

CURRENT INNOVATIVE INSTRUCTIONAL METHODS AND TECHNOLOGIES FOR QUALITY TERTIARY EDUCATION

Prof. V.I. Ezenwa & Dr. Gambari, A. I.
Department of Science Education
Federal University of Technology, Minna
E-mail: gambarii@yahoo.com
Phone No: +234-803-689-7955

Abstract

This paper discusses education, curriculum issues, evidences of declining performance of students in the first section. Facilitating changes and fostering a new image call for a new approach which emphasises new teaching and learning methods, new technologies and technological applications to meet the multiple challenges of the 21st century are also discussed. The next section introduces current technological innovations in teaching and learning that have been shown to be fruitful, effective and are fast gaining ground. The psychological and epistemological foundations underlying the methods are presented. The collaborative roles of the teacher, student, university, professionals are given pre-eminence in the concluding section of the paper.

Introduction

Education is a process individuals go through to acquire knowledge, skills and attitudes necessary for effective living in the society. One of the most important insights of most African states by the time they obtained their independence was recognition that education is the greatest instrument mankind devised for his own progress and national development. Education generally is not only profitable but a prerequisite for any meaningful and sustained national economy. No wonder, Federal Government of Nigeria adopted education as instrument par excellence for national development (FRN, 2004). There cannot be any substitute for education. The essence of education in many parts of the world is to assist individuals to maximize their potentials for optimum self and societal development.

Formal education at all levels takes place in the classroom setting. No nation can rise above the quality of its educated citizenry. Of all the factors that determine the conduciveness of the classroom, the teacher is the most important. He is the pivot of teaching and learning activities. Quality of any system of education depends largely on the calibre of its teachers. Teachers worldwide are known as facilitators of learning. Hence, teachers are to be upright, dedicated, well-informed, knowledgeable, inspiring and positively-oriented at all levels of learning. An effective teacher is one with sound knowledge of the subject-matter, skilled in diagnosing learners' difficulties, producing and utilising instructional materials and resources, and committed to the tenets of the profession.

At the tertiary level of education, there is no doubt that being a good researcher will improve a good teacher but we do question seriously whether someone who does no research can be and remain a good teacher. Today, there is unprecedented quest for functional education globally. There appears to be a paradigm shift towards technology drive by a burst in knowledge and information management, new contents and curriculum materials in the area of information and communication and technology, electronic skills and entrepreneurship which is included in the curriculum to achieve the national goals, vision 20:2020 and NEEDS (Ezeudu, 2008).

The curriculum of the 21st century is student-centred with innovative teaching and learning methods integrated with technology and elements of problem-solving, a departure from the traditional discipline-based approach (Ajewole & Akpa, 2007; Ayodele, 2007; Olibie & Obidike, 2008). Many countries are enriching their curricula in order to compete effectively and profit maximally from the emerging global village economy which is knowledge and ICT driven.

The use of information and communication technology is an important feature of the new curriculum. The relationship of classroom methodology to performance is an issue that concerns the whole curriculum. Industrialised countries like Europe and America have increasingly come to realize and recognize that curriculum at whatever level must be accompanied by appropriate teaching method and technology. Huge and giant strides developed countries have achieved in technology, economic empowerment and self-reliance can be attributed to, among other things, effective teaching and learning. Indeed, only nations that are prepared and equipped with meaningful teaching and learning will be part of the dynamic world and all its evident benefits. These nations have to contend with the provision of good teachers, good planning, adequate teaching methods, facilities and adequate ability to select instructional materials for effective instruction.

To enhance the quality of education, the curriculum is empowered by the inclusion of entrepreneurship skills at all levels of education to facilitate job and wealth creation, promote socio-economic development and alleviate poverty. The objective of Nigeria Education Policy (FRN, 2004) at tertiary level is to develop intellectual capacity, values for the survival of individuals... that will enable individuals to be self-reliant and useful members of the society. The objective can be pursued and achieved through the application of new technologies in teaching and learning. To achieve this requires integrating them into the objectives of the curriculum, either as a subject or for broader range of educational objectives.

The current practice in Nigeria indicates that there is a gap between what we teach and what we do. The widening gap between theory and practice has serious implications for graduates ability to find and/or create work. Government laid down credence to the importance of education in entrepreneurship when in 2006, it remarked that for a country to become one of the world's 20 economies by 2020, Nigeria will need to increasingly globalize education into key areas: Information and communication and entrepreneurship. Akanbi (2002) found a positive correlation between level of entrepreneurship of a country and national economic development. Hence eight countries in east Asia are described as high performing economies (HPAES) – Hong Kong, Singapore, Taiwan, South-Korea, Japan, Malaysia, Indonesia and Thailand, due to advancement in technology. Most of our computers for ICT are from these countries.

The paradigm shift in the world of social structure is towards private sector which is solely created by entrepreneur. Actually the richest people in the world are entrepreneurs not workers. There is therefore, the need to develop more effective links between industries/private sectors and schools. There is also the need to promote international standards in teaching resources, contacts and methodologies across all levels. Theory alone would not make for desired level of proficiency. In all these, it is the teacher that will facilitate the development of entrepreneurial skills to get students ready for functional and qualitative start up and the accompanying attributes.

Problems in the Educational System

The entry qualifications into tertiary institutions are revealing as shown in Senior Secondary School Certificate Examinations and Unified Tertiary Matriculation Examination results. (Table 1)

Table 1: Percentage performance of students in (May/June WASSCE, 2005 – 2009) In Nigeria

Subjects	Bio	Chem	Econs	Eng	Maths	Phy
YEAR						
2005	35.74	50.94	36.24	25.64	38.20	41.53
2006	49.23	44.90	49.44	32.48	41.12	58.02
2007	33.37	45.96	39.03	30.32	46.75	43.19
2008	33.94	44.44	49.22	35.02	57.27	48.26
2009	28.58	43.69	45.44	41.52	47.04	47.83

Source: WAEC, Lagos

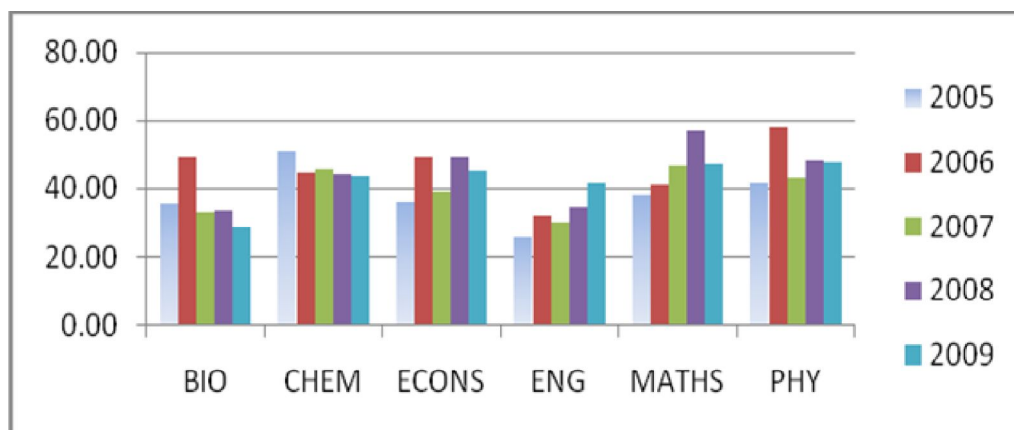


Fig 1: Bar Chart of Students' Performance (WASSCE)

The results are highly disturbing considering the fact that the products would form future undergraduates of Nigerian tertiary institutions. Part of the reason for unemployment has to do with performance and quality.

Joint Admission and Matriculation Board (JAMB) 2010 release of Unified Tertiary Matriculation Examination (UTME) results indicated that:

- (i) 1,276,795 sat for 2010 UTME
- (ii) 501,463 representing 39% scored above 200
- (iii) 330,971 representing 26% scored between 180 - 199

These candidates proceeded to vie for less than 300,000 places in the nation's universities. Many were dropped because of deficiency in "O" level results. Those that graduate from universities, polytechnics and colleges of education go to search for jobs that are not there. The question on every one's lips is: What is wrong with the education system? The large percentage that scored below 180 and many of the unqualified indicate that the system is faulty and ineffective instructional method is implicated.

If educational efforts are indeed failing, the presupposition on which these efforts have been founded (methodology) must be questioned. It seems therefore reasonable to look into causes and reasons for the present state of education. Several factors, singly or in combination are implicated in the poor performance of students and their inability to be self-reliant or secure jobs.

- Novak (2006) stated that a fundamental reason for the failure of education and poor performance had to do with the neglect of how humans construct and use meaning to guide their actions.
- Effective teaching methods are not implemented as claimed (Doymus, 2008; Basturk, 2005; and Adedokun, 2004)
- Society's needs and goals have changed. New family structures have emerged; less than 10% of mothers are currently full time housewives; therefore, the time parents and children spend with one another at home has decreased.
- Students misinterpret what they are taught and confuse new information with non-related ideas (Koroka, 2009).
- Students tend to consider each topic as an isolated event while the teacher assumes that the connecting link between topic and previous learning experience was effective (Ezenwa, 2005).

- Resistance or reluctance to change. Although most teachers have adopted ICT like PowerPoint slide and internet into their teaching, they are still unwilling to adopt more sophisticated computer-based teaching innovations (Davidson, 2011)
- Some students pass tests but do not change their ideas of how and why things behave the way they do (Ifeaker and Anekwe, 2008 and Wing, 2008).
- Employers of labour comment negatively on the quality of graduates produced.
- Inconsistent government policies (Olibie and Obidike, 2008)
- Government alone cannot cope with funding education (Obioma, 2006 and Olowa, 2005).
- Youths seem to be more inclined to business and quick money-making ventures (Ezeudu, 2008).
- Most indigenous textbooks are directed towards external examinations (Ezenwa, 2005).
- New technologies are not used in teaching (Yusuf and Afolabi, 2010).
- Lecture method is still predominately used in schools. (Gambari, 2008)

With these factors covering teacher, instructional methods, attitude, etc, it is clear that a wide gap exists between expected and observed educational outcomes. From research evidences, educators see the pressing need to reconsider the methods of instruction.

Innovative Teaching Methods

Teaching methods can best be defined as the type of principles and methods used for instruction. Instruction here refers to teaching and learning. The world has moved to the electronic stage with computer at the centre. This development has brought a lot of innovation and revolution into teaching and learning. The world is now in the age of information technology or computer age. The electronic computer system in education, according to Gambari (2007) provides the wherewithal to solve teaching and learning problems more rapidly and accurately than hitherto conceived. Computers have been found to be an effective device for presenting instructional programmes. However, a computer can never replace a teacher. It is basically a processor of information.

In recent times, the world has witnessed a rapid increase in technological innovations. This era ushered in the advent of the electronic computer system among other modern technologies. At present, computer technology has permeated nearly all aspects of organizational roles and education. Use of computer technology has been associated with improvement in peoples education, labour market prospects and everyday living. Since the use of computers help students to gain computer literacy, user rates may indicate how well prepared the current generation of students will be, to enter a workforce where computer literacy is in demand.

Computers have been found to be an effective device for presenting instructional program using different soft wares. It can be used to diversify, develop and improve the pedagogical relation of teaching and learning and aid technological and socio-economic development, (Jinui, 2005;Mustra, 2007).

Among terms used to describe computer in learning are:

Computer Based Education (CBE)
Computer Assisted Instruction (CAI)
Computer Managed Instruction (CMI)
Computer Supported Learning (CSL)
Computer Assisted Learning (CAL)

These have changed the teachers role from that of 'informer' to "learning facilitator".

Many new and innovative instructional strategies are available today. One of the most significant is computer based instruction (CBI) which is synonymous with Computer Assisted Instruction (CAI) and may be used interchangeably. A number of computer based instructions programmes

are currently available. Computer technologies are now available and are used at different levels of education. One major advantage of CBI is that students can progress at a rate comfortable to them. They can access assignments, educational details, notes, references and announcements. The psychological theories of Piaget, Brunner, and Ausubel have lent support to the new instructional methods. In its application, computer based learning is used to complement other traditional modes of instruction but not to replace them. The personal computer (PC) has revolutionized the way instructions are delivered. The new generation is as comfortable with the PC as they are with GSM phone. These new technology based instructional methods are linked with theories of learning like behaviourism and constructivism. The concept of distance learning has been revolutionized to what is now known as e-learning or web-based learning. In South Africa, e-learning is done via telephone. As a result, educators are moving to electronic delivery of information. Information and Communication Technology (ICT) also refers to information channels such as WWW, internet, intranet, electronic document, online database. ICT which includes radio, TV, as well as newer digital technologies such as computer and internet have been touted as potentially powerful enabling tools for educational change and sustainable development. These new methods complement the old/existing methods.

The methods commonly used by teachers are:

- Lecture/traditional
- Team teaching
- Inquiry
- Demonstration
- Group work*
 - Similar ability
 - * Mixed ability
 - * Interest group
 - * Random group
 - * Social group
- Project
- Field work

In a typical lesson, an effective teacher normally uses more than one method. For example a demonstration method is usually accompanied by a thorough explanation, which is essentially lecture. Often times, a particular teaching method will normally flow into another, all within the same lesson. However, there is no "one" right method for teaching a particular lesson. The teacher makes the best possible decision depending on the class, size, environment, time, etc. These new technologies in instruction make learning interesting and exciting because students are motivated to participate.

Many new teaching methods are embedded in the new epistemology termed "constructivism" that sees production of new knowledge as a human construction. It believes that significant learning is likely to occur only if the "information"/ "facts" to be learned are constructed by the learner as having personal relevance or meaning. They have tremendous research base and in all, the learner assumes the role of meaning maker and has the final responsibility for his learning. They include Analogy, Vee-Mapping, Concept-mapping, etc.

Vee-Mapping method: Vee-mapping is graphical way to help students understand why they are doing laboratory activities. The maps direct their attention to the questions, procedure, data and data interpretation.

Analogy: In analogy the teacher selects appropriate examples familiar to the students to assist in explaining. This is because, 'analogy' and 'target' share attributes that allow relationships to be identified. For instance, relating a ladder to Deoxyribonucleic Acid (DNA) where the ladder is described as having twisted sides with sugar and phosphate units at the side.

Concept – Mapping: It is a method that reduces concepts to very simple ideas that are linked in a meaningful way to aid understanding. Patterns or regularities in concepts are identified and linked using words in order to visualize the concept. This requires an understanding of what constitute the elements of the concept. The quality and numbers of links generated in the map determine how well the concept is understood. As students progressively differentiate between concepts, they appreciate the interrelatedness among sub-concepts. This way, the mapping becomes meaningful to them. Mapping activities require students to think in multiple directions and to switch back and forth between levels of abstraction. This demands that students should have a good knowledge of the attributes of the concept before locating it in the appropriate place on the map. When the steps are completed, the concept becomes meaningful to the individual/learner. He can then communicate and apply the underlying ideas very clearly because he has understood the concept. Concept map brings out the thinking patterns of students and 'misconceptions' are identified. The meaning of any concept for a person would be represented by all the propositional linkages.

The psychological theories of Piaget, Brunner, Ausubel and Gagne lent support to the methods. Piaget described it as "equilibrium of learning". Gagne stated that any piece of knowledge can be acquired by individuals who possess certain pre-requisite knowledge. Ausubel spelt out the relevance of prior knowledge in learning. The constructivist view is fast gaining ground.

The tendency of many educators to adopt the view expresses its efficacy (Okebukola, 1990; Roth, 1993; Ezenwa, 1992 and Koroka, 2009). Concept mapping method has been shown to be very effective especially with the lower ability group (see tables 2 and 3).

Table 2: Summary of ANCOVA showing the interaction of the variables of gender, achiever levels and methods on teaching (using general linear model procedure)

Source of variation	SS	df	MS	F	P
Pre-test	122.89	1	122.89	2.52	0.1144ns
Achiever Level(ACL)	1093.85	2	546.93	11.21	0.0001**
Gender (G)	78.83	1	78.83	1.62	0.2053ns
Method (M)	13436.93	1	13436.93	275.52	0.0001**
2 – WAY INTERCTION					
Achiever x Gender	66.91	2	33.46	0.69	0.5047ns
Achiever x Method	499.98	2	249.99	5.13	0.00071**
Gender x method	38.38	1	38.38	0.79	0.3761ns
3 – WAY INTEGRATION					
ACLv x G x M	27.19	2	13.60	0.28	0.7567ns

ns – not significant ** - significant at 0.01 level

Source: Ezenwa (2005)

The result of ANCOVA presented in Table 2 showed:

- a non significant difference in the pre-test and gender
- a significant difference in methods, and in achiever levels
- a significant difference between achiever and method
- a non significant different in the achiever and gender, and Gender and methods
- a non significant difference among achievers, gender and method variables

Table 3: Means of treatment (methods), achiever levels and the integration of achiever levels and methods

Methods	Pre-test	Std Err	Post-test	Std Err
(Instructional strategy)	LSM	LSM	LSM	LSM
Concept Mapping (CM)	11.20 *	0.64	38.32 *	1.02
Guided discovery (GD)	12.12	0.64	14.56	1.02

ACHIEVER LEVEL (ACLV)				
Average (A)	12.10	0.61	22.33	0.97
High (H)	13.07	0.71	28.72	1.14
Low (L)	9.80	0.98	28.47	1.59
(ACLV) VS METHOD				
A 1 (CM)	12.74	0.86	31.84	1.37
A 2 (GD)	11.91	0.86	13.16	1.37
H 1 (CM)	12.91	1.01	41.36	1.60
H 2 (GD)	11.73	1.01	15.27	1.60
L 1 (CM)	7.80 *	1.39	42.00 *	2.22
L 2 (GD)	11.80	1.39	14.00	2.22

Source: Ezenwa (2005)

- the lower level achieved more than the Average and High achievers
- CM more effective than GD

The mean post-test value for the different achiever levels in the concept mapping group are shown as 41.36, 31.84 and 42.00 for the high, average and low level achievers respectively. The high and low achievers appeared to have benefitted more from the use of concept mapping than the average achiever. The low achievers were able to successfully utilize concept mapping for better performance comparing the pre-test and post-test scores. The low achiever benefitted more from the use of the concept mapping than the higher achiever. From the mean pre-test score of 7.80, the lower level achiever obtained 42.00 while the higher achievers from mean score 12.91 obtained 41.36 in the post-test. The result with respect to achievers levels indicated that the lower achiever group was able to successfully utilise the concept mapping method for better performance than the average and higher achievers. Concept mapping method is seen to have positively influenced higher level of learning especially for the less capable students. The trend revealed that the low ability group caught up with and out performed both the higher and average ability. This result could be attributed to the nature of the method itself. The method requires students to fully participate in instruction and reduced concept to very simple ideas that are linked in a meaningful way to aid understanding. Probably the problem of the lower ability before treatment might be due to their inability to understand and see relationships in concept taught. Concept mapping encourages a breakdown of concept into smaller units or subconcepts to make meaning and enhance understanding. This could have accounted for the very high mean post-test scores of the low achievers compared to their very low achievement mean score in the pre-test.

New Technologies in Instruction

Animation in CAL: Animation is one of the emerging learning technologies. Animation literally means to breathe life into something by using a series of images to create action. It is a process of using drawings and models of objects to move in a lively and interesting way (Oliver, 2002 and Olowe, 2010). It could be enriched using sound and processes which are synchronized for effective teaching and learning.

The advantages of all these methods include:

- You can have an interactive experience without leaving your chair.
- Provide alternative ways to learning, suited to the youths who are quite comfortable in navigating virtual world.
- Enable students to be more flexible and imaginative in the real world they operate in.
- Allow wider range of stimuli, thus increases students' active participation and engagement in learning.

While there is much benefit from such instruction, the ability to apply the knowledge effectively to get desired results may depend on how rules are applied, who to talk to get something done, and the "hot buttons" of management.

Other Innovative Technologies

Blogs: It is an abbreviation for web logs: a new way to communicate and collaborate. All forms of Blogs use Micro-soft office PowerPoint. It is a website that allows people to add, remove or edit contents. For instance an area is customized by registration and the teacher post items (e.g assignment etc) there. The teacher then marks and posts it back to the students using <http://name.blogspot.com>.

CamStudio: Used to create video tutorial for class by recording all screen and audio activities on the computer. Selected images of some of these new technologies in teaching and learning are shown in figs. 2, 3, 4, 5 and 6.

Fig 2: Gravity and Simple Harmonic Motion

Features:

- Computer Assisted Instruction (CAI)
- Individualized and Cooperative Group learning
- Animation with Audio
- Evaluation



Fig 3: Energy and heat

- CAL
- Animation
- Concept-Mapping method
- Individualized and Group Learning
- Evaluation

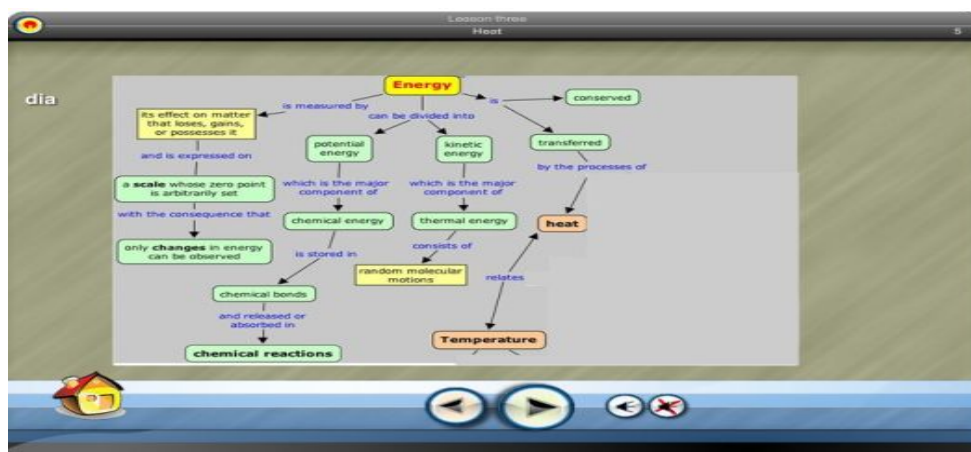


Fig 4: Digestive system

- CAL
- Animation with Audio
- e- learning

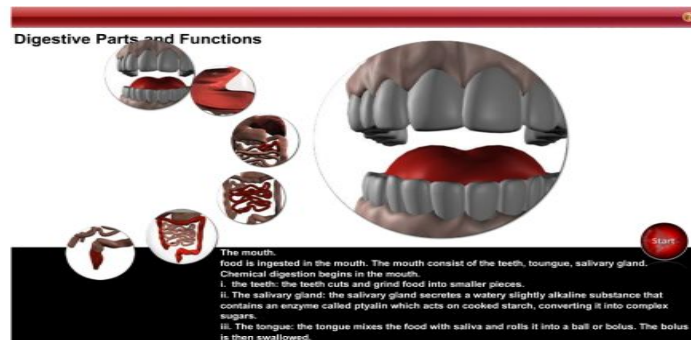


Fig 5: Ecology

- CAL for individual and Group learning
- Animation

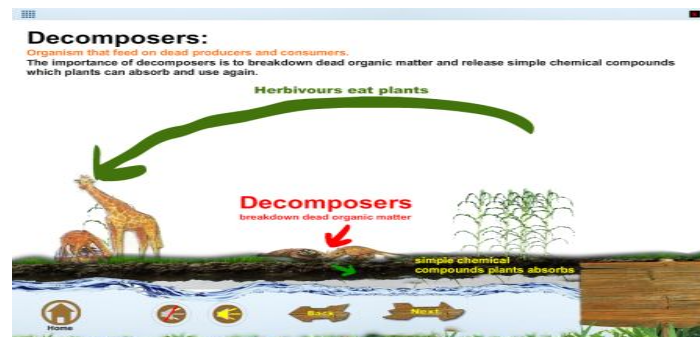
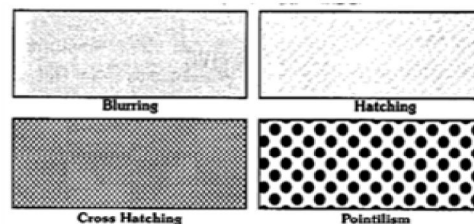


Fig 6: EDT 222 Graphic Communication Techniques of shading

- PowerPoint presentation
- Animation
- Computer e-learning package
- Individual/Group learning
- No Evaluation

- (a) **Shriving technique/Mass shading:** It refers to the application of smudging or rubbing with pencil, charcoal or paint to depict forms and to add value.
- (b). **Pointillism:** It refers to the use of small dots or points made from pencil, pen, paint or charcoal to build-up drawing or painting.
- (c). **Line Shading or Hatching Technique:** It refers to the use of thin or thick diagonal lines to depict objects and forms in drawing or painting.
- (d). **Cross Hatching Technique:** This involves the use of over-lapping diagonal lines to demarcate and depict forms in drawing, painting and illustrations generally.



- **M-Learning**
- The term M-Learning, or "mobile learning", is any sort of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies.
- **Distance Learning**
- Distance learning has been described as "a process to create and provide access to learning when the source of information and the learners are separated by time and distance, or both."



In all, teachers now have options for creating innovative practice in teaching and learning. Indeed these technologies are now widely used even for examinations.

Concluding remarks

Having critically examined education and its problems especially within the tertiary level in a rapidly changing world, it is my view that there is still a wide gulf to be bridged in the area of theory and practice, and teaching and learning. The new technologies using computer seem to be the answer, with the right attitude of teachers. Nigerian society today is determined to move ahead in a world that is in the space age and therefore universities, polytechnics and colleges of education are expected to be in the vanguard to propel it in the right direction. Then, we can look ahead of the future, full of hope and confidence that our youths will survive and carry the country forward to progress, dignity and greatness.

Recommendations

- (i) There is the need to promote and raise the level of teaching even at the tertiary level. Pedagogic training is very important. Infact in Usman Danfodio University, Management made it compulsory and mandatory for all teaching staff to get Postgraduate Diploma in Education (PGDE). This will help the lecturers to understand the psychology of teaching, how to write lecture notes, teaching methods, setting questions, preparing marking schemes, evaluation, class control, etc.
- (ii) There should be commitment and positive attitudinal changes to teaching and learning. The biggest change must come from teachers through exemplary behaviour and leadership.
- (iii) Professionals in practice could be used to teach especially practicals and customized entrepreneurial skills in the department, the universities will benefit tremendously.
- (iv) Professional bodies can set up Award for good and ethical behaviours and best graduating students in their discipline. In addition, they can set up a Foundation for research and innovations in their field.
- (v) Teachers need to be ICT compliant/driven in order to cope with current trends in pedagogical practice.

References

- Adedokun, J. A. (2004). *An evaluation of the effects of cai instruction on the performance of technical college students*. National Association of Teachers of Technology, 17th Annual Conference Abuja.
- Ajewole, G. & Akpan, B. (2007). STM education and Biodiversification. *Journal of Curriculum Organization of Nigeria*, 10(1), 16 – 2.
- Akanbi, A. A. (2002). Entrepreneurship education in the tertiary school curriculum. *Journal of world Council for curriculum and instruction, Nigeria Chapter*, 10 (1), 107 – 17.
- Ayodele, O. (2007). *Building sustainable Science curriculum in Nigeria*. Paper presented at STAN Conference.
- Basturk, K.R. (2005). The effectiveness of CAI in teaching introductory statistics. *Educational Technology and Society*, 8(2), 170 – 78.
- Davidson, V. C. (2011). *Effect of blended e-learning on attitude of social studies students*. Proceedings of International Conference Porto Novo, Benin.
- Doymus, K. (2008). Teaching chemical equilibrium with the jigsaw technique. *Research in Science Education*, 38(2), 49 – 60.

- Ezenwa, V. I. (1992). Effects of concept-mapping and guided discovery methods on students performance in chemistry. *Journal of Education*, 3(2), 109 – 117.
- Ezenwa, V. I. (2005). *Concept-mapping: A veritable tool in science education*. Inaugural lecture Series 7, F.U.T., Minna. 23rd June.
- Ezeudu, F. O. (2008). *Restructuring STM Education for Entrepreneurship*. 49th Annual STAN Conference proceeding, 268 – 72.
- Federal Republic of Nigeria (2004). *National policy on education*. Yaba, Lagos: NERDC press.
- Gagne, R. (1970). *The condition of learning*. New York: Rineholt.
- Gambari, A.I. (2007). Effects of computer graphics on the teaching and learning of mathematic. *Journal of Science Education*, 1(2), 150 – 165.
- Gambari, A. I. (2008). *E-learning: A new approach to teaching and learning in Nigerian schools*. Proceedings of the 29th International Conference, Lagos, 8th – 12th Sept.
- Ifeaker, A.E. & Anekwe, J. (2008). Capacity building reforms for improving teachers competence on continuous assessment. *Journal of Education Studies and Resource*, 4(1), 172 – 82.
- Jiniu, S. (2005). Digital democracy in higher education bridging the digital divide. *Innovative Journal Online Education*, 2(1), October/November, (online) Available from : <http://innovateonline.info> (access) 19th April, 2007.
- Koroka, M.U.S. (2009). Effects of analogy on the understanding of the concept of osmosis among secondary school students in Minna, Nigeria. *Journal of Technology and Resource*, 4(2), 80 – 88.
- Mkpa, M.A. (2003) Curriculum Diversification as a basis for Entrepreneurship. *Journal of curriculum organization of Nigeria (CON)*, 10(1), 16 – 21.
- Mustra, P. (2007). Integrating technology into the teaching learning transaction. *International journal Educational Development*, 3(1).
- Novak, J. D. (2006). *The theory underlying concept maps and how to construct and use them*. Institute for Human Cognition. New York.
- Obioma, G. (2006). *Resources for STM Education in the context of education reforms in Nigeria*. Proceedings of the 47th Annual Conference of STAN, 3 – 7.
- Okebulola, P. A. O. (1990). Attaining meaningful learning of concept in genetics and ecology, an examination of the potency of concept map teaching method. *Journal of Research in Science Teaching*, 27(5), 493 – 504.
- Olibie, E. & Obidike, N. (2008). *Emerging knowledge and skills for Education curriculum for social change*. National Conference of curriculum organization of Nigeria (CON). Sheda, Abuja.
- Oliver, R. (2002). *The role of ICT in Higher Education for the 21st century*. (online) Available from <http://elrond.scam.edu.edu.au/oliver/2002/he.21.pdf>. (Accessed 13 April, 2007).

- Olowa, O. (2005). Education and Technology for alleviation of poverty. *Journal of Education*, 3(1), 14 – 16.
- Olowe, T. (2010) *Effects of computer animation and instructional model on the performance of students*. Unpublished B.Tech Project, F.U.T, Minna.
- Wing, Y (2008). Role of group heterogeneity and process in project-based learning. *British Journal of Educational Psychology*, 78(2), 205 -21.
- Yusuf, M. & Alabi, A. (2010). Effects of CAI on secondary school students performance in biology. *Journal of Education Technology*, 9(1).