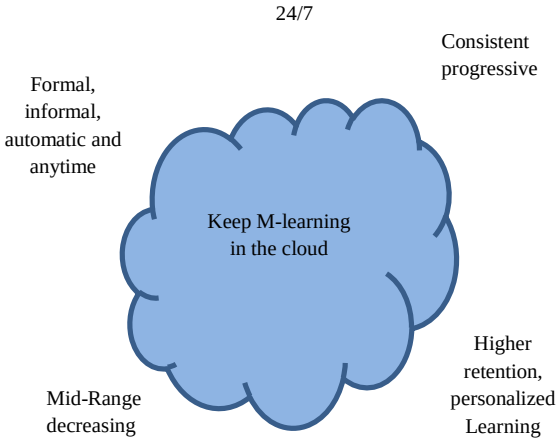

Fig. 1 M-learning in the Cloud

Two elements establish the differences between the two concepts despite their intersection; the device and the network. [14] states that: "with both E-learning and M-learning defined, it is possible to see similarities between the two processes". Most obviously, learning is a key component of both-the goal of the application, regardless of the technology utilized, and I should add devices utilized. Network infrastructure difference, is to engender the acquisition of knowledge by a learner.

VII. How Does E-learning And M-learning Suit Africa?

From what is explained early on in this paper and the differences underlined between the two dominant concepts, it is time to draw a line in agreement with some and disagreement with others when talking about e-learning and m-learning in the African context especially in the era of cloud computing. Africa is a different history when it comes to ICT use in Education and training; each concept of the topic has a place in varying degrees but both present similarities when it comes to the purpose. Several factors must be underlined to draw the line, external factors such as competition, market trends and government policy imperatives; and internal factors such as student's preferences, staff capabilities, and pedagogical approaches. Both concepts are arguably true to a greater or less extent in the African context, but the debate remains significant.

It is true that E-learning suits Africa to the extent where the opportunity of the African society to receive the benefits of world renowned educational resources, delivered to the desktop computer was at minimal cost, conveniently and in a flexible package that suits individual specific needs. The liberalization of higher education by African universities marketed through the lunch of E-learning programs was observed in previous years. When it comes to M-learning, several advocates including myself confirm that it best suits Africa to the extent where the mobile technology is aimed at

re-structuring the continent and every part is involved, regardless of location and society's class. However, advocates of technologies adoption emphasize the opportunities of access afforded by M-learning in Africa than arguments against it, as well as E-learning.

Fig. 2 African M-learning adoption

Looking deeper in activity and actors that have characterized E-learning in Africa over several years as [17] argues, most of the resources, publicity and endorsement has gone into the big, statics installations, the technologies that can be produced by large organizations working together on behalf of "people". The installations include desktop computers, virtual environments, computer suites, interactive whiteboards, etc. He carried on by stating: Resources, publicity and endorsement have less often gone into small, mobile technologies actually owned by the "people". This paper agrees with John Traxler who underline that whilst the two concepts of technology might be seen as complementary, the preferences and behavior of policy maker, vendors, most corporates, and many donors has favoured the big at the expense of the small. The technology is no longer owned by organizations but by people in the era of cloud computing in Africa; everyone is going mobile and wireless. The suitability of concept rests on the fact that technology is a very important factor of extensive social change in Africa.

VIII. Comparative Analysis Of Concepts

It is a very difficult task when dealing with comparative analysis. Hence; the focus here is to look at the existence of particular concepts within the topic, although the concepts may be implicit as well as explicit. In looking at the technology component of the issue, there are two starkly contrasting technologies at work in Africa as [17] argues. E-learning on the one hand, concentrated in metropolitan areas with adequate infrastructure and M-learning on the other hand with user's choice of devices.

Research has shown that, while an online instruction has many advantages, an E-learning course may not work for everyone, especially in Africa. The arguments against E-learning in Africa often focus on the anxiety caused by the nature and quality of technology, lack of well-built internet infrastructure and slow bandwidth. John Traxler argues that "ministries, institutions and organizations in Africa routinely attempt to deliver E-learning using large scale static installations: technologies that require or involve networked desktop PCs in clean, secure buildings with reliable mains electricity, software licenses and technician support". Another reality on the ground is that many institutions in Africa were built without provision for Internet and local Area Network (LAN) wiring. Less than two per cent of the population in many African countries has online access. To date, many buildings are still being erected without these facilities. Hence, most E-learning takes place in computer laboratories, lecture hall, libraries and others structures especially constructed for this purpose.

With E-learning, African society does not address the rural communities' issues at all. Fixed or land phones are non-existent or next to impossible to get working in such remote and rural communities. If for some advocates M-learning is a second phase or ultimate of E-learning or a different concept on its own, there is no doubt that M-learning suits Africa in this era of cloud computing. This move from E-learning to M-learning is to alternate the restriction from specific place to anywhere, anytime with any mobile device within the coverage area.

Why M-learning not E-learning for Africa in the era of cloud computing? As mobility and wireless connectivity are part of the beauty of cloud computing, millions of Africans choose, buy and use their own personal mobile devices and some advocates argue that M-learning is E-learning that uses mobile devices and wireless transmission. As mentioned earlier in this paper, the mobile phone networks on the continent are the most bouncing and groundbreaking in the world. The diversity, power and functionality of these mobile systems and devices continue to increase and in many respects surpass conventional desktop technologies, as [17] argues. If African governments can get the mobile service providers to embark on meaningful corporate venture such as making mobile-phone connectivity to provide proper national coverage and not just to the urban areas where they are assured of their sales, - the continent as a whole could benefit a lot from M-learning. As the future of Africa in education and training arena lies in the collective determination, African society should embrace M-learning as a partner in development because it is time to critically analyze what the African countries are investing in and what educational sense it will make in the future development of society.

Reference [18] underscores the fact that M-learning has spread like wildfire across the planet primarily due to the launch of dozens of successful M-learning value-added service (VAS) products sold directly to consumers by telecoms network operators, device makers, and content suppliers. According to [18], M-learning VAS represents a new type of M-learning product-a fusion of package content and services.

There is clearly as conceptual confusion and, the adoption of a new concept maybe the answer. M-learning has grown visibly and significantly in higher education globally and the African soil is moving from small scale to larger more sustained and blended deployment in the cloud. In this era of Cloud computing in Africa, [17] underlines that, mobile learning is allowing Africans to no longer engage with information and in discussion at the expense of real life in dedicated or special premises like universities, colleges, schools; business centres and cybercafé with mobile technologies. As per the cloud's definition in this paper, I can now say that mobile learning is what should be taken into account because the use of mobile devices by several actors in the continent in higher education and training allows them to engender and produce content and service as well as to store and consume them at a later stage on demand of need.

I must join [18] in underlining an important fact that not only are rural teachers and privileges sectors being provided with professional development, procedural support and decision support; but consumers and students are being provided with a range of educational content, including game-based learning content. [18] confirms the fact that the programs have been enthusiastically received by the users.

My observations in this paper begin to provide answers to questions about "which concept should be taken into account by Africa to better describe the environment in which cloud computing has impacted" and "what are the priorities drawn by the African society to address the national landscape issues of education and training"? Africa is soon to join the global phenomenon of mobile 'smart' devices surpassing fixed line internet connections due to decreasing costs of smartphones and envisaged deployment of higher speed mobile data networks. M-learning is consequently the answer toward the era of cloud computing in Africa characterized by the explosion of telecommunication in providing mobility and wireless connectivity as educationists and trainers are starting to explore with mobile technologies in teaching and learning environments.

The M-learning's choice by the African Society is proved by several advocates, [18] shows that the catalysts for M-learning tend to be different in developed and developing economies. These catalysts underlines [18] have created the foundation for a thriving international market. The regions with the highest growth are Africa, Latin America, and Eastern Europe, respectively. M-learning is now being embraced as an essential strategy to improve Education in the developing economies. In the past argues [18], the adoption of learning technology was widely believed to be a phenomenon in developed economies. Obviously, the evidence indicates otherwise.

In unambiguous contrast with the inadequacy of internet-enabled desktop computers, the proliferation of mobile phones across Africa over the past decade has been beyond belief. Several statistics published by well-known international organizations like the International Telecommunication Union (ITU) and others show how focused "M-learning" offers a considerable reach in Africa in the era of cloud computing as the reality on the ground for E-learning is that, E-learning is imprisoned in the middle of an impeccable hurricane where every single attribute is questioned or insufficient to respond to the demand. This paper joins the list of thousands of advocates who believe that M-learning is what Africa must consider to enable flexible learning with mobile and wireless technologies in the continent.

IX. Conclusion

The era of cloud computing has already started to play a very important role in education and training in Africa. It should be noted that the explosion of telecommunication in the last decade that characterized the era of cloud computing, has addressed many concerns in the learning and teaching platform where rural communities are accentuated.

Cloud computing era in Africa potentially brought the reward of placing institutions at the forefront of pedagogical practice. It addresses student requirements for flexibility and ubiquity with M-learning, that is, "anywhere, anytime, and any mobile device" student engagement.

It is without any doubt that the place of M-learning in Africa in this era should not be underestimated. The African's suitable concept is a genuineness that is growing in form and stature. M-learning in the era of cloud computing has become the learning and teaching platform of choice in Africa as the continent is a hungry mobile technology community. It is for sure true that Africa is on the move.

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