EFFECTS OF PRACTICAL ACTIVITIES ON BASIC SCIENCE ACADEMIC PERFORMANCE OF LOWER PRIMARY SCHOOL PUPILS

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Abstract

The study determined the effectiveness of practical activities in enhancing Basic Science academic performance of lower primary school pupils. The study adopted pre-test, post-test, non equivalent control group quasi-experimental Design. Two primary schools were selected in Ondo West Local Government Area of Ondo State, Nigeria using simple random sampling technique. Primary three pupils from two intact classes with class size between 18 to 25 pupils were purposively selected for the study. The instruments used for data collection was "Pupils' Basic Science Practical Activities Test" (PBSPAT) which was designed to test pupils' knowledge of Basic Science. The reliability coefficient (r) was calculated for Pupils Basic Science Practical Activities Test (PBSPAT) using test- retest method of spearman's rho (ρ). The reliability value for PBSPAT was found to be 0.75. Data collected was analyzed using t-test. The result showed that there was a significant difference in the academic performance of pupils' in practical activities group compared with that of the teacher-directed group. The study concluded that the practical activities strategy is more effective in improving Basic science academic performance of lower primary school pupils and therefore, recommends that primary school teachers should employ the use of this strategy in enhancing teaching and learning of Basic Science.

Introduction

The development of any nation is indicated by the overall social, economic and political progress and dependent upon man's activities in his natural environment. These activities revolve around science and its technological applications (Famakinwa, 2014). Science is therefore a great enterprise which nations depend on in order to advance technologically. Science is receiving much emphasis in education because of its significance and relevance to life and society. Basic Science as the foundation of sciences and the prerequisite subject for many fields of learning contributes immensely to the scientific and technological growth of a nation. This includes medicine, forestry, agriculture, biotechnology and nursing. The study of Basic Science in lower primary school can equip pupils with useful skills, concepts, principles and theories that will enable them face the challenges of science subjects in the future.

Science learning is expected to produce individuals that are capable of solving their problem as well as those of the society. Such individuals are expected to be autonomous, confident and self reliant. Science and technology constitute the basis of advancement in nearly all fields of human endeavours. In order to realize this goal, associations such as Science Teachers Association of Nigeria (STAN) and Nigerian Integrated Science Project (NISP) were set up to look into the various curricula used at various levels of Nigerian educational system. The various curricula developed, have their objectives which have to be achieved for a successful science education and attainment of the national goals and aspirations. These goals and aspirations cannot be realized except through the effective effort of the classroom teachers.

According to Nwagbo (2001), a number of factors have been identified as contributing to the non-acquisition of skills by secondary school students which invariably lead to poor academic performance and one of the factors is the teacher variable, that is, the teachers' method of teaching.

Okoli (2006) observes that many science teachers prefer the traditional expository/lecture method of teaching, that is, a teaching technique in which one person, the teacher, presents a spoken discourse on a particular subject and shy away from activity-oriented teaching methods which are student centered (such as inquiry method, discovery method, and investigative laboratory approach). Nwagbo (2006) observes that such teacher-centred approach which places the teacher as the sole possessor of knowledge and the students as passive recipients of knowledge may not enhance achievement or promote positive attitude to biology. Obiekwe (2008) reports that all is not well with science instruction in Nigerian secondary schools and noted that science teaching lays extreme emphasis on content and the use of "chalk and talk"

method neglecting the practical activity method which enhances teaching and learning. This negligence and 'shy-away' attitude from activity oriented-method of teaching has led to abstraction which makes the students less active and more prone to rote memorization.

Practical activities in Basic science provide opportunities for pupils to actually study science as opposed to learning about science. Nzewi (2008) asserts that practical activities can be regarded as a strategy that could be adopted to make the task of a teacher (teaching) more real to the pupils as opposed to abstract or theoretical presentation of facts, principles and concepts of subject matters. Nzewi (2008) further suggests that practical activities should engage the pupils in hands-on, mind-on activities, using varieties of instructional materials/equipment to drive the lesson home. Nwagbo (2008) recommends that the use of practical activities (approach) to the teaching of biological concepts should therefore be a rule rather than an option to Basic science teachers, if we hope to produce pupils that would be able to acquire the necessary knowledge, skills and competence needed to meet the scientific and technological demands of the nation. The search for a more effective approach for the teaching and learning of Basic science that will enhance the acquisition of Basic science knowledge has persisted over the years. This is because the acquisitions of practical activities knowledge is the basis for scientific inquiry and the development of intellectual skills and attitudes that are needed to learn science concepts. Practical activities knowledge is abilities which can be developed by experience and used in carrying out mental and physical operations.

Apart from teaching methods, gender is also implicated in pupils' learning outcome in science. The issue of gender and gender stereotyping permeate every aspect of human endeavour. Okeke (2007) observes that the consequences of gender stereotyping cut across social, economic, political and educational development, especially in the areas of science and technology. However, there have been conflicting reports in respect to gender and achievement in science (Abonyi, 1998 and Ezeliora, 1999). This study is therefore expected to contribute to the debate. Based on the conflicting reports in respect to gender and achievement in science, the Federal Government of Nigeria is emphasizing the teaching and learning of science process skills and principles which will lead to fundamental and applied research in the sciences at all levels of education (FRN, 2004).

A lot has been done to improve science teaching in secondary schools in Nigeria. In spite of that, students continue to perform poorly in science subjects. This situation has created the need for more effective teaching methods. It then becomes necessary to explore the efficacy of alternative

method of redressing this situation. In Nigeria, many studies (Odutuyi, 2019; Akpan, 2012; Aladejana & Aderibigbe, 2007) have been conducted on the effectiveness of practical activities on students' learning outcomes. However, most of the these efforts were targeted only at the secondary school level with little or no attention paid to the primary school level as far as practical activities are concerned. This paucity of literatures in this regard gives room for the need to conduct a scientific study on investigating the effects of practical activities on academic performance of lower primary school pupils, hence this study.

The following research hypotheses guided the study.

- There is no significant difference between the effect of the strategies on academic performance mean scores of pupils who got and did not get the practical activities strategy according to their pre-test result in basic science;
- There is no significant difference between the effect of the strategies on academic performance mean scores of pupils who got and did not get the practical activities strategy according to their post-test result in basic science;
- There is no significant difference between the effect of the strategies on academic performance mean scores of boys and girls who got and did not get the practical activities strategy according to their pre-test result in basic science;
- There is no significant difference between the effect of the strategies on academic performance mean scores of boys and girls who got and did not get the practical activities strategy according to their post-test result in basic science.

Method

The study adopted Pretest-Posttest control group quasi-experimental design involving one treatment and one control group.

The design is represented schematically as follows:

0_1 X_1 0_3 – Teacher Directed Strategy (TDS) group

0_2 X_2 0_4 – Practical Activities Strategy (PAS) group

0_1 and 0_2 are the pre-test measures of TDS and PAS groups respectively.

Also, 0_3 and 0_4 are the post-test measures of TDS and PAS groups respectively, while X_1 and X_2 are the Teacher Directed Strategy (Control) and Practical Activities Strategy (Experimental) respectively.

The study population comprised all pupils in lower primary schools in Ondo Town, in Ondo West Local Government Area (LGA) of Ondo State. The sample consisted of two public primary schools randomly selected from the chosen LGA. One arm out of primary three (3) classes consisting of pupils of intact class in each school was randomly assigned to one of the instructional strategies, making a total of forty one (16 boys and 25 girls) pupils used for the study.

The instrument is a self-designed instrument titled "Pupils Basic Science Practical Activities Test" (PBSPAT). The PBSPAT was designed to determine the academic performance during the lesson. The PBSPAT instrument contained twenty (20)-item multiple choice tests on primary three basic science module. Each item in the PBSPAT carried five marks each and a total mark of 100.

The reliability coefficient (r) was calculated for Pupils Basic Science Practical Activities Test (PBSPAT) using test- retest method of spearman's rho (ρ). The reliability value for PBSPAT was found to be 0.75. This was an indication that the instrument was reliable and suitable for the study.

The "Instructional guide" (IG) was used to arouse the learners' performance in the Basic Science subject that was demonstrated during the lesson in the class. Two instructional guides of the same content were used for the study. All the instructional guides contained the procedures for the control and experimental groups that were used for the study. The IG were subjected to face and content validation by experts in Basic Science and Early Childhood Education. The instructional guides were given to primary science experts and some primary three Basic Science teachers for validation. They went through them with respect to the adequacy, structure, language and relevance of the instrument.

The process of data collection for the study took six weeks. The administration of pre-test, the application of treatments in the control and experimental groups lasted for two periods per week. The procedural steps that were used to carry out the demonstrations were provided for each treatment. The post-test was administered to all the pupils that participated in the study after the completion of treatments. The PBSPAT results for both pre-test and post-test were scored, collated and analyzed, using t-test.

Results

Table 1: Pupils Basic Science Academic Performance means Scores of Pre-Test of TDS and PAS Groups.

Variable	Number	Mean	Standard Deviation	t	df	Sig	Remark
Pre-test (TDS)	21	39.67	9.71	-3.207	39	.315	P > .05 Not Significant
Pre-test (PAS)	20	7.65	5.58				

Based on the results presented in Table 1, there is no significant difference between the effect of strategies on academic performance mean score of the TDS ($\bar{x}$ = 39.67) and PAS ($\bar{x}$ = 47.65) before the treatment. The PBSPAT academic performance mean scores of both groups were close to each other before the treatment (t (39) = -3.207, p > .05). Hence, hypothesis 1 is hereby not rejected.

Therefore, there is no significant difference between the effect of the strategies on academic performance mean scores of pupils who got and did not get the PAS according to their pre-test result in basic science.

Table 2: Pupils Basic Science Academic Performance means Scores of Post-Test of TDS and PAS Groups.

Variable	Number	Mean	Standard Deviation	t	df	Sig	Remark
Post-test (TDS)	21	45.10	8.53	-7.482	39	.000	P < .05 Significant
Post-test (PAS)	20	66.80	8.79				

When Table 2 is examined, it is seen that there was a significant difference between the effect of strategies on academic performance mean scores of the TDS ($\bar{x} = 45.10$) and PAS ($\bar{x} = 66.80$) groups after the treatment and when the averages of both groups were examined in order to determine the difference. It is seen that there was a significant difference in favour of PAS group (t (39) = -7.482, p < .05). Hence, hypothesis 2 is hereby rejected.

Therefore, there is significant difference between the effect of strategies on academic performance mean score of pupils who got and did not

get the practical activities strategy according to their post-test result in basic science.

Table 3: Pupils Basic Science Academic Performance means Scores of Pre-Test of TDS and PAS Groups by Gender.

Gender	Number	Mean	Standard Deviation	t	Sig	Remark
Pre-test (Boys)	16	62.31	8.65	6.103	.018	P < .05 Not Significant
Pre-test (Girls)	25	51.44	15.00			

Levene's test for the equality of variance is significant ($p < .05$) as shown in Table 3.

Based on the results presented in Table 3, there is significant difference between the effect of strategies on academic performance mean score of the Boys ($\bar{x} = 62.31$) and Girls ($\bar{x} = 51.44$) before the treatment. The PBSPAT academic performance mean scores of both groups were not close to each other before the treatment ($t(6.103) = .018$, $p < .05$). Hence, hypothesis 1 is hereby rejected.

Therefore, there is significant difference between the effects of the strategies on academic performance mean scores of Boys and Girls who got and did not get the PAS according to their pre-test result in basic science.

Table 4: Pupils Basic Science Academic Performance means Scores of Post-Test of TDS and PAS Groups by Gender.

Gender	Number	Mean	Standard Deviation	t	df	Sig	Remark
Post-test (Boys)	16	62.31	8.65	2.94	39	.006	P < .05 Significant
Post-test (Girls)	25	51.44	15.00				

Using an alpha level of .05, an independent sample t-test was conducted to evaluate whether boys and girls differed significantly on a pupil basic science academic performance test (PBSPAT).

When Table 4 is examined, it is seen that there was a significant difference between the effect of strategies on academic performance mean scores of the boys ($\bar{x} = 62.31$) and girls ($\bar{x} = 51.44$) groups after the treatment

and when the averages of both groups were examined in order to determine the difference. It is seen that there was a significant difference in favour of boys ($t(39) = 2.94$, $p < .006$). Hence, hypothesis 4 is hereby rejected.

Therefore, there is significant difference between the effect of strategies on academic performance mean score of boys and girls who got and did not get the practical activities strategy according to their post-test result in basic science.

Discussion

The result obtained showed that the pupils exposed to the PAS obtained higher basic science mean scores. They achieved better compared to the TDS. The PAS was more effective than the TDS. The findings from this research also indicate that the performance of PAS improved the academic performance of basic science over TDS. The result showed that there is difference in the mean score of both boys and girls but the overall result revealed that gender has significant difference on Basic Science. This is in line with the findings of Shaibu and Mari (1997) and Adeoye (2000) that carried out a research on the effectiveness of laboratory-based and lecture methods on students' achievement in Biology and obtained significant differences in the performance of boys and girls who are exposed to practical activities. Also, Kolawole (2007) found that boys performed better than girls in both cooperative and competitive learning strategies when he conducted a research on the effects of competitive and cooperative learning strategies on Nigerian students' academic performance in mathematics.

Conclusion

The findings indicate that practical activities strategy is related to improvement in the academic performance of basic science in lower primary school pupils. These findings may begin to form a foundation for development of research-based guidelines for instructional strategies aimed to improve academic performance in basic science in classroom settings.

Based on the findings of the study on the effects of basic science practical activities on pupils' Basic science knowledge acquisition in Ondo West Local Government Area, the following conclusions were made: Practical activity method enhanced and facilitated the acquisition of basic science knowledge more than the conventional method and Practical activity method fosters acquisition of basic science knowledge in both boys and girls in lower primary school.

Recommendation

The researcher therefore recommends that practical activities strategy may be used as an intervention in the classroom.

1. Teachers should encourage pupils to develop interest in practical activities by engaging them in practical and providing instructional materials that will challenge them to be actively involved during practical lessons.
2. Ministry of Education and professional organizations like STAN should organize workshops, seminars and conferences for basic science teachers on delivering of activity based lesson.
3. Basic science concepts should be taught with practical activity so that the pupils will do science instead of learning about science.

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EDUCATIONAL MULTINDI: AN INTEGRATIVE AND COMPETITIVE DEVELOPMENT OF SCIENTIFIC THINKING AMONG NIGERIAN SECONDARY SCHOOL STUNDENTS

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Abstract
*Either by adaptive maintenance or genetic actualization, the Nigerian students multicultural as well as unique in his/her learning behaviours. It is understood that the components of human knowing constitute from formal and informal learning; therefore, it can be argued that every society is composed of students who are collective (emanating from formal training) and individualistic (emanating from informal training) at the same time. In other words, no student can be described as totally individualistic or totally multicultural in his/her thinking, problem solving and relational behaviours. This paper argues that Nigerian students, due to the country's composition are wired with a template that facilitates their development into multicultural and individualistic (multindi) persons. Even in his/her ethno (rural) or metro (urban) cultural context of families and schools, the Nigerian child is not raised in a socio-cultural contextual isolation. He/ She interprets experiences and understands information multicultural and uniquely at the same time. This study proposes that though same modes are used in understanding and interpreting the environment, the interactions between the modes for the Nigerian students make for the multicultural-individualism in their understanding and interpretation. These modes are termed selves. They are **e**nvironmental, **p**hysio-biological, **c**ognitive, **a**ffective, and **s**piritual selves. Collectively this is called the **epcas**-self. Developing the epcas-self for multindi education prepares the Nigerian student to naturally integrate all the aspects of the human power, energy and force, the characteristics of which help in the development of scientific thinking as he/she trains to participate in the labour market. The researchers present an official proposal of how multindi development works for Nigerian secondary school students.*

Introduction

The major aims of any worthwhile helping service, such as schooling is presumably to support learners; to enable them review any *positive* or

negative assessment of themselves; to facilitate the understanding of their uniqueness and worth; and to help them identify hidden strengths for challenging and coping with both internal and external pressure of becoming their best self. (Portes,1996). This study proposes that there are possible modes within an individual whose interactive development shape and form the individual's response to what he or she is being exposed in thinking and problem solving. Formal or informal settings for learning, students are being prepared by parents and teachers to become adult thinkers and problem solvers in the society. The formal setting gears a student to collective learning and informal learning provides the individuation required to shape the child into the unique person he/she is trained to be.

Multicultural-individualism (Multindi) could be described as a typology but more so a preferential mode of understanding learners as they try to understand or explain environments and others with whom they share the environmental self. A formal operational student has five basic components the interactive nature of which informs the way such student thinks and problem-solves (Udoye, 2005). These include **e**nvironmental-self, **p**hysio biological-self, **c**ognitive-self, **a**ffective-self and **s**piritual-self (**s**ource-self) – EPCAS-self.

Environmental self: The learner's **e**nvironment (**E**) includes all that is *other* than the learner which can be observed or felt in the senses directly or otherwise. This self can be described as overt and tech-vert. E-self provides the matter and the form which the students use when they begin their multindi development. It is housed in their environmental realities. The environmental-self learns to relate to realities which may include animate and inanimate objects as he/she (patient/family) develops the inter-relational preferred mode.

Learning to relate to the environmental-self involves learning for adaptation, shaping and selecting from the environment (Sternberg, 2000). This level is of primal importance in the development of EPCAS-self. Environmental model of self could be called the ***inherited self***. It is ***multicultural*** in nature and operation. It is parsimonious due to its predictability. It is an unquestioned self that could be equally sophisticated in essence, depending on its context. Every part of self here is testable, it can be said to be observable and measurable. A positive and robust development of the environmental-self at the early stage of a student's learning is assumed to be of significance to the development of the other selves. In the log, items used to assess the students include, chores, community, club, family, farming, cleaning, groups, work and *other*.

Physio-biological self: The physio-biological (**P**) includes the biological and the physiological aspects of the individual entity as he/she lives

and/or engages in human behaviours. It incorporates the behaviours and the chemical responses of the senses and the neurons. It is housed in the corpus, and can be either or both overt and/or tech-vert. This could be called sensational knowing. The statement of one with a developing multindi of this aspect is, "*If I see it, hear is or sense it anyhow, I will know it; and therefore, I will be able to solve this problem*". Students develop p-self as children and/or adolescents from the mentorship of significant other or expert during intense synaptogenetic and growing up periods. The P-self includes the sensed-self, the chemical (auto) self and the biological self (genetic). In the log, items used to assess the students include drawing, dressing, drinking, eating, exercises, self-care, talking and writing. P-self is the capsulizing of the individual-self as he/she interacts with the multicultural context of the e-self.

Cognitive self: The researchers speak of the **c**ognitive self (**C**) when humans address that aspect of the individuality that employs the processes of the human mind and mental resources in thinking, reasoning, judgment and decision-making. This self is supposed to be housed in the human mind and intellect. Prior to the advent of computers and understanding of information processing in the 1920s this component self was believed to be completely covert. Technology and psychology studies have enabled this self to be interpreted overtly and tech-vertly. The development of scientific thinking at this level is called ***informed knowing***. It is socio-culturally constructed (Vygotsky, 1978). Another name for this is ***the equatorial-self*** dividing the upper and the lower hemispheres of the epcas-self. This self asks questions in order to understand both upper and lower hemispheres. It is sometimes the *control panel*in the development of the multicultural-individualistic (multindistic) self for scientific thinking. In the log, items used to assess the students include use of computer in thinking and programming, listening, brainstorming, learning, mental exercises, attending to media news, priotizing, problem-solving, reading, think-talk and writing.

Affective self: The **a**ffective (**A**) individuality involves the responses and the interactive behaviours that students adapt as expected media for the expressions of feelings, emotions and every other affective behaviour which may be unique to a given student and/or culture. This self-development moves from an individualistic standpoint out to the multicultural peripheries. It is called ***experiential learning***. It is learning that is felt and internalized from experiences. This is the learning used to understand or feel others' or individual position. The affective-self is believed to be housed in the heart, although the responsive or reactive effects could be known or felt at the neurological arenas. Formation of attitudes originates from this self. In the log,

items used to assess the students include laughter, recreation, relaxation, rest, services, sharing, stressless and visits.

Spiritual self: The spiritual self (**S**)is the other end of the mode which includes all the individual uniqueness and inexplicability. At this core lies the actualization of internalized self. If the environmental-self includes all the direct and indirect observable and known realities learned in the senses, the spiritual-self (which sometimes is referred to as the ***source***) includes the realities learned in the extrasensory and metaphysical regions. It is simply known (Hofer, 2004). Its force **(F)** has been directly or indirectly, but indisputably though not scientifically, accepted by different fields and disciplines. This self is believed to be housed in the soul. Whereas the e-self is multicultural, the s-self is individualistic. Although personal and unique, knowing here is termed ***universal***, incorporating the fundamental human values in its expression, namely life and love. Knowing here transcends boundaries of cultures, religions and groups. It is wholistic and can be described as un contextual. Unlike the environmental-self, the spiritual self is sophisticated in its expression and explanation. Learning and knowing could be mostly unobservable and underscores a sophisticated understanding. In the log, items used to assess the students include Wholy Other-talk, aloneness, meditation, praying, presence, reflection, silence, Otherness and spiritual reading.

EPCAS-Modes for Integrative and Competitive Development in Thinking

Scientific thinking is characterized by its ***multicultural*** connectedness to all other individuals. Thinking is scientific when it incorporates the following aspects of knowing.

- Systematic method of incorporating adaptive measures in unfamiliar contexts
- Inbuilt principles for spotting opportunities and problems in thinking and economics.
- Educational training that provides theoretical knowledge of content area from where learning adaptation is made feasible.
- Self-knowledge in light of an adequate understanding of cultural background.
- Willingness and skills to engage in a meaningful exploration and learning of new things about self, other and environment without teacher losing control.
- Ability to listen without biases and stereotype.
- Providing a learning-teaching that scores self-analytical thinking and creative problem-solving.

These are challenges and they contribute in part to the reason for this study. No matter the subjects of choice in secondary schools, the Nigerian child can be trained to imbibe these aspects of thinking. The researchers argue that these attributes could be developed by training the students in the use of their *epcas* modes.

E-mode. Students who solve their problems of thinking and experiences in or with their *environmental self* are the ***competitive*** type. Their learning is more of outward focus. They tend to solve problems and answer questions that win them approval and acknowledgment. Their knowledge expression is overt, meaning that what they know in the E-self is observable and concrete. They are mostly scientific in explaining their thinking, or at the other end very primal. It is domain specific, particularly relying on their field expertise of primal knowledge base. Learning that is testable makes meaning to students who operate in this mode. Learning in this mode is heavily contextual as well as universal. *I am an achieving student. I am blessed with prosperous parents. I am happy, my family is here to support me. Just look at the moon. I like being in the laboratories during practical. I don't know what I could have done if I did not have expensive wardrobe*. This is referred to as holding environments (Hochschild, 1983).

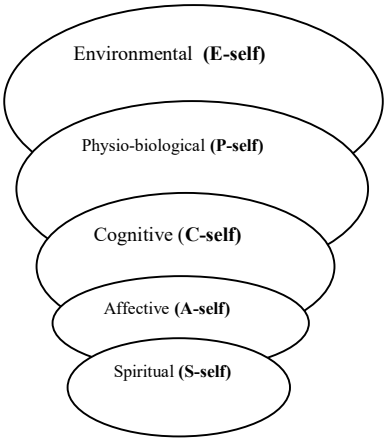
P-mode. Learning is constantly accumulating knowledge experiences from thought materials and/or matters with the physio-biological self. A student at this level believes that the more he/she knows about the bio-physiological behaviours, the better thinker or problem solver he/she will be in learning. Solving problems and answering questions in this mode can be ***contextually sensorimotor*** as well as personal. *I used to be very beautiful and strong. When I study Math, my blood pressure rises. I have lost all my hair and have no more colour because of all these hair cream. Have you ever looked at your body on the mirror and been tempted to curse the day you were born or break the mirror? I don't have quality life with my family again because my body has neither the strength nor the zest for any fun.*

C-mode. Piaget (1966) argues that by the time they are in secondary school, Nigerian students must have reached formal operational stage in their cognitive development. Learners in this mode want to develop an understanding that will eventually inform experiences. All the experiences accumulated at the P-mode are at this level remodeled for the purpose of internalizing them later. Hence, meaning-making is significant for the development of scientific thinking in problem-solving. Internalized balance starts to evolve at this learning mode. This is where learning or thinking is done for its sake. *I enjoy learning. When I read, I enjoy being informed. I feel powerful when I learn new ideas. I enjoy being in class during discussion.*

A-mode. Students whose preferential mode of thinking and problem solving involve use of affective-self are experiential. All the felt knowledge have been internalized so that –learning ***expectancies*** have been formed. Problems and questions of self and emotions are asked, solved and answered using prior felt experiences. They are motivated to feel passionately or not, because prior experiences provided them with ample templates. Their understanding of others' knowledge (Supreme Being or Human beings) is enabled from the standpoint of their constructed and internalized emotive experiences. At this mode, extrapolation or inter-subjectivity is possible. This mode is the medium through which already internalized balance is either expressed or critically tested. *The teacher does not like me and he fails me. I fail Maths because I detest the subject. If there is God, why did He let my mother die when I was 10? (I feel it is either He does not exist or He has not the might we ascribe to Him) Why did God take my parent when I needed him/her most? (I feel it is either He is unjust or He must be a wicked one)*Experiences are explained with feelings in this mode. This student has internalized emotive expectancies of God's might as related to ability to protect; and that of justice and care as "live and let live".

S-mode. Students whose spiritual self has been developed exhibit a level of ***competency*** in asking critical questions/problems, realities and ideals. They may not necessarily answer them. They know the differences between mystery and solvable. Learning model is very personal but could fit into universal patterns; therefore students here employ universal values in their learning expressions and behaviours. It is at this level that students are authentically *connected* with the other whether in the e-mode or not. They are altruistic and patriotic. They are competent, given their ability to apply their universal human values in their answering of personal questions or solving the problems of life. At this level epcas actualization takes place. A fully developed epcas-self would reason as such: *If I put the most effort, I would achieve my best. I failed because I did not study. I am sick not because I have done anything, but because I am human. Human beings get sick at one point, and sometimes die. We are not made to live forever. We are mortals. Mortals are terminal. Love is eternal. I know God loves me – when I am well as much as when I am sick.*

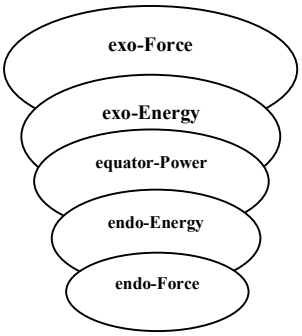
Figure 1 Epcas-self Paradigm (Udoye, 2005)



Multindi Education and Scientific Thinking

The questions always asked are: 'How is multicultural-individualism characterized?' and 'Who has it?' There is a strong and positive interrelatedness and interwoven dependency between these five aspects of the human self in order for a student to maintain a high multicultural-individualism (Multindi) used in scientific thinking. Development of epcas-self is from the core moving outward and from the outside moving inward until the student arrives at the equatorial region of the self where the c-self helps the student to formally analyse and critically think in problem-solving situations. Though it starts at the formal operational stage, it is a lifelong process of development.

Figure 2. Epcas Paradigm: Regions from where the Epcas-self operates (Udoye, 2005)



The **force-energy-power-energy-force (FEPEF)** is the flow of the epcas person connecting the exo to the endo operations, vice versa. Cognitive self – ***the equatorial self,*** placed at the centre of multindi-person seems to represent the connecting power for the other selves. Equating this to Piaget's model of cognitive development, this self reaches optimum development at formal operational stage at which age secondary school students are ready. The ***equatorial c-self*** contains the language attribute that initiates the divide between non-human animals and machines (e.g. computers). Ability to rationalize, interact with others, reason, create, and problem-solve are related to what, how, when and why of knowing and understanding, enhanced by the extent of development of equatorial c-self. Equatorial self is considered developed if the *power* of self here has been developed to hold our north (EP) and south (AS) "poles" with greater equilibration – balance (Piaget, 1969).

While the spiritual-self is the innermost core integrative aspect of the epcas model, the environmental-self is the remotest competitive self. Yet they all seem to be originating from and ending at the same source, **the source-self** (*see the EPCAS paradigm*). Attending to the reality of epcas existence makes for greater understanding and use of these selves. For instance, if something has not existed and students have not developed language for that in learning, no amount of equatorial-self maturation can conceptualize the something. On the other hand, if the something exists but students have not attended to it or imagined it, even the equatorial-self cannot know it. While one may not emphatically assume a position that these selves are age or stage-dependent in their developmental fashion; one could, however, hypothesize that to achieve the multindi education, a secondary age student has to grow from the **E** through **C** to **S** in the **epcas-self** development. It is worthwhile to note that epcas-self cannot be actualized in dichotomous reality. Actualizing epcas-self is the milestone, not necessarily achieving a stage or two. This is when we say a student has become multindistic in scientific thinking in the society.

Human societies are laden with needs, values, beliefs, epistemology, affectations, relationships and existential meanings with which matter and form are created, maintained, explained or destroyed. EPCAS model of study consists of the five interwoven and interdependent aspects of individual human existence, each of which anticipates a significant level of positive development for a given society to give its best to and benefit fully from its citizens. This is what the researchers call the **epcas** education for scientific thinking of students.

Conclusion

The researchers believe that the multicultural nature of Nigeria with above 250 languages in its conglomeration influences learners in the classroom directly and indirectly. It is quite tempting to think that the Nigerian child born in the rural area that is homogenous has only one language out of these 250 languages to contend with in his/her internalization options. The researchers argue that every Nigerian learner, like an American child, is raised multiculturally even in his/her seemingly isolated rural area. Remove such a child and put him/her in the most sophisticated city of the world, and the quick adaptive process is always a proof that the multicultural nature of the country has significant influence.

When they start school, the unique training of the child starts. Not quite long in the multicultural setting of formal education, influenced by the micro and macro paradigms of being an educated person in Nigeria, the multicultural-individualism (multindi) sets in. Epcas modes of interaction help in the development of the multindi Nigerian students. Their scientific thinking grows or dims depending on their multindistic development. Paying authentic attention to the development of the epcas-self when we participate in the teaching/learning profession is the main target of every worthwhile education for the Nigerian secondary students.

Recommendations

This study is at its very primary stage. There is need to develop the study with a scientific design model and usher it into an evidence based research.

Multicultural-individualism (multindi) and epcas models have not been fully explored. This study cannot be used for training except at the subjection of creativity or ingenuity of teachers. It is recommended that classroom teachers, irrespective of subject taught be attentive to epcas-self development of Nigerian secondary school students.

The researchers recommend that Nigerian secondary school students be exposed to a great deal of realities, even if through story-lines or folklores.

The researchers recommend further studies on this proposal in order to provide more testable frameworks, for teaching and learning activities.

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