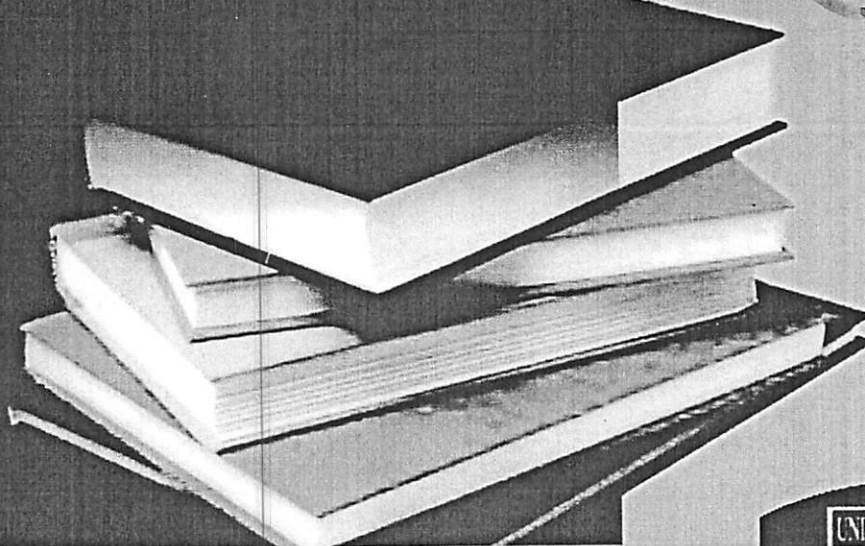


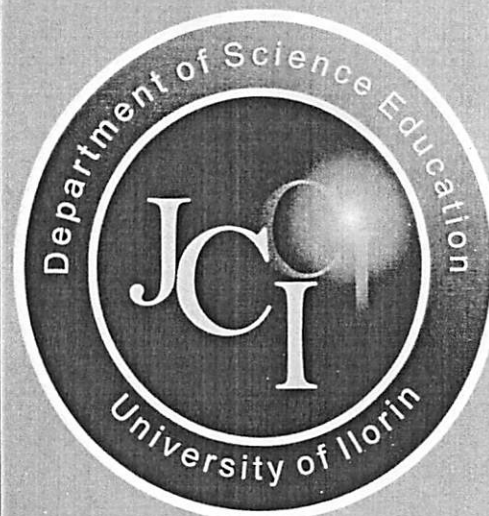
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## PROBLEM AND PROSPECTS OF INTEGRATION OF INFORMATION AND COMMUNICATION TECHNOLOGIES INTO BIOLOGY TEACHER EDUCATION IN NIGERIA

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### Abstract

*It is desirable for biology teachers to be abreast with innovation in biology and biology teaching. This is to enable him to meet the needs of the learners and that of the society as far as the integration of technology into the teaching is concerned. This paper X-ray the problems and prospects of integrating Information and Communication Technologies into the biology teacher education programme in Nigeria. First, the paper examined the impacts of the knowledge of biology on the life of individuals and the society. Secondly, it focused on the need to produce a new generation of biology teachers who can successfully employ modern digital technologies ICTs to implement the biology education curricula. Third, the paper examined the current status of the integration of ICTs into teacher education. Finally, the paper highlighted the myriads of challenges and prospects of implementing the 6<sup>th</sup> edition of the National Policy on Education on the integration of ICTs into teacher education.*

**Key Words:** Biology teacher education, Teacher education, Information and Communication Technologies (ICTs), Science education and Nigeria

### Introduction

Biology is often defined as the scientific study of organisms. In Nigeria, biology was a very popular science subject among the senior school students until science subjects were delisted from the group of core subjects in the curriculum as reflected in the 6<sup>th</sup> edition of Nation Policy on Education (FME, 2013). The impact of biology on the life of every individual globally cannot be compared with any other science subjects. The European Union Forum (2011) affirmed that without the study of biology, epidemic diseases caused by viruses and bacteria such as Lassa fever, Zika fever, Ebola, Bubonic plague and HIV/AIDS could have wiped man. Milford (n. d.) also noted that knowledge of biology is one of the



fundamental reasons why the human race has progressed and thrived over the last 2000 years. Obviously the importance of biology to man should never be underestimated since it touches every facet of human life. No matter what we do, biology is intrinsically involved in our day-to-day lives. The objectives of teaching biology in the Nigerian secondary school are as follow:

appreciation of nature and understanding of the structure and functions of living organisms by the students;

development of reasonable and functional scientific attitudes and science process skills;

ability to conduct and evaluate projects and experiment in the field of biology through the acquisition of laboratory and field cognitive and psychomotor skills ;

ability to apply biology knowledge to address daily challenges that impinge on socio-economic, health and environment at individual and society level ;

acquisition of meaningful and relevant biology knowledge required for advanced studies in biological sciences in the future;

awareness of careers in the various fields of pure and applied biological sciences;

view biology as a process of inquiry into the living world; and

Analyze the activities of living things in their environment (FME, 2009).

In spite of these noble objectives and the significant influence of biology on human beings, senior secondary school students' performance in the subject is worrisome as rightly noted by researchers ( Abimbola 2013; Altunolu, &Seker, 2015; Singer, 2015). The appalling performance of students in biology is a clear indication of the poor quality of biology education in the nation. According Jerrard (2016), the Education for All Global Monitoring Report (2013/ 2014) stated that an education system is only as good as its teachers'. It is thus imperative to improve the quality of biology teachers to enhance qualitative biology education. Integrating Information and Communication Technologies (ICTs) into biology teacher education could significantly improve the biology teachers' effectiveness and efficiencies and by extension students' performance in biology.

### **Biology Teacher Education**

The 6<sup>th</sup> edition of the National Policy on Education FRN (2013) clearly stipulated that all teachers in educational institutions should possess teaching qualification;their programme shall be structured to contain all that is required to ensure effective delivery of their duties; and that the Information Technology (IT) is infused into all teachers training programme. However, this stipulation is largely not implemented in teacher education institutions in the nation. Teacher education in biology can be conceptualized as the policies, procedures and programme designed for prospective biology teachers to equip them with biology



and pedagogic knowledge, skills, attitudes, behaviors needed to effectively and efficiently facilitate meaningful learning of biology. Three stages are usually involved in biology teacher education namely, initial teacher education, induction, and continuing professional development (Abimbola, 2012; Wikipedia, 2012). In Nigeria, the initial biology teacher education programme is offered in Colleges of Education, National Teachers Institutes (NTI), Faculties of Education in Universities, and in some Polytechnics (Ejima, 2010). The 6<sup>th</sup> edition of the National Policy on Education emphasizes the need to formally welcome the newly recruited teachers into the profession through the process of induction (Federal Republic of Nigeria, 2013). However, the induction of fresh biology teacher within the first few years of teaching is undertaken by dutiful senior biology teachers because official induction programme is yet to be implemented fully. Biology teacher professional development is the last stage. It is a continuing in-service education to improve biology teachers' academic and professional currency, effectiveness and efficiency. This stage is usually facilitated by government agencies such as the National Teachers Institute, Federal and State Ministries of Education, and Local Government Education Authorities, as well as the Science Teachers Association of Nigeria, and so forth.

### **Information and Communication Technologies (ICTs) in Education**

Information and Communication Technologies (ICTs) refers to electronic technologies used for receiving, storing, processing and retrieving information. The widespread application of ICTs in almost every sphere of daily activities makes it a distinguishing feature of the present post-modern era. The global trend in this era is a race toward the emergence of e-society, a society driven primarily by digital technologies in the form of modern ICTs. The United Nations Educational, Scientific and Cultural Organization UNESCO (2002 a) noted that within a short time, ICTs is inseparable to modern society and that mastering the basic skills involved in it is itself fundamental education in conjunction with numeracy and literacy

The education industry has become ICTs driven in recent time as indicated by the emergence of new paradigms such as, e-education, e-learning, e-library, e-classroom, e-book, e-portfolio, e-registration and so forth (Bello & Abimbola, in press). The United Nations Educational, Scientific and Cultural Organization (UNESCO) (2002b) also noted that globally, educational systems are under intense pressure to employ modern ICTs to teach students the knowledge and skills they need in the 21st century. The evolving global digital society is an indication that the next generation of student will not likely make use of paper and pencil. Consequently, the global trend in Teacher Education is toward producing a new generation of teachers who can successfully employ digital technologies (ICTs) for delivering educational services successfully.

Researchers have revealed the immense positive impacts of ICTs on teaching, learning, and research, delivery and quality of education. ICTs-driven instructional aids and strategies influence how teachers teach and how students



learn. It increases the flexibility of delivery of educational services thereby enabling students to access education independent of time and geographical barriers. They provide rich environment and offer new horizon for the teachers and the students. (Al-Ansari, 2006; Japheth & Cyprian, 2013; Noor-Ul-Amin n.d.; Yusuf, 2005). Also, they generate, stimulate, and sustain students' interest during the delivery of lesson in a face to face class interaction. When ICTs are effectively integrated to teaching and learning, they concretize abstract topics and conceptual abstraction more meaningfully. Habiba (2013) noted that research studies revealed that the use of ICTs in teaching and learning also, improve course management, higher order thinking skills, communication skills, and support teaching methodology.

### **The Need for a New Generation of Biology Teachers**

There is sufficient evidence in biology education literature that Nigerian students' academic achievement in biology is very poor (Abimbola, 2013; Bello, 2002; Bello, 2014). The poor academic achievement could be likened to the quality of biology teachers and quality education given to the nation. Teaching and learning are the two dominant activities in the field of education. Although learning can take place without teaching, the roles of the teacher as facilitators of learning are indispensable in the field of education. The fact that teachers can only teach their students what they know is not debatable, herein lies the significance of high quality teachers in education delivery. Indeed, the pivotal roles of quality teachers in providing quality education is well documented in the 6<sup>th</sup> edition of the National Policy on Education (FRN, 2013). The Teachers Registration Council of Nigeria (TRCN) also noted that the quality of our education system greatly depend on the quality of its teachers (TRCN, 2004).

There is a growing public outcry against the low quality of the products of the educational institutions in the nation in recent time. Reference to the appalling performance of Nigerian secondary school students in public examinations especially in biology and other science subjects and the lack of employability skills by university graduates are frequently cited as indicators of the poor quality of education provided in the nation. Evidences from literature seemed to suggest that the teacher poor quality is one of the significant factors responsible for the worrisome poor performance of secondary school students in public examinations in the country (Agoro&Akinsola, 2013; Ladipo, 2013; Wadup, 2014). Since no education system can rise above the quality of its teachers as rightly affirmed by the Teachers Registration Council of Nigeria(2004), it is obvious that improving biology teacher education through the integration of ICTs would impact positively on the quality of the biology teachers in the nation. It is therefore, imperative to produce a new generation of biology teachers who can successfully use modern ICTs tools for teaching to enhance meaningful learning because the objectives of biology education can only be achieved if the qualities of teachers improve significantly.

### Information and Communication Technologies (ICTs) in Biology Education

In the field of biology education ICTs gadgets and software programmes could be used to deliver class lessons on difficult and abstract topics such as genetics and evolution. Habiba (2013) rightly observed that 'emerging knowledge and understanding in biological sciences can be represented in a wider range of formats' (p.22). ICTs provide opportunities to use high quality pictures and video clips of animals, plants, microorganisms that are not either accessible, or available for students to inspect and study in the class. Images of living things can be represented in three dimensions (3D). Computer simulations and animations, of complex biological phenomena and processes can equally be integrated into biology lesson to enhance meaningful learning. The biology virtual laboratory is another important ICTs tool that could assist both the teacher and the students to overcome the problem of inadequate facilities in biology laboratory due to poor funding.

After conducting extensive literature review on ICTs in pedagogic, Cox, Webb, Abbott, Blakeley, Beauchamp, and Rhodes (2003) concluded that evidence shows that ICTs contribute immensely to students' academic performance. However, the contribution of ICTs "depend on the way in which the teacher selects and organizes ICT resources, and how this use is integrated into other activities in the classroom and beyond" (p.4). The aforementioned researchers identified teachers' pedagogical frameworks for the integration of ICT effectively into teaching, learning and the curriculum. The frameworks include the need for biology teachers to:

1. understand the relationship between a range of ICT resources and the concepts, processes and skills in their subject
2. use their subject expertise to select appropriate ICT resources which will help them meet the specific learning objectives; this includes subject-specific software as well as more generic resources
2. be aware of the potential of ICT resources both in terms of their contribution to pupils' presentation skills, and their role in challenging pupils' thinking and extending their learning in a subject
3. 4. develop confidence in using a range of ICT resources, via frequent practice and use beyond one or two familiar applications
4. 5. appreciate that some uses of ICT will change the ways in which knowledge is represented, and the way the subject is presented to and engages pupils



5. know how to prepare and plan lessons where ICT is used in ways which will challenge pupils' understanding and promote greater thinking and reflection
6. 7. recognise which kinds of class organisation will be most effective for particular learning tasks with ICT, for example, when pupils should work on their own, how working in pairs and groups should be organised, and when to use ICT for whole-class teaching(p5).

### **Current Status of Integration of ICTs in Biology Teacher Education in Nigeria: Policy and Implementation**

ICTs integration into biology teacher education involve the utilization of digital information technologies to enhance effective pedagogy and curriculum implementation and also, to support the activities of the pre-service and in-service biology teachers inside and outside the classroom (Nwana, 2012). There are several policies that indirectly provided the basis for the integration of ICTs in education in Nigeria and by extension biology teacher education. For instance, the nation initiated a National Policy on Computer Education as far back as 1988 (FRN, 1988). In 2004 the Federal Ministry of Education also launched a ministerial initiative on e-Education for the nation's education system, which stated clearly that "education delivery all over the world is moving towards the adoption of the e-Education framework" (p.20). However, the actual policy on the integration ICTs into the national teacher education programme emerged only recently in 2013. The policy statement is embedded into the 6<sup>th</sup> edition of the National Policy on Education, it states that 'Information Technology (IT) shall be incorporated into all teachers training programme'.

Evidence is yet to emerge from literature in the field of teacher education in Nigeria indicating the implementation of the policy statement on the integration of ICTs into teacher education apart from occasional ICT workshops being organized for teachers. Indeed the teacher education curricula produced by the National Universities Commission (NUC) and the National Commission for Colleges of Education (NCCE) did not include integration of ICTs as a core course. The NUC and NCCE are responsible for the control of Universities and Colleges of Education in the nation respectively where biology teachers are produced; it is obvious the current pre-service and in-service biology teachers have no formal training in the application of ICTs for teaching and learning. Indeed, Fareo (2013) rightly noted that, under development of Nigeria teachers as far as ICT skills, competences and capabilities are concerned is a hindrance to effective implementation of ICT in education. This problem had however prevented Nigeria from competing with the global information super highway.



However, Fareo (2013) noted that the NUC and NCCE provided physical ICTs infrastructures in some selected universities and colleges of education in Nigeria respectively. This is in addition to organizing ICTs workshops for lecturers among which are the biology teacher educators. All these are to ensure that effective implementation of the ICTs integration.

### **Problems of Integrating ICTs into Biology Teacher Education in Nigeria**

The integration of ICTs in biology teacher education in Nigeria is bisected with myriads of problems. Some of these problems include; lack of ICT knowledge, poor pedagogical content knowledge, lack of confidence in using ICTs tools by the teachers, generation gap, availability and access to ICTs resources, Poor Infrastructural Facilities, poor policy implementation, poor funding, poor maintenance practices, and so forth. The list presented and discussed in this paper is by no means exhaustive.

*Lack of Knowledge of ICT:* Biology teacher in teacher education institutions in the nation lack the prerequisite ICTs knowledge and competencies required to integrate ICTs into the implementation of biology teacher education programme. This is largely due to the fact that most of the teachers were equally not trained with ICTs. Biology teacher educators have to possess a very sound knowledge of ICT in order to choose the most appropriate resources in addition to a good understanding of how to incorporate the use of ICT into their lessons. Cox, et.al (2003) stated that very few teachers have a comprehensive knowledge of the wide range of ICTs resources now available in education. Ohiwerei, Azih and Okoli (2013); Thomas, Babatope, and Jonathan (2013), pointed out that many lecturers including biology teacher educators in Nigeria lack the necessary skills and competencies to effectively train biology teachers on the use of ICTs. In Nigeria, not many biology teacher educators were neither trained using ICTs nor possess the skills needed in utilizing ICTs as a pedagogical tool in the teacher training classroom. These categories of teachers form the majority of teacher educators in Nigeria. The dominance of teacher educators that lack the skill of ICTs appreciation and usage thus pose a great challenge.

*Biology Teacher Educators' Pedagogical Content Knowledge:* Possession of Pedagogic knowledge is not a requirement for appointment as a lecturer in Nigerian universities except for lecturers in the Faculties of Education. Undergraduate biology education students offer courses in the Department of Biology. Lecturers in the Department of Biology without pedagogical content knowledge are therefore not in position to integrate ICTs into their course even if they have basic ICTs knowledge. Indeed lecturers in the Faculty of Education who already possessed pedagogical competences also need to develop new pedagogies to successfully integrate ICTs into the implementation of the biology teacher education programme.

*Lack of confidence in Biology Teacher Educators use of ICTs:* A high degree of confidence on the part of the teacher is a prerequisite for successful teaching



and by extension it is also, necessary for successful integration of ICTs into biology teacher education programme. It is required that biology teacher educators have confidence in their use of ICTs for successful lesson presentation. Tella, Tella, Toyobo, Adika, & Adeyinka (n.d.) reported that teachers in Nigeria and many other African nations, lack confidence in using a wide range of ICTs resources.

*Generation gap:* Research studies indicated that generational gap is a potential barrier to the use of ICTs. The young people explore and use new ICTs more than the old generation (Brown, De Rijk, Patel, Twum-Ampofo, & Van Belle, 2006; Colle, 2002). Old generation biology teacher educators at the professorial and senior lecturer level as well as some at the lower levels belong to old generation. Hence, they would most likely to be enthusiastic in integrating ICTs into the implementation of the biology teacher education programme. Indeed, Azuh and Modebelu (2013) reported that many biology teacher educators are resistant to change and hence usually reluctant to welcome new developments such as the introduction of ICTs.

*Availability and Access to ICT Resources:* Availability and access to ICT resources in Nigerian Universities and Colleges of Education where biology teachers are produced is very low as indicated by several studies (Egomo, Enyi, & Tah, 2012; Okon & Jacob, 2002; Ramboll, 2004). The aforementioned researchers noted that ICT facilities are mostly used for research and administrative purposes in Nigerian tertiary educational institutions than for teaching and learning. The quantity and range of ICT resources available to the biology teacher educators is crucial to the successful integration of ICTs into biology teacher education. Limited ICT resources such as, subject-specific software, computers, multimedia projectors, interactive whiteboard, e-learning facilities, broadband internet access, and so forth are inadequate in teacher education institutions and this inadequacy might result to lack of access by most teacher educators.

*Poor Infrastructural Facilities:* Basic infrastructural facilities needed to facilitate the integration of ICTs into biology teacher education are in short supply in the nation. For instance, electricity supply in the nation is erratic while alternate sources of power such as solar energy are underdeveloped. Internet broadband coverage is still very low. According to Gbenga (2015) the Federal Ministry of Communication Technology puts broadband penetration rate at 6% as of December 2012, with average broadband download speed of 2.26 Mbps and upload speed of 1.57 Mbps. The low level of penetration and speed of available broadband in the nation cannot support the use of ICTs facilities such as videoconferencing, interactive virtual class, and biology virtual laboratory successfully.

*Poor Policy Implementation:* In Nigeria there seems to be no synergy between the policy makers and the implementers. As mentioned earlier, the policy on e-education in Nigeria came into existence through the Ministerial initiative on e-



Education for the Nigerian education system in 2004. Similarly, the 2013 edition of the National Policy on Education stipulated that ICTs should be integrated into teacher education at all levels. But neither the NUC nor the NCCE teacher education curricular complied with this policy, consequently teacher educators and institutions are not presently implementing the policy.

*Inadequate Funding:* The government is the sole financier of public higher education in Nigeria. One of the major persistent problems facing higher education in Nigeria is the problem of under-funding. For decades, budgetary allocation to the education sector is below the international benchmark. Oseni (2012) reported that the inability of the developing countries to meet the international benchmark in the aspect of budgeting of educational sector is another serious problem confronting effective integration of ICTs. Inadequate budgetary allocation to tertiary education institutions makes provision of ICTs an uphill task. Thomas, Babatope, and Jonathan (2013) observed that ICTs facilities are expensive and unaffordable to government establishments.

*Poor Maintenance Practices:* There is a prevailing culture of poor maintenance of facilities in public institutions in Nigeria. Babatope (2010) reported that Nigerian university students and staff poor maintenance culture contributed to high destruction of the available facilities. Maintaining the scarcely available ICT gadgets is thus a major challenge in integrating ICTs into biology teacher education in Nigeria. The lack of proper maintenance practices could deny many pre-service biology teachers access to many ICT gadgets.

*Inadequacy of Technical Experts in Software Development:* Inadequate ICTs experts in software development such as biology virtual laboratory, simulation and animation of biology phenomena are major obstacle to the successful integration of ICTs into biology teacher education. Thomas, Babatope, and Jonathan (2013) even noted that poor remuneration for the inadequate personnel in ICT often keeps them away from the Nigeria labour markets.

### **Prospects of Integrating ICTs into Biology Teacher Education in Nigeria**

In spite of the foregoing seemingly insurmountable obstacles to the integration of ICT in biology teacher education, there are real prospects of successful implementation of the ICTs in biology teacher education in Nigeria. The following steps are hereby suggested to enhance the integration of ICTs into the biology teacher education taking into consideration the problems.

The knowledge base of the biology teacher educators and biology lecturers in all teacher education institutions should be upgraded through mandatory training in all aspects of e-education especially in the aspects of teaching and learning. The re-training should go beyond the elementary knowledge of how to use ICTs tools because they have to possess the skills needed to use ICTs as a pedagogical tool. The retraining programme on the infusion of ICTs in teaching and learning should emphasize the practical components to boost the confidence of the recipients in the use of ICTs tools.



The NUC and NCCE should take a closer look at the 6<sup>th</sup> edition of the National Policy on Education released in 2013 with the intention of implementing the policy on ICTs in teacher education. The two agencies revise the current biology teacher education curricula and introduce ICT integration into teaching and learning as a compulsory course. Lecturers in the Department of Biology and other cooperating departments where pre-service biology teachers offer courses should be mandated to obtain additional qualification in the field of pedagogy. This is to ensure that they also, possess pedagogical content knowledge required to successfully integrate ICTs into teaching and learning.

The problem generated by the generation gap phenomenon on the use of ICT tools should be address through the encouragement of intergeneration activities on the use of ICTs. This would allow the professors and other senior cadre biology teacher educator to learn informally at their own pace from the young lecturers that are skillful in the use of ICT tools for teaching and learning.

Biology teacher educators should facilitate a robust mutual cooperation between the proprietors of schools / stakeholders and their respective teacher education institutions with the aim of establishing private-public partnership in the funding of biology teacher education. This would open up another channel of funding to solve the challenge posed by the inadequacy of the required ICT gadgets and other resources for teaching and learning in biology teacher education programmes. Teacher education institutions should equally approach multinational companies and donor agencies for assistance in the provision of ICT resources for biology teacher education programme.

There is no alternative to availability of basic infrastructural facilities and technical experts in the field of ICTs such as software developers and hardware technicians. Infrastructures such as electricity and broadband, Internet services should be improved and adequately enhanced to ensure regular availability. Regular supply of electricity either from the national grid or modular solar panels should be provided by the government. This could be achieved through the provision of dedicated power lines to tertiary educational institutions in the nation.

Biology teacher educators are not expected to become ICT experts, but they the need the services of software developers and hardware technicians as supporting staff to local production and maintenance of ICT gadgets and software. Recruitment of ICT experts by teacher education institutions is thus, imperative. These experts should be adequately remunerated to retain their services. ICT units should be established in the Department of Science Education in all Universities and Colleges of Education.

There is a need for a synergy between the education policy makers and the various teacher education institutions that will have to implement the policies at the classroom level to avoid rendering policies redundant.

## **Conclusion**



Nigeria is in dire need to adopt global best practices in (biology) teacher education to provide high quality education to the citizens. Implementing the National Policy on Education stipulation on the integration of ICTs into the biology teacher education would go a long way in putting the nation on the road to world class industrialized economy. This is because a sound science education is the key to industrialization. It would equally produce a new generation of biology teachers who can successfully utilize modern digital technologies for service delivery in the field of education in line with global best practices. The prospects of achieving this goal are enormous despite the challenges

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