

Barriers and Identified Solutions to the Integration of Digital Technologies in the Classroom: A Case Study of Teachers in Nigeria

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Abstract—This paper presents the results of a study on the adoption and integration of Information and Communication Technology (ICT) in the classroom in Nigeria from the teachers' perspective. Although the Internet and digital devices are becoming increasingly accessible by many more people in Nigeria, the literature shows that their adoption and integration in the classroom is still low. This research adopts the case study method to examine the barriers as well as the solutions from the perspective of the teachers. Twenty science teachers from different schools in Ekiti State, Nigeria participated in this study. A combination of focus groups and questionnaires was used to collect data. The results show that the main barriers against the adoption and integration of ICT in the classroom include a lack of adequate and well-trained personnel, poor internet service, as well as high cost of access. The identified solutions include changes to the curriculum to support digital literacy, funding and material support from both regional and national government, and digital literacy training for the teachers. These findings provide practical insights for school leaders and policy makers on strategies and recommendations to improve the adoption and integration of ICT in schools in Nigeria.

Keywords—ICT, education, technology adoption, classroom practice, digital literacy

I. INTRODUCTION

Over the last two decades ICT is increasingly being used in education. Research has shown that one of the potential ways to diversify the learning experiences of young people in the classroom, and promote active learning is by using technology [1]. Boticki et al. [2] maintain that technology offers new ways to learn such as providing authentic learning environments that enhances the educational experience for students. Research has also shown that student engagement improves when learning occurs through technology [3]. Learning using technology enhances engagement by promoting instant access to information and providing hands-on learning [4]. It can also supply immediate feedback to the learner and their tutor, which is particularly potentially beneficial in the Nigerian context where it can often be difficult for teachers to provide

effective feedback to pupils on their performances due to high student numbers in the classroom.

However, while the development of ICT tools to enhance classroom experience continues to increase, the adoption, integration and use of these tools have not witnessed the same progress particularly in developing countries like Nigeria [3].

II. TEACHERS AND TECHNOLOGY ADOPTION IN THE CLASSROOM

Pupils and teachers are regarded as the main users of digital technologies in formal settings like the classroom. While pupils are usually keen to embrace technology, it is often the teachers that are the main barrier to acceptance [5]. Consequently, much of the recent research around technology adoption and integration in the classroom has been focused on the teachers [6], [7], [8], [9]. “*In a classroom, the teacher perceives and defines a teaching situation, makes judgments and decisions and then takes related actions*” [10]. The role of the teacher is therefore central to the adoption and effective integration of technology in the classroom.

Research also suggests that it is critical to understand teachers' pedagogical beliefs in order to fully understand technology adoption and integration [11], [12], [13], [14]. Several studies have examined the slow pace at which technology is adopted and integrated in education by teachers [15], [16], [17]. Several of these studies have been carried out in developed countries, where digital inclusion is widespread and the government has made a sustained commitment to leveraging ICT for educational transformation. For example, in the United Kingdom the National Council for Educational Technology was expanded and formed into the British Educational Communications and Technology Agency (BECTA) in 1998 and tasked with promoting and integrating ICT in education [18].

The barriers to technology adoption and integration have been discussed, categorized and published by several different authors [19], [20], [13]. However, most studies adopt two main areas of classification [21], [22]. These are

FIRST ORDER BARRIERS (Extrinsic to teacher)	SECOND ORDER BARRIERS (Intrinsic to teacher and possibly subconscious)
Lack of access to technology	Beliefs about teaching (and learning)
Insufficient time to plan for integration	Beliefs about computers and technology
Lack of training	Beliefs about classroom practices and routines
Inadequate technical and administrative support	Unwillingness to embrace change

Table 1. First and second order barriers to technology adoption and integration by [23].

external barriers defined as barriers related to resources and the institution; and internal barriers defined as those barriers related to teachers and their attitudes. Ertmer [23] describes these two classifications as first-order (extrinsic to the teacher) and second-order (intrinsic to the teacher) barriers (see Table 1).

Recently, [24] added a further classification: third-order barriers, which relate to a teacher's ability to set learning experiences considering their learners' context and needs. They questioned if removing first and second order barriers would automatically cause technology adoption and integration to happen. They further argued that due to the dynamic nature of the classroom, a teacher's ability to create learning materials and adapt the instructional needs of the learner for different contexts is equally as important as their access to sufficient facilities, resources, and their own positive attitudes and beliefs.

III. AIMS AND MOTIVATION

The world of work is changing with emerging jobs becoming more intensive in their use of digital technologies. The World Bank's Annual Report highlights the need to invest in people to develop "human capital" so that "everyone can fulfill her or his potential to thrive in the 21st century economy" [25]. Its 'Connecting to Work' Report recommends that developing countries need to "bridge education to employment by developing skills for ICT jobs and promoting digital literacy using innovative models" [26]. Digital literacy is the skills and capabilities needed to participate fully, effectively and equally in our digital world, but half of the world's population is still offline. Many of these 3.9 billion people are women with the majority from developing countries. Closing the digital literacy gap is critical in achieving several of the United Nations (UN) Sustainable Development Goals (SDGs) including SDG 4 which seeks to "ensure inclusive and quality education for all and promote lifelong learning" and SDGs 1: No Poverty, 5: Gender Equality, and 8: Decent Work and Economic Growth. One way to support this is to introduce technologies early in a young person's life through their use in the classroom; and continue to engage them in technology throughout their education. This requires teachers to adopt and embed technology within their classrooms. Yet this is still an issue particularly in many developing countries.

The aim of this research is to explore why the use of technology in the classroom remains such an issue in Nigeria. The study adopts a user centred approach to examine the barriers and potential solutions to them through the perspective and voice of the teacher, who is the

practitioner in the classroom. It also seeks to understand the culture and environment in which they are operating.

IV. PARTICIPANTS AND RESEARCH METHODS

Data was gathered from 20 science teachers (from 20 different schools) during a 3-day workshop in Ado-Ekiti, Nigeria in the summer of 2018. The Ekiti State government was rolling out a digital literacy initiative amongst teachers in the state. Teachers involved in this study were part of the wider intervention in the state. The teachers were drawn from both government-owned schools as well as private schools.

This study adopted a case-study approach to explore the barriers with the teachers. Case studies are particularly strong for exploratory research as they are valuable for investigating complex ideas at the micro level and in developing ideas for further research [27]. They are also very useful in capturing 'lived realities' thereby capturing more of the 'noise' than any type of research method. This is particularly useful in complex contexts and studies like education [28]. There were 2 research questions focused on in this case study. The first was "List those 10 negative barriers to successful integration of ICT in classrooms" while the second was "What can we do about each of the 10 points identified previously?". Thematic analysis was used to examine the data from their responses.

The responses received from the teachers were classified into either first-order barriers or second-order barriers and are discussed in detail in the next section.

V. FINDINGS AND DISCUSSIONS

A. First-order barriers

In all, the teachers identified 18 first-order barriers. These barriers were thereafter group into three main themes (Table 2.)

1) *Barriers resident in the society*

These barriers encompass the instability of government and government policies, underfunding of the education sector and infrastructural deficits resulting in a lack of electricity, low quality internet service and inadequate ICT centers. According to the teachers, the government plays a crucial role in the adoption and integration of ICT in the classroom. In Ekiti State, and the wider Nigerian context, most schools are government-owned and thus the practices in these schools are shaped by government policies and investments. Despite the fact that repeated Nigerian governments have admitted the importance of providing adequate funding for good education, the actual budget allocated to the Nigerian Education ministry has remained one of the lowest. The Central Bank of Nigeria's [29] data shows that between 2000 and 2010 the allocation to the Education ministry was always less than 14% of the national budget. In 2017, there was a sharp drop to just 6% of the total national budget, the lowest since 2012 [30]. Compared to developed countries, and many developing ones, this allocation by the Nigerian government is low and remains well under the 26% recommendation by UNESCO [31]. The state governments in Nigeria model this poor funding as well. According to

[30] in 2016, 33 states of the federation allocated a combined 10.7% of their total budget to education, resulting in a nationwide strike of the Academic Staff Union of Universities calling for increased budgetary allocation to the education sector.

Category	First - Order Barrier
Barriers resident in the society	1. Unstable educational curriculum 2. The paucity of ICT centers 3. Unstable government and government policies. 4. Lack of materials and relevant gadgets 5. Lack of capital 6. The high cost of facilities 7. Lack of good quality internet service 8. Poverty 9. Poor funding from the government 10. Lack of electricity
Barriers resident in the family	11. Parental misconceptions 12. Cybercrime and social vices 13. Poor educational background of the students
Barriers resident in the schools	14. Institutional barriers 15. Insecurity 16. Lack of maintenance 17. Unconducive environment 18. Inadequate time in the classroom

Table 2. First-order barriers identified by teachers

2) Barriers resident in the schools

The state of the schools presents an environment that is not conducive for the adoption and integration of digital technologies. The learning environment plays a vital role in the integration of ICT, thus creating an enabling environment is key. According to [32], the classroom environment is a complex and dynamic one. It places a high level of demand on the teacher, especially when he/she attempts to integrate innovative tools or practices into his/her classroom instructions. An enabling environment for the integration of ICT needs to be safe, have good standard buildings and have consistent source of electricity and internet all of which are lacking in most schools. In a study by [33] on the primary school environment in Nigeria, they found that dilapidated Classrooms were in 42.2% of the schools, with 21.9% of them having no ceilings, 62.5% of them being partially ceiled and 81% of schools having different degree of health hazards such as being exposed to flood/ open drainages (53.1%), animal droppings in classrooms (57.8%) etc. They also found out that only 29.7% of the schools have a school fence, 1.6% have a fire extinguisher and 62.5% having no form of safety measures. Also 65% of schools in Nigeria don't have access to electricity [34] and 62.2% of students reported computers in their schools are not connected to the internet [35]. Thus all this environmental issues pose a great challenge to the integration of ICT in schools. The school timetable also presents a barrier to the use of digital technologies in the classroom. Teachers mentioned that the time in the classroom allocated to deliver curriculum content is not enough to accommodate the use of digital technologies in their teaching practice.

3) Barriers resident in the family

The presence or otherwise of digital devices in the home is the main cause of the digital divide [36]. In Nigeria, the paucity of digital technology devices in schools is a reflection of its absence in homes and families. The low

economic status of many families is the main reason why digital technology devices are not that common in the homes. Teachers in this study are of the opinion that students should also have some form of access to digital technologies outside the classroom, in addition to using digital technologies they access in schools. They maintain that making exposure to digital technologies the sole responsibility of the schools and the teachers is not feasible as they have little time to use it during lesson hours. As [37] suggested, ICT knowledge and skills are enhanced when students are able to access ICT facilities outside their school sessions with family computers and devices. In Nigeria, owning a computer at home is not the priority for many parents. Apart from the inability of some families to afford it, some parents also have misconceptions about digital technologies. One of the major misconceptions in Nigeria is that computer and digital skills is synonymous with cybercrime/internet fraud (popularly known as yahoo-yahoo) [38]. Teachers suggest that this popular association that people make between computers and internet fraud result in parents discouraging their wards from being 'ICT-savvy'. Another major barrier resident in the family is the poor educational backgrounds of the students. Given that the literacy level of many parents is low. This is often coupled with low levels of digital literacy. Combined together, parents do not see the need for digital technologies and thus put the pressure on school management to incorporate them into the classroom.

B. Second-order barriers

The teachers identified 5 second-order barriers, and these were grouped into two themes as shown in table 3.

Category	Second - Order Barriers
Beliefs about computers and technology	1. Attitudes and beliefs of teachers and other relevant stakeholders 2. Misinformation and poor orientation about computers
Competence and digital literacy	3. Failure to apply/use digital tools properly. 4. Laziness of teachers 5. Lack of well-trained personnel

Table 3. Second-order barriers identified by teachers

1) Beliefs about computers and technology

The information teachers have about digital technologies, as well as their pedagogy beliefs have been proven to have a direct impact on how teachers adopt and integrate technology in their classrooms [39], [40], [41]. Teachers' personal beliefs about the use and efficacy of digital technologies are a main determinant of their readiness to adopt and integrate ICTs in their classroom. This study suggest that this is true regardless of the availability of digital devices, support of the school management, and the presence of government policies that support the integration of digital technologies in the classroom. When explored further with the teachers, one of them elaborated – "some of us think it is a waste of time as there are more important things to do in the classroom than play with computers". This response suggests that some teachers may consider using computers and other digital devices as an unnecessary distraction that should not be

allowed in the classroom. By using the phrase ‘play with computers’; this teacher expresses the belief that the use of computer is not for any tangible pedagogy exercise. There is also the fear of breaking the devices and being made to cover the costs of repair or replacement. One of the teachers said “*If I take the students into the ICT lab, I am responsible for that period, and with the principal constantly remind us to be careful around the computers, you just feel it is not worth the stress*”. This suggests that some teachers also have beliefs about how difficult classroom management is in the ICT lab and that ultimately presents a barrier to them. This barrier about beliefs is often time based on socio-cultural factors as well as misconceptions about the role of ICT in the learning and teaching experience.

2) Competence and digital literacy

As [42] noted, most of the educational practitioners in Nigeria at all levels of learning lack the necessary skills and competence needed for the use of ICT in their practices. This ICT skills and competence barrier was also highlighted by [3] from their work with digital educational games for teaching mathematics in Nigeria. Teachers in this study were concerned about the lack of training and expertise required to work with digital technologies in the classroom. As inferred from some of the concerns they shared, the main challenge is that the confidence needed to use ICT is not there and hence it would be hard to use it in the classroom before being well trained to do so. Garba [42] further noted that the pedagogical practices and curriculum design of teacher training in Nigeria is yet to be directed toward the production of ICT literate teachers capable of integrating ICT in their professional practices.

The low levels of digital literacy among teachers can be largely attributed to the fact that Colleges of Education and other teacher training institutions of higher learning in Nigeria are yet to fully integrate ICT in their teacher education program. The Colleges of Education award the Nigerian Certificate of Education (NCE), which is the minimum qualification to be a teacher. However, the training programme is mostly theory-driven and usually leaves teachers unprepared for an active-learning and engaged classroom [43]. Similarly, there is very little done in the area of ongoing professional development to support ICT adoption and integration by in-service teachers [44]. This implies that teachers that received their qualification years ago before the advent of ICTs have very little or no training on the use and applicability of digital technologies in the classroom. This barrier is compounded by the image teachers have of themselves and the image they believe pupils, parents and the public have of them. Reference [3] maintains that teachers are considered the ‘sage on a stage’ in the classroom in Nigeria and are such are expected to know everything. The fear to appear clueless or inexperienced in the use of ICT means that teachers are not positively disposed to trying out digital technologies in their classroom practice.

VI. SOLUTIONS PROFFERED TO BARRIERS BY TEACHERS

After the teachers in the study identified the barriers, they were also asked to suggest some solutions and

recommendations to tackle the barriers and encourage ICTs to be embedded/integrated within their classroom educational environment. The authors categorized the solutions into recommendations for the three different sets of stakeholders – government, teachers, and school management. These are presented in table 4 below:

Stakeholders	Solutions to the barriers
Government	<ol style="list-style-type: none"> 1. Government and private entities should help in providing the devices and resources to enhance learning and provide suitable levels of funding potentially including the use of foreign aid 2. The curriculum should be developed in such a way that it integrates digital technology within teaching practice whilst also factoring in teachers ability to cover the syllabus 3. ICT centers/ labs must be established in all schools
Teachers	<ol style="list-style-type: none"> 4. There is a need to work on the mindset of teachers to embrace digital technologies within their classroom practice. 5. Teachers using digital tools should have adequate knowledge of the tools 6. Students should be given good practice guidance on the use of technology such as being cautioned against accessing inappropriate websites
School management	<ol style="list-style-type: none"> 7. The learning environment should be made conducive for using digital technologies in the classroom 8. The schools should provide opportunities for professional development of teachers with respect to digital technologies and their application to education and learning 9. The school management should encourage the creation of a community of practice among their teachers with respect to technology enhanced learning

Table 4. Solutions to the barriers against ICTs integration in the classroom identified by teachers.

1) Government

The adoption and integration of ICTs is driven by solid infrastructural requirements [45]. These include essentials like computers (and other digital tools) electricity, internet, and safe, conducive spaces that teachers in this study have identified. It is the responsibility of government to first allocate adequate funds for this, and second to ensure that the funds allocated are used for the intended cause. The government of Nigeria needs to firstly increase the allocation to education generally so that it is generally in line with the UNESCO recommendation. Secondly, the education ministries need to develop policies and programmes that highlight the importance of technology enhanced learning and stipulate practical ways to get teachers started on its adoption. Likewise, the curriculum needs to be revised to accommodate ICT and its use in pedagogical activities as well as management tasks (such as assessments and attendance) in the classroom.

In order to tackle the barrier of low levels of digital literacy among teachers in-training, the government in partnership with the IT sector and professional bodies should commission new courses that present and promote digital literacy skills’ development in its Colleges of Education and other teacher training institutions. Alongside this, teachers in-practice should be encouraged to take on Continuous Professional Development (CPD) courses that

will increase their digital literacy and digital expertise to make them more comfortable with using ICT in their classrooms.

2) School management

School management has the responsibility for using the support of the government in providing an enabling environment for teachers to adopt and integrate digital technology in the classroom. Although funding is vital to technology adoption and integration, the manner and process in which this adoption and integration take place is equally as important. School management is responsible for driving and managing the change that comes with introducing technology-enhanced learning. Ritchie and Rodriguez [46] highlight various methods through which the school management can support the process of technology adoption. This includes “*providing and selling the vision to the community, obtaining resources such as time, personnel, knowledge, materials and facilities, and providing encouragement and recognition for teachers successfully making the transition*” [46]. The school management should also create “*the role of a technology leader – someone who is comfortable with ongoing change and who can keep themselves abreast with products, procedures and policies relating to digital technologies while supporting and empowering teachers to adopt technology*” [46].

Finally, the teachers recommended that other teachers who have practical knowledge of digital tools should be encouraged to train their colleagues who do not have these skills. This community of practice may help reluctant and slow adopters share their concerns, increase their confidence and efficacy and eventually make them willing to integrate digital technologies in their teaching practice.

3) Teachers

Finally, it is the responsibility of the teachers to maximize the support of the government and that of their school management in integrating digital technology in the classroom. As highlighted earlier, one of the barriers to the use of digital technologies in the classroom is the lack of skills on the part of the teachers. It is therefore recommended that teachers commit to skills development that would help them get more comfortable with using technology in their teaching practice. This commitment is predicated on two things –first, a good understanding of the value and importance of technology enhanced learning for example, the learning and engagement opportunities it offers [47] and second, the value and importance of personal and professional development.

VII. CONCLUSION AND FURTHER WORK

This study investigates the barriers and potential solutions to the integration of ICT in classrooms from the perspective of teachers. The study highlights that there remains a number of barriers. These barriers were classified as first and second order barriers. The first order barriers encompass barriers that are extrinsic to the teacher and were themed according to those barriers that are resident in society, those resident in the family and those resident in the schools. The second order barriers include those that are

intrinsic to the teacher and were classified based on the teachers’ beliefs about computer and technology and on the competency and digital literacy of the teachers. Solutions were suggested by the teachers and were categorised into a set of recommendations to each of the three key stakeholder groups: government, school management and the teachers themselves.

The authors also acknowledge that this study is focused on a sample from one state in Nigeria. It would be interesting to explore whether these barriers and solutions also apply in other regions and developing countries. The research team is working closely with the Ekiti state government and other organizations to explore how to implement the recommendations from this study.

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