

2nd

ANNUAL SCHOOL OF SCIENCE AND SCIENCE EDUCATION CONFERENCE



**FEDERAL UNIVERSITY OF TECHNOLOGY,
MINNA**



BOOK OF READINGS

Theme:
**Challenges in Science and Technological
Advancement and Economic Reforms**

Date: 19th - 22nd November, 2006

Edited By:

Dr. Y. Aiyesimi, Dr. (Mrs) I. N. Mogbo, Dr. (Mrs) G. A. Okoli

EDITORIAL BOARD MEMBERS

DR. A. Y. Aiyesimi
DR. N. I. Akinwande
DR. P. O. Akinyeye
DR. G. A. Chike Okoli

MEMBERS OF THE LOCAL ORGANIZING COMMITTEE

Dr. (Mrs.) I. N. Mogbo	-	Chairperson	Science Education
Prof. O. A. Oladimeji	-	Member	Biological Science
Dr. Y. Aiyesimi	-	Member	Maths/Comp Sci.
Dr. N. I. Akinwande	-	Member	Maths/Comp Sci
Dr. P. O. Akinyeye	-	Member	Geography
Dr. (Mrs.) A. G. Chike-Okoli	-	Technical Secretary	General Studies
Alh. A. A. Jigam	-	Member	Biochemistry
Mr. Y. B. Paiko	-	Member	Chemistry
Mr. C. Onuevho	-	Member	Geology
Mr. J. A. Alhassan	-	Member	LIT
Mal. A. M. Idris	-	Member	ITE
Mal. F. A. Kuta	-	Member	Microbiology
Mr. S. A. Jonah	-	Secretary	Physics

DR *unlo* E. *unlo*

- 42 Gambari, A. I.¹ And Zubairu, A. A.²: Impact Of Videotape Instructional Package On Achievement And Retention In Primary Science Among Primary Pupils In Niger State, Nigeria. 257
- 43 Gambari, A. I. & Mogbo, I. N. (Phd): Gender Disparity In Educational Attainment, Attitudes And Skills Acquisition In The Use of ICT Technology in Tertiary Institutions. 266
- 44 Gbodi, Elizabeth Bimpe (Ph.D) And *Sole, David O :The Concept Of Education Technology From The Perspective Of College Students. 274
- 45 Adaeze Chike-Okoli :A Study On Effective Human Resources Management For Sustainable Technological Advancement In School Administration. 283
- 46 Gambari, A. I. And Gbodi, E. B. (Phd):Accessibility And Effectiveness Of Information And Communication Technology Facilities As Perceived By University Students (A Case Study Of F.U.T., Minna, Niger State) : 292
- 47 Gambari, A. I. & Mogbo, I. N. (Phd): Gender Disparity In Educational Attainment, Attitudes And Skills Acquisition In The Use Of Ict Technology In Tertiary Institutions: 302
- 48 Adaeze Chike-Okoli And *Gambari, A. J.: Information Technology And The Re-Engineering Of Business Organizations For Technological Advancement: Implications For Human Resource Management. 310
- 49 Rafiu A.A And Adetona A.A :Obstacles Encountered By Students In Understanding Basic Concepts Of Physics, And New Teaching Approach To Overcome Them 317
- 50 Adeyeye M. M. (Mrs)Building The Scenario As A Management Challenge For Technological Advancement: 321
- 51 Shehu Amada Tijani :Community Resources Materials For Teaching Physics 326
- 52 Kolo, M.G.M.: The Need To Assess Environmental Impact Of Herbicide Application In Nigeria: A Call For Action: 332
- 53 *Okoye, E.I. Ph.D, Cna, Acit, Amnin And Ogbada, E.I, Fcca: Evaluation Of The Process Of Planning And Control Techniques In Organizational Process: 335
- 54 Mogbo I. N.: Ph.D, Science Education And Technological Advancement In Nigeria: The Challenges And Implication For Counselling: 342
- 55 *Okoye, E.I. Ph.D, Cna, Acit, Amnin And Ogbada, E.I. Fcca :The Comparative Study Of The Role Of Accountants In Democratic And Undemocratic Governance (1995-2005): Nigeria Experience.: 347
- 56 Badamosi, R.O: Strategies For Improving Teacher Effectiveness In Nigerian Schools. 354

Obstacles Encountered By Students in Understanding Basic Concepts of Physics, and New Teaching Approach to Overcome Them

Rafiu A.A and Adetona A.A
Department of Physics
Federal university of Technology Minna

Abstract

Individual teachers of college level physics sometimes develop deep insights into how their students learn and what elements of classroom instruction are valuable in facilitating the learning process. Yet these insights rarely persist beyond the individual instructor. Educational methods seem to cycle from one fad to another, rarely cumulating increasingly powerful knowledge in the way scientists expect understanding to grow. In this paper I explore the character of our understanding of the physical world and of teaching about it. The critical factor is using "the culture of science", the set of processes that allow us to build a community consensus knowledge base. Elements of the beginning of a base for our educational knowledge are discussed and examples given from discipline-based physics education research.

Introduction

Physics education research shows that students entering introductory physics classes have naive beliefs and preconceptions about the physical world. Research has also shown that traditional physics instruction at the introductory level does not do much in the way of changing these beliefs. The main cause of these preconceptions is that the student has conceived incorrect mental models to explain his/her experiences about the physical world.

The past two to three decades have seen many attempts at reforming physics education, especially at the introductory college level. These efforts have emphasized the need for more active participation by students in an inquiry-oriented setting to construct their own knowledge. Many reformed courses have emerged that incorporate insights from physics educational research and they employ some sort of interactive engagement teaching method with success. We have used some of these methods in our classes and experienced the fact that students learn better when they are actively engaged discovering things for themselves.

Some of the exiting developments in physics at the beginning of the 20th century that can be imbibed into the curriculum that would make the teaching and understanding of physics better and more interesting are as follows:

The use of computer simulation and animation can be of great advantage in teaching topics such as atomic structures, study of planetary bodies, thermal radiation and quantum physics.

An excursion into industry by students to see illustrations of application of invention based on modern physics could arrest the interest of students applications of photoelectric effect in design counting machines, the use of radiation for scanning and taking pictures of transistor based on energy levels of semi conductors, the use of rays and electronics are few of such applications that always remain permanent in students memory.

It is appreciated that the advent of clear and more distinct knowledge of physics on topics such as blackbody radiation, photo electric effect in terms of light quanta, the use of laser as a form of energy of great economical advantage and planks theory has really increased the

volume of knowledge in the curriculum, less attention is given to the time required by the student to understand to this volume of knowledge (Baierlein, Ralph, 1995).

Historical Background

Here the development of Physics is x-rayed from 20th century to date. Various stages of physics development are highlighted.

- End of the last century, physics considered fully understood and well developed.
- Only few phenomena and experimental observations defied valid explanation.
- *Atomic spectral lines:* Absorption lines of sun's spectrum by Wollaston in 1802 and Fraunhofer in 1817; active research in subsequent years; well-known formula for Balmer series of hydrogen's spectral lines by Balmer in 1885.
- *Propagation of light:* Series of measurements by Michelson and Morley during 1881 – 1887 (trying to observe motion of light relative to medium of propagation) yielded negative result.
- Several other discoveries and new phenomena:
 - Spectral distribution of *blackbody radiation*,
 - *photo-electric effect*,
 - x-ray,
 - *natural radioactivity*.
- Development of modern physics.
 - Planck proposed *quantum theory* in 1900
 - Einstein put forward *special theory of relativity* in 1905
 - Einstein explained photo-electric effect in terms of *light quanta*
 - Bohr in 1913 extended quantum theory to describe motion of electrons around the atomic nucleus
 - Quantum mechanics developed in 1925-1926 by Schrödinger, Heisenberg and others as general approach to atomic phenomena
- Advent of quantum mechanics → understanding of many problems and vast amount of data involving nuclei, atoms, molecules, and matter in the solid state.
- Basic understanding of atomic phenomena → advancement of modern technology.
 - Development of *transistor* is based on the understanding of energy levels of *semiconductors*.
 - *Laser* is developed out of the basic paper by Einstein in 1907 on *stimulated emission of radiation* from atoms, and a good understanding of the energy levels of molecules.

Present Physics Curriculum at Upper Secondary Level or Pre-University Level

Exciting development in physics not given enough emphasis in present physics curriculum. This makes it difficult for students to appreciate the subject and see it as abstract. Also, Modern physics' often put at end of text-books as a result of this the teachers are not always teach the topic before students write their external examinations.

Critical Evaluation of the Present Curriculum

1. Approach too formal.
 - Too much emphasis paid to logical flow of the content.
 - Students without good analytical mind find approach very dull (Arons, Arnold B 1990).
 - Their concentration easily dissipated.
2. Too much mathematics utilized.
 - Students tend to view physics as another mathematics subject.
 - Many find it too difficult.

3. Linkage of physics to everyday life not well elaborated.

Students do not find physics interesting at all.

4. Students see no connection between modern technology and physics they have learned in the schools (Hobson, 1999). They do not share the excitement derived from applying physics to modern technology.

5. Observations above are serious flaws in present physics curriculum, they are the cause of current decline in enrolment in physics.

Propose Change in Physics Curriculum

After looking at the shortcomings of the present curriculum, the course of change recommended is as follows:

- In order to make physics an interesting subject, instead of a dull one, physics must be taught as an empirical subject, and not in the present formal approach. Examples from every day life and interesting situations must be incorporated as an integral part of the content.
- Concepts and principles in physics must be adequately treated and well demonstrated with illustrations.

Mathematics used in the teaching of physics must be reduced to a bare minimum. This is important not to scare away students with imaginative mind but yet having a fully developed analytical skill.

Connection between physics and modern technology must constantly be stressed. This is to allow the students to share the excitement in the development of modern technology.

- These suggestions appear to be logical steps to take in formulating a solution to the present problem of declining students' enrolment in physics.
- We have to keep in mind that students may leave physics after their upper secondary or pre-university study. Physics taught at such level must be self-contained.
- Physics at this level is strongly recommended be taught in the empirical-conceptual way as suggested in the proceeding section.
- Physics taught in the empirical-conceptual approach at this level could be very different from physics that needs to be taught in the university, where the students are more mature and have a good grasp of physics to undergo a more formal approach.
- As far as the more logical development of physics concepts and ideas, where mathematics is extensively utilized, the students can pick up in courses in theoretical physics.

Conclusion

The important aims of physics teaching at this level are:

- Exposing the students to a wide spectrum of interesting things in physics.
- Providing them with a good grasp of the concept and principles in physics so that these can be easily developed to explain physical phenomena.
- Training them to appreciate the beauty of physics, its importance to society, and its role in modern technology.
- Preparing them to be rich in science culture.

A more formal approach of physics can be left to the university level, where the ideas and concepts in physics are developed fully. The full mathematical treatment in physics, however, may be done in theoretical physics courses

References

- Arons, Arnold B, 1990, Guide to Introductory Physics Teaching, New York: John Wiley.
- Baierlein, Ralph, 1995, Physics Today, p. 87, March.
- Bloomfield, Louis A, How Things Work: The Physics of Everyday Life, John Wiley and Sons, 2001.
- Ellis, Art, College Level One Mission, Field-Tested Learning Assessment Guide (FLAG), http://www.flaguide.org/tools/tools_discipline.htm
- H-ITT, 2003. <http://www.h-itt.com/>
- Hobson, Art, Physics, Concepts and Connections, Second Edition (New Jersey: Prentice Hall, 1999).
- Holton, Gerald James, Introduction to Concepts and Theories in Physics (Reading, Mass., Addison-Wesley Pub. Co, 1952).
- Holton Gerald and Brush Stephen, Physics, the Human Adventure: From Copernicus to Einstein, (New Brunswick, NJ, Rutgers University Press, 2001)
- Holton, Gerald, Rutherford, James and Watson, Fletcher, Harvard Project Physics (NY: Holt Rinehart and Winston, 1975)
- March, Robert, Physics for Poets, McGraw-Hill Science (2002)
- Noyes, Alfred, Collected Poems (Torch Bearers) Port Washington, N.Y.] C. McCutcheon 1966.
- Padamsee, H, 2002. Unifying the Universe, IOP Publishing.
- Starry Night, 2003. SPACE.com Canada, Inc., 284 Richmond Street East, Toronto Ontario CANADA, M5A 1P4
- Styer, D 2002, Journal of College Science Teaching, 32(2): 139.