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TEACHING AND LEARNING SCIENCE: IMPERATIVES OF SPECIALIZED PEDAGOGY IN A CHANGING WORLD

By

FRANCISCA OLU ALADEJANA
Professor of Science Education

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INTRODUCTION

Mr Vice Chancellor Sir,
Members of the Academic Community,
Distinguished Ladies and Gentlemen,

It is my pleasure to stand before you today to deliver the 274th Inaugural Lecture of this University. It is significant that today's lecture is the 12th in the Faculty of Education and the first in the Institute of Education. My choice of teaching as a career was a divine one. Teaching fell from its highly esteemed position in the history of modern education in Nigeria largely because of poor remuneration which led to low prestige and social status of teachers. This made it a last choice of career for young people. Many are there not by desired choice but a lot of us have found it quite fulfilling.

Teaching is one of those activities that nearly everybody thinks he or she can do better than the experts. Everybody has taught something to somebody at one time or another. Traditionally, parents, elders, religious leaders and sages taught children how to behave and think and what to believe. Generally, people interpret teaching as the process of giving instruction. This makes it look like a foregone conclusion that no one needs to take a special form of education to teach. Teaching learnt through trial and error or dependence on learning on the job use students as experimental samples. The resultant effects include failure, dropping out of subjects and/or schools and development of poor attitude which may not be easily reversible or corrected. But then, it is much more so as no teaching has taken place if learning has not. Probably because of the large number of those who teach, teachers have become part of the landscape. Unlike sports, politics, entertainment, the sciences, the arts, or the law, teaching does not give rise to 'stars'. Whoever has heard of Nobel Prize for teaching achievements?
Teaching may best be defined as the organization of learning to achieve desired results. For effective teaching to take place, there

must be learner(s), the facilities, orderly procedure, evaluation and of course the teacher who organizes all these to bring out result. It is therefore a process of systematic causing to learn and acquire desired behaviour(s). Teaching is not just what anybody can do well as there is an appropriate way of doing it; it has its own arts and techniques. One main erroneous concept about teaching is that all one requires is a good knowledge of the subject matter, hence the "all-comers attitude" into the profession.

Ability to motivate learners, provide conducive environment, understand learner characteristics, facilitate understanding, recognize when to teach, apply various methods and assess change in behaviour are pertinent to teaching. Passion for the job, good communication skill, and to be interesting are also important. It is imperative therefore to learn these arts and techniques through appropriate teacher education. Even though a great teacher is never a finished product but rather is always striving to be one; starting training on the job may cause irreparable damage to the learners

An educated person is not necessarily an effective teacher if he or she is not trained in the arts and techniques of teaching. According to Mohanan (2005), an educated person is one who has undergone a process of learning that results in enhanced mental capacity to function effectively in familiar and novel situations in personal and intellectual life. Specifically, the educated person has depth of knowledge in a particular field, can use language clearly and precisely, conceptualizes and solves problems amongst other things. Thus, Mr Vice Chancellor, I stand here to assert that all of us that have taken one form of degree or another are educated people but not all of us can teach effectively. In this lecture, I intend to share with this august audience my modest contributions to the teaching and learning of science during my sojourn in academia spanning over two decades.

Teaching and Learning Science

Generally, science can be understood from its general attributes of *universality*, its power of *prediction* which is grounded on the concept of *necessity* and by its attribute of *objective truth,* (Olorode and Illoh, 2000). It is intellectual, systematic and consists of organized, testable knowledge. Science has become the great tool to understand the past, deal with the present and predict and win the future. It practically determines how we live, eat, relax, and even how we die. Proficiency in science is a major determinant of career choice.

Science teaching must therefore ensure that it is presented to learners in such a way that the best can be got out of them. The state of science and technology education in Nigerian secondary schools is a matter of serious concern for while there is a considerable increase in enrolment in 'soft' science subjects like Economics, Government; the enrolment for 'hard' science subjects such as Physics and Chemistry continues to decline. This may not be very obvious at the tertiary level of education where admission quota cannot accommodate more than 20% of applicants.

Although with the various government educational policies, some of the components of standard of education have improved considerably over the years like the curriculum content, qualification of teachers, the physical and abstract environment. The quality which describes the degree of competence and performance of the graduated students who hold the prescribed certificates is however falling. For example, the Junior Secondary School Science curriculum moved through Nature Study to General Science, later to Integrated Science and now Basic Science and Technology with wider, enriched content. But then, a standard six teacher of those days most likely spoke better English than many graduates now, even when such graduates have been exposed to a richer curriculum, and taught by more qualified teachers in an obviously better environment.

Unique characteristics of successful schools are correlated with student success. A successful school is also an effective school as the products, what learners have gained from their years in school in terms of cognitive, affective and psychomotor domains, ultimately judge effectiveness. Our study of successful and unsuccessful secondary schools in Nigeria showed that 65.81% of schools are unsuccessful largely because of low performance of students especially in English Language, Science and Mathematics in the final examinations. The percentage of candidates that obtained credit and above pass in both English Language and Mathematics at WASSCE has been consistently very low. According to the Head of the National Office of WAEC, only 31.28% of candidates obtained credits in five subjects including English Language and Mathematics in 2014, a decline from the performances in 2012 and 2013 with 38.81% and 36.57% respectively. The NECO November 2015 results have shown some slight improvement.

In our assessment of the quality of Early Childhood Education in South-west Zone, Nigeria, the standard of learning activities was found to be fair, the learning environment averagely good, while the standard of assessment of learning, staff qualification and family participation were low, (Aladejana and Adelodun, 2003).

One major thrust of my research was therefore to investigate the factors that could impede or enhance science teaching and learning with the ultimate goal of improving students' academic performance. These factors are discussed in this lecture.

Bidirectional Relationship between Nigerian Indigenous Science and Modern Science

Science and Technology have been described as the arrow of time to measure development, hence the need to look into effective science learning especially at the primary and secondary school levels. One of the keys to effective learning is relevance of content matter to learners. There is therefore the need to ascertain what the

learner knows and teach him/her accordingly. This is the learner's prior knowledge, not just what is learnt from previous lessons but also what is held from the culture. It is important that this knowledge does not interfere with science teaching by ignoring them as if they do not exist. Rather, they should be addressed to identify wrong ones and determine the ones on which new knowledge can be built.

Indigenous science and technology in Nigeria are part of the knowledge which people have developed over time but which has almost been eradicated with modern science. However, many scientific phenomena (lightning, causes of disease, malformed babies, leisure etc.) are still explained with beliefs from indigenous science as it constitutes part of the way people seem to understand the world and are often willing to pass them on. According to ICSU Study Group (2002), indigenous science is a cumulative body of knowledge, know-how practices and representations developed and maintained by people with extended histories of interaction with the natural environment.

Although some of the knowledge from indigenous science has been found to be connotations of wrong ideas and beliefs about how, and why things happen, which may be at variance with modern science conceptions, they can be very resistant to change. However, many aspects of indigenous science have been found to be useful and at times relevant to modern science as no educational system stands apart for the society. Researchers, development workers and educationists often fail to see the influence of indigenous science on modern science because they presume that it is primitive, backward, culture-bound, mythical and irrational.

In a study by Aladejana and Odejobi (1999), an analysis of responses from 20 purposively selected adults in South West Nigeria based on the criterion of being conversant with indigenous science revealed some relevance between indigenous and modern science which can be appropriately explored for effective learning as shown in Table1.

Table 1. Comparative Study of Indigenous and Modern Science	
Indigenous Science	Modern Science
1.(a) Making pots for cooking that can withstand and maintain hotness (b) Making pots that provide cooling effect for the water stored in them.	These pots are made of clay. The important characteristics of clay that make these properties possible for the pots are: - high water retention capacity - fine soil particle size - low porosity.
2. Making of black soap using cocoa pods, melon pods, kernel oil	Saponification process in chemistry involving the preparation of soap using oil (palm kernel oil)
3a. Local wine and gin are brewed from plantain, maize, guinea corn and palm wine. b. Food processing – cassava tubers to make Gari, Cereals to make ogi/palp	This involves the process of fermentation
4. Making various local dyes and colourings for clothes, the body cosmetics	Extraction of colours from leaves using various chemicals.
5. In agriculture (d) Soil classification (i) By colour Iledu Ile pupa Ile funfun (ii) By fertility Ile olora Asale	 Humid dark soil Brown/reddish soil Highly leached soil/sandy Fertile soil Infertile soil
6. Indigenous mathematics (a) Counting yams is sets of 50, 100, 200, selling yams in sets of 3 or 5; base in Yoruba system- ewa (10), ogun (20), ogbon (30), etc	Set theory in mathematics; Regular mathematics calculation is in base 10.

(b) Using strokes to count e.g. /// to count months of pregnancy	This is tally system used in statistics for grouping of frequency.
7. Classification of living things is done in Yoruba as follows: Ohun Elemi Ewéko / Eranko i. igi ogbin — i. eran osin ii. ewebe — ii. eranko igbe iii. itanna — iii. kokoro iv. igi eleso — iv. eja v. igi gedu — v. eranko afayafa	There are some parallels to these in taxonomy. Living Things Plants / Animals i. domesticated — i. domesticated ii. vegetables — ii. non-domesticated iii. flowers — iii. Insects iv. fruiting trees — iv. fish v. timber — v. reptiles & other crawling ones

Some Factors that can affect Learning

Learning is commonly defined as a process that brings together cognitive, emotional and environmental influences and experiences for acquiring, enhancing or making changes in one's knowledge, values, and world views (Illeris, 2003) Various researchers have identified factors that can enhance or impede learning and many have provided appropriate recommendations. However, I will concentrate on my research findings.

Alternative Conceptions

The term alternative conception refers to ideas people have which are inconsistent with scientifically accepted ideas (Ogunniyi, 1988). Such conceptions develop from students building ideas from experience in a process referred to as personal constructivism. My study of 210 final year students selected from rural and urban locations to assess their conceptions of six genetic concepts confirmed that students hold alternative conceptions different from scientific conceptions. Some examples are:

- Inheritance is in the blood, the idea of blood relations (as against chromosomal inheritance)

- Heredity also means that offspring can be reincarnate of dead ancestor.
- The fish comes down directly from heaven not hatched (the Ebenezer Obey song in Yoruba "Orun leja ti wa saye")
- A dominant gene is the gene of the stronger parent
  A couple that has all-female children can be attributed to the mother only. Men do not have infertility problem, women are to blame.
- Most sicknesses and deaths especially in young and middle aged do not occur naturally, they are likely caused by evil forces.
- Hurricanes, typhoons, floods are caused by water spirits that need to be appeased.
- Sex during menstruation leads to an albino.

Some students still hold on to the alternative conceptions even after they have been taught the scientific conceptions in schools. This can adversely affect learning and performance if they are not properly addressed. As a result, I therefore recommended that text books should give adequate coverage to alternative conceptions. Teaching should not treat students as lacking information but should provide considerable opportunities for students to address their alternative conceptions with a view to changing them, (Aladejana and Ehindero, 1995).

The Use of Mother Tongue

Integrated science is the child's first experience with the sciences. It should perform the dual role of achieving scientific literacy in the learner as well as lay an adequate foundation for subsequent special studies. Therefore no effort should be spared in ensuring good performance and genuine interest of the students. According to Fafunwa (1975), the African child like any other child (in India, Germany, France, China, Britain etc.) could be helped right from the start to develop some or all the scientific skills and abilities in his or her own mother tongue. This is essentially so as one dreams and thinks best in

the mother-tongue. Ehindero (1974) asserted that the plurality of languages imposes an additional problem on the learner who must operate both in mother-tongue and English language.

An experimental study by Aladejana and Odejobi (1999) of 300 randomly selected Junior Secondary School students in Osun State Nigeria where the experimental group was taught Science in Yoruba their mother tongue while the control group in English language was carried out. A glossary of translation of some science concepts into Yoruba Language used in the study includes:

Reflex action	-	Ikugbuu
Spinal cord	-	Opa eyin
Irritability	-	Imolara
Brain	-	Opolo
Response	-	Idahun
Nerve	-	Isan Imo
Effector	-	Asonfa
Receptor	-	Olufaragba

The results of the study revealed that students in the experimental class taught in mother-tongue performed significantly better than those taught in English Language. This agreed with earlier findings of Fafunwa (1975). It was also found that the classroom atmosphere of the experimental group was livelier with active participation and students showed keener interest compared to the control group. The retention rate was also higher in the experimental group. It was therefore recommended that at least in the early stages of learning science, the use of mother tongue should be encouraged with gradual switch to English Language in upper classes.

Learning Environment

The learning environment can best be understood in terms of its components which can be physical or abstract. The physical component includes the location, amount of light, furniture, science equipment, instructional materials and ventilation. The

abstract component deals with the non-physical structure of the classroom such as the teacher factor, noise-control, class size and tone (Wilson, 1996). The knowledge of what classroom environment is can provide teachers with meaningful information that can serve as a tangible basis for improving classroom activities.

Fraser (1986) identified five dimensions of the abstract classroom learning environment. These are satisfaction, friction, competitiveness, difficulty and cohesiveness. In my study which investigated this abstract component of the environment with particular reference to student-teacher relationship, I found that students' perception of the classroom abstract environment can be objectively assessed by their teachers. Such assessment can help the teachers to plan lessons, carry out instructions, maintain the right atmosphere and achieve effective learning process. My assessment of the various components of the environment indicated:

- low satisfaction suggesting that most learners do not always enjoy school work and are not happy in the classroom.
- Fairly low level of friction which is an indication of less fighting and meanness among learners. Also an indication of a good level of classroom discipline by the teacher.
  High level of competitiveness implying that most learners would want their
  work to be better than those of their classmates.
  Fairly high difficulty level showing that learners often find class work hard to
  do hence the low level of satisfaction.
- High level of cohesiveness, an indication that most students like one another as
  friends and would readily want to work together.

The study also showed that gender did not affect satisfaction and difficulty levels, however a significant difference was found in the levels of friction, competitiveness and cohesiveness. Friction was higher among males. The implication for teaching is that the

teacher does not need to dichotomize the students as male and female to provide the required atmosphere for effective learning. Male and female students should therefore be given same tasks in the classroom. Both sexes would readily want to compete for rewards. However, male students have higher cohesiveness in terms of moving closely as a group than females, while the girls tend to have less friction in terms of disagreements and fighting than boys. All these have implications for classroom learning and discipline.

Science Laboratory Environment

The science laboratory environment is a subtle concept that can also be better understood in terms of its components, which can either be physical or abstract. It is widely accepted that science is better taught using the discovery method (guided or unguided inquiry) or the experimental approach. Five different dimensions of laboratory environment are: Student cohesiveness, SC (degree to which students know, help and are supportive of one another); Open-endedness, OE (degree to which the laboratory activities emphasise an open-ended divergent approach to experimentation); Integration, IN (degree to which the laboratory activities are integrated with non-laboratory and theory classes); Rule Clarity, RC (degree to which behaviour in the laboratory is guided by formal rules) and Material Environment, ME (degree to which the laboratory equipment and materials are adequate (Quek et al. 1998).

In our study of some components of the laboratory environment and their impact on learners, we found that students were able to assess the various components of their laboratory environment. Students assessed student cohesiveness SC, highest indicating a high level of cooperation, help and support among the students as well as a high level of interaction between the learners. The second highest assessed was Rule Clarity RC, which shows that there are clear cut guidelines that learners must follow in the laboratory classes amongst which are precautions and rules. However, too

formal environment can detract from the quality of interaction. The third rated component is Integration revealing that laboratory activities are not integrated with non-laboratory and theory classes. The laboratory classes should emanate from theory classes such that students can actually see science as one to be learnt by activity and discovery and not by memorizing notes of the theory classes.

The fourth rated is the open-endedness component indicating that students do not have opportunity to pursue their science interests in the laboratory class. Most of the students see themselves as just carrying out whatever activities are designed by the teacher where their initiatives are not used and innovations are not likely to come up. The least rating for material environment confirms the fact that equipment and materials needed for laboratory activities are generally inadequate, the laboratories are crowded and the appearance unattractive. Equipping the laboratories has been a major problem for schools and this might not be unconnected with factors such as funding and lack of commitment by government.
A significant correlation was found between the ways students perceive the quality of science laboratory environment and students' academic performance. In particular, Integration, Material Environment, and Student Cohesiveness were strong correlates of achievement. This reiterates the importance of ensuring good quality in these components to improve achievement. The study has been able to revalidate in Nigeria the research instrument- Science Laboratory Environment Inventory (SLEI) designed and validated by Fraser et al. (1993) as it was found to have high validity as an instrument for assessing the total laboratory environment as well the five components of the environment, (Aladejana and Aderibigbe, 2007) .

Curriculum and Science

The curriculum is the totality of planned and unplanned experience of the learner under the auspices of the school (Ehindero, 2012). The curriculum determines not only the content of what is to be learnt but also dictates the method and implementation in schools.

A good curriculum must have internal relevance (meet the set goals) and external relevance (sensitivity to trends and changes within the valve system and meeting foreseeable needs and goals and evaluation). My empirical analysis of the Nigerian JSS Integrated Science Curriculum showed that it is well designed, adequate in scope and depth and has internal and external relevance. There were adequate topics on contemporary problems of environment and global scientific issues such as personal cleanliness, pollution of air and water, purification of water, flooding, wild life conservation and drug abuse. The curriculum has adequate content and scope to develop scientific knowledge which span through Chemistry, Physics, Biology and some Social Sciences. However, the content tends to be over-ambitious with some topics above the cognitive level of the learners like the Particulate theory of Matter and Electrolysis.

Most of the recommended activities in the curriculum have the potential for training the mind for intelligent inquiry and problem solving which are the requirements for developing a scientific mind. These activities require learners to manipulate, investigate and find out. The various action verbs used in the activities include: classify, count, observe, draw, perform, examine, demonstrate, collect, sort, compare, watch, measure, and construct. These activities if properly executed can guide to make rational decisions, understand the world around and have meaningful learning. The role of the scientist in development is not adequately covered and this is an aspect that could build up curiosity and interest of learners in Science. Also, the curriculum has not addressed the issue of alternative conceptions that students might bring into the classroom hence has not provided the learner with the opportunity to sift through a wealth of information, to learn the appropriate ones and ignore the unsound. There is therefore the need for curriculum enrichment.

Special Focus on Functional Secondary Education in Ekiti State, Nigeria

Given the strategic place of secondary education in the Nigerian educational system, it is important that it should be "near-perfect" in both standard and quality but the present state is of major concern. Secondary education has a consumer and producer status as it stands as a change-over bridge receiving primary school leavers at one end and turning out her products mostly as freshmen and women for postsecondary education at the other end. An overview of the secondary school curriculum shows that it specifies in great depth the content to be taught, pedagogy and assessment of what students have learnt.

A comparative analysis of the current JSS curriculum with the Forms 1 and 2 curricula of the 60s and 70s revealed that the content has been improved and expanded considerably to include Introductory Technology, Computer Education, Vocational and Technical Education, Social Studies and Integrated not General Science. The senior secondary school which receives the end-product of the JSS also has a diversified curriculum. The SS students have a wider range of subjects to select from and so may be choosing from over a range of 25 subjects with improved content as against about 10-15 in the past. Given all these provisions, should the standard of education be regarded as fallen curriculum-wise? The likely answer may be, "no, look elsewhere" and the 'where else' may call for an examination of other inputs into education or contributions at the disposal of education.

The current secondary curricula have been expanded to include family life education, HIV & AIDS education, Computer education, drug prevention education, basic African cultural knowledge, cultural and creative arts and Nigerian history, (FGN, 2007); all of which are important for the wholesome development of the child. However, I have added my voice to the suggestion that moral education be included to address the problem of decaying moral values of our younger generation. Library periods

also need to be encouraged to develop reading habits recognising the problems of students with language and reading.

Mr Vice Chancellor Sir, I have been able to investigate some other factors of secondary education which are very pertinent to how well our schools can provide functional and sustainable education. Factors identified include the issue of large class size and teacher-pupil ratio sometimes as high as 1:90 as against the required standard of the UNESCO's recommendation of 1:30 and that of the National Policy on Education 1:40. Little meaningful learning and teaching can take place in such congested classes. The irony of this is that many unemployed teachers are begging for appointments. Other factors include: the school population size as small school environment has been found to favour more positive student attitudes, lower incidences of negative social behaviour, better monitoring and a greater variety of co-curricular activities than large schools. All these I remember and agree with, with my experience in my alma mater, St Louis Girls Grammar School, Ikere-Ekiti.

Another major problem is the issue of truancy, absenteeism and students not being able to spend adequate time in school to read up after classes, do assignments and be involved in co-curricular activities. The entertainment world, media and technology have so much taken over that an average student is busy on the iPod, mobile phone – music, text messages or keyed to the internet on Facebook, pinging, tweeting. This situation is compounded by the fact that many parents are absentee parents; they are away all day and at times all night on business leaving the children to take important decisions and to the influence of their peers. The restoration of boarding house might be a way out of this crisis; although the boarding house removes students from home and requires adjustment into a new environment, the advantages are overwhelming.

Other identified factors include poor budget allocation to the education sector especially the secondary schools as most states in

Nigeria have never met the UNESCO recommendation of 26% of the annual budget to education which may explain the infrastructural failures and the poor salary structures that are also in turn probably accounting for the dismal performance of secondary schools. Neglect of the affective life of schools in favour of the so-called effective academic performance has also been found. Schools are emotional places; everyone remembers their school days through the rhythm of emotional highs and lows. Yet, participation in network experiences, social activities, games which can provide students with a lot of fun and pleasurable experiences that can promote positive attitude to learning have been found reduced considerably in these.

Gender Issues in Science

Gender denotes the set of meanings, expectations and roles which a particular society ascribes to its members. Gender is a social construct while sex refers to the biological category. Gender has been found to play significant roles in determining the sequence of job positions one occupies throughout life. Female education is especially very important as it affects family health and nutrition, fertility and the training of the younger generation. Women have however been found to be under represented in professions strictly based on science and technology that can, to some extent be attributed to gender role perception of the society, which often start at an early age and are reinforced within the family, at school, in the media and the society at large.

My analysis of some departments in Obafemi Awolowo University during the 2012/2013 session revealed cultural professional stereotype evident in the percentage female representation in enrolment. For example, female enrolment was found to be high in Home Economics but very low in Quantity Surveying, Building Technology, Architecture and Electronics and Electrical Engineering. In five out of nine science-based faculties in the University (Agriculture, Basic Medical Sciences, Clinical Sciences, Technology and Environmental Design and

Management, EDM), there was the under representation of women. Only the Faculty of Pharmacy had percentage female enrolment a little above average. This is quite interesting as this may not be unconnected with the fact that the profession has link with buying and selling in pharmacy shops and culturally buying and selling is more of a female profession. The least female representation was in the Faculty of Technology where most of the engineering courses are offered. This was followed by the Faculty of EDM where courses such as Architecture, Building technology, Estate Management and Quantity Surveying are offered.

The under representation of women was also found among secondary school science teachers. All these obviously result in the absence of female role models, an important factor as the culture readily identifies the odd one out, one that is non-conformist and the implication of this is that most girls would rather fall in line with careers in which they see women examples. One cannot therefore underestimate the place of role models. From personal experience, my daughter while growing up always wanted to be a nurse, the only major influence was that all my three sisters were nurses and they were the great role models she saw around but eventually became a lawyer. My younger son kept changing his name from that of one footballer to another, the role models he saw were Wengili, David and he played all over the Staff quarters and would have loved to end up in Old Trafford, but he didn't make it to a great team! However, my elder son was very scared of injection as a small boy, I think he still is and he saw the doctor that could just look at a patient and prescribe injections as the ultimate and loved to be one; today he is a medical doctor.

In a similar statistical analysis of overall enrolment, I found more males than females in 15 science-based courses in all the Nigerian Polytechnics for a period of five years, 1993 – 98. In some of the years, three courses had an all-male class: Printing technology, Ceramics and Photogrammetry, while over the period of five years; three courses (Food Technology, Catering/Hotel Management,

Nutrition/Dietetics had a significant difference between male and female enrolment with females having a higher enrolment.

One of our studies also found that tertiary institutions are dominated by male leadership with under representation of women in leadership positions in the education sector in Nigeria. In 2004, only 4.24% of vice Chancellors/Rectors/Provosts in the country were women, 4.43% of Deputy Vice Chancellors/Deputy Provosts/Vice Rectors, 15.32% of Bursars and 19.20% of Registrars. The percentage of women serving as senate/academic board members was 12.51%, Deans 12.88% and heads of department 12.74%, (Aladejana and Aladejana, 2003; 2005). There is no doubt that the situation might have improved since the period of study, but one still has reason for serious concern with the 2013/2014 enrolment in some science-based courses of OAU, Ile-Ife as reported in the university annual report. Percentage of female enrolment is still low in the Faculty of: Science – 41.87%, Clinical Sciences – 32.14%, EDM – 29.65%, Pharmacy – 29.36% and Technology 17.43%. There is therefore still a lot more to be done to encourage girls in science and technology and for leadership positions generally.

I have been able to investigate two factors related to the disparity in enrolment and attrition of girls from science classes - classroom dynamics (in terms of the curricular content and teacher activities) and the textbooks used by students. My study of 40 science laboratory activities randomly selected from the revised Nigerian Junior Secondary School Integrated Science Curriculum showed that 57.5% were biased to boys' out of school experiences, 27.5% biased to girls' out of school experiences, while 15% are found to be gender-neutral. Examples of activities biased to boys are: using a bicycle pump to compress air and flying a kite; those biased to girls include leading discussion on child rearing and socialization while gender-neutral activities include differentiating between the movement in plants and animals. Such stereotypes can discourage girls from entering science and technology courses and careers while putting boys at an advantage.

The findings revealed ten causes of attrition of girls from science. The five leading causes are: prevalence of career misinformation, cultural stereotypes, inadequacy of female role models, lack of access to out-of-school activities that provide meaningful science-related experiences and lack of career counselling. Thus, boys are involved in inclusive plays with trucks, kites, creative toys, building blocks while girls are virtually restricted to playing 'mothers' with boy babies, pots, food and sewing. As they grow older, girls cook and take care of the house while boys can operate the television, and radio, fix electric bulbs, fix tyres and take initiative with mechanical and electrical appliances in the home. Other identified causes of attrition of girls are: peer influence, lack of interest in science, parental influence and early marriage.

In terms of teacher activities, teachers were found to give the impression that boys are better than girls, use longer wait-time for boys, use graphic representations of scientists as male, call mostly male volunteers to answer questions and carry out activities, and often leave out girls who may be shy to raise up their hands to answer questions. Also, while boys are encouraged to be independent, explorative and assertive, girls are encouraged to be submissive, complacent and dependent. Generally boys were the class captains and girls were the assistants. The teaching strategies of the teachers were usually competitive rather than the cooperative approach which girls are more prone to use.

There is therefore the need to educate the society in general to encourage boys and girls to participate equally in all activities. The science curriculum should be more gender-friendly while teachers should avoid gender-stereotype behaviours in their interaction, language, and strategy in the science classroom.

Textbooks and Career Choice

I also studied the print media which are powerful channels of disseminating information and have contributed substantially to

facilitate and encourage formal education through textbooks, magazines, journals newsletters, bills and posters. The textbook which is most widely used of all teaching instruments is almost synonymous with the school and traditionally the medium through which curriculum contents are organized. Students' interaction with textbooks helps them to construct images about objects, events, phenomena and even themselves. Students often give extended attention to the illustrations in textbooks from which they can perceive hidden but influential and important messages which subconsciously can influence learners' personal feelings, attitudes and values, (Weber and Mitchel, 1996). Such influence can have long-lasting effects especially when formed at the formative years.

Drawings and pictures are compelling sources of data that have seldom been used in educational research. Our study carried out an analysis of pictures in 23 Nigerian Primary English Textbooks published from 1995 – 2000 by four different publishers. It was found that gender-induced cultural stereotypes are clearly manifested through the pictures representing various professions in the selected textbooks. While men were shown as doctors, scientists, pilots, and judges, women were shown as nurses, secretaries, and those doing house jobs like sweeping, cooking and caring for babies. In many of the pictures, boys were shown working on the microscope, pouring chemicals, weighing objects while girls were merely standing and watching the actions of the boys.

Analysis of the drawings by the primary school pupils of five science-related professions showed that some professions were typically perceived and drawn as male such as doctors and scientists; some were perceived and drawn as female such as nurses and cooks while teachers were perceived and drawn almost equally as both male and female. A high correlation was found between the professional gender bias in textbook pictures and learners' drawings of professions. A reasonable amount of causal influence can be drawn on the textbooks used by learners during the formative years of the basic education and their perception of

the gender of people that should be in some specific professions. Therefore publishers and textbook authors carry considerable responsibilities to ensure that learners are presented with images which address the issue of female under-representation in some professions.

Efforts in Textbook Improvement

I have co-authored six primary science textbooks and three junior secondary school science textbooks and their workbooks. These books have tried to cover the curriculum extensively, providing specific objectives, activities and revision exercises that make teaching and learning effective when handled by good teachers. The practical activities are mostly with familiar objects except in very few cases where the use of specialized equipment can make learning better. Gender issues were also taken into consideration in the language used, the examples given and in pictures and diagrams.

Teacher Factors

Teachers have been identified as the singular most important factor in learning and can be said to be the heart of education. According to the FGN (2007), no educational system can rise beyond the quality of its teachers. There is also a significant relationship between the quantity and quality of teachers and students' academic performance. The teacher is very important in dictating the classroom environment by verbal and non-verbal communication, as well as the quality of interaction. His/her acceptance or rejection of a student especially at the early stage of life can determine the future of the child not only in that subject but in school generally.

Looking back at your primary and secondary schools days, one can readily bring back to mind the best or worst teacher. Whoever is considered as best or worst teacher obviously had a lot of influence on one's choice of career. I know clearly that I dropped History in Class three because my History teacher seemed to find fault with

everything about me, giving me up as a never-do-well, whereas the Chemistry teacher was lively, encouraging, patient, accommodating and brilliant. Even though I was also good in both the Arts and Sciences, I quickly keyed into the Sciences.

There are various factors that have been identified to determine who a teacher is and how competent he or she can be; all of which can affect the effective functioning of schools. I have been able to look at some of these factors.

The Functionality Perspective of Teacher Education in Nigeria

It can be surmised that a teacher should not just have any teacher education but a functional one. For teacher education to be functional, it must equip entrants into the profession with training in methodology, what to teach, how to teach it and the practice of teaching or internship just like other professions. It must involve the mastering of the subject matter, good preparation and efficient delivery of lessons. According to the Free Dictionary, functional means practical rather than decorative, designed for or adapted to a particular function or use. Thus, functional education selects knowledge that is concrete and usable rather than abstract and theoretical; it can therefore be described as education that comes from the needs of the learners.

An overview of teacher education shows that there are some aspects that have had considerable improvement over what they used to be in the past. Schools no longer have untrained teachers as the prescribed minimum qualification is the National Certificate in Education NCE for pre-primary, primary and Secondary Schools. Also, there are minimum standards for teacher education by the National Commission for Colleges of Education (NCCE) for teacher education at the NCE level and by the National Universities Commission (NUC) for the graduate teacher education level. These two bodies apart from setting the benchmark

also conduct regular accreditation of courses to ensure that there is strict compliance.

Another improved aspect of the teacher education is the improved and robust curriculum content. Teachers in training are exposed to courses in vast areas like Philosophy, Sociology, Administration, Management, Guidance and Counselling, Methodology, Curriculum, Educational Technology, History of Education, Special Education, Psychology, Child development, Test and Measurement in addition to courses taken in their specialized subject areas like Economics, Biology, Chemistry, Mathematics, Yoruba, Technology, Fine Art and others. There is also the Teaching Practice which constitutes a major part of the curriculum.

I have been able to identify some challenges that could detract from the functionality of teacher education in Nigeria, one of which is the problem of attrition from teaching and falling enrolment in teacher education programmes. This might not be unrelated to the lack of motivation for teachers as the conditions of service are not enticing enough to attract and retain the best of brains especially in primary and secondary schools. The ultimate implication of this is the poor attitude of teachers to the profession.

The quality of admission into teacher education has also been found not to achieving the set goals through the teacher preparation process. It has consistently been difficult for the profession to attract very good students and young school leavers; the few who enroll do so mostly because they have no choice, it is really the last option to be considered. Thus, most Colleges of Education cannot fill their quota for admission as directed by the Joint Admission and Matriculation Board, JAMB for these obvious reasons. It is equally difficult to retain teacher educators in Colleges of Education as they want to move to the university as soon as they obtain their PhD.

Another challenge is the plague of frequent political unrest which has generated a lot of negative effects and change in educational

policies. The situation has recently been made worse by frequent strikes by students, teachers and administrative staff. Closely related to this is the decadence in the society that recognises and honours wealth without identifying the source; a society that places prestige on acquisition of wealth rather than knowledge; that renders certificate almost valueless as a result of high rate of unemployment. Complete re-orientation is very important to achieve desired goals in education, (Ojedokun and Aladejana, 2012; Aladejana and Ilugbusi, 2013).

Other Related Issues to Effective Teaching and Learning

One identified factor against having an effective school is the high rate of teacher migration and possible attrition. The root causes of teacher migration and possible attrition from my study have been found to be largely related to lack of job satisfaction it. It was found that teachers are prone to migrate from private to public schools, from rural to urban schools and from lower schools to tertiary institutions. A lot of us in the universities and other tertiary institutions most likely have taught at a lower level at one time or another. Attrition, especially of the best brains to other sectors was also found to be high particularly in the sciences to other professions.

The need for reforms to reduce migration and attrition has been established by a further study of attrition of teachers in Nigerian Universities which revealed that before the reforms, university teachers' self-efficacy (the belief individuals hold about their capability rather than what they are actually able to accomplish) and self-esteem (the personal judgment of worthiness) were generally negative. But with the reforms, largely in form of improved wages, positive effect was observed on the teachers' self-efficacy and self-esteem; while both migration and attrition reduced considerably; thus, the ability of the system now to retain the best brains.

Imperatives of Specialized Pedagogy

Generally in Nigeria, science teaching at various levels still retains the old conservative approach with the teacher in most cases acting as the repertoire of knowledge and the students the dormant recipient. There is over-reliance on textbooks with only occasional demonstrations and experimental classes. Classrooms are still a cycle of memorization, repetition and note coping. This method of teaching does not seem to be meeting the needs of the present generation recognizing the ultimate poor output from schools especially the primary and secondary schools. In spite of the fact that the media and entertainment industries have taken over the attention of learners with their fun and excitement, classrooms still remain passive, teacher-oriented, non-participatory and irrelevant to the day-to-day activities of the learners.

Students must be able to have fun and enjoy school. One major way of achieving this is for classrooms to become active, relevant, student oriented and participatory; hence, the imperatives of specialized pedagogy. The recommended trend in teaching and learning is now towards the theory of constructivism, a philosophy which perceives learning as a process of adjusting mental models to accommodate new experiences: constructing knowledge, developing thinking skills, building learners' ability to reflect and generating strategies for defining a problem and working out solutions rather than working on answers that the teachers wants. Thus, learning how to learn, knowing how to know, and contextualization of learning are some features of constructivism (Duffy and Cunningham, 1996).

Use of Science Stories

For the learning of science to have a solid foundation, it is imperative that primary school learners must have a substantial exposure to science. Much emphasis is often put on developing communication skills and writing proficiencies at this level to the neglect of science study. My review of 21 primary English

textbooks from five Nigerian publishers revealed that they have some science content which was obviously not included for the purpose of teaching science. The concepts were introduced as Exercises and Comprehension passages. The percentage of science topics in these books ranged between 0.59 – 12.5%. Examples of topics found include: Parts of the body, measurement of time, Crude Oil Refinery, Water, Food, Environment, Machines and Work and Wires.

My experimental study of 512 primary four pupils in South-West Nigeria in which the experimental group was taught the topic 'Water Cycle' using a science-based English Comprehension passage titled "Water in Air" basically describing the water cycle and the control group taught the same topic as a science lesson found that there was no significant difference in the performance of learners in the two groups. It can then be inferred that students can learn a significant amount of science passively from English comprehension classes that is comparable to what can be learnt from science lessons at this level. This strategy can thus serve as supplement and complementary to regular science lessons where either approaches are used. This agreed with earlier findings of Young (1979) that the use of science stories in language lessons can help to transmit both scientific knowledge as well as language.

For science to be effectively learnt in English lessons, the learner must primarily enjoy reading a story and at the same time passively learning science. This strategy is not only of an advantage to the learner but to the English teacher who is not likely to be have great science knowledge. There are however some limitations to the use of science stories as they cannot be used effectively for topics that require labeled diagrams for understanding, symbols and formulae, construction, design and demonstration.

ICT in Teaching and Learning

The world today is steeped in science and technology and governed by ever increasing discoveries, inventions and innovations. Technology has become an integral part of children's everyday lives, at home they come in contact with mobile phones, television, computers, remote controls and toys that have buttons and particular functions. Whilst outside the home, they see cash registers, bar-code scanners, traffic lights, automatic doors, and security cameras to mention a few. Almost everything around the child now has an i-component – play, sleep, food, movement, leisure, whatever one can think of. The obvious implication of this is for the child to become an 'i-child'.

There is the need to bring technology into science classroom. The concept of Computer Assisted Instruction is as a result of the advent of Information and Communication Technology (ICT). CAI is a kind of instruction that exploit computer software to assist teachers teach information or skills related to a particular topic and students can interact directly with lessons programmed into the computer system, ((Roblyer, 2004)). If the classroom does not become compliant with the outside environment of the child, then some crisis is imminent, whatever may be the colour of the child. Have you ever pondered why children do not seem to like school, why they are so reluctant to go there and so eager to leave the place? Could something really be missing? Bringing ICT into the classroom may possibly provide some answers to these questions. For this to happen, there is the great need for teachers to be compliant, but the real issue is that a large majority cannot or will not teach what they did not learn. Like it's always said, teachers cannot continue to use old maps for new highways.

In our experimental study using Junior Secondary School (J.S.S.III) Fine Arts students in Southwest Nigeria, we identified the cognitive styles of students and assessed the effect of the use of computer assisted learning on these learners' academic performance based on their cognitive styles. The two main groups

of students based on the cognitive styles are Field Independent and Field Dependent Cognitive Styles. Field independent cognitive style focuses on parts, rather than on the whole, are reality oriented to objects and can analyse discrete elements; while field dependent cognitive style learners focus on the whole, rather than the parts. They are reality oriented to relationships and social attributes. The Field dependent individuals prefer group while the field independent prefers independent work.

Our study found a significant difference in the performance of students (field dependent and field independent) exposed to computerized graphic package and those (field dependent and field independent) exposed to the conventional method of teaching. Students exposed to computerized graphic package (a form of computer-assisted instruction) performed significantly better in graphics than those exposed to conventional method. This agrees with the earlier finding of Wang, Wang and Ren (2003). However, a significant difference was found in the performance of field dependent and field independent learners after exposure to learning using the computerized graphic package with field independent learners performing better than field dependent learners as earlier found by Cakan, M. (2000). The study also established that the use of CAI can be useful in both arts and science classes. It is therefore recommended that teachers should identify the cognitive styles of their learners as well as make special efforts to use computer assisted learning in their classrooms, (Idowu and Aladejana, 2008).

Blended Learning and Teaching of Science

Although technology has been identified as playing a critical role in curriculum, very little efforts have been made in its integration into the Nigerian secondary school classroom. There is therefore the need to energize action to bring technology into the classroom for improved learning and performance. I have however identified various barriers to ICT use in these schools to include: poor infrastructure; epileptic power supply; lack of electricity; lack of trained personnel/teachers; poverty; inadequate funding and

limited or no internet access. Hence, advocating a total shift to technology-assisted classroom might be unrealistic in most secondary schools.

Blended learning can however be a better alternative, which is the combination of multiple approaches to learning. This can be achieved by having technology-based activities and face-to-face sessions used together to deliver instruction. In my descriptive and experimental study, using Senior Secondary School II students and their teachers, the experimental group had the topic 'Evolution' taught using the blended learning approach involving discussion method, the traditional chalk and talk method and Computer-assisted instruction. The control group was taught by the typical traditional method, with each lesson following the format of review of previous knowledge, teacher presentation, summary (using questions) and note writing.

A significant difference was found in the performance of learners in the two groups. A similar study carried out amongst primary school pupils also revealed a significant difference in academic performance. It can thus be concluded that the use of blended learning can make a significant difference in the performance of learners compared to when the traditional chalk and talk approach to teaching is used. Various advantages have been identified for the use of blended learning. It can help to combine the strengths of many methods and accommodate a variety of learning styles as students often have preferred learning styles which when used lead to improved performance.

The results of the study have also shown that most of the teachers are computer literate but very few have specialized skills that will enable them to use ICT in the teaching and learning process and make meaningful impact on the students. Most of the students were found to have better skills which can enable them to use ICT for learning than the teachers. Thus, the teacher educators need to enrich the curriculum and acquire more skills to train the student teachers who will go out to teach in the secondary schools.

Teachers should be encouraged to use blended learning to help to improve the performance of learning in the senior secondary science classes.

Simulation and Games

Globally, science and technology is changing the world at an unbelievable rate; the 21st century classroom must therefore be matched with 21st century education which should be flexible, creative, challenging and complex. Since a total shift to technology-assisted classroom is unrealistic in most secondary schools and blended learning is an alternative, one of the combinations of multiple approaches that can be explored is the simulation games which have the benefits of experiential and active learning. Simulation games in the classroom are used to copy what is found in a real life situation; participants are provided with a simulated environment or simulating activities in which to play. These games are intended to provide learners with insight into the process or event from the real world which is being simulated.

Simulation games are argued to be an excellent supplement to the standard lecture and has key benefits such as: adaptable to the level of the individual while providing support; games are learner-centered; built with multiple levels; ensuring user's skills are challenged; engage users for hours in pursuit of a goal; played with others; online communities provide engagement; provide immediate and contextualized feedback; and encourage creative expression, problem solving in complex situations.

Our study determined the comparative effectiveness of Simulation Games and Computer Assisted Instruction for teaching basic science at the lower primary school with a view to recommending it in situations where facilities for CAI are greatly deficient. This was predicated on the assumption that the use of computers and games affects the motivation of students in the learning of science. The study was underpinned by Bandura's theory of observational

learning and theory of constructivism. Bandura's theory of observational learning lays emphasis on experimental methods, with variables that are observable, measurable and manipulative, and they avoid whatever is subjective, internal, and unavailable. The study was also predicated on the theoretical framework of constructivism, a philosophy of learning founded on the premise that by reflecting on our experiences, we construct our own understanding of the world we live in.

The three groups of study were taught four different topics selected from the primary school curriculum of basic science and technology The first experimental group was taught using the "Game Tactics Skill package" (GTSP) which involved pupils playing the Simulation Games. The second experimental group was taught using "Computer Interactive Package" (CIP) which involved cluster teaching and individual interaction with the software designed for CAI while the control group was taught using traditional lecture method (chalk and talk) and pupils copied notes at the end of the teaching.

The study found that there was no significant difference in the performance of pupils in the two experimental groups, that is, those who were exposed to the simulation games and computer assisted instruction. This implies that what CAI can achieve, SG can also achieve it. However the performance of learners using conventional method was significantly different from the performance of learners in the two experimental groups. Thus, performance of learners in science can be enhanced using both simulation games and computer assisted instruction over the conventional method of instruction. Recognising the limitations of most Nigerian environments in terms of availability of facilities for CAI, it is recommended that simulation games be put to use to promote active learning where facilities for computer assisted instruction are minimal. Moreover, these two strategies assist learners to believe that they are capable of accomplishing school tasks and hence develop a high sense of self-efficacy, (Sowunmi and Aladejana, 2013).

Deep Knowledge of Content Matter

For teachers to be qualified and effective, they must acquire knowledge that will lift them higher than those they teach. An excellent teacher demonstrates mastery and command of the subject to be taught. In recognition of the challenge I was to face in teaching Science up to the doctorate level and in my quest for excellence as a science teacher in education, I did a Masters in Science Education and PhD in Botany. The focus of study was the botanical and cytogenetic studies of some indigenous species in the A-Genome complex of the Genus Oryza Linn (known to us all as Rice). Let me provide you with a very brief summary of my research activities.

The A-Genome Complex

Germplasm Exploration and Collection.

The study on the A-genome complex involved germplasm survey and collection, characterization of the accessions collected, investigation of the species relationship among the species in the A-genome complex, genetic studies of attributes of agronomic importance in the accessions and cytogenetic studies. The A-genome is the genomic group of Asian Rice, *O. sativa* Linn. which is the cultivated rice. This underscores the importance of this study for its potential in the improvement of the rice crop. The study was based in the agroecologies of the Nigerian savannah where the members of the A-genome:

O. longistaminata A. Chev. et Roehr., *O. glaberrima* Steud., *O. sativa* Linn. And *O. barthii* A. chev. are endemic.

O. longistaminata occurs in low-lying swamps some of which are basins of rivers; most are flat lands that retain water (fadamas). The members of this genome occur in Bidda, Badeggi (Niger State) and Jebba in Kwara State. *O. longistaminata* is also found as a weed in cultivated crops.

The characteristic feature of rice agriculture in the savanna is intense cultivation of lands inundated with water and the existence of interphases among *O. glaberrima*, *O.longistaminata* and *O. sativa* Linn. in the Bida and Jebba agroecologies; the intephases are generally less disturbed. Impoundments (natural) around which active cultivation goes on has also created more permanent interphases in Jebba.

Plate 1: A thicket of *O. longistaminata* (background) around a Lake in Jebba

Plate 2 : A natural impoundment at Jebba.
Note the rim of *Oryza longistaminata* around the impoundment (A) and *Oryza sativa* being cultivated around in the fadama (B). The arrow shows the surface of the water in the impoundment covered with *Nymphaea*

In all the survey, *O. glaberrima* was not found under cultivation confirming its status as a lost crop. It is not quite understood why a fairly large population of this species was preserved in Jebba as at 2000.

Genetic Studies

This study succeeded in identifying valuable genetic resources such as photoperiod neutrality, long grains, awnlessness, dense panicle, early maturity, heavy tillering and compact panicle form

from the cultivated and wild gene pools of *Oryza* indigenous to Nigeria. While many of these characters have high agronomic value, some of them are important as genetic markers.

The inheritance of ripened hull colour monitored in a cross between two accessions of *Oryza glaberrima* (TOG 12083, straw X TOG 16771, black) and an interspecific cross between *Oryza glaberrima* and *Oryza barthii* (TOG 5236, straw X TOB 7382, black) segregated 9black: 7straw confirming the complementary mode of inheritance and the dominance of black hull colour. Normal sterile lemma is dominant over long sterile lemma in a ratio of 3 normal: 1 long sterile

The biology and genetics of photoperiodism were studied in *Oryza glaberrima* and *Oryza barthii* where the trait was frequent. Only TOG 16771 was day-neutral Day-sensitivity occasioned significant reduction in the number of primary branches, number of secondary branches, tiller number, plant height, panicle length and spikelet number but spikelet parameters (length and breadth) were however relatively unaffected. Root weight was significantly lower in the day-sensitive accessions but the number of internodes did not vary between the accessions and their F_2 subpopulations.

Day-sensitivity is a very important phenomenon in Agriculture. It limits the range of cultivation of any crop across latitudes. *Oryza longistaminata* provides an extreme example of this phenomenon because it does not flower at latitudes south of Jebba. There are also subtle manifestations of this phenomenon in our land races of *Oryza sativa.*

Cytogenetic Studies

The highlights of the cytogenetic investigations are:

1. Hybrids between *Oryza longistaminata* and *Oryza sativa* were sterile in spite of the modal chromosome configuration of 12II.
2. The F_1 between *O. glaberrima* and *O. barthii* (TOG 5236 x TOB 7382) was fertile with a spikelet fertility of 78%, modal chromosome configuration of 12II and the

occurrence of a translocation at pachynema. There was correlation between the occurrence of the translocation and non-disjunction. Also a fit to Mendelian ratio for duplicate gene interaction in which pubescence is conditioned by the recessive state at two loci was determined.

3. Restoration of fertility in the BC_1F_1 of the *O. glaberrima* x *O. sativa* cross and segregation for fertility in the BC_1F_2.

Plant form of the Oryza sativa x Oryza longistaminata cross (top, right) recovered from Jebba and its panicle form (left); Bottom plate shows panicle forms in O. sativa, O. glaberimma and their hybrid.

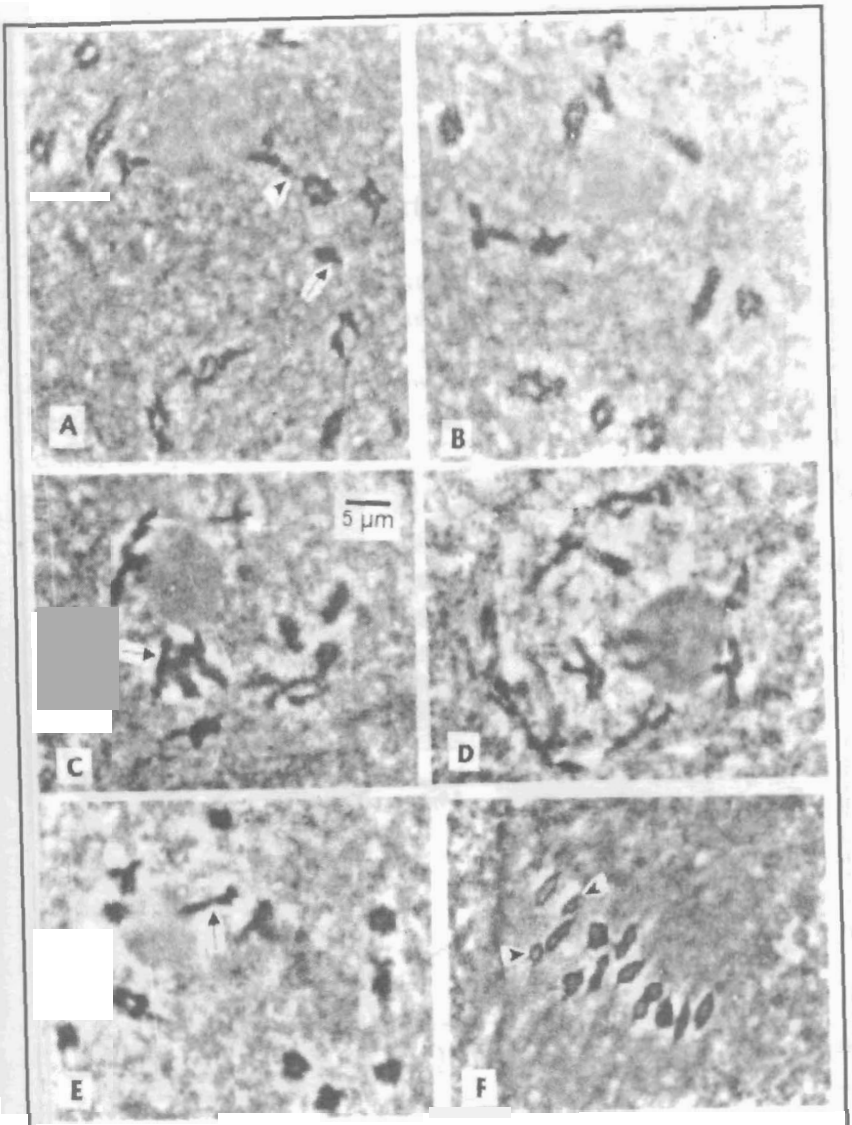

Plate 4 : Chromosome configurations in an O. sativa x O. glaberrima cross (TOG 10985 x IJ86-B): A. Diakinesis showing 10II+1III+1I B. 12II C. 1VIII+1IV+6II D. Diplonema showing 12II E. Precocious separation at Diakinesis (arrow) F. Metaphase I showing 11II+2I (arrows show univalents).

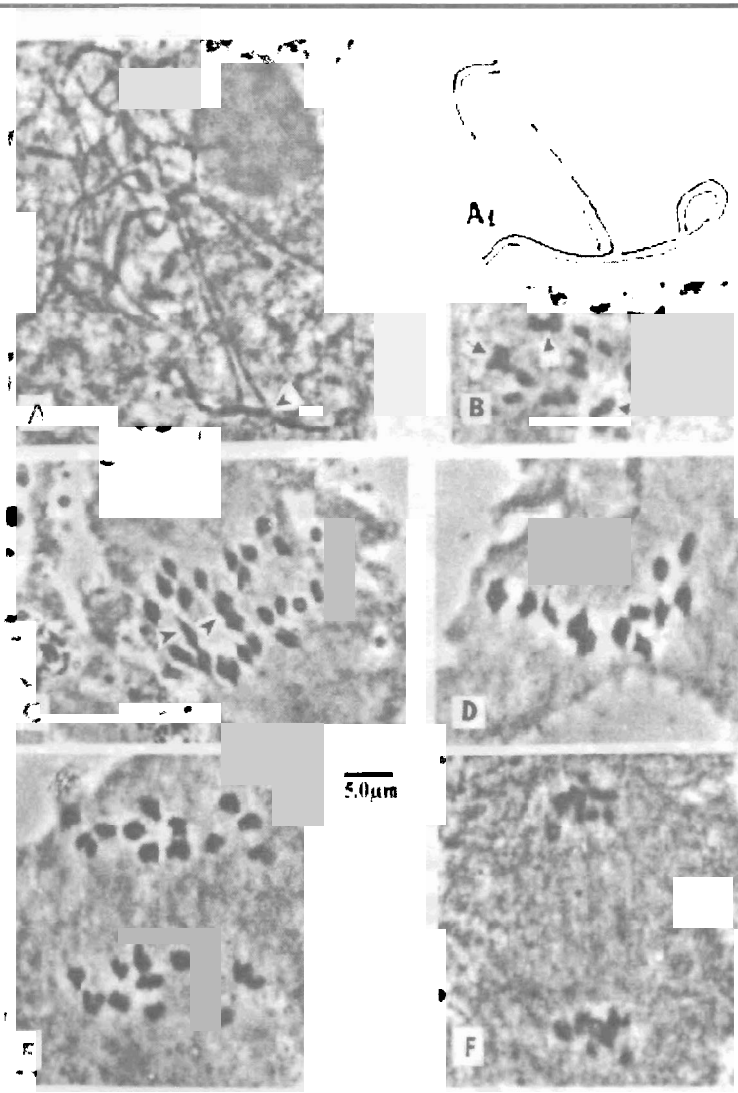

Plate 5: Chromosome configurations In an O. glaberimma x O. barthii cross (TOG 5326 x TOB 7382): A. Pachynema showing a translocation breakpoint; A_1. Diagrammatic interpretation of A; B. Diakinesis showing 4II+16I C. Non-disjoined bivalents at Anaphase I; D, E, F are normal.

Population Dynamics and Phylogeny of the A-genome Complex

The population dynamics proposed for the A-genome complex at Jebba is based on the totality of evidence from the genetic, cytogenetic and agrobotanical studies. The occurrence of natural impoundments and the interference of man (opening up of the fadama for rice cultivation, leaving off offtypes during harvesting, exclusive fadama season planting which inadvertently also enabled the cultivated rice to synchronize with the wild rices in flowering).

Figure 1 shows that hybridization and introgression leading to the restoration of fertility of the hybrids and subsequent segregation either as F_2 as in the *O. glaberrima x O. barthii* cross or as BC_1F_2 or their advanced generations as in the other crosses. This study

demonstrates that chromosome rearrangement is involved in the process of speciation in the A-genome as evidenced by the occurrence of a translocation in the *O. glaberrima x O.*

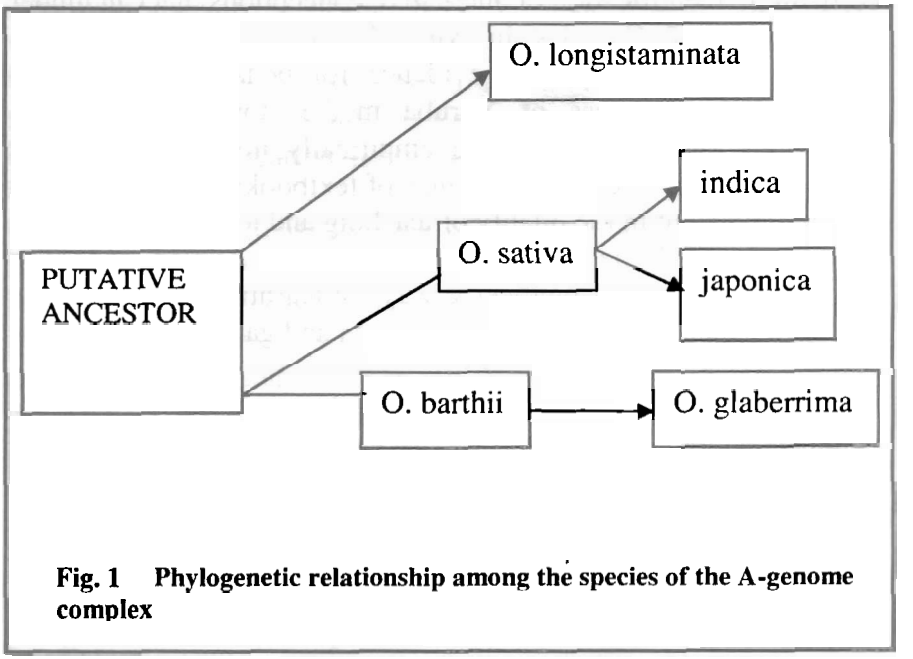

Fig. 1 Phylogenetic relationship among the species of the A-genome complex

barthii cross and that *O. glaberrima* arose from *O. barthii* through this process, (Aladejana and Faluyi, 2001, 2007; Aladejana, Nwokeocha and Faluyi, 1995; Faluyi, Nwokeocha and Aladejana, 1999; Nwokeocha, Faluyi and Aladejana, 2007a&b).

Conclusion

The thrust of my research is in the area of science education where I have contributed immensely to the improvement of science teaching and learning. I have been able to research extensively into what teaching is and who a teacher is supposed to be. Specifically, I have delved into the state of science teaching and learning in Nigeria especially in primary and secondary schools and identified various factors that can impede or enhance effective teaching and learning of science. Factors discussed include teacher characteristics, classroom dynamics, the learning environment, the curriculum, identification of alternative conceptions that can hinder the learning of Genetics in particular, etc. In my research endeavour, I have provided evidence for pedagogic value and cultural imperativeness of Yoruba mother tongue as well as indigenous knowledge. I have empirically investigated gender issues in Science and the importance of textbooks in career choice. For improvement in the quality of teaching and learning of science, I have provided the basis for the use of improved pedagogy specifically in form of innovative ways of learning science such as the use of science stories, ICT, simulation and games.

My research in Botany in the area of Genetics was on the A-genome complex of the genus *Oryza*. It elucidated the potentials of variability, the population dynamics and evolutionary relationships in the complex. The results revealed the potential and real value of population dynamics in the complex in creating a broad pool of variability for the improvement of the rice crop.

Final Remarks

Mr Vice Chancellor Sir, with all sense of humility, I want to encourage all students in the Faculty/College of Education that feel frustrated at their choice of career, that having found themselves there, it can indeed be the career that can open the gates of the world to them. I got there as a last resort like many of them and today to the Glory of God, I have attended and presented papers in at least 20 conferences outside Nigeria – Israel, United Kingdom, Canada, Australia, Germany, Finland, Ireland, France, Four States in America, Egypt, South Africa, Ghana, Ethiopia and Kenya, most of them sponsored.

I have also had modest achievements as a teacher that can qualify me as a role model to my younger colleagues. I was selected as one of Nigeria's Foremost 100 First Class Graduates in 2010. I have about 15 Awards of Excellence relating to Education, teaching and learning. I was appointed University Public Orator, Obafemi Awolowo University, Ile-Ife, 2011, Member, Congress of African Scientists and Policy Makers, Country Coordinator, International Congress for School Effectiveness and Improvement, ICSEI, USA and Provost of one of the best Colleges of Education in Nigeria, the College of Education, Ikere-Ekiti.

I owe a lot of gratitude to some great people who have been very instrumental in my life to make all these achievable. I acknowledge my dear parents – Late James Omotayo and Mary Borisade who were just wonderful in their special ways. I appreciate my husband and friend, Prof Tony Aladejana who has allowed me to fly without any restriction and who continually provides a peaceful home to return to. My siblings – Lady Funlayo Dada, Chief Akin Borisade, Mr Mathew Borisade, Mrs Monica Ajibola, Mrs Paulina Falode, Mr Yomi Borisade and their families have given me great support all my life in our close knit relationship. My gratitude also goes to my auntie, Mrs Cecilia Adegbite and her children.

I have drawn great inspiration and joy from my children – Taiye, Kehinde, Jako and Ayotunde who made child rearing pleasurable and as grown-ups now, sources of immeasurable satisfaction. I am much thankful for my lovely grandchildren, Abiola, Toluwani and Temitayo who are iconic gifts from God. The younger Taiye, Kehinde and Tolulope have filled the vacuum in the house as our own children, I appreciate you. I thank the entire Aladejana Royal Family of Iworoko-Ekiti for being supportive all the time. I acknowledge Prof Femi Adelowo, Prof Fatiu Arogundade and Dr Tony Akintomide for their special care.

I acknowledge the immense contribution of my supervisor Prof J.O. Faluyi who taught me to be an academic, some great Professors who have made significant impact on my career – O.J. Ehindero, Omotoye Olorode, Dibu Ojerinde, Modupe Adelabu, Kayode Alao, Esther Adesulu, Yemisi Obilade, Olu Jegede, Bayode Popoola and all my teachers at the various levels of my education. The contributions of Dr Bola Odejobi and the entire Institute of Education family are hereby appreciated. I am immensely grateful to the Management, Staff and students of the College of Education, Ikere-Ekiti for the actualisation of my potentials. I recognise the roles played by The Apostolic Church family and all my fathers in the Lord for spiritual upliftment. I thank all distinguished people here present to honour me on this day of my joy and glory.

Finally, I return all the glory to God Almighty who has given me life, opportunities and great people that helped me to succeed. I can only surmise by singing one of my favourites:

Great is thy faithfulness, O Lord my father
.....
Morning by morning new mercies I see
All I have needed, thy hands have provided
Great is thy faithfulness, Lord unto me.

Mr Vice Chancellor, Distinguished Ladies and Gentlemen, I thank you all for your attention.

REFERENCES

Aladejana, F.O. (1999).The Use of Science Stories in the Teaching of Science in Primary Schools, Ife *Journal of Curriculum Studies and Development* Vol. 1 (2): 73-79.

Aladejana, F.O. (2000a). An Assessment of the Science Classroom Learning Environment. *Ife Journal of Behavioural Research* Vol.2 (1&2): 82-88.

Aladejana, F.O. (2000b). Gender Effect on Career Choice: the Nigerian Polytechnics in Perspective. *Ife Journal of Theory and Research in Education,* Vol. 5 (2): 90-99.

Aladejana F.O. (2001): An Empirical Analysis and Review of the Junior Secondary School Curriculum for Functional Science Education in the new Millennium, *African Journal of Research in Education,* Vol.1 (2):1, 23-126.

Aladejana F.O (2002a): Effects of Reforms on Teachers' Self Efficacy and Esteem: The Nigerian University Teachers in Perspective. *ICET International Yearbook on Teacher Education, Amsterdam, Holland.*

Aladejana, F.O. (2002b). Gender Equality in Science Classrooms: Curriculum Implications for Sustainable Development. *Nigerian Journal of Curriculum Studies, Vol.9 No2, p.85-91.*

Aladejana, F.O. (2005). Teacher Migration in the Nigerian Educational System: The Root Causes, *ICET International Yearbook on Teacher Education, Pretoria, South Africa.*

Aladejana, F.O. (2006a). Concept of Teaching I. In Ehindero, O.J. and Aladejana, F.O (eds). *Introduction to the Teaching Profession.* Institute of Education Publication, Lagos, Literamed Publications Nigeria Limited, p.32 – 39.

Aladejana, F.O. (2006b). Teacher Education: Roles, Curriculum and Competence. In Ehindero, O.J. and Aladejana, F.O. (eds.) *Introduction to the Teaching Profession,* Institute of Education Publication, Lagos, Literamed Publications Nigeria Limited p. 92 – 108.

Aladejana, F. (2007). The Implications of ICT and NKS for Science Teaching: Wither Nigeria. *Complex Systems.* Vol. 17 Nos 1&2, p.113-124.

Aladejana Francisca (2008). Blended Learning and Improved Science Teaching in Nigerian Primary Schools. Conference Proceedings, *3rd International Conference on ICT for Development, Education and Training, Accra, Ghana, eLearning Africa.* Berlin, Germany, ICWE, GmbH, p.255-258.

Aladejana, F. (2009). Blended Learning and Technology-Assisted Teaching of Biology in Nigerian Secondary Schools. In Ao, S. (ed.) *IAENG Transactions on Engineering Technologies,* Vol. II. American Institute of Physics, Melville, New York, pp. 133 -140.

Aladejana, F. O. (2011a). Secondary Education in Ekiti State: The Functional Perspective. Paper presented at the *Ekiti Education Summit,* Adetiloye Hall, Ado-Ekiti, 4-5, May 2011.

Aladejana, Francisca (2011b). The Child in the 21st Century, Can ICT Change the Face of Learning? Paper presented at the *3rd International Conference of the Faculty of Arts and Social Sciences,* University of Lagos in collaboration with the Early Childhood Association of Nigeria, University of Lagos, 23-24th November, 2011.

Aladejana, Francisca (2012a). Teacher Preparation, Curriculum Transformation and Globalization: The Imperatives, Lead paper presented at the International Conference of the Faculty of Education, University of Nigeria, Nsukka in collaboration with Ministry of Education, Anambra State and her affiliates, 6th – 9th June 2012.

Aladejana, Francisca (2012b). Teacher Education: The Functionality Perspective. Keynote Address presented at the *4th National Conference of Colleges of Education, Academic Staff Union, South West Zone* at Federal College of Education (Special). Oyo, 16th -20th July, 2012.

Aladejana, Francisca (2013a). Nigerian Senior Secondary School Students' Academic Achievement in Mathematics: The Real Issues, *WAEC Seminar Series* held at WAEC Research Seminar hall, Lagos on May 31, 2013.

Aladejana, Francisca (2013b). An Educated Person: An Ideal Tool for Service, Paper presented at the Investiture Ceremony of Rotary International held at the Queen's Court Hotels & Resort Centre, Ado-Ekiti on 24th August 2013.

Aladejana, F.O. and Aladejana, A.I. (2003). Textbook, Gender and Career Choice: Towards an Increased Participation of Women in Science in Nigeria. *Conference Proceedings, Conference on Learning and the World We Want, Victoria, Canada*, pp.93-104.

Aladejana, F.O. and Aladejana, A.I. (2005), Leadership in Education: The Place of Nigerian Women, *International Studies in Educational* Administration, Vol. 33, No.2, p.69-75.

Aladejana, F.O. and Adelodun, O.A. (2003). An Assessment of the Quality of Early Childhood Education in South West Zone, Nigeria. Ehindero, O.J. and Aladejana (eds), F. O.

Readings in Early Childhood and Universal Basic Education. Accra, Ghana, Lantern Books, p. 255-272.

Aladejana, F.O and Aderibigbe, O. (2007). The Science Laboratory Environment and Academic Performance *Journal of Science Education and Technology,* Vol. 16 No 6, p.500-506.

Aladejana F.O. and Ehindero O.J. (1995): Students Conception of Genetic Phenomena: *Ife Journal of Theory and Research in Education.* Vol. 14, Nos 1&2 Pp. 39-44.

Aladejana , F.O. and Faluyi, J.O. (2001). Incidence, Biology and Genetics of Reaction to Photoperiod in Accessions of *O. barthii* A. Chev. and *O. glaberrima* Steud. *Plant Science Research Communications* 1(2): 11-19.

Aladejana, F.O. and Faluyi, J.O. (2007). Agrobotanical Characteristics of Some West African Indigenous Species of the A Genome Complex of the Genus *Oryza* Linn, *International Journal of Botany,* Vol.3 No3 p.229-239.

Aladejana, F.O. and Ilugbusi, A.A. (2013). Analysis of Selected School Variables' Effect on Academic Achievement in Mathematics at the Senior Secondary Level in Ekiti State, Nigeria, *Journal of Science Education,* Vol. 11, No1; pgs 107 – 121.

Aladejana F.O., Nwokeocha, C.C. and Faluyi J.O. (1995): Agro-botanical and Genetic Studies of *Oryza barthii* strains. *Rice Genetics Newsletter* Vol 12. 162-164.

Aladejana F.O. and Odejobi, C.O. (1999): Effects of Mother tongue on J.S.S. Students' Performance in Integrated Science. *Ife Journal of Behavioural Research,* Vol. 1 No. 1, Pp. 84-91.

Aladejana, F.O. and Odejobi, C.O. (2006). Actualizing the Effective Learning of Science in a Globalized World: The Place of the Nigerian Indigenous Science. *Conference Proceedings, International Congress of School Effectiveness and Improvement (ICSEI)*, Florida Atlantic University, Florida, USA.

Aladejana, F.O. and Odejobi, C.O. (2006). The Bi-directional Relationship between the Nigerian Indigenous Science Education and Modern Science, T*he African Symposium*, 6 (1&2), p. 23-32.

Cakan, M. (2000). Interaction between cognitive styles and assessment approaches. *Unpublished doctoral dissertation*, Louisiana State University, USA. Baton, Rouge.

Duffy, T.M. and Cunningham, D.J. (1996). Constructivism: Implications for the Design and Delivery of Instruction in Janassen, D.H. (ed) Handbook of Research for Educational Communications and Technology, Macmillan Library Reference, New York, 1996.

Ehindero, O.J. (1974). Science Education and the Challenges of Effective Learning among Children. A paper presented at the OMEP Osun State Science Workshop/Exhibition at St. Clares Nursery/Primary School, Osogbo.

Ehindero O. J. (2012) Intellectual Foundation of Curriculum Studies, Ehindero Press Jos (in Press)

Fafunwa, A.B. (1975). Education in Mother Tongue: A Nigerian Experiment. The Six Year (Yoruba Medium) Primary Education Project at the University of Ife, Nigeria West African Journal of Education, 19 (21), 205-215.

Faluyi, J.O., Chinyere C. Nwokeocha and Francisca O. Aladejana (1999). The Biology and Genetics of Dense Panicle in two

Cultivars of rice, *Oryza sativa* Linn. *Ife Journal of Agriculture*. 20 (1&2):55-56.

Federal Government of Nigeria, FGN (2007). National Policy on Education, National Education Research and Development Council (NERDC), Lagos, Nigeria Fraser, B.J. (1986). Classroom Environment London: Croom, Helm.

Fraser BJ, Giddings GJ, McRobbie CJ (1993) Development and Cross-national Validation of a Laboratory Classroom Environment Instrument for Senior High School Science. Science Education 77:1–24

ICSU Study Group (2002): Science and Traditional Knowledge. Report from the ICSU Study Group on Science and Traditional Knowledge. http://www.icsu.org/Gestion/img/icsu_DOC_Download/

Idowu L and Aladejana, F. (2008). Towards Improved Academic Performance: An Assessment of the Effect of Computer Assisted Learning on Nigerian Students' Cognitive Styles using Computerized Graphic Package, *Conference Proceedings, International Technology Education and Development Conference,* Valencia, Spain.

Illeris, Knud (2003). The Three Dimensions of Learning. Malabar, Florida, Krieger Publishing Company.

Mohanan, K.P. (2005). Who is an Educated Person, Centre for Development of Teaching and Learning, http://www.cdtl.nus.edu.sg/ publications/educated/who.htm.

Nwokeocha, C.C., Faluyi, J.O and Aladejana, F.O. (2007a) Cytogenetic Studies in the ABC Genome of the Genus Oryza Linn. Research Journal of Botany 2 (1), p.41 – 47.

Nwokeocha,C.C., Faluyi, J.O. & Aladejana, F.O. (2007b). Meiotic and Population Dynamics in the Indigenous Representation of the A-genome Complex of the Genus *Oryza*. *International Journal of Botany*, Vol.4 No 1, p.33-40

Ogunniyi, M.B. (1988). Adapting Western Science to Traditional African Culture, International Journal of Science Education, 10(i), 1-9.

Ojedokun, O.E. and Aladejana, F.O. (2012). Standards Responsible for the Decline in Quality of Secondary Education in Nigeria, *World Journal of Education*, Vol.2, No. 2, p. 76-84.

Olorode, O. and Illoh, H.C. (2000). Variety of Forms in the Plant Kingdom, The Book Project, Ile-Ife, p.2-4

Roblyer, M. D. (2004). Educational technology in action: Problem-based exercises for Technology integration. *www.utc.edu/Faculty/Margaret-Roblyer/index_files/Page590.htm*

Sowunmi Olubola and Aladejana, Francisca (2013). Effect of Simulation Games and Computer Assisted Instruction on Performance in Primary Science in Lagos State, Nigeria, *West East Journal of Social Sciences*, Vol 2, No 2; p.117 – 122.

Young, B.L. (1979).Teaching Primary Science, London: Longman Ltd; P61-122

Wang, L.J., Wang, X. and Ren, M.Z. (2003). Field-Dependent-Independent Cognitive Styles in Solving Dynamics Problems, *Psychological Reports*, Vol. 92, No 3, p.867-880.

Weber, S. & Mitchell, C. (1996). Using Drawing to Interrogate Professional Identity and the Popular Culture of Teaching. In I.F. Goodson & A. Hargreaves (Ed). Teachers Professional Lives, London, Falmer Press.

Wilson, B. G. (1996) Introduction: what is a constructivist learning environment? In: Wilson, B.G. (ed) Constructivist learning, Journal of Science Education Technology (2007) 16:500–506 505123 environments. Educational Technology Publications, Englewood Cliffs, p. 3-8

Quek CL, Wong AFL, Fraser BJ (1998, April). Teacher–student Interaction among Gifted Chemistry students in Singapore Secondary Schools, Paper presented at the Annual meeting of the National Association for Research in Science Teaching, San Diego.