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Implementing Interactive Learning Technologies to Catalyze Academic Performance and Development in Ugandan Education: A Comprehensive Analysis

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ABSTRACT

This comprehensive analysis delves into the integration of interactive learning technologies (ILT) in Ugandan education to enhance academic performance and development. With Uganda's increasing investment in ICT-related infra-structure and education, there's a growing need to understand the potential impact of ILT on the educational landscape. Through an examination of existing literature and empirical evidence, this study explores the benefits, challenges, and strategies associated with implementing ILT in Ugandan schools. It also addresses the importance of personalized learning, bridging the gap in access to quality education, and enhancing critical thinking skills. The analysis culminates in recommendations to optimize the utilization of ILT for fostering student engagement, motivation, and academic achievement in Uganda.

Keywords: Interactive learning technologies, Ugandan education, academic performance, development, and personalized learning

INTRODUCTION

There has been a rapid increase in ICT-related companies in Uganda, and 10% of Ugandans are employed in these companies. Uganda's government has made significant steps in increasing ICT-enabled government services [1, 2]. For instance, the government has computerized its procurement, tax collection, and general service delivery, while the Rwandan government has gone ahead to enable all communication between the government and non-government actors like registering companies to be electronic. The Central Pneumatic Computer Company offers computer services to the rural community, giving many people in the countryside access to computers, printing, internet, and photocopying services. Most mushrooming schools are ICT-enabled. Open Distance eLearning has legal precedence in delivering at the university level; several other universities in Uganda are keen on delivering at least part of their courses using eLearning. Whether ICT should be included or excluded from any society's trajectory is no longer subject to debate because there is clear evidence showing economic growth with ICT investment and the inevitable inputs of ICT in everything else [3, 4]. Several studies have been done since the international community has placed ICT as a central development strategy. All the studies are focused on how it can be effectively incorporated into the education process. A documented success story of the integration of ICT education can be traced to the 1990s when School Net Uganda was piloted in one of the rural schools. These schools acted as the School Net intervention schools while there was no comparable rural counterpart school. After seven years of the intervention, the School Net was proven to be effective. The successful School Net initiative aimed to use ICT to result in several desirable education points like increasing teaching resources, reducing rural-urban educational disparities, improving achievements, increasing resource sharing, and reducing learning curves. Over the years, Uganda has increased its ICT penetration to 45%, the biggest increase in Africa according to the International Telecommunication Union (ITU), 2011 [5-7]. Despite the potential of interactive learning technologies to catalyze the academic performance and development of African students, inadequate research syntheses in this domain have lowered the consensus and utility of technology-based interventions.

Background of the Ugandan Education System

Uganda is one of the country's leading Africa in dedicating 31% of its total budget to the education sector, but it has not done so out of mere obligation. A supportive body of research has shown countries

developing faster today and gearing up for strong, takeoff growth in the future as long as they invest in educating their citizens. International research underscores the importance of pre-primary education in ensuring uninterrupted and consistent mental and cognitive development. Little or no international research has been undertaken to measure the potential of education technology in developing countries, of which Uganda is representative [8, 9]. The Ugandan Ministry of Education has a good plan for the future. Uganda is one of the first African countries to dedicate 31% of the total budget to the education sector. Nonetheless, the transformational nature of these tools can serve as a real catalyst for achieving quicker and more effective results in a timelier manner and on a bigger scale. As of now, no scientific study has been conducted to measure its potential impact on the education sector. In summary, since the adoption of the Education 2007-2015 Sector Plan and the wider National Development Plan (NDP), as well as the eventual Vision 2040, the good or bad that Uganda delivers on development to ensure that by 2020, it can successfully transition into the Middle-Income Economy rests to a large extent with how the quality of its human capital fares. Recognizing this, the sector embraced the Commonwealth commitment that National budgets must dedicate 15% to Education to put its house in order [10, 11].

Importance of Academic Performance and Development

There is an increasing demand for an educational system that involves effective, efficient, and sustainable delivery of available human, material, and financial resources in schools. However, innovative, engaging, interactive, and participatory activities are yet to penetrate the Ugandan education systems. This is despite the potential of diminishing resources, modern methods, and evolving needs of the diverse and dynamic student community for conducive learning and academic realizations. There is a further need for us to examine the importance of improving students' academic performance and development in developing countries, the critical factors that hinder meaningful academic progress and the transformative behavior of both students and educators, and strategies the governments can use to effectively, efficiently, and sustainably address the problems [12, 13]. Developing countries continue to struggle with the achievement, academic performance, and development of students in their education system. For example, the 8 years of Universal Education in Uganda have increased the number of students in school and enhanced the students' abilities to read and write. However, the school system still performs low in developing the competitiveness, academic performance, and developmental skills of the students. The system still graduates students who are not performing well academically and have not acquired the skills to enable them to advance to higher levels of education, the job market, or business enterprises. The rising number of students in the schools is not matched with quality leadership, teaching staff, learning resources, building facilities, and administrative systems, thus creating overcrowded, poorly performing, and unequipped learning environments. With second-rate academic staff and students who are not academically well prepared, classroom lectures have not been very good at achieving effective, efficient, sustainable, and transformative performance of the students [14-17].

Interactive Learning Technologies in Ugandan Education

Though it is possible for a student to cram, disseminating the content from such a class, it is short-lived as they quickly forget the crammed content. The physically limited engrossment of the interaction between the teacher and the students in traditional classes creates an atmosphere where some students impact negatively their self-esteem, leaving them with lingering feelings of despair, learned helplessness, low academic level of aspiration/norms, and self-efficacy. Students consequently disassociate realities presented by traditional classes and take them as another of those infinite school drudgeries, investigating the meaning associated with acetone, alcohol, heroin, Indian hemp (marijuana), pegging on hope, and crying a voice, not yet a voice. Two contrasting edifying outcomes are central to involvement in traditional classes [18-20]. Since the inception of schools in Uganda in the 1890s, a teacher who is physically present, explaining or demonstrating the learning content orally, has always been the epitome of knowledge of the subject matter. And this still holds in many schools today, with students writing lecture notes in rows in traditional classes. Instruction began with the teacher explaining a concept, setting questions, and asking students to answer the formed questions. The teacher also answered the question(s) he/she had set. Recounting answers by students is an orthodox instructional technique. A host of problems have been drawn from this traditional instructional method, except for the high-scoring students who feel bored, robot-like given the avalanche of copied notes, circuits, schemes, and diagrams drawn in coma-ward-like traditional classes and embedded in a meaningless juncture of marking time. Students are therefore faced with disjunctive pursuits, striving to be crammers as they learn in these traditional classes, tarrying the closely-knit relationship as it is with professional pedagogy [21-24].

Current Implementation of Interactive Learning Technologies in Ugandan Education

Even though there have been programs such as OLPS in Uganda tailored to facilitate the integration of interactive learning technologies into schools, there is very little written on how schools have implemented the technology, what factors have further facilitated the implementation process, and what factors have inhibited the implementation process. As educational psychologists suggest interactive learning technologies could be a valuable tool in initiating and sustaining that the readily learned knowledge not only crystallizes into cognitive schemas but are also long-lasting, and they further state that students can acquire such knowledge when they regularly interact with the environment they wish to understand. Preventing each sound, they hear is seemingly turned into a word, phrase, or sentence with the aid of feedback from their listeners, and even those countless cognitive processes which seemingly need little effort e.g. attention keeping and effortlessly alternating between several sources of stimulus clearly illustrate the fact that knowledge is acquired in this interactive manner [25-27].

For primary schools, the government of Uganda has launched the Uganda Communications Commission (UCC) to identify the cellular network with the best coverage in unserved areas of the country, and to install wireless networks in the said areas. Additionally, there are new private sector initiatives such as Uganda-based Vodafone Smart which subsidizes the cost of a smartphone by 50% for the beneficiaries of the One Laptop per School (OLPS) program. That being said, OLPS has led to the implementation of interactive learning technologies but there are several challenges which include the ultra-high subsidies by the government (which may not be sustainable) at 85% of the cost of the computer and a lack of continuous repair and maintenance infrastructure for the equipment's and thus students often develop a disliking for the computers due to this once bitten twice shy mentality. For the OLPS program, rural schools were considered first as they were the most disadvantaged in terms of resource endowments in comparison to urban schools and as such if all schools were to implement interactive learning technologies at the same time, then disparities between urban and rural schools would increase [28, 29].

Benefits of Implementing Interactive Learning Technologies

[30], observed that the use of ICT-based learning in classrooms had increased the pupils' attention span, stimulated scientific creativity, and improved academic performance. [31], sees the effective use of innovative educational technology in the student learning process as a platform for reducing the learning cycle and improving academic performance. It also serves as a reference point for students to evaluate self-knowledge and help in practical preparation for future professional work. [32], in his study revealed that the pedagogical use of software CD in Mathematics by commercial secondary school students in Sokoto produces a positive effect on student's attitudes toward the subject, immediate recall, and examination results. The pedagogical use of VCD in mathematics by the students of Sokoto metropolis showed a considerably improved examination result. [33], says that with the integration of ICT into learning students who received this approach exhibited better academic performance and had a more positive perception of Mathematics relative to students in the control group who received conventional learning. [34], undertook a qualitative study that assessed the impact of implementing interactive learning technologies (ILT) in eight primary schools in Uganda. It was revealed that the productive and responsible ICT use in the learning process increases pupils' initiative, and develops their logical thinking and problem-solving skills besides making them creative. [35], who implemented IT-based instructional material to nineteen senior-high students from ten schools in the Eastern region of Ghana, indicated that the students showed improvement in personalized learning, attentiveness of the students, and student performance in the examination. This agreement is echoed by [36] whose cross-sectional study involving Palestinian students using a Virtual Learning Platform (VLP) at two universities in Israel found that ICT was directly related to student's performance in examinations. [37], supported this view in their study conducted in some selected schools in the UK and concluded that the student's use of ICT in and outside the classroom has a significant impact on students' examination results.

Impact of Interactive Learning Technologies on Academic Performance and Development

Furthermore, the motivation to implement interactive learning technologies in African communities is partially anchored on the positive effects of technology on student academic performance and school progress. A majority of interactive learning technologies deployed in Ugandan schools are radio lessons, possibly motivated by the wide network coverage of radio in the country. Notably, the focus on student education in many previous meta-analyses, and an emerging ECOWAS research question, have led researchers to focus attention on rural schools as a COE research area. Despite the increasing research attention towards interactive learning technologies in African education, the treatment of such interventions is increasingly characterized by narrative reviews, particularly among high-impact journals.

As a result, the existing literature on interactive learning technologies in the African education environment is marked by concerns of generalizability, reliability, and variability among reviewed studies [38-42].

Improved Engagement and Motivation of Students

Engagement of students and teachers in instructional programs is very important as they result in very positive outcomes. Engaged students become deeply interested in their studies, take an active role in classes, learn from books, from others, and feel safe in their surroundings. Teachers, on their part, as well as students who get directly involved in learning activities, have a higher likelihood to increase academic achievement, and cognitive, social, and emotional development of students. It is against this background that the ICT for Education Policy for Uganda (2013) calls for improved engagement of students as well as teachers in learning activities through the utilization of IT in the teaching and learning programs.

The various segments examined the current utilization of ILTs in the Ugandan education system. This section, on its part, examines the benefits in terms of student as well as teacher engagement and motivation. Here, student engagement refers to the extent to which students are charmed and in attendance in their learning activities. The more they are captivated and involved in their education, the more occupied, influenced, and meaningful learning for them will be. At the personal level, student engagement reflects energy, interest, and effort made in the learning process, while at the interpersonal level, it reflects interaction with the teacher, school members, and home parents. The same definitions apply to the teacher's context. Motivation, on the other hand, is referred to as why people behave the way they do [43-46].

Enhancing Critical Thinking and Problem-Solving Skills

Uganda is faced with the problem of decay in the academic performance of learners in both examinations as an objective of assessment and in curriculum activities as a process of citizenship education and preparation of livelihood skills. Literature looked at during the study showed that with activities that promote interactivity preponderance, learners are more likely to enjoy participation in learning and competence enhancement for better academic achievement and personal development. Uganda has initiated and continues to transform her learners' education process and outcomes mainly by change of curriculum content but not by the mode of delivery and as a result, examination monotonous poor results are particularly evident in the English language and Mathematics. The literature available on the study's focus on the use of implementation of interactive supported instruction to promote academic performance is not fully exhausted. This study sought to investigate the effect of implementing an interactive methodology of instruction, as inspired by technological tools, on the promotion of learners' academic performance and individual personal development in selected UBE schools in three districts that offered the implementable S.4 curriculum of 1215. The study came at a time when the government of Uganda was busy with the implementation process of the 21st Century under the new curriculum. The knowledge of such factors would therefore provide the stakeholders with epistemic information and guide practice for the betterment of the OBE system in the 21st Century phase of Uganda's education [47, 48].

To further strengthen the ability of learners to critically think is the thought experiment. In his endeavor to find the desired rational method of approach to his subject matter, man involuntarily finds himself, to be; his equation is a constant quantity. To minimize this "personal equation" which tends to narrow the viewpoint and life of a group of students or people, teachers must suggest thought problems for discussion in class. Martin defines a thought problem as one that teaches that the truth concerning both reality and human affairs does not magically appear or unfold itself, but is realized through methodical ways of thought and action and that it is both being mediated by thought as necessity and can also be found as having mediated through the thought process itself. The development of real knowledge requires the creature who articulate together with the object about which he thought [49].

Personalized Learning and Individualized Instruction

Consequently, individualized instruction using advanced technologies has become a solution to the personalization constraint by offering a broad array of learning options. Even large classes with novice teachers offer inescapable options for individual attention because the devices that instruct, assess, and generate learning on each student can provide learning opportunities that fit the level and content the student requires to develop further in the learning process. Individualized instruction provides learners with the opportunity to study on their own time, either at school or at home. Data from the Uganda pilot studies shows that students with at least three-monthly usage of NABU apps improved their average performance over each round. This continuous growth in learning from the individualized instruction suggests increased engagement and a larger share of pupils' connections in equity in the NABU

intervention sites. These data are based on the average performance across all the pupils. However, it was also observed that sometimes, the NABU interventions did not help the lowest achievers move from a small plateau in learning [50, 51]. Learning is a personal process. Each student processes information differently based on their personal experiences and abilities. As such, personalized learning or individualized instruction may be the best way to get the ideal academic experience. Educational researchers estimate that student-designed learning experiences – such as being allowed to select a topic of interest and working with others to develop and present learning ideas in ways that are most comfortable for them – can improve academic performance. Psychologists categorize personalized learning as self-regulated learning and say it strengthens cognitive learning since personal learning will easily fit and be readily used in real-life situations. However, in a typical under-resourced country's class setting, teachers find it difficult to offer the desired individualized instruction to their students due to large enrollment numbers. For some subjects, for example, science subjects, which need practical work, it is almost impractical for a teacher to offer individual attention to all students. This has often raised concerns about whether the ways we structure learning environments in schools are well-suited to enabling personalized education [52, 53].

Bridging the Gap in Access to Quality Education

The Oxford Strategic Consulting found that primary schools in Ugandan rural areas struggle with the need to attract and retain qualified teachers and have a high pupil-to-teacher ratio. In such cases, the reality is; that it is 'go and teach' in a class that may have 150 pupils. In such communities, the community computer library may be self-explanatory because it can also serve as a supervised blended e-learning center after school. Many pupils who struggle with catching up in the photo real classroom setting deserve ample time. Expanding the photos used manuals slowly as per their preferred pace can yield a big difference. This should cut backward failing grades. This kind of exposure may also make learners computer literate. Native administrators should communicate with all parents' cards and should be advised that manaichi keeps checking the general performance of a learner [53, 54].

According to the Uganda National Household Survey, quality education is still a privilege for the privileged. Over 60 percent of households live within a distance of two kilometers from a primary school. That means no extended direct hourly walking distance. Imagine if all schools were using the iLearn system where that particular child is from; it is that close! Novice computer users should be at ease because both teachers' and learners' manuals to guide operations are provided. This creates an opportunity to reduce the large percentage of repeated primary school grade ones. It is well known that a significant number of grade ones repeat either the entire year or the respective subjects. The first admission age in Uganda has an average variation of about two years; that yields an average age range of four years between the youngest and the oldest students in the same grade. Mature students may be likely beneficiaries of self-explanatory teaching resources [55].

Challenges and Future Directions

The emerging digital building block technologies (interactive technologies, online networks, virtual environments, and more) have the potential to exacerbate and offer the necessary impetus towards achieving those most ambitious academic attainment expectations in this digital education era. As such, not simply designing experts, educators - the users - and their general pedagogical skills will need to be better developed to enhance and sustain learners' interests to self-initiate, work, or collaborate with their peers or professors through live, self-paced, enriched technical and textual content invoked educational objectives. While several technologists and training establishments effusively pursue network, infrastructure, and other hands-on, practical training for educators, their efforts remain comparatively less transformative - and overall, largely unyielding - in constantly maintaining, and further stimulating, educators as commendable agents of digital change in their broad areas of practice. This situation, which persists across the globe, is gradually becoming a significant concern demanding research's full interest to earnestly analyze, explicitly comprehend, and persistently intervene to bend all requirements toward necessary teaching and learning-related solutions [56]. The deployment of educational technology is generally deemed an effective measure of facilitating innovation in teaching and learning. This expedient, instructional-focused innovation, however, tends to manifest considerable challenges limiting general achievement on any educational technology-primed objectives. At the onset of the 21st century, one such feat becomes foremost essential - most notably, the capacity of professors or teachers to systematically deliver instruction to foster successful, ubiquitous utilization of educational technology. The global educational transformation commendably began to prioritize and support the realization of this noble task. Within the United States, for instance, the 'No Child Left Behind' and 'Moving Education

Technology into the 21st Century' Acts were institutionalized as part of the nation's plans to bestow educators the invaluable opportunity to attend to professionally crucial computer technology literacy, and endeavor to exemplify that technology proficiency, among a series of other technology-rich stratagems. With such initiatives, instructors are anticipated to increasingly cultivate expertise by critically integrating authentic learning experiences and technology into lesson plans through effective pedagogical practices that will improve teacher proficiency and student academic performance [57].

Challenges in Implementing Interactive Learning Technologies in Ugandan Education

In most Ugandan institutions and schools, technologies alone or their occasional use and mere possession cannot necessarily facilitate effective learning and achievement of expected educational outcomes. Strong reliance on rote memory learning technique inherited from the antiquated traditional education system stifles the keen academic interest of students to tirelessly brainstorm and engage in active and ongoing critical reflection to encouragingly interact with innovative software packages associated with social issues in clusters through educational games, constructive tutorials, or scientific exercises. Whereas such social and team-based learning tasks in small-size aggregated classrooms naturally can offer interactive peer learning, a sort of practical mentorship that inherently enhances learners' intellectual productivity and appreciation of theory-based concepts [58]. Despite the increase in government allocation of resources for science and technology and expansion of educational programs to enhance student and faculty ownership and use of innovative information and communication technology infrastructure in recent years, the successful implementation of technology-based education innovations in Uganda's general education remains a challenge. One major issue is the inaccessibility to reliable electric power supply in most of the country and potential areas of acquiring interested support in favor of public education. The alleged inadequate political centrality to satisfactory funding of the Ugandan Education Ministry, divergent interests in our politically volatile and young multi-party democracy, and the poor networking and advocacy within the National IT advocacy coalition that would influence policy, implementation, and monitor the progress of the IDLELO spirit fulcrum. The other limiting factors are mainly associated with the less fortunate socio-economic and professional background of most instructors who now offer instruction for ICT-based educational interventions [59].

Strategies to Overcome Challenges

What schools need is to change the method of the curriculum. Schools may not afford to buy numerous computers for every learner, but phones are readily available and affordable. For these reasons, ICT instruction tends to move toward mobile-based applications. Frequent compilation of academic data in schools was a major concern since it affected the management and decision-making processes. The Directorate of Information Communications Technology and Services, MWA recommended ParrSAR, the Central Govt Management Information System 'MIS'. According to MWE, 2 out of 2 staff in ICT at the district level knew how to use the system. It was established that 100% of the respondents from various schools did not know how to construct it shows that improvement of all learners' performance can only be improved by ensuring that knowledgeable human resources at the district level teach instructors. Preliminary transformations call up a burning desire for more technologies to come as a leading industry for schools. The inclusion of vast numbers of countries is setting solid goals in terms of educational technology going deeper into digital learning identification and curriculum enhancement. The philosophy of 1:1 computer implementation, especially in developing countries, facilitates various strategies to address pedagogy and curriculum impacts. These strategies could spearhead the nationwide transformation of Uganda's Education and positively influence the management and leadership developments thus improving all learners' performance [60]. The findings of this study revealed that challenges were mitigated by the use of readily available devices at learners' disposal. It was evident from the study that the cost of equipment was one of the main barriers to the introduction of interactive learning technologies. However, 100% of the learners had mobile phones, indicating that cost is not a significant factor. They had network coverage 24/7 for 50/= per minute, which made it cheaper, realistic, and attainable for learners at a lower cost. At the time of the experiment, all learners were using mobile phones to prepare for practical examinations. It was discovered from the responses that 72% of the learners attended 'Mobile Tech camps' organized by the Project code-named 'ICT4EDU'. In other words, 'mobile tech camp' was a weekly practice session that took place in schools after classes to teach learners how to effectively use mobile devices to connect and construct digital artifacts such as websites, mobile apps, sophisticated designs, animations, games, and movies. Participants attended voluntarily but appreciated the initiative because of its ability to improve their performance and confidence in the preparation of practical examinations for their assessments in computer studies. These camps were facilitated by peer learners and graduates to enhance learning. It is consequently proven that the country

can increase the rate of learners' achievement by utilizing readily available mobile devices to implement computer education. This implies that methods of teaching and types of content that are primarily based on acquiring new skills and knowledge can be personalized using mobile technologies for all Ugandan regions [61-63].

CONCLUSION

The integration of interactive learning technologies presents promising opportunities to enhance academic performance and development in Ugandan education. Despite challenges such as limited resources and infrastructure, there's substantial evidence suggesting that ILT can improve student engagement, motivation, and critical thinking skills. To overcome these challenges, stakeholders must prioritize technical support, relevant content delivery, and teacher training. By embracing ILT and implementing tailored strategies, Uganda can bridge the gap in access to quality education and empower students for success in the digital age.

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