

## IMPROVING THE TEACHING AND LEARNING OF MATHEMATICS AND SCIENCE EDUCATION THROUGH, “ACTIVITY STUDENT EXPERIMENT AND IMPROVISE- PUPILS DO SEE AND IMPROVE (ASEI-PDSI) APPROACH” IN PRIMARY SCHOOLS IN NIGERIA.

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### Abstract

*This paper examines how activity based approach can improve the teaching and learning of mathematics and science education in our primary schools. It starts by explaining the meaning of activity and some definitions given to mathematics and Science Education by some scholars in the field. It goes further to elucidate on ASEI-PDSI overview, ASEI-PDSI enhancing teaching, difficult nature of science, tools, problems of fostering ASEI-PDSI, ways of improving mathematics and science teaching through ASEI-PDSI approach and implication for education are also discussed. The paper finally recommends among others that teachers of mathematics and science education should encourage and be friendly to the pupils and students or learners to be active and creative.*

**Key words: Mathematics, Science, School, Primary Education, ASEI-PDSI**

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### Introduction

Over the centuries, activity people's have provided new solutions to the problems of their times. The ability of human beings to find activity solutions to problems are essential for the well being of the human race. As the progress of any nation lies in the productivity of its citizens and quality education, the present state of our educational system indicates the need for development of activity skills among the pupils / students. This however, cannot be achieved, if Primary school teachers themselves lack the knowledge of developing it in the pupils / students. Primary School is where formal education takes place, which is an

extension of the society where knowledge, skills and character and good habits are impacted in the student / pupils or learner to better their life and society (Kwasau, 2008). Basic education commences at the primary level of education in everywhere in the world. The primary level of education is the first point of education which is concerned with the transformation of the philosophy of education into knowledge, attitudes and skills necessary for overall national development. Such education is crucial to the social, physical, psychological and academic development of the primary school child. The successful achievement of these components of education by pupils can

be greatly influenced by the teacher. The Federal Republic of Nigeria (2004) in her national policy on education referred Primary Education as the education given to an educational institution to children aged 6 – 11 years plus prior to their entering the secondary school. Since the rest of the education system is built upon it, the primary level is the key to the success or failure of the whole system. Primary education is the genesis of a child's education. These backdrops necessitated the need to improve teaching / learning process through ASEI-PDSI approach.

In the past mathematics was referred to as the science of quantity. Towards the middle of the 19<sup>th</sup> century, mathematics came to be regarded as the science of relations. This latter view regarded mathematics as the science of using symbols to provide an exact theory of logical deduction and interference based on definitions, axioms, postulate and rules (Okolo, 2005). Mathematics is the science of quantity and space. It is the creation of human mind, concerned primarily with ideas, processes and reasoning. Odilo (2006) noted that, mathematics is dependent on two view points: process and product, from the product point of view; mathematics is characterized by its distinctive concepts; propositions and the method of verifying mathematics as a family of purpose. Mathematics comprises mostly of human activities driven by arrangement of human goals, intensions and purposes. Adebola (1999), maintained that as the modern world is faced with high level of technological development, mathematics as the bedrock of science and technology is not left out of this great technological advancement. However,

mathematics is a social construct that is open to change process and development. Obodo (2000) is of the view that mathematics is the language that uses carefully defined terms and concise symbolic representations which add precisions to communication.

Ikoku (1984), observed that “science is available in a world-wide system of publications accessible to anyone who knows the language of the publication. As fundamental as mathematics is, it holds the key to the answer, because it is an elixir which opens the gate for technological and overall national development. Unodiaku further in Ali (2012:58) (ed) Quoted Ukeje (1997), as saying certainly that “without mathematics there is no science, and without science there is no technology, and without technology, there will not be all the factors of modern society”. Hence it equips, individual recipients with the necessary knowledge, skills, attitudes and values to enable them live happy and productive lives as fulfilled individuals in their immediate and distant environment with focus to achieving a country's economic well-being. Mathematics plays a significant role in the national development of Nigeria, as well as other nations of the world. National Open University of Nigeria (Noun, 2006), from ancient civilization (Egyptian, Greek, Roman etc), mathematics has been found to be the foundation for their educational thoughts and general development.

Abiodun (1997); Adeyegbe (1987), espouse that in science and other related fields, mathematics is the major tool for formulating theories and explaining concepts. Azuka (2001) as cited in Odili (2006) stated that the importance attached to mathematics in school curriculum from the primary to the

secondary levels of the school system reflected accurately the vital role played by the subject in society.

The word science is derived from the Latin Word Scire, meaning “to know”. Okeke (2007:3) posited that science “is the systematic investigation of nature with a view to understanding and harnessing them to serve human needs”. Science, a systematic study of nature, has permeated all fields and facets of human endeavour. It is one of the most human aspirations, a necessary ingredient for both mankind and a country's socio-economic development.

It is poised for probe beyond natural phenomena which is articulated in the processes and products of science and their application to practical life situation. Balogun, in (UNESCO, 1995) argued that a good science education should enable us develop science process skills, and understand the conceptual structures of science as well as how science and technology affect human beings and society. Certainly, science as a sound mind trainer has some in-built practical values which aid individual recipients who are exposed to its study to acquire the scientific knowledge, sine qua non for development in all aspects of life and in ones profession. Science education refers to the teaching and learning of science technology in the education industry throughout the established levels of the sector. This broad area of study includes basic and technology (at Primary School Level). Basic Science (at JSS), Biology, Chemistry, Physics, wood work, Electronics, Agricultural Science, PHE, Home Economics, Mathematics and the rest. Science education requires a talented, hardworking and active teacher before pupils/students or a learner could have proper understanding of it. A teacher of science is the 'engine room'

and strong force to effective and productive science. This is due to the fact that out of so many techniques and methods that can be applied to the teaching and learning of science education to enhance the interest and commitment on the part of the pupils or students activity base is superb. The above therefore necessitates the topic “improving the teaching and learning of mathematic and Science Education through activity approach”.

#### **Activity Student Experiment and Improvise-Pupils Do See and Improve (ASEI-PDSI) Approach: An Overview**

No single definition of activity has been universally accepted as it has been viewed by different people in different ways. According to Hornby (2010), activity is a thing you do for interest or pleasure, or in order to achieve a particular aim. It involves the use of skill and the imagination to produce something new.

The current obvious situation in mathematics and science education is the staggering decline in the performances of learners at all levels of our Education System (FEMSA 1997, Simon 2000). The implication for this trend which has persisted for decades are threat to the technological and scientific development of any nation, especially now that the entire world is driven by scientific and technological advancement. It is in recognition of this fact that the Dept of technology and Science Education (DTSE) the Federal Ministry of Education (FME) has been organizing and conducting in-service education and training (INSET) such as the Science Orientation Course (SOC) for primary school teachers and the Teacher Vocation Course (TVC) for secondary school teachers. Unfortunately the SOC and the TVC appeared to be moribund and

needed revitalization.

In an attempt to chart a new direction for INSET in Nig; the DTSE and the Japan International Cooperation Agency (JICA), reached an agreement to re-establish a system of retraining for serving teachers in the areas of mathematics and science education. The choice of JICA was born out of the several success stories of its collaboration in establishing, organizing and executing sustainable and quality INSET programmes for teachers of mathematics and science in many African countries. Such countries include Kenya, Ghana, South Africa Uganda, Malawi and Egypt among others. In addition, Nigeria is a beneficiary of the government of Japan's initiative to support developments in mathematics and science education in Africa through the Overseas Development Assistance (ODA). This initiative in Africa has produced the SMASE – WECSA network. The Federal Government of Nigeria (FGN) officially joined the SMASE – WECSA Association in 2004 and subsequently became interested in adopting / adapting and promoting student-centred methods of teaching through the ASEI (Activity, Student Centred Experiment and Improvisation) movement and PDSI (Plan, Do, see and improve) approach. ASEI movement and PDSI approach was meant to be activity – base in teaching and learning of science and mathematics.

Therefore, following the FGN expression of interest to revitalize the teaching of mathematics and science based on the ASEI PDSI, JICA agreed to partner with DTSE to re-establish a new system of INSET for primary school teachers in Nigeria. Three states, namely, Niger, Kaduna and plateau were selected

as pilot states. These states were chosen as pilot states because JICA was already constructing additional classrooms in the states and for easy assessment of the project from Abuja.

Today, following the FGN expression of interest and JICA agreement with DTSE Ebonyi State Government under the umbrella of State Universal Basic Education Board (SUBEB) and under the charge of Engr. Dave Eze the State Coordinator and State Desk officer has keyed up in new development of teaching and learning mathematics and science using ASEI – PDSI approach, to better the education of our children in Ebonyi State and National.

ASEI – PDSI approach, to enhance the quality of teaching / learning of mathematics and science, ASEI – PDSI approach is advocated. ASEI – PDSI stands for activity, student-centred, Experiments and improvisation. Plan, Do see and improve. The ASEI principle calls for a paradigm shift from traditional practice of teacher-centred and knowledge based teaching, through PDSI approach, to pupils – centred and activity based method.

ASEI – means to involve actively pupils or students in teaching / learning process through experiments and improvisation utilizing locally available materials in the classroom. It is an integrated approach to mathematics and science more effective.

**Activity:** Teachers should select pupils' activities that effectively enhance participation, interest, understanding and retention of knowledge and skills.

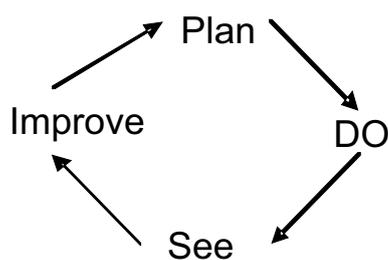
**Student/Pupil-Centred:** Pupils should be given chance to think, express,

exchange this ideas or check their achievement.

**Experiments:** Simple experiment should be used in classes. Pupils learn much effectively through real experience, such as touching objects, feeling temperature, smelling and observing. Chalk and talk and chorus answer may be efficient but may not be effective.

**Improvisation:** Some of pupils' activities require instructional materials. Teachers have to obtain skills to improvise teaching and learning and teaching material from locally available materials.

#### PDSI Cycle



**PDSI – PDSI** Is an acronym for Plan, DO, see and Improvement. Planning is the actual preparation of the lesson plan. Developing a lesson plan before teaching is considered to be one of the most important activities of teachers. Doing and seeing refer to the teaching and evaluation processes by the teacher during the lesson. The teacher is expected to improve future lessons by incorporating correction of weaknesses observed in the previous lesson.

PDSI aims to improve teachers' activity through repeating the cycle. In school Based Training (SBT), PDSI should also

be carried out in a group of teachers. They plan together, observe teaching of others, and discuss to improve their teaching skills.

#### Difficult Nature of Science

The abstract nature of science poses challenges to science education. A scientist is usually a curious person, he takes time to observe things in the environment and he asks questions of 'what', 'how' and 'why' about things in the environment. He wants to find out why things are the way they appear or how it happens. He observes and carries out experiment while applying science processes. These procedure is time consuming and not entertaining, the youth these days easily adapt to curricula that create room for enjoyment, entertainment or socializing.

These are often applicable to art subjects hardly to science subjects.

#### Tools for Teaching Activity

1. **Brainstorming:** This is a divergent teaching / learning approach in which the teacher poses a problem while pupils / students are encouraged to find as many different answers to it as possible. The aim is to stimulate divergent thinking through pupils' / students' efforts to use the posed problem to derive different solutions. Brainstorming combines a relaxed informal approach to problem solving with lateral thinking. It asks that people come up with ideas and thoughts that can at first seem to be a bit crazy. The idea here is that some of these ideas can be crafted into original, activity solutions to the problem you are trying to solve, while others can spark still more ideas.

#### Crawford's Slip Writing Approach:

The Crawford's slip method is a simple yet effective type of brainstorming that

gives the opinions of all team members' equal weight, however quiet they are. The method simply involves collating input from people on slips of papers. Not only does this help generate a wide variety of solutions, it also helps people get involved and feel that their contributions are valued.

**The Stepladder Technique:** The stepladder technique is a simple method that manages how members enter the decision making group. Developed by Steven Rogelberg, Janet Marnesfarrel, and Charles Lowe in 1992, it encourages all members to contribute on an individual level not being influenced by anyone else. This results in a wider variety of ideas. It prevents people from “hiding” within the group and also helps people avoid being “Stepped on” or stampeded by stronger, louder group member.

**Metaphorical Thinking:** A direct comparison between two unrelated or indirectly linked things is called a metaphor. Example “times is money”. Metaphors can create strong images that can be used to a great effect in every day communications and thinking. They can add impact or help explain a difficult concept by associating it with a more familiar one. Metaphoric thinking can also be used to help solve problem. Metaphors are used to extend and generate new ideas for solutions hence activity.

Making effective use of encouragement, praised and positive languages. Teacher's competence is another approach that can be used to enhance teaching / learning activity in the classroom, according to Hornby (2010) defines competence as the ability to do something well. Science teacher is the guide and liaison

between the students / pupils and learning materials. (Acheme, 2012). Ityokaa (2015) asserts that teachers' role is to translate the new mathematics methodological elements into their practice and testing the changed approaches. According to Ochu (2011), effective science teaching and learning depends more on the competence of the science teachers. The author maintained that quality teaching depends on the competence of the teacher and how prepared he / she is before stepping into the classroom. It is only when the teacher is competent and confident in the teaching of the subject that he/she can motivate his / her students' and the students' motivation remains the key to the entire learning process in any subject. In the view of Fanyam (2015), science teachers' competence encompasses certain teacher characteristics such as professional training, experience, commitment, keeping abreast with current development in their field (the awareness of research information), proficient in the use of information technology (ICT), conference attendance among others.\

#### **Problems of Fostering ASEI-PDSI among School Children.**

➤ **The use of Wrong Motivational Teaching Approaches:** Teachers nowadays do not seem to be familiar with activity method of teaching that are bound to generate and foster activity behaviour in the learners. Mkpa (1987) state that many teachers do not employ activity methods in their classroom. Most of them adopt the lecture, and note taking methods which demand little or no physic and

or mental effort on the part of the learners.

- **Inadequate Materials:** Insufficient teaching materials do not give teachers / pupils opportunity to learn effectively and interact with everything around and as such meaningful experiences are not gained.
- **Lack of Reinforcement and Reward:** Encouraging activity in young children is a process where teachers must open their own channels of allowing, accepting and turning over some control to the children themselves. The activity teacher encourages children to be creative, among other ways, through rewarding and evidence of activity responses made by them. It motivates them to initiate more ideas that leads to unique production.
- **Emphasis on Conformity:** Insistence on conformity defeats the idea behind originality if the class teacher insists on a stereotyped procedure, the learner will not be encouraged and this impedes the development of activity among all categories of learners.
- Non-going for in-service training

**How ASEI-PDSI Approach of Teaching and Learning Enhance Pupils / Students Understanding of Mathematics and Science**

In teaching of Mathematics and Science education, the degree of success depends on the correct and effective use of activity skills. The roles played by

activity skills are reflected and detected in the level of understanding of the subject by the learners. Without gain saying, the correct and effective use of approach improves the level of understanding of any subject. This is the view of Abimbade (1999), who claimed that creative skills perform some roles that consequently lead to better understanding of every subject.

- **To Promote Effective Learning Activities:** The activity approach develops learning readiness in students. Student / pupils are eager to investigate and pay attention to details.
- **To Promote Effective and Good Memory:** The students / pupils remember better principles and concepts they discover by themselves. This is in line with the Chinese proverb that states  

“What	I hear	I forget”,
“What	I see	I remember”,
“What	I do	I understand”.
- **To Promote Effective Experimentation and Drawing Inferences:** The application of activity in teaching mathematics and science education provides the opportunity to develop the initiative, resourcefulness, responsibility and other personal qualities in the student.

- **To Promote Effective Manipulative Skills:** Activity technique when applied in teaching / learning of mathematics and science brings about physical thinking skills and scientific investigation on the part of the student and the teacher.

- **To promote Effective Activity:** Activity technique of teaching creates interest in Students / Pupils. The mathematics and science education student is motivated when he/she is guided to find solution to his/her problems.
- To Promote Communication Skills.
- To promote organizational skills.
- Going for in-service training (INSET).

**WAYS of Improving the teaching and learning of mathematics and science education through ASEI-PDSI approach.**

To enhance the quality of teaching and learning of mathematics and science, ASEI-PDSI stands for Activity, Student – centred, Experiments and Improvisation – PUPIL, Do See and Improve. The ASEI principle calls for a paradigm shift from traditional practice of teacher – centred and knowledge-based teaching, through PDSI approach, to pupils-centred and activity based method. SMASE Nigeria baseline survey (2006) revealed that majority of Primary School teachers opted for demonstration method of teaching in preference to group work activities, employ more of lecture method, seldom use project method and utilize little questioning method. This could be the reason for poor performance in mathematics and science at the Primary School Level. (FRN, 2004) states that “Teaching shall be participatory, exploratory, and experimental and child centred. There is need to enrich classroom practices through strengthening of the above teaching strategies. This would enhance the ability of teachers to plan and present effective lesson and the pupils would

participate actively and their interest sustained. This could lead to the production of future scientists for national development

The methods include:

**Performance Method / Learning by Doing:** Performance as a teaching method refers to individual ability to do something. It is the end result of the teaching learning process. If acquired, the learner can be said to have achieved because he will be able to perform specific or broad production through the combinable use of mental and manipulative abilities. By so doing, he has achieved self – reliance which is the ultimate goal of the present educational policy. Teaching aids to be used must be ready before the commencement of lesson, this agrees with the saying that teaching aids are “Things before ideas and ideas before world”. Students need greatly the assistance of the teacher when performing an activity (Abubakar and Dantani, 2005). This method should be employed in the teaching / learning of mathematics science.

**Demonstration Method:** According to Abubakar and Dantani (2005), this method of teaching is sometimes referred to as showing. Demonstration as a teaching method is considered as a comprehensive way of teaching in that it includes telling, showing, testing and application. Demonstration as a teaching method is probably the most important and greatest means of imparting fundamental skills and practices in the shortest possible times.

**The use of Periodic Assignment:** This is an integral step in the realization of educational objectives. It is largely determined by the goal a teacher has in mind. It can be related to on-going class activities with special emphasis on the

learner's needs and concerns. It helps the learner's to become independent and self – reliant (Institute of Education, University of Ibadan, 1989). This approach is also quite useful in teaching and learning of mathematics and science education, simple because it gives more room for activities / creativity.

### **Implication for Education**

Children, particularly younger children, are inherently active. Around the age of 8 – 10, the opinions of others become more important, the fear of failure emerges and they lose their willingness to try new things. The challenge for educators is to nourish and develop children's natural activity, not to stifle it. This could be achieved by:

- Providing regular opportunities for hand-on experimentation, problem solving, discussion and collaborative work.
- Actively encouraging pupils/students to ask questions, make connections, envisaging what might be possible and exploring ideas.
- Using failure or set backs as opportunities to learn.
- Facilitating open discussion of the problem that children are facing and how they can solve them.
- Asking open-ended questions such as what if? How might you?
- Ensuring that assessment procedures reflect and reward activity, enterprise and innovation.

### **Conclusion**

In this paper, any teacher of mathematics and science education at all levels should understand that activity – based approach of teaching the subject is the best not only because it creates interest in the learners to understand every bit of the lesson, but

also, it makes them to be able to think of other and better ways of solving problems that come their ways. When this is achieved, our present and future problems in the filed of mathematics and science will be better solved. However, no teacher will be able to do this unless he or she is creative, and ready to extend such to the pupils / students or learners. Therefore, ASEI as a paradigm shift is not a new method of teaching; rather it is rallying point for teachers to consciously focus on the pupils who is the main player in the teaching / learning process. Whenever a teacher looks at a lesson plan or observes a lesson being taught, he/she should easily make a quick evaluation by simple answering the question, is it an ASEI lesson? To succeed in attaining the ASEI condition in the classroom, every teacher has to go the Plan, Do, See and Improve (PDSI) way.

### **Recommendations**

In addition to the ways of improving mathematics and science earlier discussed, this paper in its holistic approach to improve activity in the teaching and learning of mathematics and science suggests that all the stakeholders in Education Government, Schools, Teachers, parents and students have certain roles to play as stated below:

- ❖ Government should intensify efforts in identifying and recruiting activity-based teachers to teach mathematics / science through the use of appropriate aptitude test for recruitment.
- ❖ Our schools should always provide suitable and activity / creative environment for teachers and students of mathematics and science. This can be in form availability of different teaching aids, most especially a standard

- and school science laboratory to teach the subject.
- ❖ More time should also be allotted to teaching of the subject as much time is needed by the teachers to teach activity.
  - ❖ The students of mathematics/science education should dedicate more time to independent study and develop enough courage to perform independent work. They should know that activity does not necessarily require special ability but initiative.
- To the teachers of mathematics and science
- ❖ They should always use relevant teaching method. The teacher should be able to measure the suitability of his proposed teaching method to a given set of students in relation to the content before adopting the method.
  - ❖ They should welcome divergent thinking and views. Our teachers should know that total inclination to conformity does not open room for new knowledge per se. Therefore, whenever it is possible emphasis on conformity should be reduced to the barest minimum to allow learners to think of solving emerging problems in a better way.
  - ❖ Teachers should be friendly and always encourage activity based by being patient to tolerate the mistakes and errors made by students while trying to be creative. They can do this by adequately rewarding any activity based approach to problems by students, whether the approach is right or wrong.
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