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INNOVATIVE METHODS OF TEACHING MATHEMATICS

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INTRODUCTION

The role of education in recent times is undeniable. It is the driving force that moves society from the state of inertia and slow growth to the rapid movement of progress and development in both economic and human resources. It is an issue of national security and the first line of defense against the dangers and disadvantages of globalization. It is also the basic tool for the investment of human resources, which is the main basis for economic progress and globalization (Algani, 2018).

Coe (2018) identifies in-depth knowledge of mathematics as the underlying spin for advancement in science and technology, which every nation moving towards sustainable development needs to consider. Based on this assertion, it is important for every mathematics teacher to have a good knowledge of the subject matter in order to appropriately apply the right method of teaching Mathematics. This is because every effective teaching and learning demands that the teacher must be knowledgeable enough in different teaching methods. However, as it

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stands it is doubtful whether mathematics teachers have knowledge of these teaching methods. But the fact still remains that it is imperative and desirable for mathematics teachers to be abreast of different teaching method types in this 21st century to be relevant and make rational choices and apply them when the need arises (Agwagah, 2018).

Mathematics teaching (or instruction) in our schools has long embraced traditional methods, non-interactive methods of teaching. That is the methods in which the students are the receiver of delivering from the teacher Traditional approaches can be seen to be dominated by the theory and not to address the needs of most students. It is even argued that these methods have not evolved much since the times of ancient Egypt and Assyria 5000 years ago. Recently there have been calls for reforming Mathematics instruction by considering more innovative pedagogical approaches, often noted in constructivist theory, to promote students' conceptual understanding (Abdulkarim; Bomala & Aimbola). It is in view of the above that the researchers try to look at the possible innovative methods of teaching mathematics.

Science and knowledge are the main basis for any development, so there should be a priority for all countries in order to cope with the massive technological development that the globe currently witnesses. Mathematics is an integral part of sciences; in fact, it is the core component of science. If we actually understand its importance and the applications in real life, we will be able to use it in the right ways that will meaningfully contribute to the scientific and technological advancement of our nation. However, for the fact that majority of our students consider it a difficult subject to learn make it urgent for our schools to exploit all resources and strategies to help students understand it (Algani, 2018).

However, the fact remains that the more strategies for teaching Mathematics are sought, the more failures occur in mathematics results. Therefore, available means should be employed to improve teaching of mathematics in our schools. Furthermore, some important obstacles stand in the face of employing effective

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strategies in teaching mathematics in schools, which are manifested mainly in the burden of completing the entire loaded study material of the textbook instead of employing various strategies while teaching. Teachers of mathematics would have to build upon the material taught by the previous teachers because mathematics is cumulative in nature.

Nevertheless, if the previous teachers were not good enough, a critical problem arises. The current teacher would have to explain the material that the student did not understand. In doing this it would be time consuming. Attention should be paid by teachers of mathematics to the strategies applied in teaching the subject. Consideration of the existing obstacles, the needs of students, and the objectives that have to be achieved should be attended to. It is essential, for the teacher, to pay attention not only to the topics that must be included in the programs, but also, the manner in which it can be considered more convenient to be worked on by the students. The relationship between themes and the way to approach them is so strong that it can be argued that both themes and didactic treatment strategies are inseparable. It is evident that the way the material is presented and explained affects the students understanding and their attraction to Mathematics. This urges teachers to employ innovative methods that have proved to be effective while teaching mathematics. The way in which Mathematics is taught in our schools makes abstract contents prevail. There is no support in resources that allow building knowledge, from concrete representations of mathematical ideas and concepts, to synthesis activities that facilitate the abstraction and generalization of contents. It is also, imperative that all should keep up with the massive continuous development in all fields. Alternative process or method of teaching has to be adopted in this fast-developing world where knowledge explosion has been taking place every day in every sphere of life. It is unreasonable to expect that spoken or written words alone can convey the volume of relevant information to the learner (Rajikumar and Herma, 2016, P.1). it is vital to note to the fact there are plenty of modern teaching methods that employ technology such as ***Smart classroom, Flipped classrooms, Virtual classrooms, Blended learning and Mobile learning***(Rajikumar and Herma, 2016). These and other applicable methods and strategies are to be discussed and

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the question here is: what are the innovative ways to teach mathematics that teachers have employed in our schools?

However, teachers should be familiar with the objectives of teaching mathematics prior to deciding how to teach it. This is because setting up the objectives determines the way mathematics is to be taught.

General objectives of teaching Mathematics

A mathematics teacher should be quite clear in his mind why he teaches this particular subject. For example a geography teacher should have a very clear mind why he teaches geography. The same applies to mathematics teacher. Any good and serious teacher should in the course of preparing Instructional objectives, express explicitly in clear terms the objectives of his instructions. Therefore the objectives of teaching Mathematics include among others:-

1. Development of basic skills
2. Developing ability to think critically
3. Developing the ability of communicating precisely in symbolic form.
4. Developing the Aesthetic Appreciation of the Environment.

Development of Basic skills

In daily life situation we are faced with problems such as selling or buying of goods, preparing for a wedding party, projecting how long it will take a person to save a certain amount to buy something. These kinds of activities require application of basic computational skills. Therefore, the students we teach should acquire competence in solving such basic or everyday life problems. The development of basic skills is therefore an important aim for teaching mathematics.

Developing the ability to think critically

The ability to think critically refers to a person's competence to reflect, evaluate, accept or reject an opinion on the basis of available evidence "The attitude of

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intelligent caution, the restraint of commitment, the belief that difficult problems can be subjected to critical analysis" should be an important gain by those who have been effectively taught mathematics as capable of developing a learners ability to think critically. As a mathematics teacher if you teach students effectively, they should be able to think and to analyze problems critically in schools as well as in situation outside the school.

Developing the ability of communicating precisely in symbolic form

Mathematics has a language of its own, which is universal and expresses complex ideas in concise form. The language of mathematics will be understood universally whether one is a German, a Japanese or a Nigerian while for example the expression $E = mc^2$reduces highly complex ideas into an apparently simple form. This symbolic language may be one reason why mathematics has been generally found to be a difficult subject which has left many learners of mathematics in a state of bewilderment. This is probably because of this bewilderment that mathematics is seen as an abstract subject. The beauty of Mathematics as a symbolic language lies in the simplicity and brevity of the symbolic forms the impersonal character of the symbols devoid of emotions and the universal understanding of the symbols. For example, "instead of Eric, the teacher is in the school for work" we can write "p is in school for work". Precisely again, instead of "Mrs Joy, the first lady is the defense witness number one," we can write 'y is DW_1.' In fact in all Science subject including mathematics symbols are freely used.

Developing the Aesthetic Appreciation of the Environment

Try to focus your eyes on the beautiful flowers and admire their symmetry. Look at the leaves, the rainbow and man –made features. Mathematics is hidden in them all. The beauty of mathematics is expressed throughout our environment. A person not properly taught mathematics will probably not appreciate this. But a person who is well taught mathematics will appreciate the beauty of the world and the mathematics which permeates it. A certain famous British mathematician called Paul Dirac is reported to have remarked that "God used very advanced

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mathematics to construct the universe".

However, teachers as a matter of fact should emphasize the importance of mathematics in public life by teaching students about the impact of mathematics on cultural development. It is vital to provide students with essential and necessary skills to understand what they are studying and to discover new relationships, as well as to help them in shaping positive trends and attitudes towards mathematics. It is also important if students are helped to rely on themselves in studying mathematics alongside with developing good habits such as accuracy, order, cooperation, mutual respect and constructive criticism, and improving mutual skills and scientific innovation (Algani, 2018).

HOW TO ACHIEVE THE OBJECTIVES OF TEACHING MATHEMATICS

Teaching of mathematics is an interesting profession but at the same time not an easy task. It is believed that it derives both its pleasure and difficulty from the nature of the mathematics and the learner and his/her perception of it. Teaching requires adequate knowledge and art.

Teachers of mathematics must develop themselves professionally by constantly researching and attending events such as conferences, seminars, meetings and professional training to be familiar with its appropriate knowledge as well as learning methods and strategies that make the learning environment effective. This will then make teachers connect mathematics with the daily life and provide students with examples and applications that are tangible so that they can interact with the teacher and the material as well as the learning environment.

Teachers should be creative in choosing examples related to the living experience of students. They should also connect mathematics with abstract thought as well as the real things in life for students to understand and appreciate mathematics. Students' integration into the society help them to learn the art of thinking. If the mathematics the teacher teaches does not relate to the individual in any way, learning it will be useless and merely involve memorization for the examinations.

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The talents the students have must be helped by teachers to use them and provide them with all the available means of illustration especially the modern methods.

Teachers of mathematics should accept procedural and conceptual methods of learning mathematics. Conceptual method leads to the development of learning mathematics among students and which increases their motivation to study mathematics.

INNOVATIVE METHODS OF TEACHING MATHEMATICS

It is the duty of the teachers to teach our students to study mathematics as a practical subject, not as purely theoretical material. They have to memorize mathematical laws and rules only. They should be guided the way to apply the laws and rules to be familiar and get used to at an early age.

Specifying a practical class to introduce students to some rules of mathematics in the surrounding environment through a number of activities and methods and presentations of life examples should be adopted by mathematics teachers. Also, mathematics should be taught together with strategies such as magic squares and crossword games, where students use several calculations and mathematical rules sequentially to reach a relationship. Mathematics can as well be taught using games which is very effective way to enhance motivation and performance. Teachers of mathematics should develop strategies for cooperative action and team work among students, because of their positive effects. Practical application of mathematics rules, and the connection of mathematics to our life, will increase motivation to learn mathematics and allow the students to understand its basic principles and applications.

However, through exploring assignments and demonstrations, the students understand mathematical theories in-depth, overcome the difficulties and common mistakes in mathematics and see the beauty of mathematics. It is also good to exploit technology and mobile phones laws or to practice mathematical problems through games, which also develop the intellectual abilities of students and compliments the educational materials. The aim of using modern

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technological tools in education is to raise the level of educational process as a whole and thus to create a generation that would keep up with scientific and technological developments.

This is the creativity and novelty of the teacher which changes the style and method of teaching. Educational institutions implement new ideas, methods technology based innovations to enhance teaching and learning. The following innovative methods are discussed.

1. *Virtual classroom:* Virtual classroom is an online learning platform that allows for live institution between an instructor and the learner. The created environment can be web-based and accessed through a portal or software based and require downloadable executable file. Examples include;

a) *Massive open online courses* (MOOCs) which are a virtual class that is available for anyone to enroll and participate.

b) *Boot camps*: this is another example of courses that can take place using virtual classrooms. It is an intensive training program that provides participants with a strong foundation upon which to build their careers as computer programmers and technical entrepreneurs.

2. *Smart classrooms:* This is a technology-enhanced classroom that fosters opportunities for teaching and learning by integrating technology, such as computers, specialized software, audience response technology, assistive listening devices, networking, and audio/visual capabilities. In standard smart classrooms are teacher led learning spaces that usually include a computer, interactive whiteboard and projector. Like a traditional class, teachers deliver front-of-class learning but the smart technologies provide students more opportunities to interact with the content, the teacher and each other.

Benefits;

- ❖ Digital classroom which is an advanced form of school that follows different ways of teaching to improve efficiency
- ❖ They work towards providing a better environment for learning

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- ❖ Prioritize a healthy classroom where the students are interested in learning

Disadvantages

- ❖ Creating presentations, videos and programs are difficult
- ❖ Expensive and complex to implement
- ❖ High maintenance cost
- ❖ Highly dependent on electricity

3. *Flipped classroom:* Flipped classroom is an instructional strategy and a type of blended learning, which aims to increase student engagement and learning. It is structured around the idea that lecture or direct instruction is not the best use of class time. Instead students encounter information before class, freeing class time for activities that involve higher order thinking. For instance, a situation where the students engage with new materials individually at home in order to use class room time to expand upon the topic under the guidance of the teacher.

Benefits:

- ✓ Greater development of independent learning skills.
- ✓ Less affected by absenteeism
- ✓ Able to build a deeper understanding to topics.
- ✓ Improved engagement.

4. *Blended learning (hybrid learning):* This is a method of teaching that integrates technology and digital media with traditional instructor led classroom activities giving students more flexibility to customize their learning experiences. It is equally applied to the practice of using both online and in person learning experiences when teaching students. For example, learning stations, labs and flipped classroom where learners practice the lesson before attending the face-to-face training. Blended learning models usually leverage a combination of in-person instruction techniques, teacher-led online modulus, and self-paced

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learning. Blended learning helps students to explore technology and use different tools or techniques for teaching. For example, power point, virtual classrooms, video lectures etc. Blended learning improves the quality of education and information assimilation while making teaching more efficient and productive.

Benefits

- Blended learning programs provide a safer learning environment.
- Increases student engagement.
- Flipping the classroom improves comprehension.
- Students have more autonomy over their learning.
- Provides efficient use of instructor time.
- Gather learner data for better insights.

5. *Mobile learning (M- Learning):* M-Learning is a way of assessing learning at the point of need, enabling users to access content whenever it suites them. It allows learners to access information in a quickly and easily, able to pick up learning as and when suites them. As a result, smart phone learners complete course materials 45% faster than those using a desktop computer. It is time efficient from an administrative stand point.

Obstacles inherent in the innovative methods of teaching Mathematics

Experienced mathematics instructors argue that teaching mathematics to students at different educational stages may seem difficult for teachers, students and even guardians. The obstacles include:

- The disparity between the educational abilities of the students.
- individual differences between the students,
- the lack of educational qualifications among the teachers, and
- the differences in the educational levels of the guardians or parents cause a critical gap in teaching mathematics.

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How to dismantle the obstacles in teaching Mathematics

First and foremost:

- Reconsidering the nature of the curriculum for mathematics itself,
- The quality of the methods used in the explanations.
- The extent to which the students accept their content and achieve good results at the end.

Teachers of mathematics should employ technology in teaching mathematics because students love technology and will be more than happy to study mathematics using technological tools. However, it is argued that technology cannot replace effective teaching but can provide students with additional representations of mathematical ideas, allow inquiry based exploration reinforce procedural learning and fluency. Also provide efficient screening and diagnostic assessment data as well as significant learning.

Procedural learning refers to the acquisition of motor skills and habits and types of cognitive skills. Unlike declarative learning and memory, procedural memory is typically inaccessible to conscious recollection. While factual information is consciously recalled in declarative or explicit memory. In procedural learning acquisition and memory are demonstrated through task performance. Procedural learning usually requires repetition of an activity and associated learning is demonstrated through improved task performance.
Significant learning occurs when students learn beyond the facts, interpret information, create connections between facts, and think about the processes of their comprehension, and apply new concepts to new situations. Students must think, solve problems, change their positions and opinions, and develop skills and build knowledge.

Also, some pedagogical principles, the application of which is liable to lead to the significant learning have been adopted. These principles are based on a constructivist paradigm. Constructivist is a theory of learning that proposes an explanation on the nature of knowledge and how people learn. It claims that

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people create or build up their understanding and new knowledge on the basis of interaction between what they already know and believe and the ideas, events and activities with which they come into contact. The constructivist approach is based on the following premises:

(a) ***Learning as an active process*:** In the process of learning, every student is active cognitively, physically, socially and emotionally in the construction of personal significance.

(b) ***Learning as a constructivist process*:** Here, the students build up knowledge through the use of previous knowledge. The combination of earlier and new knowledge contributes to the construction of new understanding. In this process, knowledge is built up actively by the learner through an internal cognitive process at a high level that acts on stimuli from the environment (Michael,& Model 2003).

(c) ***Learning as a social process:*** Learning occurs in the social interaction between students and their classmates and arouses internal processes of significant creation.

(d) ***Authentic learning:*** This type of learning is the one that is based on experience in the real world. Materials and activities are arranged around connections in which they are use***d "in real life". Other innovations methods include:***

Use of variety of teaching and evaluative methods:

It is based that the non-use of various teaching methods and evaluating techniques by teachers in order to promote learning constitutes a barrier in effective learning. Some teachers failed to bring examples to the classroom and only draw on the chalk board or solve problems. There are no concrete mathematical presentations. Teachers do not mark homework assignments in a thorough manner. However, the fundamental principles of teaching which allows learning is the use of indirect teaching methods as mentioned above which were as active involvement in the building up knowledge and the creation of understanding by the student.

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Differential teaching also should be adapted to the personal characteristics and unique abilities of the students. It is also one of the procedures on which the teachers should always look at when teaching. The process and approach of adapting teaching the characteristics and abilities of the students is one of the ways that makes learning more relevant to the learner (Algani, 2018).

Another one is the use of digital tools and applications. Teachers of mathematics should try and make use of digital tools as and when necessary in the classroom to bring about meaningful learning. Ash burn and Flodden (2006), were of the view that technology acts for the learners like an intellectual partner who helps to advance in thinking, learning and understanding the world in which we live. Learning with the help of technology will promote significant learning if it is based on the involvement of the learners in the construction of *knowledge; on dialogue; on self-expression of the knowledge acquired; on the use of reflective thought.*

Finally*, evaluation for the sake of learning*; most teachers tend to use evaluation only in the examinations at the end of term or semester. Some will give not indicate why answers are wrong. However, the fundamental principles of evaluation allows for significant learning through rich feedback which is continuous and mediating. It is rich because it gives the learner detailed information about his achievements and failure and continuous because it is done throughout the learning process. It is also mediating because it is derived from the product that the learner creates. The importance of evaluation in the teaching and learning pedagogy cannot be overestimate. It gives teachers and learners information about the development of the learning process and allows for significant feedback in evaluating learning during its process and after wards in order to make decisions on the improvement of teaching.

Summary

The write up highlights the strategies used by teachers to teach mathematics in the classroom. The authors examine how they are used by teachers in the

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classroom. The role the teachers play, some innovative methods highlighted, also general objectives of teaching mathematics. Obstacles inherent in the use of the innovative methods and possible ways of dismantling them were discussed like; reconsidering the nature of the mathematics curriculum; adopting technology which can provide students with additional representations of mathematical ideas; allow inquiry-based exploration; reinforce procedural learning and fluency and significant learning.

Recommendations

It is important to point out that for effective teaching to be in place, there is need for teachers to adopt effective innovative methods during mathematics instructions. The following were therefore recommended;

- Attention should be paid on the strategies employed in teaching mathematics like modern technologies.
- Innovative and modern strategies should be considered.
- Load of mathematics curricular to be re-considered.
- Priority given to students understanding of mathematics via exploring various means and employing modern technological innovative strategies of mathematics.

References

Abdulkarim, A.;Bomala.I.; Abimbola, N.G.A (2019). Effect of ICT-Driven Pedagogy on the academic achievement of secondary school students within Gombe metropolis in Geometry. *The journal of the Mathematical Association of Nigeria.* 44(1). 144 -150

Agwagah, U N.V;& Ezike, A.E. (2018). *Emerging issues in Science and Vocational Education. Godfrey Okoye University, Enugu.* Enugu, God's Will printer.

WEBSITE: https://globaljournalhub.com
ISBN: 978-978-798-430-7

Algani, Y.M.A. (2018). Innovative ways to teach mathematics: are they employed in schools? *Journal of Computer and Education Research,* 7(14) 496 -514

Ashburn, E.A. & Floden, R.E. (2006). Meaningful learning using technology: what educators need to know and do? New York: Teachers College Press.

Coe, K A. (2018). Strengthening student educational outcomes: mathematics menu of best practices and strategies. OSPI, RCW 28A.165 & 28A.655.235.

Michael, J. A. & Modell, H. L. (2003). Active learning in secondary and college science classrooms. Mahwah, NJ: Lawrence Erlbaum.

Rajkumar, R. & Hema, G. (2016). Modern mathematics classrooms: facilitating innovative teaching methods and learning strategies for 21st century learners.

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ISBN: 978-978-798-430-7

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TEST ITEM BIAS AND IMPLICATIONS IN EXTERNAL EXAMINATIONS IN NIGERIA

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INTRODUCTION

Psychological testing as a procedure and psychological tests as instruments have come under various criticisms since testing began in the school system. A large proportion of the criticisms revolve on fairness of test to the various identifiable groups taking the same test. Measurement experts have begun to intensify research work in this interesting, sensitive and sentiment-laden issue especially now that universities and other tertiary institutions conduct aptitude tests for students to complement JAMB admission procedures. Sequel to these submissions, the article discusses issues in test item bias in public examinations in Nigeria. It specifically examines the meaning, types and sources of test item bias as well as different methods of detecting it in a testing situation. Also the implications of test item bias in Nigerian educational system especially at post primary school level were highlighted.

Concept of Test Bias

The issue of fairness is what critics labeled “bias” in testing. When the whole test is the unit of concern, then “test bias” is the issue to be examined whereas when

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an individual item is the unit of concern, then "item bias" is the concept of focus. A more decorated term for item bias has been formulated namely "differential item functioning". Differential item functioning (DIF) occurs when examinees from different groups show differing probabilities of success on the item after matching on the underlying ability that the item is intended to measure (Zumbo,2009). Item bias occurs when examinees of one group are less likely to answer an item correctly than examinees of another group because of some characteristic of the test item or testing situation that is not relevant to the test purpose. That a test item is not biased is an important consideration in the selection and use of any psychological test, that is, it is essential that a test is fair to all applicants, and is not biased against a segment of population taking the test items.

In many cases, test items are biased due to the fact that they contain sources of difficulty that are irrelevant or extraneous to the construct being measured, and these irrelevant factors affect performance. Perhaps the item is tapping a secondary factor or factors over-and above the one of interest. When items have the same construct validity for all examinees in a population, examinees of comparable ability may have the same chance of getting the item correct (Berk, 2007).

TYPES OF TEST BIAS IN MEASUREMENT OF ABILITIES

Camilli and Shepard (2009) discussed the following types of bias which can easily be encountered in the process of testing. They include:

a) Content bias,
b) Atmosphere bias, and
c) Bias in use-social consequences.
d) Assessment Bias

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e) Socio-Economic Bias
f) Gender Bias
g) Ethnic/Racial Bias.

1. **Content bias:** It occurs when the content of the test items gives a systematic advantage to a particular group of test takers. Usually the bias reflects differences in the opportunities to learn the material tested. Test items may be biased and unfair to the members of any group if they have not had the opportunity to learn the material. However, if members of various groups have had equal opportunities to learn the test contents, any observed differential performance may not be persuasive evidence of content bias.
2. **Atmosphere bias:** It could arise as a result of the testing conditions on the examinees' performances. It could emanate from the type of motivation elicited, factors related to the examinee-testers interaction, and factors in the evaluation and scoring of responses. The goal in testing is to minimize any possible test condition effects and this is usually accomplished by using standard testing conditions.
3. **Bias in use-social consequences:** They occur when treatment assigned on the basis of test result vary in quality. A test could be a valid predictor of an outcome but the use of the test might lead to undesirable consequences. It should be noted that this approach requires consideration of factors other than test quality. A fair and unbiased use of test involves more than psychometric validity; it encompasses the consequences to the decision made on the basis of test scores. (Camilli and Shepard (2009).
4. **Assessment Bias:** This type of bias is according to Popham (2012) obtained when one or more test items on a test offend or unfairly penalize learners because of those learners' personal characteristics such as gender, race, religion, social-economic status. Popham explained that this definition suggests that there are two aspects of a test's items that can contribute to assessment bias. They are offensiveness and unfair penalization.

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Offensiveness occurs when test items contain contents that insult, irritates or causes pain to students because of these students' personal characteristics. However, many learners will be and ought to be offended by test items that disparage any group. If a class has a large number of students from a given subgroup, for instance, Muslim children or children who are physically challenged, it is fair easy for the teacher to be attentive to what may offend those learners. The second kind of assessment bias is unfair personalization. This arises when a test item actually penalizes a student because of that student's personal characteristics such as place or location. Consider location (urban/rural) as an example, if one of your test's first few items is set in the context of information and technology (ICT) which is more available in urban areas than in rural areas, more students in rural areas will be more disadvantaged to answer the question correctly than the urban students'. This is because ICT and electricity to operate it are more available in urban than rural areas.

5. **Socio-Economic Bias:** This type of bias is obtained when students are offended or unfairly penalized because of their family socioeconomic status (SES) e.g. A test has this kind of bias when it contains test items that denigrates impoverished parents. This offends low SES student. Students from less affluent background find that, on some test items, they do not have as much chance to succeed as their more affluent classmates. Due to the fact that those diminished chances for success is hinge not on a student's effort/ability, but rather on the student's social or economic background, this clearly constitutes a good instance of unfair penalization.
6. **Gender Bias:** When a student is offended or unfairly penalized because the student is a male or a female, then gender bias has occurred. In our culture, there is a historical dominance of males in most settings. Hence, gender bias in educational tests is most likely to have a negative impact on females. Consider a test item that is focused on football profession. Because males

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participate and love football more than females, this test item will be biased against females. This item is gender biased.

7. **Ethnic/Racial Bias:** *The New Oxford American Dictionary* (2001) defined *race* as "each of the major divisions of humankind, having distinct physical characteristics. *Ethnicity* is defined as the fact or state of belonging to a social group that has a common national or cultural tradition". Generally, *racial* refers to a major human species subdivision, while *ethnic* refers to a subgroup within a race. For example, if Africa is regarded as a race, then one can identify different African ethnic groups because of national traditions (e.g., Nigeria versus Ghana) or cultural traditions (Nigerian Hausa versus Nigerian Yoruba). In this research, *racial* will be regarded as a major anthropological division of humankind (e.g., African) while *ethnic* will be regarded as subgroups within those divisions e.g., Nigerian Ibo's Hausa's and Yoruba's descent in Africa. When a classroom teacher or examiner tries to avoid any content in test items which will offend or unfairly penalize students because of their race or ethnicity, he is being attentive to avoiding racial/ethnic bias in test construction.

Methods of Detecting Test Item Bias in the Measurement of Ability

Many methods of detecting test item bias in the measurement of ability exist and those to be explained here include: item characteristic curve, chi-square method, transformed item difficulty method and differential item method and so on.

a) **Item characteristic curve:** Item characteristic curve approach of detecting test item bias, states that a test is unbiased if all the individuals having the same underlying ability have equal probability of getting the item correct regardless of subgroup membership (Pine, 2006). In other words, an item is said to be unbiased if the characteristic curves for the item measured on two groups are identical. If the situation does not hold, then the item is biased

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and the area between the group ICCs serve as a measure of the item aberrance (Lord, 2002). All item characteristic curves are plotted from test data and form curves of the same general form: from left to right, beginning low, inclining sharply, and leveling off dramatically as illustrated thus:

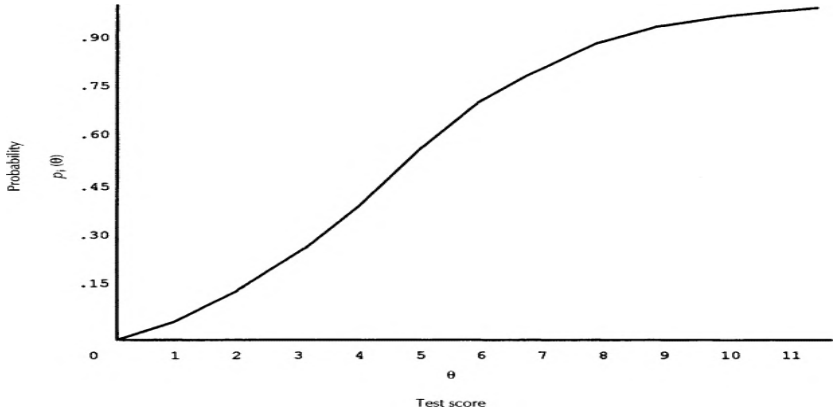

Figure 1.0. An Item-Characteristic Curve, pi, = probability that a test taker with trait value θ passes item i.

A steep ICC indicates that the item discriminates well, a shallow slope that it discriminates poorly. Also, an ICC provides bi an index of item difficulty that increases, rather than decreases, with difficulty. This index is simply the total test score that corresponds to a pi (θ) of .50. Thus, in Figure 1.0, bi is about 4.5. Transforming characteristic levels to give them a mean of zero and a standard deviation of 1 allows a test constructor to compare the bi indices of two or more measures. The transformed bi values usually range from + 2 to –2 (Allen & Yen, 1979; Hambleton, Swaminathan, & Rogers, 1991). ICCs can alert a test constructor if an item is functioning differently for different groups of people (Allen & Yen, 1979). If the item has different ICCs for different groups, it is measuring different characteristics for the two groups. In such cases, the item is

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not working properly for at least one group. On the other hand, if the ICCs look the same, the item might be working appropriately for all groups. A comparison of ICCs can identify a bad item but not a good one. It is still useful, however, because it can signal the test developer to discard certain items.

b) **Chi-square method:** In the chi-square method an item is unbiased if for all persons of equal ability, the probability of a correct response is the same regardless of each person's cultural or ethnic group membership. Each major population for comparison is divided into various ability sub-groups on the basis of observed total test scores. Within each score-group, the p-values are computed and compared for the major populations. The expected values for each cell are obtained by multiplying the proportion of examinees who respond correctly to the item within a total score interval by the total number of examinees within the cell. Observed cell values are simply the number of examinees within the cell that respond correctly to the item. For each item, the magnitude of the group difference is indicated by the value of the resultant chi-square statistic divide by its degrees of freedom or mean square (Swaminathan & Rogers, 2005).

c) **Transformed Item Difficulty Method:** The Transformed Item Difficulty, proposed by Angoff, considers bias to be characteristic inherent in all test items. Ostalind, defines an item as biased if the item comparatively more difficult for one group to answer than it is for the other (Ostalind, 1983).With TID, the p-value (the proportion of subjects answering items correctly) obtained first for two different groups on a set of items. Each p-value is then transformed into delta scale, with a mean of 13 and standard deviation of 4. The pairs on deltas are plotted on a bivariate graph. Ideally, the plot would be a perfect 45 degree of line indicating the absence of bias. The items filling at some distance from the 45degree of line are regarded as the result of item-by-group interaction. On the other hand, these are items

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that are especially more difficult for one group than the other, and bias is suggested.

d) **Differential Item Functioning (DIF) Method:** The issue of test bias has been the subject of a great deal of investigations in recent years, and a technique called Differential Item Functioning (D1F) analysis has become the new standard in psychometric bias analysis. Test bias is often examined at the item level, with differential item functioning (DIF) analyses being part of the framework for probing item bias. (Geranpayeh & Kunnan, 2006).

When psychological tests are used, one of the core issues in comparing individuals and groups is to ensure that item bias (differential item functioning)is investigated in order to minimize inappropriate interpretations. The Employment Equity Act 55 of 1998 of South Africa specifically prohibits the use of psychological tests and other such measurer, unless it can be shown that they are not biased, do not discriminate against any group and can be used fairly for all (employees) (Baer, 2004). When tests are labeled "biaseril" or DIF, the I accusations often have to do with the instruments chosen for a particular context, the way in which these tests are administered or the way in which the results are interpreted and/or used.

Test fairness is a moral imperative for both the makers and users of the test. DIF is said to occur whenever examinees from different subgroups that nave the same amount of the underlying trait measured by the test perform unequally on an item. A test item is labeled with DIF when people with equal ability, but from different groups, have an unequal probability of item success (Walker, 2011).Conversely, a test item is labeled as non-DIF' if examinees having the same ability have equal probability of getting the; item correct; regardless of group membership. IRT provides a good framework for DIF testing. An important tool in item analysis is the investigation of item bias or differential

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item functioning (DIF), in which one group responds differently to an item than another group. Information about the items location on the underlying trait allows researchers the opportunity to identify trait levels not measured or overtly measured by the instrument. After estimating item properties there are many graphical resources to view the items' location along the underlying trait. One common and interpretable graphical tool to model" the item locations for the Rasch model is an "item map". The Rasch or IPL - IRT model constrains the items' discrimination power (item slope) to be equivalent, and estimates the location of the items on the underlying trait Θ.

The fact that some items in a test might be unfair to one subgroup or another has become a matter of great concern, to test developers and test users. The most extreme definition of item and test bias is that a test is biased to the extent that the means of two groups of interest are different (Ebuoh, 2004). The obvious problem with this definition is that other variables beside item bias contribute to these differences. By this definition, a measuring stick is biased because it shows that females are, on the average, shorter that males. Another definition of item bias that can be advanced is that an item is unbiased if the item-difficulty Index (or *p* value) for one group is the same as that for the second group of interest. However, the disparity that can be found between the, *p* values for the two groups might be the result of social and educational bias.

Also, when a set of items is unbiased, it is reasonable to expect the rank ordering, the *p* values to be the same for two groups as long as the discriminating powers of the items are similar. A more stringent expectation is -that the correlation between the *p* values is 1. When this happens, all the *p* values are less than 1 on a straight line. In this case, it could be said that the items are unbiased (or equally biased). Thus, item's that do not fall on the best fitting line of the scatter plots of item difficulty values may be taken as biased item. A major shortcoming, however, is that the plots of item difficulties will I not be linear so

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long as there are group differences in ability Lord as cited in Ojerinde, Popoola, Ojo, & Onyeneho, 2012).

In the past, differential item functioning has been called "item bias" in the literature because such item biases one group to have a higher scale score than another group. Item bias indicates that groups are treated unfairly. However, Angoff cited in Ojerinde, Popoola, Ojo and Onyeneho (2012) cautions that differential item functioning can occur without judgments of unfairness to one group or another. For example, when two different national groups were compared on a common measure as part of a research effort to study linguistic differences researchers were not interested in item bias, but were investigating cultural differences. Therefore, the term "item bias" has either been replaced by the expression differential item functioning or the terms are used interchangeably in the current literature.

Differential item functioning (DIF) is most frequently defined in the context of item response theory (IRT). Camilli and Shephard as cited in Ojerinde, Popoola, Ojo and Onyeneho (2012) remarked that item trace lines provide a means of comparing the responses of two different groups, say groups *reference* (e.g., control) and *focal* j(e.g., treatment), to the same item. In the framework of IRT, item parameters are assumed to be invariant to group membership (in contrast to classical test theory where parameter estimates and statistics vary with the sample being measured). Therefore, differences between the trace lines, estimated separately for each group, indicates that respondents from the reference group and focal group at the same level of the underlying trait have different probabilities of endorsing the item. More precisely, DIF is said to occur whenever the conditional probability, *P(X),* of a correct response or endorsement of the item for the same level on the latent variable differs for two groups.

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The key decision that must be made for DIF analysis is the selection of the appropriate IRT Model. Different models allow a different number of item parameters (i.e., b, a, c parameters) to be estimated from the data of item responses, and thus, allow for the evaluation of DIF for different item properties. The IRT approach in solving the problem of item bias is made possible because IRT provides a test of item equivalence across groups (Camilli & Shephard as cited in Ojerinde, Popoola, Ojo & Onyeneho, 2012.), We can test whether an item is behaving differently for blacks and whites or for males and females, for example. The same logic can be applied to translations of attitudes scales into different languages.

We can test whether the item means the same thing in English and French, for example. If the ICCs for two populations are the same, the item is not biased. If the ICCs are different, the item is biased. This means that, it is functioning or behaving differently across the groups. Ojerinde, Popoola, Ojoand & Onyeneho (2012) remarked that DIF can detect item bias if and only if the following assumptions are true:

i. That the test items are measuring a single trait. What if there are multiple traits behind the scene? For example, a math test may consist of items in both numeric and essay forms. A. tester who is low in math skill but high in reading skill may answer difficult math questions expressed in a numeric form correctly, but fail to answer easy questions expressed in an essay form. This dual-trait situation is unavoidable because almost all tests require reading skills. However, when a skill involves multiple traits other than the content and the language, say A and B, DIF may not be useful. The test item may bias against male on A. but bias against female in B.
ii. That the overall test is fair and only several items are biased. Therefore, the total score is used as a reference to classify testers into high and low ability group. However, what if more than half of the items are biased?

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iii. That the abilities are equivalently distributed across groups. Therefore, certain test score differences are due, to unfair questions rather than inherent group differences. Those who challenge this assumption are always criticized as "racist," "sexist" or some type of narrow-minded people. However, whether certain groups have inherent advantages on certain tasks should be open to scientific investigation rather than settling down by political correctness.

In the pact, differential item functioning has been called item bias in the literature because such item biases one group to have a higher scale score than the another group. Item bias indicates that groups are treated unfairly. However, differential item functioning can occur without judgments of unfairness to one group or another. For example, when two different national groups were compared on a common measure as part of a research effort to study linguistic difference, the researchers were not interested in item bias, but were investigating cultural differences. Therefore, the item bias has either been replaced by the expression of differential item functioning or the terms are used interchangeably.

Assessment of Differential Item Functioning (DIF) can be earned out using Item response theory. Ojerinde, Popoola, Ojo and Dnyeneho (2012) opined that DIF is most frequently defined in the context of item response theory. Item trace lines provide a means for comparing the responses of two different groups, say reference (example, control) and focal (example, treatment) to the same item. The item parameters in the IRT framework are assumed to be invariant to group membership (in contrast to classical test theory where parameter estimates and statistics vary with the sample being measured). Therefore, differences between the trace lines, estimated separately for each group indicates that respondents from reference group and focal at the same level of underlying trait have different probabilities of endorsing the item. More precisely-DIF is said to occur

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whenever the conditional probability, P (0), of a correct or endorsement of the item for the same level on the latent variable differs for two groups.

Differential item functioning (DIF), from an item response theory (IRT) perspective, can be established as a difference between groups in item response functions. Zwick (2009) viewed differential item functioning (DIF) as a difference in item performance between equally proficient members of two demographic groups. The classic example of a DIF item is a mathematics question containing sports jargon that is more likely to be understood by men than by women. An item of this kind would be expected to manifest DIF against women: They are less likely to give a correct response than men with equivalent math ability.

Differential item functioning (DIF) majorly occurs due to item difficulty level. Gnaldi, Bartolucci and Bacci (2012) pointed out that even in the presence of a two-parameter logistic (2PL) or three-parameter logistic (3PL) parameterization, it reasonable to suppose that the main reason of DIF is due to the item difficulty level, which may depend on the individual characteristics of the respondents. DIF are differences in the functioning of items across groups, oftentimes demographic, which are matched on the latent trait or more generally the attribute being measured by the items or test. It is important to note that when examining items for DIF, the groups must be matched on the measured attribute, otherwise this may result in inaccurate detection of DIF, the groups are usually labeled as the "reference" and "focal" groups. Although the designation does not matter, a typical practice in the literature: is to designate the reference group as the group who is suspected to have an advantage while the focal group refers to the group anticipated to be disadvantaged by the test.

Identifying the causes of DIF is also important part to understand about the relative strength and weakness of the examinee groups or the different skills and

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abilities that the test items measure. Ahmadi and Bazvand (2016) highlighted some possible sources for such trends may include item content, item type or format item context, content and cognitive dimensions associated with items. It may be possible to gain considerable insight into the potential causes of DIF by considering the statistical evidence of item level DIF in light of such item attributes. Practically, items identified as showing substantial DIF are not necessarily deleted from future tests, but these items are among those that need to be carefully reviewed prior to any subsequent use.

Policy Issues in the Implementation of Differential Item Functioning

Clauser and Mazor (2008) postulated that the entire domain of item bias is really about policy. In fact, by even considering a bias analysis one is already in the domain of policy. Some organizations have bias analysis legislated whereas others take it on as part of the day-to-day validation process. If bias is being "legislated" from an outside body, according to Zumbo (2009), this legislation will help one to determine the answers to the following policy matters:

1. If there are a lot of different sub-groups to be contrasted, one needs to be clear as to which one are of personal and moral focus. The standard comparisons are based on gender, race, subculture, or language.
2. One needs to discuss how much DIF one needs to see before one is willing to consider the item as displaying DIF. In most cases, it is not sufficient to simply rely on the answer that all statistically significant items are displaying DIF because statistical power plays havoc on one's ability to detect effects. In essence, how much DIF does one need to see before one puts the item under review or study?
3. Should an item only be sent for review if it is identified as favouring the reference group or should an item be sent for review irrespective of whether it favours the reference or focal group?

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4. The timing of the DIF analysis is also important. We could consider two scenarios (a) examiner is using a ready-made test; or (b) examiner is developing his own new or modified measure. First of all, in either case, DIF analyses are necessary. In the first scenario where one has a ready-made test that one is adopting for use and there is pilot testing planned with a large enough sample, DIF analyses are performed at the pilot testing stage. When one does not have a pilot study planned or one does not have a large enough pilot sample then DIF analyses are conducted before final scoring is done and therefore before scores are reported. In the second scenario where one is developing a new test, DIF analyses should be conducted at pilot testing and certainly before any norms or cut-off scores are established.
5. What does one do when one concludes that an item is demonstrating DIF? Does one immediately dispense with the item (we won't subscribe to this because the domain being tapped will quickly become too limited) or does one put an item "on ice" until one sends it to content experts and for further validation studies? Part of the answer to this question has to do with the seriousness of a measurement decision.

Implication of Test Item Bias in Educational System

Bias can result in systematic errors that distort the inferences made in any selection and classification. There is existence of a number of examination bodies in Nigeria and these bodies cater for candidates of various backgrounds all over the country. Candidates who participate in the examinations conducted by these examination bodies are in different settings and therefore differently toned for personal and environmental reasons. As a result of this, the problem of test item bias cannot be ruled out in these examinations. It is expedient that the examining bodies examine the degree of bias in their examinations. It has been claimed that some of the national examinations unfairly favour examinees of some particular groups example, cultural or linguistic groups to the extent that it is now believed

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that a particular section of the country perform most woefully in these national examinations. A critical look at the perception of people on such national examination in Nigeria indicates the serious nature of item bias.

For a test to be free from bias, it must be one-dimensional. Unidimensionality is the assumption that an item is intended to measure a single attribute or skill for all examinees. The assumption of unidimensionality is the most complex and most restrictive assumption of item response theory. In general, unidimensionality means that the items measure one and only one area of knowledge or ability. Lumsden (2003) provides an excellent method for constructing unidimensional tests. Lumsden concludes that the method of factor analysis holds the most promise.

Other tests for unidimensionality include the eigen-value test, the random baseline test, and the bacterial test. When factor analysis is used to check for unidimensionality of item, the ratio of first factor variance to second factor variance is used as index of unidimensionality (Hambleton & Cook, 2005). There are possibilities for this assumption to be violated. For example, two items designed to assess multiplication skill in mathematics could be as follows: (i). what is 5×9? (ii). what is the product of five and nine? Item (i) requires only knowledge in mathematical operations, while item (ii) requires for its solution, a specific amount of reading competence as well as knowledge of mathematical operations. When different attributes are being measured as in item (ii), the issue of item bias enters into consideration if such item is administered to two different groups and the responses of one of the groups are dependent on the secondary skill. This type of item measures different types of skills among different groups has been observed that some of the national examinations often over-predict or under-predict some candidates from certain states during the selection exercise. Moreover, some examining bodies have different policies of awarding the final grade to examinees. For instance, JAMB has accepted different cut-off points for

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selecting candidates into Nigerian tertiary institutions based on merit, catchment area, educationally disadvantaged states and institutional discretion. This problem of bias in selection fairness could persist if the examining bodies do not ensure that examination items have zero error of prediction for all the candidates across the nation, which is a great task to accomplish (Dibu-Ojerinde, 2006). According to him, the language of the test item should be such that it is not apt to be offensive to members of any subgroup. Ideally it is expedient to construct test items in a manner that no element of it would offend examinees on ethnic, sexual, cultural, religious or socio-economic grounds. For instance, a test item on Social Studies which describes, "Reverend Father Chukwudi Emenike Okafor as the leader of deadly armed robbery gang that has been terrorizing the residents of Makurdi town" is a biased item. It is obvious that some catholic Christian candidates would be offended because of the implication that 'Reverend Father' led the deadly gang in the first instance. On this term too, Ibo candidates may feel offended that their kinsman is involved in the heinous crime. The candidates from Benue State and those who have relation in Makurdi town may concentrate on the issue in the item instead of the examination. The national examination bodies could take care of bias in such item by reliance on a judgmental approach for detecting and eliminating biased items.

To create bias-free items, the national test developers may ensure that the activities and connotations reflected in the test items are relevant to the life experiences of examinees responding to the items. Test items ought to be written in a straight forward, uncomplicated, easily read manner. Excessive wordiness can obviously interfere with examinees' ability to respond appropriately to test items and therefore constitute bias in the paper. Supposing mathematics item is written like, 'what is the cumulative summation of the integer three when appended to a quantity of an identical nature?' This is a case of wordiness; the item might be written in a better way as "what is 3+3?" or "what is three plus three?"

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The procedures employed in the administration of the national examination are likely sources of bias. The actual administration of the examinations constitutes a complex interaction among examiners' variables, examinees' variables and situational variables. A situation where candidates in some areas write national examinations in stuffy, poorly furnished, uncomfortable classrooms is an indication that the examinees being tested will perform badly in the examination and sometimes, examination bodies keep mute about this ugly situation, which is of course, an imaginable absurdity. The behaviour displayed by an examiner during examination period can be influential in determining the way that examinees will perform on the test.

Some candidates especially those in the rural areas may be less familiar with the typical testing formats of some examination papers. Such candidates are intimidated by the nature of the test itself. To help in creating uniformity in the national examination, the school teachers and others who are concerned with the performance of the candidates could ensure that examinees are given ample practice opportunities to become accustomed to the formats of the examination items. The classroom teachers ought to see that examinees acquire 'test-wideness'' that may enable them to answer some items correctly through familiarity with testing practices even when they have a limited knowledge of the concept in the items. For instance the longest option in some multiple choice test items may be more likely correct than the short options and this can only be acquired through frequent testing practices (Dibu-Ojerinde, 2006).

Item bias may lead to erroneous conclusions because of distortion or dilution of the effects measured. In comparing groups, item bias analysis, tests whether the information about possible differences between groups, obtained by the variables constituting an index, are correctly passed on by the index score.

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Recommendations

The author made the following recommendations in order to enhance and prevent test item bias in external examinations in Nigeria:

a) The author recommends that vigilance against test item bias can help to isolate and expunge biased examining practices in Nigeria. It is therefore desirable that examination bodies use examiners who understand the candidates and the subjects of the examination. The national examination bodies can solve the issue of bias in this situation by appointing qualified examiners who are genuinely committed to the success of the examination generally. It is also important to provide examination administration settings that are conducive in promoting the examinees' best efforts in all the centers throughout the country.

b) To create bias-free items, the national test developers should ensure that the activities and connotations reflected in the test items are relevant to the life experiences of examinees responding to the items. Examination bodies and educators should take more cognizance of the possibility of test item bias in a testing situation and with this kind of effort, candidates from educationally disadvantaged areas and low socio-economic status would be certain to be fairly treated.

c) The national examination bodies must try as much as possible to attain unidimentionality in the test and this is one of the very essential assumptions of the test theory and also a vital condition in item bias studies.

d) It will therefore be necessary that the examination bodies should examine the degree of bias in their examinations.

e) In addition, examination bodies should construct test items in such a manner that items are free from writing errors such as wordiness, irrelevancy, offensiveness, and excessive stimulation, so that when an inadequacy exists

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between groups' examination item scores, the disparity will be attributed to true differences in whatever the test purports to measure in the examinees.

Conclusion

It is important to note that societies have now come to conclusion that test results are better criterion for selection purpose than subjective evaluation. Though accepted in most societies as the most objective method of decision-making, nonetheless, the use of test has sparked off some grave concerns among the members of the public in recent years. These concerns have tended to erode people's faith in the power and efficacy of tests. Various criticisms have been leveled against psychological testing and a large proportion of the criticisms pivots on fairness of test to the various identifiable groups taking the same test. It has been affirmed that test bias is inevitably one of the characteristics of examination process which demands a staid attention of examination bodies. Various types of test bias exist and they consist of content bias, atmosphere bias, bias in use-social consequences.

Many methods for detecting test item bias in the measurement of ability exist and they include among others: item characteristic curve, regression method, chi-square method and transformed item difficulty method among others. Bias can result in systematic errors that distort the inferences made in any selection and classification.

References

Ahmadi and Bazvand (2016): *Gender differential item functioning on a national field-specific test*: The case of PhD entrance exam of TEFL in Iran. Iranian Journal of Language Teaching Research 4(1), (Jan., 2016) 63-82

WEBSITE: https://globaljournalhub.com
ISBN: 978-978-798-430-7

Allen, M. J., & Yen, W. M. (1979). *Introduction to measurement theory*. Monterey, Calif.: Brooks/Cole Pub. Co.

Anigbo, L.C. (2014). *Teachers' handbook on measurement and evaluation for effective teaching and learning.* Executive Press Limited

Baer (2004) Assessment of Mindfulness by Self-Report: *The Kentucky Inventory of Mindfulness Skills*http://www.div12.org/section9/

Bandalos, D. L. (2018). *Measurement theory and applications for the social*

Bartolucci, and Bacci, (2012). Multi LCIRT: An R Package for Multidimensional Latente Class Item Response Models. arXiv:1210.5267v1 [stat.AP].

Berk (2007). Item Bias Detection Methods for Small Samples. *Dissertation abstract internationa*l.

Cameron, L, Adler, M., & Reid, I. (2014). A comparison of three methods of assessing Differential Item Functioning (DIF) in the hospital anxiety depression scale: *ordinal logistic regression* Resell Analysis and Mantel- Henszel Statistics .https://www.researchgate.net/publication

Camili, G., and Shephered, L.A. (2009) *Methods for Identifying Bias Test Items* (Vol.4) Thousand Oaks, CA: Sage Publications.

Clauser, B.E., and Mazor, K.M. (2008) Using Statistical Procedures to Identify Differential Item Functioning Test Items. *Educational Measurement: Issues and Practice,* 17, 31,-44

WEBSITE: https://globaljournalhub.com
ISBN: 978-978-798-430-7

Dibu-Ojerinde, O. O. (2006). Test item bias and implication for testing in Nigeria. Nigerian Journal of Guidance and Counseling, 3 (1-2), 108-116.

Ebuoh. C. N. (2004). *Educational measurement and evaluation for effective. teaching and learning.* Enugu: Sky Printing Press.

Ede, M.O., Oleabhiele, E.O. & Modebelu, M.N. (2016). *Fundamentals of Economics Education*. Awka: SCOA Heritage Nig. LTD.

Emaikwu, S. O. (2011). Evaluation of student's ability in schools. Being a paper presented at a workshop on teaching practice on Friday, 29th July in the College of Agricultural & Science Education, Federal University of Agriculture Makurdi, Benue State.

Emaikwu, S.O. (2012) Issues in Items Bias in public Examination in Nigeria and for testing. I*nternational Journal of Academic Research in Progressive Education and Development January* 2012, Vol. 1, No. 1 ISSN: 2226-6348

Hambleton, R. K., & Cook, L. (2005). Latent trait models and their use in analysis of educational test data. Journal of Educational Measurement, 14 (3), 75-96

Hembleton, R.K, Swaminathan, H and Rogers, H.J..(1991) *Fundamentals of Item Response Theory*. Newbury Park, Califonia: Sage Publications

Joshua, M. T. (2005). Test item bias in psychological testing: Evidence in Nigerian system. A paper presented at the annual conference of

ISBN: 978-978-798-430-7

Nigerian Association of Educational Psychologists held at Ahmadu Bello University Zaria from 24th-28th March.

Lord F. M. (2002). Applications of item response theory to practical testing problems. Hillsdale,

Lumsden, R.T. (2003). Sampling from a matrix with application to the theory of testing.

National Council on Measurement in Education [NCME](2013) http://www.ncme.org/ncmenSTCME/ResourceCenter/Glossary Archived New Jessey: Erbaum press.

Nunnally, R. S. (2008). Using the Rasch approach to measurement in solving practical school testing problems. Journal of Educational Measurement, 13 (4), 116 – 124

Nworgu, B. G. (2015). *Educational measurement and evaluation: theory and practice.* University Trust Publishers

Ojerinde. D. (2012, May 23). *Classical test theory (CTT) vs item response theory IRT: An evaluation of comparability of item analysis results* [Paper presentation]. Institute of Education, University of Ibadan

Ositalind S.J. (1983). *A test item bias*. California. Sage publication Ltd. *paper presented at the annual conference of Nigerian Association of Educational* Psychologists held at Ahmadu Bello University Zaria from 24th -28th March.

WEBSITE: https://globaljournalhub.com
ISBN: 978-978-798-430-7

Pine S. M. (2006). Applications of item response theory to the problem of test bias. Research

Popham, W.J. (2012). *Assessment Bias: How to banish it (2nded*), Boston, MA. Pearson education Inc publishing for Ally and Bacon. Princeton University: Statistical research group report no.53regression procedures. Journal of Educational Measurement, 2 (7), 361-370.report of the Department of psychology, University of Minnesota.

Sapmaz, Z.M 2019). *Detection of gender-related differential item functioning in Mathematics subsets in Turkey* [Published Graduate. Theses arid Dissertations]. Scholar Commons, University of South Florida. *sciences.* Guilford Publications.

Swaminathan, H., & Rogers, H. J. (2005). Detecting differential item functioning using logistic test data. Journal of Educational Measurement, 14 (3), 75-96

Walker, C. M., & Beretvas, S. N. (20011). An empirical investigation demon-strating the multidimensional DIF; paradigm: A cognitive explanation for DIF. *Journal of Educational Measurement, 38,* 147-163.workshop on teaching practice on Friday, 29th July in the College of Agricultural & Science Education, Federal University of Agriculture Makurdi, Benue State

Zumbo, B.E (2009). *A handbook on the theory and methods of differential item functioning (DIF): scores* Ottawa, ON: Director of Human Resources and Evaluation, Department of National Defence.

WEBSITE: https://globaljournalhub.com
ISBN: 978-978-798-430-7

3

USE OF FLATS INSTRUCTIONAL MATERIAL IN TEACHING AND LEARNING OF ALGEBRA IN SECONDARY SCHOOLS

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INTRODUCTION

Mathematics is a compulsory subject in Nigeria education system both in primary and secondary school educational levels. It is an indispensable subject for all and sundry. Mathematics is very essential in our daily life activities and has much regards in the society due to its relevance in industrialization, entrepreneurship, scientific and technological development of any nation (Nwoke 2017). This suggests that any nation without a plan for improved standard in mathematics has a plan of non-development in science and technology. No wonder Tella (2013) said that mathematics is the bedrock for technological advancement, and development for all nations. Federal Republic of Nigeria (FRN, 2013) stressed the importance of technological development out of which mathematics cannot be left out. In the light of the above, it is necessary to note

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that education is veritable tool for achieving scientific and technological development. Ihendinihu (2013), opined that mathematics is the foundation for any meaningful scientific endeavour and any nation that must develop in science and technology must have a strong mathematical foundation for its youths.

Moreover, mathematics education is the practice of teaching and learning of mathematics as well as a field of scholarly research and practice. Irene and Nwigboji (2017), opined that, mathematics education is the process of shifting from methods of teaching which has to do with acquisition of computational skills to methods of learning mathematics, which enhance the understanding of mathematics and its application in other fields of study and real life situation. Okafor (2015), opined that no nation can advance economically, scientifically and technologically without laying emphasis on the teaching and the development of mathematics education. This suggests that mathematic education is necessary for national development. This is the reason mathematics curriculum today aims at preparing students with essential mathematical knowledge and made compulsory from primary education to secondary education. Regrettably, research evidences such as Ohanusi (2011),Derbuck and Kpakor (2012), Oluremi and Ajao (2012) in Nneji and Alio (2017), submitted that this all important subject is dreaded ,hated, feared and massively failed by students, especially at secondary school level. Omoniyi (2015), suggested that the study of mathematics was established in schools in order to produce competent persons who are skillful in applying mathematical knowledge in solving everyday life problems. Mathematics education is a precursor of scientific discoveries and inventions (Nwoke 2017). Hence, Mathematics Education needs serious attention in the aspect of instructional approach in teaching and learning of mathematics. This paper discussed one of the instructional approaches, quadratic equation flats.

Quadratic Equation Flats were designed and constructed by Bruner (1995) for teaching quadratic equation. It is a flat of different types. They are x, x-squares

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and unit- square flats. The flats are preserved in a box called quadratic equation box. The flats are instructional materials that can enable an individual or a group to lay out ideas on quadratic equations and expressions in plane rectangular shapes. It is a concept of using rectangular plane to enhance meaningful learning and develop meta-cognitive strategies in Algebra. This instructional material (x, x-squares and unit- square flats) is hoped to be capable of resolving the cognitive conflicts introduced in the minds of the learners towards Algebra aspect of mathematics. National Council of Teachers of Mathematics (NCTM, 2015), reported that algebraic concepts need to be presented in a context that is meaningful to students. Algebra is not usually presented in a meaningful or interesting way, causing students not to enjoy learning the subject (Iji, Okoronkwo and Anyor 2017). Iji, Okoronkwo and Anyor stated that without algebra, advancement into most areas of mathematics, and the study of other disciplines requiring mathematical abstraction and modeling are limited, if not impossible. Nnakwo (2019) stated that students dislike certain topics in algebra because they feel the topics are difficult and cannot be understood easily. Some teachers experience difficulties in achieving effective teaching in school system. Hence, many students in secondary schools experience difficulties in the learning of some aspect of the Algebra. One of such topics in Algebra that teachers and students have problems is in the area of quadratic equations/expressions. Quadratic equations/expressions is an important equation that is used in many areas of science and engineering and a good grounding on the topic becomes compelling as part of preparing students for useful life after schooling(Bourn, 2007). This is why it is necessary to determine the best approach for teaching quadratic equations among factorization, completing the square, quadratic formula approach of solving quadratic equations/expressions in Secondary Schools. Hence, quadratic equations/expressions deal with an unknown quantity, there is need to use an active participation approach which will increase students zeal to learn.

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The Concept of Quadratic Equation flats And How to use it to teach quadratic equation/expressions

Quadratic Equation Flats was named, designed and constructed by Bruner, (1965). The flats are made up of x, x-square, and unit-square flats. X- flat is measured 10cm x 1cm, x- square flat measures 10cm x 10cm and unit flat measures 1cm x 1cm, which are preserved in a box called quadratic equation box. The flats are used for teaching expansion of algebraic equations and factorization of quadratic equations and expressions. The box in all contains 20 x-square, 40 x-flats and 60 unit flats (squares).

Therefore, Quadratic Equation flats can be regarded as flats (x-flat, x-square and unit-square flat) constructed in order to achieve a particular mathematical purpose.

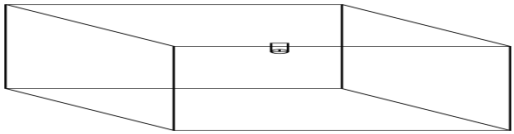
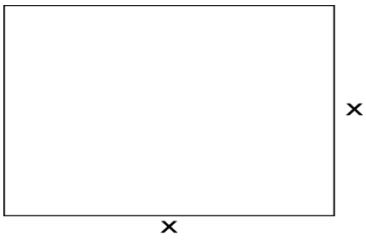
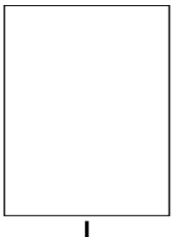


Figure 1: QUADRATIC EQUATION BOX



x-square flat

Figure 2



x-flat

Figure 3

unit –square flat

Figure 4

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Figure 1 shows the diagram of Quadratic Equation Box.

Figure 2 shows the diagram of x-square flat

Figure 3 shows the diagram of x-unit flat

Figure 4 shows the diagram of unit-square flat

Construction of Quadratic Equation Box

According to Obodo (2004) Quadratic Equation Box can be constructed through the following procedures:

Materials for Constructing Quadratic Equation Box

1. Plywood of dimension *100cm* X *100cm* with thickness of *0.5cm* (about on quarter inch) of 1 full length of ½ inch plank.
2. Saw
3. Hammer
4. Some one inch nail
5. Felt pen or marker
6. Staple, hinge, joiner, small key.

Procedure for Constructing Quadratic Equation Box and flats

1. Using the saw, cut out six wooden square shapes each measuring *20cm* by *20cm*.
2. Using the nails, couple the six square shapes in number 1 above to form a box as shown below.

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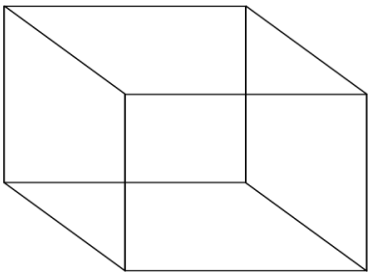
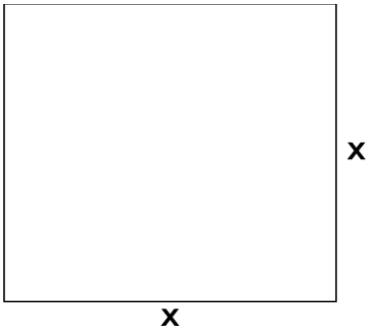
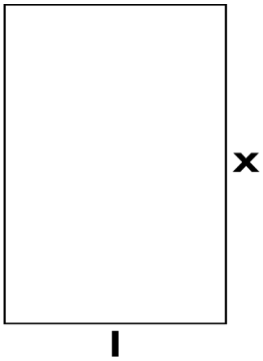


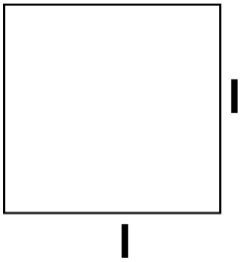
(a) Cubic Box



(b) x-square



(c) 1*x* or *x*-flat



(d) 1 by 1 or 1 flat

The top of the box should be such that it can be opened. The box should also have hinge, staple and a key for locking it.

3. Cut out three 10cm X 10cm square shapes using saw. Put them in the box. Each is marked *x* square as in figure *b* above.
4. Cut out 15 or more rectangular shapes measuring 10cm X 1cm. Each is called 1*x* or *x*-flat. The dimensions are *x* units or 1 unit as in figure *c* above.

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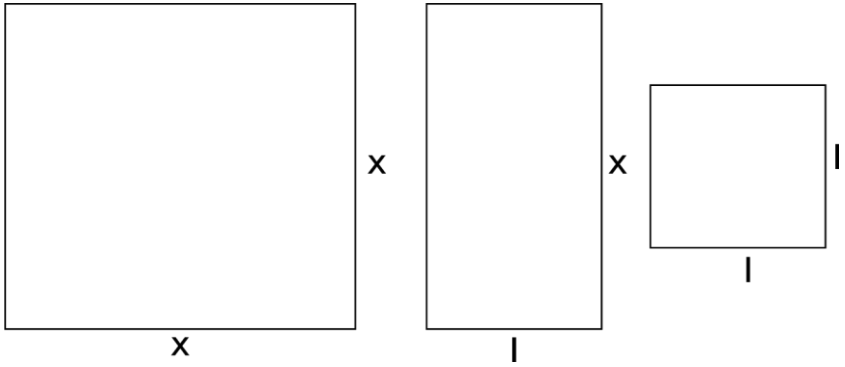
5. Using the saw, cut out 30cm or more 1cm X 1cm square shapes as in figure *d* above. This is called 1 by 1 or 1 square flat. It is regarded as a unit square flat. They are also contained in the box.

The Quadratic Equation flats are provided with a box locked with key to preserve the content. Quadratic Equation flats are an instructional material that may help to guide the learners towards greater understanding of the concepts involved in algebra. This paper will show how you can use the Quadratic Equation flats in teaching algebraic concept particularly quadratic equations and expressions.

How to use Quadratic Equation Flats in Teaching Quadratic Equations/ Expressions



The teacher informs the students that the first one is to be called either the '*unknown square'* or *'x-square'* while the second flat which is rectangular in shape should be called *'*1*x'* or just *x* because it is *x* units long on one side and 1 unit long on the other side. The third flat is known as *'a small* or *unit square'* or '1 by 1'.

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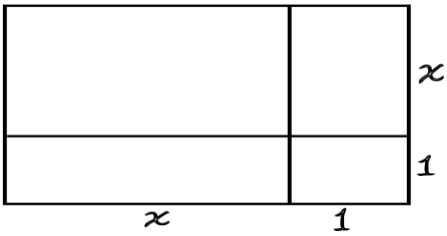
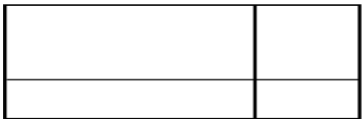
The students will be given many opportunities to play with these flats and feel them. The teacher gives them a problem by asking the students: *to make larger squares than this x-square by using as many flats as they want?* Most Students make another square.



That is $(x + 1)$ square

Teacher asks them to describe what they did. Their reply might be *'we have one square x, with two x's and a 1'*. The students will be asked to keep a record of what they have done. The notational (symbolic) system for describing this is $x^2 + 2x + 1$, where x^2represnts the square *x*, a '+' for 'and'. Also, the figure above can be denoted by describing each side which has an '*x*' and a '1'. Thus each side can be denoted as '$x + 1$' and the square is $(x + 1)(x + 1)$ after some work with parenthesis. This means that there are two basic methods of describing the same square.

Hence,$x^2 + 2x + 1 = (x + 1)(x + 1)$. This description oversimplifies the procedure used. The students will be asked to continue forming squares and thus deduce the notation for each as shown below.



$x^2 + 2x + 1 = (x + 1)(x + 1)$

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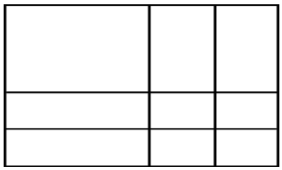
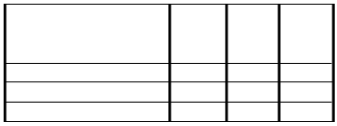
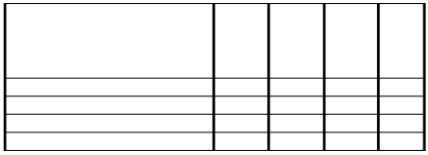


$$x^2 + 4x + 4 = (x + 2)(x + 2)$$



$$x^2 + 6x + 9 = (x + 3)(x + 3)$$



$$x^2 + 8x + 16 = (x + 4)(x + 4)$$

EXAMPLES

Quadratic Equation flats will be used to teach the following quadratic equations and expressions.

1. Expansion of the algebraic expression of the form $(\boldsymbol{x} + \boldsymbol{b})(\boldsymbol{x} + \boldsymbol{c})$

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2. Factorization of quadratic equations and expressions of the form

$x^2 + bx + b$ where x is a variable and b is a constant.

Expansion

Expand $(x + 1)(x + 1)$

1. The teacher gives out 2 x-flats, 1 x-square flat and 1 unit square flats.
2. The flats will be arranged in such a pattern that a square will be formed. See figure 5.
3. Figure 5 is a square of $(x + 1)$.
4. The answer to the problem $(x + 1)(x + 1)$ will be the sum of the total area of the figure

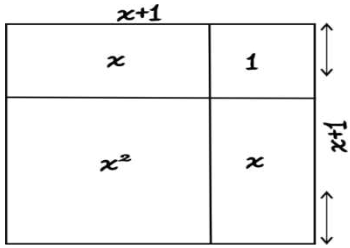

Figure 5

Therefore, expansion of

$$(x + 1)(x + 1) = x\ square + 2x\ flats + 1unit = x^2 + 2x + 1$$

Factorization

Factorize $x^2 + 2x + 1$

1. The teacher gives out 1 x-square flat, 2 x-flats and 1 unit square.

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2. The flats will be used to form a square. See figure 6.
3. The dimensions of the figure will give the answer to the problem.

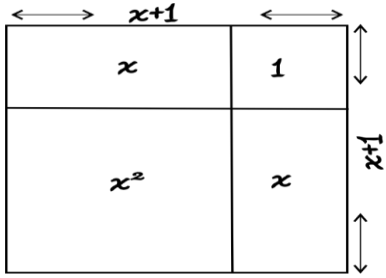

Figure 6

Hence, factorization of $x^2 + 2x + 1 = (x + 1)(x + 1)$

Expand $(x + 1)(x + 2)$

1. The teacher give out 3 x-flats, 1 x-square flat and 2 unit square flat.
2. The flats would be arranged in such a pattern that a square will be formed. See figure 7
3. The answer to the problem $(x + 1)(x + 2)$ will be the sum of the total area of the figure.

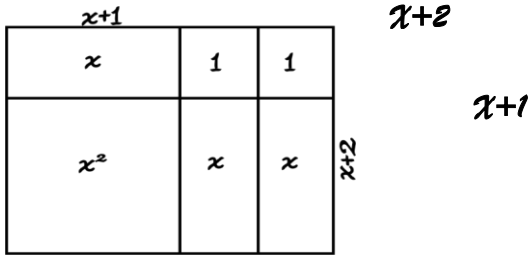

Figure 7

The expansion of $(x + 2)(x + 1)$

$$= 1\ x\text{-square} + 3\ x\text{-flat} + 2\ \text{unit square} = x^2 + 3x + 2$$

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Factorize $x^2 + 3x + 2$

1. The teacher gives out 1 x-square flat and 3 x-flats and 2 unit square flat.
2. The flats will be used to form a square. See figure 8
3. The dimensions of the figure will give the answer to the problem.

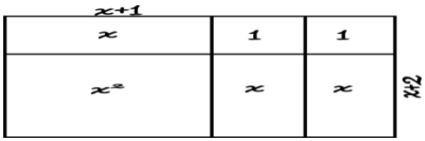

Figure8

Factorization of $x^2 + 3x + 2 = (x + 2)(x + 1)$. $x+2$

IMPORTANCE OF FLATS IN TEACHING AND LEARNING QUADRATIC EQUATION/EXPRESSIONS

Quadratic Equation Flats provides the students opportunity to touch, and feel t materials and use it to solve quadratic equations/ expressions by themselves. will make the students participate actively in the classroom. Quadratic Equation Flats may give room for self-discovering and allow students to concentrate in their lesson. Mathematics teachers can use flats to reinforce the knowledge of algebra, especially quadratic equations/expressions. Mathematics teachers should also use very often provocative or leading questions sarcastically in order to elicit discovering.

Summary

Instructional materials like quadratic equation flats are very important in teaching and learning algebra. It makes them remember easily what they have been taught and encourage them for active participation. It promotes student-

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centered learning. Flats may be useful in teaching and learning of quadratic equations/expressions.

Conclusion

Quadratic Equation flats should be used by teachers in teaching quadratic equations/expressions. Teachers should be encouraged to use instructional materials in teaching and learning of mathematics for easy understanding of mathematics concepts.

References

Bourne, M. (2007). Quadratic Equations: Retrieved on June 12, 2017, from *http://www.tmathe.com//quadratic-equation-intro-php.*

Federal Republic of Nigeria (FRN) (2013).National policy on education (4th Edition). Lagos: Nigeria Educational Research and Development Council (NERDC).

Ihendinihu, U.E. (2013), Enhancing Mathematics achievement of secondary school students using Mastering Learning Approach. *Journal of emerging trends in Educational Research and Policy Studies* (JETERPS) 4(6), 848-854

Iji C.O., Okoronkwo M. & Anyor, J. W (2017), Improving Junior Secondary Students' interest in algebra word problems using Igbo Language as a medium of instruction in Abia state, Nigeria. ABACUS: *The Journal of Mathematical Association of Nigeria* (MAN), 42 (1), 29-30

WEBSITE: https://globaljournalhub.com
ISBN: 978-978-798-430-7

Irene O.E. and Nwigboji E.C. (2017), mathematics Education in Nigeria: current issues and challenges. ABACUS: *The Journal of Mathematical Association of Nigeria* (MAN), 42 (1), 344-355.

National Council of Teachers of Mathematics' (NCTM) (2015).Principles and standards for school mathematics. Reston, VA.NCTM

Nnakwo, F.O. (2019), Effect of Quadratic Equation x-flats on secondary school students Academic achievement, interest and retention in Algebra in Enugu State. Unpublished M.Sc dissertation, ESUT, Enugu

Nneji, S. O. and Alio, B. C. (2017), Effects of use of computer Animations strategy on secondary school students' achievement and retention, in algebra in Enugu State. ABACUS: *The Journal of Mathematical Association of Nigeria* (MAN), 42 (1), 12-21.

Nwoke B.I. (2017).Impact of information and communication technology (ICT) facilities on gender differentials in mathematics achievement among secondary school students. ABACUS: *The Journal of Mathematical Association of Nigeria* (MAN), 42 (1), 416-426.

Obodo, G. C. (2004). Principles and practice of mathematics education in Nigeria (Rev.ed). Enugu. Floxtone Press

Okafor P.C. (2015). Effect of Some Mathematical games on primary school pupils' achievement, interest and retention in mathematics. *Unpublished Ph.D thesis*, ESUT, Enugu.

Omoniyi, M.O. (2015). Causes of Mathematics phobia among senior school students. Empirical evidence from Nigeria. *The African Symposium.*15 (1), 50-56.

ISBN: 978-978-798-430-7

4

USING PI CIRCULAR APPARATUS IN TEACHING AND LEARNING OF CIRCLE THEOREM

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Abstract

This paper is to educate the teachers in particular, the importance of using pi circulars apparatus in circle theorem, using pi circular apparatus have a huge impact on how students retain information. While words can be abstract and hard to retain, the apparatus usage tends to be more concrete and easier to recall. It was written through consultation of textbook, dictionaries, journal and websites. This paper discussed the overview of circle theorem, the diagram of pi circular apparatus, construction, the use/ application of picador apparatus in teaching and learning of circle theorem, when to use pi circular apparatus, significance off using peculiar apparatus in teaching circle theorem, advantages and disadvantages of pi circular apparatus.

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INTRODUCTION

Mathematics is the science of quantity and space. So, it is much more than arithmetic's (the science of numbers and computation). It is not enough with algebra- (the language of symbols and relation); far more than geometry (the study of shapes, size and space) it is more than numerical trigonometry- (which measure distance to stars and analyzes oscillation); it involves more than statistics- (the science of interpreting data and graphs); more than calculus- (the study of change; infinity and limit). It is a systematized, organized and exact branch of science.

Circle is the locus of all points equidistant from a central point. It describes a fixed point on a place at a constant distance from many other points. The fixed point is the centre of radius, while the boundary of the circle is the circumference.

The line which passes through the centre joining the two points on the circumference of a circle. Chord is a line segment within a circle. Pi (π) is a number, 3.141592….., equal to (the circumference)/ (the diameter) of any circle. Sector is like a slice of pie (a circle wedge). A line perpendicular to radius that touches only one point on the circle is tangent of circle (N.D, 2018).

In order to describe the shape of an object, object appropriate dimensions in needed. It is harder to describe the shape of a triangle, it requires all the lengths of the three edges (a, b and c). in cases of a circle, it is much easier, it only the need its radius or diameter to describe its geometry (N.d, 2020). With the help of radius and diameter the geometry of a circle shape will be easy to learn and teach.

Using pi circular apparatus in the teaching and learning circle theorem, makes learning and understanding more clear to the learners. The roles of circular

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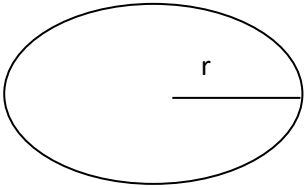
apparatus, basing learning in sense experiences, extending experience, encouraging participation, stimulating interest, individual instructions, serves as a source of information, making learning permanent (Mathew &Alidmatt, 2013).

The specific objective of this seminar paper is to enlighten teachers and learners on the importance of using pi circular apparatus in teaching and learning circle theorem.

Circle Theorem

A circle describes a fixed point on a plane at a constant distance from many other points. The fixed point is the centre of radius, while the boundary of the circle is the circumference.

The line which passes through the centre joining the two points on the circumference is the diameter.



Area of circle = πr^2

The number π is a mathematical constant, the ratio of a circles circumference to its diameter, commonly approximated as 3.14159. it has been represented by the Greek letter "π" since the mid- 18th century though it is also sometimes spelled out as "pi". Being an irrational number, π cannot be expressed exactly as a faction (equivalently, its decimal representation never ends and never settles into a permanent repeating Pattern). Still, fractions such as 22/7 and other rational numbers are commonly used to approximate π.

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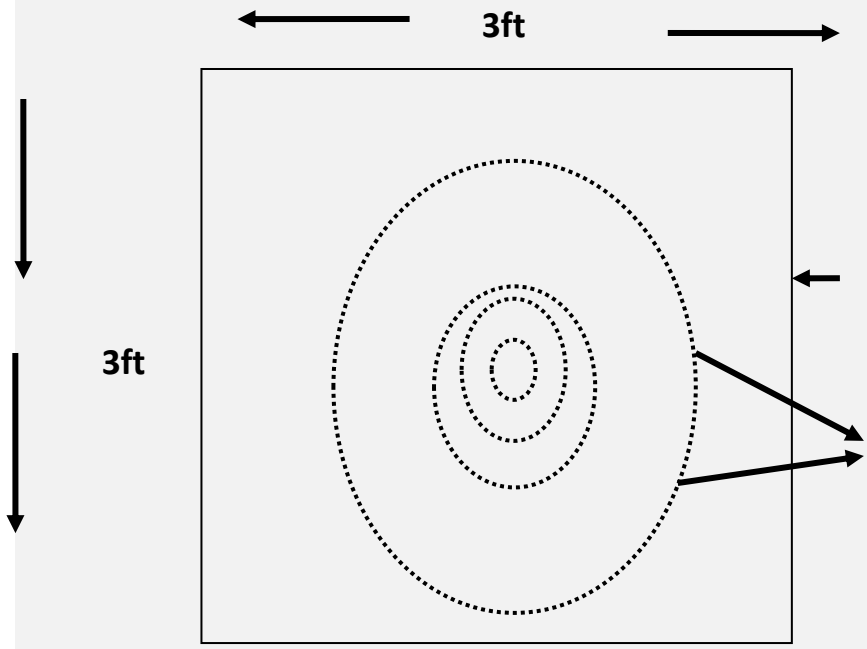
Ancient civilizations needed the value of π to be computed accurately for practical reasons. Meaning of Pi (π).

The circumference of a circle is slightly more than three times as long as its diameter, the exact ratio is circle's circumference to it diameter d.

The Diagram of Pi Circular Apparatus



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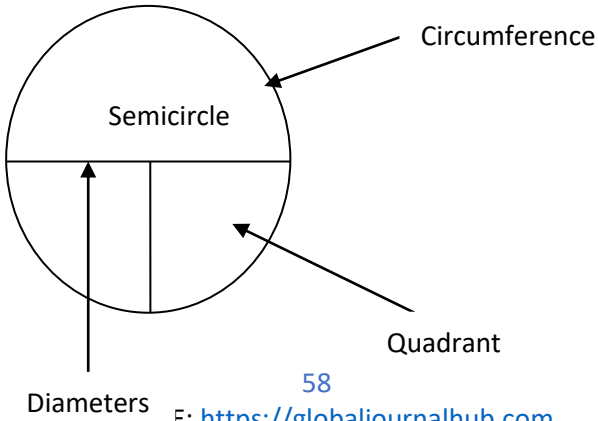
Construction

The diagram above is a pi circular apparatus. It is used to carry out an experiment to show that pi (π)= 3.142 just as the simple pendulum can be used to carry out the experiment that acceleration due to gravity (g) = 9.81 M/S^2. It can be constructed by obtaining plywood of any convenient dimension. Choose a convenient centre O. with centre O, using a pair of compass with pencil, draw the inner most circle with a convenient radius (r). at small intervals, use $1^1/2$ inches or 2 inches nails and nail them round the inner most circle along the circumference of the circle. Ensuring that the nails form a good circle.

In a similar manner, with centre O, using pair of compass, draw the middle circle. Put nails round the circles to form a good circle. With centre O again, using pair of compass, draw the third and the outermost circle. Using the nails to form a circle round the circumference.

Overview of Circle Theorem

According to Longman Dictionary 6th Edition (2017), state that circle is a completely round shape, like the letter O. A circle is a round plane figure with a boundary (called the Circumference) that is equidistant from its center. It is fundamental objective studied in geometry.



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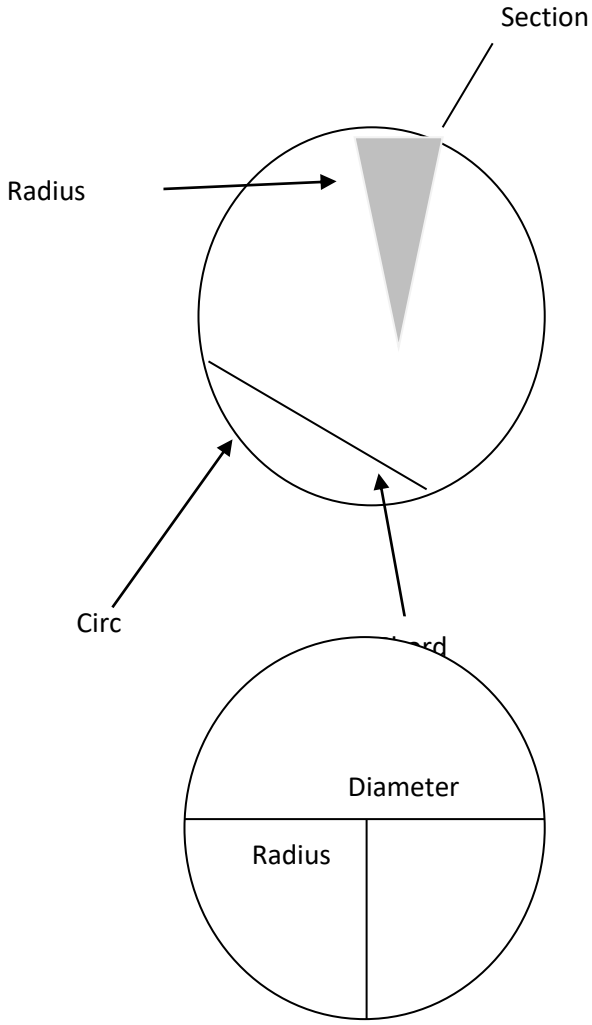

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The radius of a circle is the distance from the center of the circle to any point on its circumference. The diameter of a circle is the length of line that starts at one point on the circle, passes through the centres and ends on another longest possible chord opposite side. It also referred as the longest possible chord in the circle.

The radius R and the diameter D are interrelated as

d= 2r

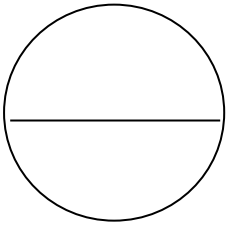
The formula for the circumference of a circle is

π d = 2 π r,

where d = (diameter of the circle), r = (radius of the circle and π is the mathematics constant, “pi”

The first 10 digits of π are 3.12159265….., but any finite list of digital is/and can only be an approximation of π. Furthermore, π, (written “pi” and produced as “pie”), is an irrational number (meaning it cannot be described by any ration o whole numbers, a/b.)

Pi



$$\frac{\Pi\, d}{d}$$

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π is the ration between a circle's circumference and diameter. That is

$$\text{Circumference} = \frac{\pi}{\text{Diameter}}$$

Finally, π appears in various expression, plays a key role in analysis etc. (n.d, 2020).

THE USE/APPLICATION OF PI CIRCULAR APPARATUS IN TEACHING AND LEARNING OF CIRCLE THEOREM

The Pi demonstration board is used in experimenting that the value of pi is 3.142 the materials to use are tape, paper and pen. The records of the measurements look like the table below.

S/N	C	D	C/D=π
1			
2			
3			

Where C = circumference, D= diameter.

Procedure: There are three or more nail circles in a p1 circular apparatus showing that the tape, begin from one nail point and circle the tape round the innermost circle back to the starting point. Place the tape by the side of the nails

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not on top of the nails. The length of the tape after the measurement is the circumference of the circle. Record it in column C row 1 in the table above. Use the tape to obtain the length of the diameter from one point of the nail through the centre nail at point O to the opposite point of the nail. Record the result in column D row 1 in the table above. Use the tape to obtain the length of the diameter from one point of the nail through the centre nail at point O to the opposite point of the nail. Record the result in column D row 1. Repeat the C and D measurements for the middle and outermost circles and record the measurements in row 2 and 3 respectively. For each, calculate C/D for each of the three measurements to give the value of pi (π) for each.

When to Use Pi Circular Apparatus

Pi circular apparatus can be used when the mathematics teachers want to teach and carry out some experiments to prove that a Pi (π) is equal to 3. 142, the application of a pi circular apparatus is only applied on a circle theorem while teaching and learning some fact about a circle. It is equally used to check the understanding of the students during and after lesson pi circular apparatus can be used while assessing large and small group.

Significances of using pi Circular apparatus in teaching circle theorem

- Pi circular apparatus helps to visualize abstract ideas in circle so that they will be meaningful.
- The apparatus can be used in illustrating the application of pi (π) to circle theorem.
- It helps students to have interest in learning circle theorem.
- It provides active participation of students in the classroom during lesson.
- The use of these concrete materials in teaching contributes greatly to student's retention of knowledge long after it has been acquired.

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- The material enhances communication between the teacher and the learner
- It serves as a remedial tool to the teacher when teaching circle
- The material helps to keep the students busy and active.

Advantages of pi circular Apparatus

- It may be used to arouse interest and motivate the students
- It enables students to visualize what is being studied
- It helps to prove that pi (π) is = 3.142
- It helps the weak and brighter students to participate in the lesson.
- Pi circular apparatus is used for effective teaching
- It provides fast method of re-teaching what had been taught.
- Pi circular apparatus help to concertize an abstract idea.

Disadvantages of pi circular apparatus

- It is very time consuming in preparing materials
- Inability of the teacher to use appropriate method
- It can lead to laboratory accident
- When the nails are not well arranged, it can introduce error in measurement.

CONCLUSION

Teaching and learning of mathematics cannot be interested without the application and manipulation of instructional material/teaching aid.

The construction and the use of Pi circular apparatus in teaching and learning of circle theorem will go a long way to minimize the abstract nature of this concept (circle theorem) in mathematics.

ISBN: 978-978-798-430-7

Since students learn mathematics more easily by doing mathematics Pi circular apparatus demonstration in the learning mathematics. This work focuses more on construction, application and significance of pi circular apparatus.

References

Mathew, N. G and Alidmatt, A. O. H. (2013). A study on usefulness of Audio-Visual Adis in EFL Classroom Implications for effective instruction, international Journal of Higher Education Vol2, 2013: http://www.sciedu.ca /journal/ index phylijh / article/ viewfile/ 2737/1607.

N.D (2018) A study on circle Theorem and pi ctoried index from http//www. Mathopenref.com

N.D (2020) A study on laboratory-apparatus. From http//www. Laboratory-apparatus.com

National Mathematics Centre (NMC) (2003). National Mathematics Centre Teaching Module 3 for Junior Secondary Schools. Abuja: Literamed publication Nig Ltd.

Obodo, G.C. (2004). Principles and Practice of Mathematics Education in Nigeria. Enugu Division of General Studies, ESUT, Enugu.

The Longman dictionary of contemporary English (6th edition) © 2017. Pearson Education LTD.

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ISBN: 978-978-798-430-7

5

STUDENTS' ATTITUDES AND IMPACT TOWARDS CHEMISTRY LABORATORY

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INTRODUCTION

Laboratory is a building, room or place equipped, set apart for practical activities or experimental activities. Laboratory is where good scientific programme enable students to have experience that is consistent with the goals of scientific literacy (Omiko 2007). Laboratory is a room or a place used for scientific research, demonstration, testing experiments, analyzing of data. Besides what is carried out in science laboratory is to acquire skill to foster advance scientific knowledge which will later lead to development of human society. Dienye and Gbamanjain Omiko Akani (2015) discuss that the method of laboratory teaching is an activities oriented involving two-way approach implemented by one or many people through exercise and experimental approach both are needful in science teaching. The experimental approach afford an opportunity for student to discover information using experimental procedures. This call for observation, investigating, questioning and interpretation of data

Attitudes display feeling of like or dislike of person, object ,or event that describe a human being (Heng and Karpudewan 2015) . Attitudes are outcome of knowledge gained during learning process (Oh and Yoger 2004). Attitudes toward science can be observe as integration of peoples values, beliefs, feelings towards science (Montes, Ferreira Rodrigues 2018) .

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Laboratory work

Chemistry is a science that depends on experimentation so conducting experiment in laboratory setting is essential in its teaching and learning. Effective teaching and learning of chemistry can be carried out when theoretical explanations are complemented with real practices in the laboratory. The teaching of chemistry in the laboratory is a standard method of training, equipping students in skills and values gear to scientific investigation and needful in the development of positive attitude to chemistry. Students investigate phenomena cooperatively in small group in chemistry laboratory. This style of instruction has potential to intensify constructive social interactions together with positive attitudes and performance in academic work. Although the knowledge of chemistry to the society is essential, students attitude and performance in the subject as measured by their scores in senior secondary certificate examination is actual poor (Nnagbo Daberech 2021)

Poor performance in science: The poor performance in chemistry in SSCE, authenticate that chemistry teaching and learning and condition on which it takes place need to be probed. These include availability of learning resources and laboratory learning environment can intensify student performance in the subject. The chemistry laboratory as a unique learning environment is a setting in which students cooperatively work in small groups to investigate scientific phenomena. The laboratory environment is less formal, when compared to the conventional classroom setting and it presents favourable condition for more interaction between teachers and students, such interactions enhance positive social interactions (Hofstein, Nahum and Shore,2001).Although the same learning environment is shared by teachers and students but their perceptions of such learning environment differs. Chemistry laboratory learning environmental nature makes difference on how students are urge to achieve their set objectives, the physical environment of the laboratory such as ventilation, workbenches,

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facilities, space, lightening tools in the laboratory determine the comfort and safety, learning of such subject and students attitudes towards chemistry. It influences student personal development. The chemistry laboratory learning environment in which teaching and learning take place influence students learning outcomes and positively enhances teaching and learning of chemistry as well as how and the extent they learn and retain knowledge (Aldridge, Fraser, & wood, 2002, Luketic and dolan, 2014).

Class room environment can be assessed using different scales. Each scale has been categorized according to Moos (1987) scheme for classifying human environment. The form of human environment include: relationships, personal development and system maintenance (Moos1987). The learning environment inspect by theoretical model through personal development and system maintenance. Personal development focus on path which knowledge development progress, relationship refer to nature and intensity of personal relationship. System maintenance and system change relate to control, clarity, responsiveness and orderliness to change in the environment. According to Fraser, Merobbie and Giddings's (1993) five dimensions were identified, open-endedness, student cohesive, integration, material environment and charity. Open endedness centers on students chance to design their own research and gear to individual interest thereby increase their personal scientific knowledge. Students cohesiveness give description how students known each other's work very well and thereby support one another. The integration describes how laboratory activities are conjoin to theoretical material taught in science classroom. Material environment characterizes the adequacy of their laboratory equipment and materials. Inventory of science laboratory environment was developed as a measured of science learning environment (Fraser, Merobbie and Giddings 1993).

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Poor performance of chemistry students at secondary such level might be as a result of the failure of teachers to carry out laboratory activities in a way to motivate students participation in teaching and learning of chemistry and students perception of laboratory learning environment. Inadequate inherent in laboratory activities at school reflected to very poor performance of students in chemistry and other related science subjects. Furthermore, Low performance of chemistry is as result of negative attitude towards teaching and learning chemistry, ineffective instructional techniques and teaching aids (Khan and Ali 2012, Morabe 2004) support them, he carried out an experiment in Hong Kong and the students interviewed claim that the hate chemistry because of traditional teaching method which based on chalk and talk by the teacher while solving problem. They indicate that their teacher prepare them for public examination only where they avails materials for memorization. Some factors that contribute to negative attitude of student toward chemistry include the following--- teachers' inability to carry out good quality practical activities. Deficient knowledge of scientific concepts and realize difficult of chemistry. As a result of these, students need assistance to develop good attitudes in chemistry. Chemistry is branch of science and it is also prerequisite subject for many fields of science. These fields are medicine, nursing, pharmacy, biochemistry, agriculture and chemical engineering. It enhances technological growth of the nations, for a nation to develop scientifically and technologically need to pay much attention to the quality of chemistry education taught in the schools. This made the Federal Government of Nigeria to recognize specific objectives to be achieved in the teaching and learning of chemistry at school in the National Policy on Education (NPE 2004):

1. The students should be provided with basics knowledge in chemical concepts and principled from efficient picking of content and sequencing.

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2. The use of techniques acquired and scientific concepts in integrated science with chemistry should under transition.
3. Display chemistry in its inter-related relationship with other subjects.
4. Exhibit chemistry and its link with benefits, industry everyday life and hazards
5. A course should be provided for student not proceeding to higher education, reasonably enough for post secondary chemistry course. The policy suggests that science teaching and learning should be students centered activity oriented such that student gain adequate laboratory experiences. To achieve these objectives depend on the, students, materials, teachers, the laboratory and how the teachers and students perceive them in relation to the outcomes of goals.

The study of chemistry involves the learning of laws and theories, established principles, concepts, activity-oriented laboratory work. Principles taught in the theory demonstrate practically in the laboratory experiments. As well the laboratory experiments show properties of substances taught theoretically in the school, test the validity of chemical laws. Studying of chemistry is not only learning of concepts and facts that illustrate physical world at the atomic level but examine in the laboratory physical evidences of chemical principle.

Teaching science through laboratory work

The following methods can be constantly evaluating the teaching science through laboratory experiments. Student academic achievement taught through the laboratory method should be compared with the student achievements taught through other model. (Harty and AI-Felah (1983) noted student that were taught through laboratory base achieve much more than those that receive lecture-demonstration method. Zitoon and Alzaubi (1986) suggested that in developing scientific skill laboratory method is much more effective than traditional method.

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When students who achieve low, use laboratory method they perform better than their mates who receive the lecture method (Odubunmi and Balogun, 1991)

Furthermore the stated objectives of teaching science need to be investigated to find out the extent in which laboratory experiments, instructions and textbooks are congruent. Tamer and lunette (1981) indicated that laboratory handbooks failed to give student opportunity to explore and use scientific inquiry method of teaching and learning. Moreover, Tamer lunette (1981) insist that laboratory instruction help to achieve some science teaching goals but not all the goals in science education. Since teachers failed to incorporate laboratory goals into their evaluation and instruction. In addition, the efficacy of science laboratories can be found out by investigating conditions and particular aspect of laboratory instruction methods (Fraser, Merobbie and Giddings (1995) for instance assess the efficiency and laboratory activities through traditional curriculum and textbooks lead to lack of efficiency.

Importance of laboratory activities to students of chemistry

Chemical knowledge is subpart of science and technology, its contribution and skill underestimate economic and industrial progress of the society. Enough experimental training need to be provided since students have been introduced to laboratory in determination and preparation of the many properties of compounds. The type and nature of the laboratory exhibit a very important role in influencing students attitude in chemistry laboratory works. Science teachers associate noted that laboratories used in 1980 are skills in deplorable situation. This occurrence made chemistry laboratory work uninterested and students view it as unpleasant waste of energy and time. In addition, administration exhibits little enthusiasm attitude towards the supply of equipment needed in the laboratory and availing chance for students to perform experiment, observe measure and use scientific method of solving problems. With arrival of modern curriculum which lay emphasis on higher cognitive skills, this made laboratory to

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gain a control role not only a place for demonstration but as a place of genuine practical exercise in learning and teaching of chemistry. Laboratories are important and indispensable for effective teaching and learning of chemistry.

The following are laboratory activities in chemistry:

1. Planning and carry out experiment as a project
2. Executing out experiment
3. Building model
4. Field trips and excursion for investigation of students that display positive attitude to laboratory work, learning and comprehend what they do in solving problem in their place. Identification of laboratory activities give chance for students to develop creativity, empirical abilities and manipulation skills, students perform better when engaging personal observation that reading his textbook .

Importance of developing positive attitudes towards chemistry

In the words of Oh and Yager (2004) lifelong learning and interest in science depend manipulating of positive feelings toward chemistry. Khan and Ali (2012) carried out an experiment to find out importance of developing a positive attitudes towards learning of chemistry among secondary school. The result show that attitudes, predict their behaviour and is directly depend on academic performance. It also indicated that students with positive attitudes strive to excel in the subject being taught when compare with those with negative attitude. Students attitudes changes during the learning process through experience, observation and study environment so changes in attitudes affected by teachers' behaviours, classroom environment, instructional methods, teaching aids, availability of infrastructure, students interest, social environmental factors eg parents ,peer group etc

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Instructional metho- teachers instructional methods influence students attitudes towards chemistry during the learning process (Khan and Ali, 2012) .For example chemistry laboratory experiment is the one of effective instruction method that enhance students' attitudes toward chemistry (chepkorir ,Cheplonui and Chemutai 2014) .Laboratory activities is use to practice the theory learnt in the classroom, that promote students attitudes. Students enjoy laboratory practices and it's improve their understanding of the concepts taught in the laboratory. (Yunus and Ali ,2018). According to Oh and Yages (2004) teaching and learning environments need to be designed to permit students to construct knowledge from experiences acquired, these enable them to possess more positive attitudes toward chemistry .

Teachers' behaviours - teachers' behaviours and attitudes affects students attitudes towards chemistry activities . Knowledgeable teachers share their experiences permit students to ask questions, give ideas, suggestions, opinions on the subject, through the interactions students' attitudes are improved toward chemistry (Yunus and Ali 2018).

Teaching aids and availability infrastructure -Teaching aids and availability infrastructure such as laboratory equipment, textbooks, computers influence students attitudes. The use of teaching aids enable students to assimilate chemistry contents. When inadequate instructional materials are presented it negate students' attitudes

Attitudes are like academic achievement and essential result of science education in secondary school, students develop positive attitudes to chemistry as major duty of every chemistry teacher but unfortunately research has shown that what happens in science classroom is not conducive to students.(Stark and Gray(1999). Students positive attitudes to science lesson in school is essential and has two main reasons. Research has reaffirmed that attitudes ar8864888e linked with academic achievement. For instance Salta and Tzougraki (2004) observed that

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the correlation between high school students achievement in chemistry and their attitudes toward chemistry ranged from 0.24 to 0.41. Bennett, Rollnick, Green and White (2001) state that undergraduate students who had poor positive attitude to chemistry got lower examination scores. The second reason why it is needful to develop students positive attitude toward chemistry lesson taught in schools because attitudes predict students behavior (Glasman and Albarracin (2006). Moreover research has shown that students display different attitudes in chemistry, biology and physics in school (Barnes, Mclinerneu, March 2005). Warrington and Younger (2000) state that girls prefer to respond positively to biological science than to physical science. Students attitudes in chemistry lesson had in classroom was reviewed by nine previous studies (Barnes, Mclinerneu, March 2005, Salta and Tzougraki 2004). The nine studies are informative and some give mixed results, the reason why they produced mixed result was that they studied did not investigate the interaction effect between gender on students attitude and grade level in chemistry lesson. This is essential because attitude research in science education shows that gender and grade level can interact with each other (George 2006, Greenfield 1997). As a result there is variation on gender difference in student attitude toward chemistry lesson. Besides altitude multidimensional concept and research reaffirm that interaction effect between gender and grade level can occur in certain dimension (Green field 1997)

Advantages of Laboratory in Science Teaching:

Ufodu (2009) and Omiko (2015) indicated the following advantage of laboratory in science teaching:

a. Laboratory teaching engage students to learn nature of the science, this foster the knowledge of human enterprise in science increase intellectual understanding and aesthetic of the child.

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b. Studying scientific inquiry skill which can be carried to other sphere of problem solving. This primary aim of science education to help students study skills that can be applied to similar situation.
c. Students learn to appreciate the roles of scientist through acquisition of manipulative skills.
d. Students develop values, interest, attitudes by considering what is involving in science, it is noted that experience has potential for stimulating students interest in science, students increase in science is accrued as they explore and investigate their environment Omiko (2007) enumerated scientific attitudes which could be nurtured in science laboratory in the school. These includes: curiosity, objectivity, open mindedness, intellectual, nationality, honesty, humility willingness to suspend judgment, reverence for life.

Five Laboratory Educational Objectives

Omiko (2007) stresses five educational objectives to acquire through the use of laboratory in science teaching and learning:

1. Investigative skill, inquiry skill, manipulative skill, communicate skill and organization skill
2. Mastery of concept for instance theoretical model, hypothesis and tax anomic category.
3. Acquiring of cognitive abilities- problem solving critical thinking, application, synthesis and analysis.
4. Having insight of nature of science; scientist & how they do their work, scientific enterprises, scientific method of multiplicity, inter-relationship between science and technology and among other discipline in science.
5. Acquiring of scientific attitude for instance interest curiosity, risk taking, precision, perseverance, confidence, responsibility, satisfaction, collaboration , consensus and collaboration.

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As a result, therefore the role of science (chemistry) laboratory in teaching and learning shows that schools without laboratories where students do chemistry practical's would graduate students without knowledge of practical. Practical is needed by West African Certificate Examination Council (WAEC) and (NECO) National Examination Council to be successful in senior school certificate examination sequel to that, these students not possess the requisite requirement qualifications to offer some course like engineering, medicine agricultural science and other related disciplines.

Laboratory studies are one of distinctive, features of science education (Reid and Shah,2007). Laboratory studies play central role and characteristics in science curriculum (Hofstein and Mamlok 2007). Empower students to acquire affective, cognitive, psychomotor skills and teacher-student communication (Ayas, Karamustataoglu, Sevim and Karamustafaglu, 2002). Laboratory applications are essential in learning and teaching of science. Therefore in the laboratory students study theoretical knowledge by application of many tools, and acquire practical experience f several time. In the words of Kozmza in SertCibik and Ince Aka (2021), laboratory enhance learning and intensify laboratory performance. At this juncture background knowledge students learn agnate how they learn. Activities of laboratory are arranged into two groups as content and process. The content is refer to learning, scientific facts, related concepts , while the process is all about how to make use of a laboratory tool, the student interact with people, task duration, how to address a particular method.(Millar.Tiberghien and Le Marechal. 2022), Alkan 2012 explains the use of chemical and glass materials, communication, laboratory, safe knowledge are skills gain in the chemistry laboratory. Moreover there is advancement of other skills for instance gaining manual dexterity, account for the feedback from the instructor and feeling experimental areas. The teachers possess needed knowledge and skills for laboratory practices. Costu. Ayas. Calik, Unai, andKaratas (2005) Preparation

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of solution using proper laboratory materials is the major aim of laboratory practices. In this situation skills and knowledge correlate to preparation of solutions, concentrations and concepts should be concretized for teaching because. Chemistry subject is very hard to understand. As a result teachers suppose to be equipped with skills to perform laboratory activities and affective factors for example anxiety and attitude are essential in making individual realize the need to study . Attitude is mental inclination of individual towards objects, people, subjects events, it is noted as essential predictor of behavior with its affective, cognitive and behavioral mark, (Ekici 2002). The affective characteristics such as comprehending scientific, concepts ,motivation , interest and practical skills. In fact attitudes develop and change with the experiences acquired in the laboratory. According to Sneddon and Douglas (2013) students attitudes towards laboratory experiences endanger their laboratory learning as well as development of their knowledge and skills. Kaya and Boyuk (2011) states that science teachers should have positive attitudes and opinions to laboratory practices because of necessity and importance of using laboratories in science(chemistry) lesson. Costu. Ayas. Calik, Unai, and Karatas (2005) emphasized that teacher ought to gain knowledge and skill about laboratory practices during their university education periods. However there are problems in laboratory applications as a result of deficiencies in laboratory equipment getting experience and subject matters (Bati, 2018, Costu.B. Ayas. A. Calik, M. Unai, S. and Karatas F.O. (2005) . Kaya and Boyulc 2011). Although there is insufficient quantities of laboratory equipment, it is still essential to be skillful in laboratory applications,. This could be achieved with better participation and performance in the laboratory.(SertCibik and Ince Aka (2021).

Use of Computer in the Laboratory

Many schools and colleges use computer in their office for administrative work but few of them expose their students and teachers for computer use. With

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advancement of technology in the world, students are gradually using computer to access their practical work in science laboratory and teacher use computer for organization and management of laboratory which includes record keeping, filing and link with account. As a result computer is very important in all sphere of life, In future it will be hand to observe institution or laboratory that will not be marking use of computer for manipulation and organization of laboratory. Integrating computers softwares into the practical work- recently there are some softwares in CD s and diskettes that is computer simulations that can help students to do their practical work .Some diskettes on chemistry can help the students run their practical on the computers, for instance if students want to titrate in chemistry , the computer soft wares assist to set up titration process involves identifying the right indictor, filling in the acid in proper apparatus , ensure the experiment run through and record their observation and inferences. Integrating computer into observing ,recording and interpreting the work is very important apart from computer assisting students to run the practical exercise , record the results and interpreting is a section, students might not find easy, but will integration of computer, students quickly interpret the result by entering the data into analytical software and interpretation will appear .

Problems for The Use of Computer in Schools

There are some problems envisage in the use of computer in schools.

i. There is need for a standby generator because of irregular supply of electricity.
ii. It is important to train the science teachers in the use of computers
iii. There is need employment one or two computer experts for assistance if need be .
iv. Once there is computer in the school laboratory competent security men are needed(Power2001)

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Conclusion

Chemistry subject is important. For one to learn it permanently, it needs to be supported by relevant experiments that enable the students to gain, first-hand experiences. It is a discipline that permit students to gain skill and knowledge about the subject. Chemistry depends on observation, experimentations and activates all senses. Laboratory premises and opportunity are essential for students to develop attitudes that are positive towards the laboratory. As a result laboratories need to be enriched with enough tools and equipment in terms of number and quality. Chemistry experiments and chemical instructional aids need to be encouraged in the process of learning is energize students to possess positive attitudes. Learning strategies which include project-based learning or problem based learning which is relevant to students subject changes their perception. There is need for integration of computer to complement experiment in school laboratory, the use of many softwares' into practical work, recording and interpretation are as well essential.

References

Alkan,F. (2012). KendikendineOgrenmer in KimyaLaboratuvarndaOgrenciBasarisma. Ogrenmehazrbulumuslugung, laboratuvarbecer I lerineyoneliktutum -unaveEndisestineEtkisi(Yayimlanma mis DoktoraTezi). Hacettepe Universities, Fen BilimleriEnstitusu Ankara.

Ayas, A.KaramustafaogluS.Sevim S. and Karamustafaoglu O. (2002). GeneikimyaLaboratuvarVygulamalainnOgrenciveogretimelemamgo zuyledegeriendi

WEBSITE: https://globaljournalhub.com
ISBN: 978-978-798-430-7

Aldridge, j, fraser, B.J, &wood,D. (2002). Students' perception of outcomes---focus on technology-rich learning environments. Proceeding of the annual meeting of the American educational research association (AERA), new Orleans.

Federal republic of Nigeria. (2004). National policy on education. Lagos: NERDC press

Bati, k. (2018). Turkiye de Frenegtimitive.Kimyaegitimilaboratuvaruygulamalarmagenelbir. BakisDogu Anadolu SosyaBilimlerdeEgilmlerDergist 2(1), 45- 55.

Barnes,G.Mclinern et, D.M. and Marsh, H.W.(2005). Exploring Sex Differences in Science Enrolment Intention: An application of the general model of academic choice, Australian Education Researcher, 32(2), 1-23

Bennet,J. Rollnick, M. Green, G. and white, (2001). The development and use of an instrument to assess students attitude to the study of chemistry. *Internation Journalof Science Education*, 23(8). 833-845.

Costu.B. Ayas. A. Calik, M. Unai, S. and Karatas F.O. (2005). Fen OgretmenAdaylariniCozeltiHazulamaveLaboratuvarMalzeMelerini KullanmaYeterliliklerininBelirlenmesihacettepeuniversitesiegitimfakultesdergisi, 28, 65-72

Chepkorir, S.Chephtonui, E. M. Chemutai. A.(2014) . The relationship between teacher-related factor and students' attitudes towaeds secondary school chemistry subject in bureti district. Kenya *Journal of Technology and Science Education*, 4(4), 228-236

Dienye N.E. and Gbamanja, S.P.T(1990), Science Education, Theory and Practice, OwerrTotan Publishers Ltd

WEBSITE: https://globaljournalhub.com
ISBN: 978-978-798-430-7

Ekici G. (2002). Biyolojiogretmenler in laboratuvardersineyonelic tutu olcegiHacettepe University EgitimFakultes, Dergisi 22, 62-66

Fraser, B,, McRobbie, C.J. & Giddings, G.J (1993).Development and Cross-National Validation of a Laboratory Classroom Instrument for Senior High School Students. Science Education,77, 1-24 .

Fraser, B,, Giddings, G.J & McRobbie, C.J. (1995) evaluation and validation of a personal form of an instrument for assessing science laboratory classroom environment, Journal of Research in Science Teaching, 4,. 399-422

Glasman,L.R and Albarracin, D. (2006). Forming attitude that predict future behavior: A meta –analysis of the attitude- behavior relation. Psychological Bulletin, 132(5), 778-822 .George,R. (2006): A cross-domain analysis of change in students' attitude toward science and attitudes about the utility of science. International Journal of Science Education, 28(6), 571-589.

Greenfield T.A. (1997). Gender and grade-level difference in science interest and participation. Science education, 81,259-276.

George, R.(2006) A cross –domain analysis of change in students' attitudes toward science and about the utility of science. International Journal of Science Education ,28(6) ,571-589 .1

Hofstern, A. and mamloke- Naaman(2007) The Laboratory in Science Education: The State of the Art C11hemistry Education Research and Practice,8(2), 105-107.

Harty,H.&AI-Faleh,N.(1983) Saudi Arabian Students' Chemistry Achievement and Science Attitudes Stemming from Lecture Demonstration and

WEBSITE: https://globaljournalhub.com
ISBN: 978-978-798-430-7

Small Group teaching methods, Journal of Research in Science Teaching,9, (l). 861-866

Hofstein, A., Nahum, T.L., &shore, R . (2001). Assessment of the learning environment of inquiry-type laboratories in high school chemistry. Learning Environment Research, 4, 193-07.

Heng C.Kand . Karpudewan,M. (2015) The Interaction effect of gender and grade level on secondary school student's attitude towards learning chemistry, Eurasia Journal of Mathematics ,Science and Technology Education,4(11),889-898.

Khan ,G.N.and Ali A.(2012) Higher Secondary School Students' Attitude towards chemistry. Asian Social Science ,8(6) 165- 169. http//doi.org /10.55539/ass.v8n6p165

Kaya, H. and Boyussk.u. (2011). Fen BilimleriOgretmenlerininLaboratuvarCalismalannaYonelikYeterliklenErctyes Universities Fen BilimleriEnstitusudengist 27(1), 126-134.

Luketic, C.D., & Dolan, E.L(2014). Factors Influencing Student Perceptions of high- School Science Laboratory Environments, *Learn Environ Res*, 16(1), 37-41.

Miller, R, Tiberghier and le Marechai (2022) varieties of labwork : A way of profiling labwork tasks. In D.Psillos, and H. Niedderer (Eds). Teaching and learning in the science laboratory(PP9.20) . Dordrecht: Kluwer Academic publishers.

Moos, R. H. (1987). The Social Climate Scales: A User's Guide. Palo alto, C.A. :Consuting Psychologists Press.

ISBN: 978-978-798-430-7

Montes, L. H. Ferreira,R. A.and Rodriguez, C. (2018).Explaining Secondary School Students Attitudes Towards Chemistry in chile. Chemisty Education Research and Practice ,19(2) 533-542 .http://doi.org/10.1039/c8rp 00003d.

Morabe O.N. (2004) The Impact of The Sediba Project on the Attitude of Participating Educators Towards Chemistry and Chemistry Teaching North –West University

Nnagbo ,Daberechi (2021) Students Attitude Towards Laboratory Work and Its Impact on Academic Performance in Chemistry in Enugu State An Unpublished Thesis of University of Nigeria Nsukka.

National Policy on Education 4th Edition . (2004), National Education Resource and Development Council. Press, Lagos Fereral Republic of Nigeria.

Odubumi, O. & Balogun, T.A. (1991) the effect of laboratory and lecture teaching methods on cognitive achievement in intergratedscience ,*Journal of Research inScience Teaching*, 3, pp, 213-224.

Omiko, A.(2007). Jobs orientdtion and placement : The role of science education in a developing economy. Abakaliki Larry and Caleb Publishing House.

Oh, P.S.andYager,R.E.(2004). Development of constructivist science classrooms and changes in students attitudes toward science learning. *Science Education International,15(2),105-113.*

.Omiko, A.(2015) Laboratory Teaching Implication on Students Achievement in Chemistry in Secondary Schools in Ebonyi state of Nigeria, 11 *Journal of Education andPractice* 6(30) .

WEBSITE: https://globaljournalhub.com
ISBN: 978-978-798-430-7

Power Lab8 (2001) The New Paragon In Science Labs. Modern School Supplies Inc Hardford C.T.06143

Reid,N. and Shah, (2007). The role Laboratory Work in University Chemistry, Chemistry Education Research and Practice, 8(2), 172-1 85

Salta k. and Tzougraki, C. (2004). Attitudes Towards Chemistry among 11th grade students in high school in Greece. *Science education*, 88, 535-547.

SertCibik,A.and Ince Aka, E. (202l) Students View On Altitudes Towards Chemistry Laboratory Skills. Online *Science Education Journal* ,6(2), 100--113

Stark, R. and Gray D. (1999). Gender preference in learning science. *International Journal of Science Education*, 21(6), 633-643

Sneddon, P.H and Douglas R.(2013). The attitudes towards and experiences of laboratory works teaching in year/ chemistry and physics university courses, new director in the Teaching of Physical Science. 9(1), 49-54

Tamer, P. &Lunetta, V.N. (1981) inquiry-related tasks in high schools science laboratory handbooks, *science education*, 5, pp. 477-484.

Ufodu,N.U.(2009). The role of the Laboratory on the Academic Achievement of Students in Biology in Abakaliki Education Zone of Ebonyi State: unpublished P.S.C: Ed thesis. Abakaliki Ebonyi state university

Warrington M. and Younger .M.(2006) The Other Side of The Gender Gap Gender and Education, 12(4) 493--508.

ISBN: 978-978-798-430-7

Yunus, F.W.and Ali Z.M.(2018) Attitudes towards learning chemistry among secondary school students in Malaysia. Asia n Journal of Behavioural Studies Studies ,3(9) 63 .http: //doi.org/10.21834/ ajbes.v3:9.61.

Ziltoon, A. & Ai-zaubi, T. (1986) the effect of using laboratory on developing science thinking skills of the trader studentsstudents in Jordan, *Journal of Education*, 9, pp. 94- 117.

WEBSITE: https://globaljournalhub.com
ISBN: 978-978-798-430-7

6
PEDAGOGICAL AND INNOVATIONS IN SCIENCE AND TECHNOLOGY EDUCATION: AS KEYS TO SUSTAINABLE DEVELOPMENT

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INTRODUCTION

There is a big demand for high quality education mostly, science and technology education. Parents want to be confident their child is receiving a good education as this prepares them for the future and further education. The skills and knowledge they learn in school are very valuable and puts them in good stead for future experiences. This extends beyond the classroom setting and is important for everyday life, from personal to peer relationships. The way teaching is delivered comes in a variety of forms. Furthermore, due to technology, there are a lot of ways teachers can impart science and technology education to their students and engage them in the learning process.

The modern education in science and technology should be an empowering process that allows and guides students to develop their passions, critical thinking, compassion, and orientation towards wisdom for timely action (Ahlam

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and Deepika, 2014). Education changes the perceptions of society, enhances scientific knowledge and creates new perspectives on research, its foundation, goals and opportunities (Goodyear, 2016). The goal of the pedagogical concept is a given reference point to which all of its content is directed to ensure the effectiveness of the studied process or phenomenon. While setting goals in science education we should take into account: first, the social order, and secondly, theoretical concepts, and thirdly, the tradition of training and education, and, fourthly, international experience (Goodyear, 2016).

Innovation is primarily associated with pure science or technology and the term is often generalized to mean technological progress. Nevertheless, pedagogical innovation assumes many other forms. The term 'innovation' is similar, in its literal meaning, to that of adjustment, improvement, development, study/pilot project, experiment, or even modernization, reform or renewal. Pedagogical innovation can also be called scholastic innovation, in education or in training. Pedagogical innovation calls for one-off, measured and sustainable positive change. Pedagogical innovation in a university context is characterized by an intentional action that aims to improve university students' learning in a sustainable manner. The technological, financial and social changes of today's university require greater performance from the teacher, which is assessed by their peers' and students' qualitative criteria. Pedagogy is a relatively independent scientific discipline that combines fundamental and applied (scientific-theoretical and technical-constructive) function.

Sustainable development has been defined by many in various ways. Adebola, (2017) defined sustainable development as a kind of development that can be initiated and managed properly in such a way to give attention to continuity and preservation as people explore an explicit available resources for the enlargement of their existence. Ugoh, (2018) described sustainable development as a construct, which envision development as meeting the need of the present

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generation without compromising the needs of the future generation. Osuafor, (2019) posited that for development to be sustained, there must be human development. According to Arogundade, (2014) the major essential tool for achieving sustainable development in science education should include:

1. Improving the quality of basic education
2. Re-orienting existing science education program to address sustainable development
3. Developing public awareness and understanding
4. Providing training for all sectors of private and civil society.

Ugoh, (2018) further argues that continued sustainable development is only possible or assured when concrete steps are taken to make the youth acquire skills that will enable them to be self-reliant and therefore become the tools for achieving development and sustainability.

Sustainable development implies the fulfillment of several conditions; preserving the overall balance, respect for the environment and preventing the exhaustion of natural resources. Reduced production of waste and rationalization of production and energy consumption must be implemented. A sustainable development must be based on better development mode of consultation between the community and the members it comprises. The success of such a policy depends on consumers accepting certain constraints and citizens observing certain requirements with regard to transparency and participation. The aim of sustainable development is to define viable schemes combining the economic, social and environmental aspects of human activity. The ultimate goal of sustainable development is to find a coherent and long-lasting balance between these three aspects. In matters of sustainable development, the consensus of the participants in society is required in order to define objectives and implement them: private and public sector companies, associations, NGOs, unions and citizens (Mannix, 2015).

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Concept and Importance of Education

Education is the process of receiving or giving systematic instruction, especially at a school or university. Orobosa (2019) defined education as the process by which an individual acquires the many physical and social capabilities manned by the society in which he or she has been born into. This is in agreement with that of Schofield (1980) that defined education as a type of initiation into the culture of a society because the learner is being exposed to specific learning situations. According to Longman Dictionary of Contemporary English (5^{th}), Education is the process of teaching and learning. Dienye (2017) defined education as the medium through which the society transmits its cultural heritage to its younger generations. It went further to say that education of any society involves the transmission all knowledge that is deemed worthwhile. To Yekini (2018), education is the process of acquiring knowledge, skills, competence, and the cultural norms of a society by people and to transmit this life to the coming generations so as to enable perpetual development of the society. This is in line with Okoro (2014), education as a form of learning in which the knowledge, skills and habits of a group of people are transferred from one generation to the next through teaching, training or research. Education is power and a process of acquiring knowledge and ideas that shape and condition man's attitudes, actions and achievement, it is the process of developing the child's contributions in social reforms, it is the process of mastering the laws of nature and for utilizing them effectively for the welfare of individual and for social reconstruction. It is the art of utilizing knowledge for a complex living.

Education could be formal or informal. Formal education occurs in a structured environment whose explicit purpose is teaching students. Usually, formal education takes place in a school environment with classrooms of multiple students learning together with a trained, certified teacher of the subject. While informal learning occurs in a variety of places, such as out of school time, in

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youth programs at community centers, in worship centers like shrines, churches and even at village squares. Informal education does not follow a specific curriculum and may originate accidentally, in association with certain occasions, or from changing practical requirements.

The whole essence of education is to ensure the proper functioning and survival of an individual in his society. Education enhances an individual's ability to impact positively on and improve his society. Therefore, through education, learners are not only taught, trained, and adequately guided to acquire relevant skills and knowledge but also how to adapt to acceptable public life. Dienye (2017) observed that the society has vested the educational institutions with the responsibility of molding the ideas, habits, attitudes of learners so as to produce well balanced personalities that are physically strong, mentally alert, emotionally stable, culturally sound and socially efficient. It went further to argue that quality education is a prerequisite for sustainable development. Bereday cited in Yekini(2018) observed that distinguished economists had long confirmed the convention long held by educators that poor countries would become rich only if they invest heavily in education. It means that education supposed to create wealth and liberate the recipients from the shackles of poverty and ignorance.

Problems and Challenges to National Education Policies: Way Forward

Policies when documented are fair and genuine but the implementation often encounters bottlenecks hence objectives and goals are eventually rarely met. Olunloyo (2014) noted the problems associated with educational policy and planning in Nigeria, which includes those of power relation at the directive stage of planning, poor preparation and costing, and weak evaluation of projects. With respect to the implementation of educational policies, Olujuwon (2017) identified areas either not implemented or not satisfactorily implemented to evolve around the following; the development of national consciousness and unity, inter institutional cooperation, teaching and learning, areas of need and priority,

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training of staff in methods and techniques of teaching and indifference on the part of government. A lot of funds are pumped into policy planning and documentation but it is disheartening when the plans fail to yield through lack of implementation or bad implementation. Supervisory and financial problems are also some of the reasons for failure in the implementation of education policies in Nigeria.

From the foregoing, there is clear demonstration of governments' positive intentions for science and technology education having realized that it is the vehicle by which a nation can be lifted to attain scientific and technological sophistry. This is overwhelmingly but to pretend that there is no shortfall in enrolment and performance in science and technology education is deceptive. In November 2, 2006, the Honorable Minster for Education at one of the official ceremonies in Abuja delivered the keynote address titled "science and technology for youth empowerment" specifically states as follows:

Our education system is malfunctioning creating in particular problems of scientific and technological manpower production. The situation is so pronounced today that the nation faces crisis of scarcity of scientific and technological manpower. In essence, we are producing less and less of leaders of tomorrow: the managers, the entrepreneurial class, the teachers, the doctors, the policy makers, the law enforcement makers, the professionals. This is because the transition through the various levels of education is not in favor of technology and science career (Gusen, et.al.2017).

Government is not irresponsive too to the decline in participation in science and technology education programs that seems to defy possible solution. The president in the headline of one of the Nigerian lead newspaper THISDAY of March 3, 2008 states; "FG, W' bank to promote science education", Mr. president alluded that the Federal Government, in conjunction with World Bank, is ready to promote science and technical education at the nation 's tertiary

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institutions. All these are steps taken to ameliorate the problem. At the International Council of Associations for Science Education (ICASE) world conference 2007, delegates noted the need to stage action to bridge gaps between science, technology and the public. The identified some key reasons for a global decline in the level of interest in science include; at the International Council of Associations for Science Education (ICASE) world conference 2007, delegates noted the need to stage action to bridge gaps between science, technology and the public. The identified some key reasons for a global decline in the level of interest in science include;

a) Difficulty in finding, training and retraining of well qualified science teachers.
b) Difficulty in keeping up with emerging science and changing teaching practice.
c) Public perceptions related to science.
d) Difficulty in maintaining a relevant science curriculum at all levels.

Pedagogy and Innovation in Science Education

Innovation in Science Education has received increasing attention over the decades emphasizing the improvements in quality of instruction and curricula (Nathan & Pearson, 2014). A trend of shift in modern education theory has moved away from traditional modes towards a more constructive approach (Smyth et al., 2016). A student-centered learning approach has been developing in education research over the years. In particular, experiential learning promoting learning-by-experiencing has been rapidly expanding in education research (Gorghiu & Ancuta Santi, 2016). Students' learning is promoted through their active engagement of participating in activities which are structurally designed by educators. Many universities have adopted the outcome-based teaching and learning approach at the course-wide level, which aims to articulate what educators in higher education expect students to learn with a clear design of

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effective curriculum, appropriate assessments to measure achievement, and to plan the learning process for the students. However, a gap between student learning activities and intended learning outcomes is commonly found in the design of innovative courses (Biggs & Tang, 2017). One might argue that actual implementation of a university course remains inadequate and, more empirical evidence should be sought to support the effectiveness of different pedagogical approaches toward the intended learning outcomes. "Much science education at a tertiary level, even in more innovative courses, still relies on lecture-based teaching and formulaic labs" (Smyth et al., 2016, p.193).

Pedagogy refers to the method and practices of a teacher. It is how they approach their teaching style, and relates to the different theories they use, how they give feedback, and the assessments they set. When people refer to the pedagogy of teaching, it means how the teacher delivers the curriculum to the class. When planning a lesson, teachers consider the best way to communicate the relevant information to enable pupils the best possible learning experience. They will take into account the context of the subject and also their own teaching preferences. This delivery depends on the age of the children and the classroom setting. There are various approaches to pedagogy which aim to support learners through their journey so they can achieve the maximum outcome. Employing effective pedagogy approaches enables students to reach their full potential and provides a strong foundation for learning. This also helps students realize their own capabilities which improve their self-confidence and self-esteem. In turn, this increases the likelihood of students achieving, as they will be more motivated to participate in activities.

Children have a right to high quality education as this prepares them for their future. The way education is delivered comes in a variety of forms and lots of teachers have their own methods of teaching. Teachers should be aware of the

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importance of a good pedagogical approach to ensure each and every child receives the best possible learning experience.

Importance of Pedagogy in Science Education

The points below highlight the importance of pedagogy:

1. Pedagogy is important because it gives teachers an insight into the best practices for a classroom setting.
2. It allows them to understand how different students learn so they can tailor their lesson to suit these needs.
3. As a result, this will improve the quality of their teaching as it will be well received by students.
4. By being mindful of which theories you're using, and how children are interacting with them, you can create more meaningful lesson plans.
5. Understanding and implementing good pedagogy helps teachers reconnect with their pupils and builds a better, more collaborative, relationship. There is understanding from both parties so that you are working towards a shared goal.
6. Also, the right pedagogy enables instructors to observe the academic progress of their students.
7. Pedagogy can improve the overall quality of teaching by making the student more receptive during lessons. As a result, this enhances the student's level of participation and contribution during the learning process.
8. A well-developed pedagogy helps impart education to students using a range of learning styles. It enables pupils to develop a deeper and more meaningful understanding of a particular subject.
9. A good pedagogical approach is required for students with special needs or students who come from disadvantaged groups or minorities. The

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approach supports the needs of these students and helps them integrate better into the mainstream learning community.

10. An appropriate pedagogy enables students to develop higher order skills including analysis, synthesis, and evaluation.
11. A well thought out pedagogy can improve the quality of teaching and the way that students engage in different activities. This increases the likelihood of children achieving their goals as they are more likely to participate in the classroom.
12. Pedagogical approaches can help stimulate a child's development and motivate them to keep learning. This is an important building block for their future as it means they will be excited about the learning process as a whole.

Role of Science and Technology Education

The role of technology education in national development cannot be overemphasized. Any nation which fails to pay attention to technology education has planned to be left behind or all spheres of development. Okeke 2017 admitted that rapid and sustainable development of a country can only be achieved through scientific research, rational application of science and technology knowledge and skills. The developed nation did not attain their levels of development by merely wishing it; their dreams and aspirations were actualized through a well thought out, planned and executed education system. According to Okoli and Onwuachu 2019, science and technology is tool for economic, social and political development of a nation.

Worthy of note also is that in all aspect of endeavor such as health, agriculture, food, security, communication, economy, transportation, science and technology are applicable. Presently, countries in the world are categorized as; developed, developing, and underdeveloped countries however rests on the ability of the developed countries to convert scientific ideas to useable technology while the

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developing and undeveloped countries are yet to do so effectively (Uwaifo, 2014). Presently, Nigeria remains a developing country with low economic, social, political, cultural and technological indicators (UNESCO Institute of statistics, 2017; United Nations, 2019). In recognition of the impact of science and technology development to the overall development, federal government of Nigeria has been supporting it through policies, actions and programs. Specifically, science and technology is included in National Policy on Education (2014) while there is National policy on science and technology (2013) which is prepared for a 25year time and whose philosophy emphasizes Nigeria's commitment to the creation of independent, integration and self-sustaining economy with the policy itself serving as the frame work for effort toward the fulfillment of the commitment. Nigeria can also boast of educational institution such as technical colleges, colleges of science and technology, mono technics, research institutes as well as specialized universities of science and technology, for provision of science and technology education for the citizens. Education is synonymous with the existence of human societies. It can be explained to mean the medium through which the society usually reflects its whole essence.

The primary purpose of science and technology education is gainful employment for those who are preparing to enter occupations in agriculture, commerce, home-making, industrial and technological fields. The key roles expected of science and technology education in Nigeria's development includes:

1. Generation of employment/Job opportunity: science and technology education equips its graduates with saleable skills for gainful employment, corporate organizations, or self-employment.
2. Industrial development: Science and technology education is expected to help the nation develop technologically and industrially by producing people competent and capacity of developing technologies for industrial and economic development.

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3. Entrepreneurship and innovation: science and technology education offers its graduates the opportunity of becoming self-reliant, job creator and an employer of labor.
4. Poverty alleviation: In this era of global economic meltdown and incessant retrenchment of workers, most retrenched employees have fallen back to their handiwork for the sustenance of their families.
5. Revenue generation: Our science and technology products can be exported to other countries thereby promoting the Nigerians economy through foreign exchange earnings.

Challenges of Innovation in Science and Technology Education

Various efforts have been made by the federal government in areas of science and technological education in particular and tertiary education in general. Therefore, we need to critically examine and look at the issues/ cause of science and technology backwardness in Nigeria despite all these efforts. Some issues that are at stake in science and technology education in Nigeria are as follows:

1. Inadequate funding of education: Over the years, education has been inadequately funded in Nigeria in spite of its roles in national development. No nation can develop technologically when the formal education sector that drives the technology is not adequately funded. The federal government yearly allocation to the education sector has for over the years been far below average.
2. Lack of equipped laboratory and workshop: the roles of laboratory in science and technology education provision cannot be over emphasized. As buttressed by Owoeye (2016), the success of any science subject depends on its provision. Laboratory /workshop play vital roles in technical oriented science curriculum and provide students the opportunity to engage in the process of investigation and inquiry. The nations universities, polytechnics and technical colleges that are

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supposed to help train proficient engineers, technologists, and technicians are now filled with out-dated and in most cases non-functional equipment.

3. In appropriate curriculum: adequate curriculum content is germane for effective education provision. Offorma (2015) agrees that functional education is determined by the equality of the curriculum content and its implementation. Ivowi (2019) also stated that functional science curriculum content must be valid, relevant, significant, learnable, consistent with current social realities of the country, useful and reflect the interest of the learners. In spite of the importance of curriculum in education provision, much led been said about the inappropriateness of curriculum of education in Nigeria (Ige, 2016; Balogun 2019), of particular focus is the curriculum science and technology education which has been adjudge to defective (Uwaifo, 2016; Udele 2019); Ugwu, 2018; Udofia & Salami, 2014; Ogunkunle & Mbedele, 2018). It its thus worthy of note that due to defective curriculum, many graduates of science and technology education cannot find job in the labour market (Ibeh, 2019; Dabo, 2018; Borisade,2018; Okebukola, 2014) while many among those employed are finding it difficult to cope with the demand of work (Dabaleen, Oni & Adekola, 2018).
4. Poor academic performance of students: the issue of mass failure of students in public examinations has been a major concern government, parents and education stakeholders in Nigeria. This is of the huge expenditure being marred on the training of the students in educational institutions as well as the expectations from them at the end, in terms of what they can contribute to the society.
5. Lack of power supply: even if the institution has all the needed material resources, electricity holds the key to conducting meaningful laboratory and workshop practical. Some of the science and technology institutions are not connected to the national grid, and were they are connected; the

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epileptic nature of the public power supply has limited practical work to unacceptable standard.

6. Corruption / Mismanagement of Fund: corruption has been a thorn of Nigeria's economy over the years. According to Transparency International (2011) report, cited in Oyinola (2014), Nigeria ranked 144th out of 146 most corrupt countries in the world, beating only Bangladesh and Haiti to second and last positions respectively. Oyinola (2014) further reported that the menace is pervasive in the educational system, from primary to tertiary levels. Due to corruption, money meant for infrastructural development and maintenance is often misappropriated by educational managements.

Science and Technology Education for Sustainable Development

Science education is a kind of education that aims at producing scientifically literate citizens and potentially scientific and technology manpower while technological education leads to the acquisition of practical, applied skills, as well as the basic scientific knowledge (Okonkwo, 2016). It is designed to develop skills, knowledge, abilities, attitudes, and work habits needed for self-reliance. Technology education is also the process of training technically oriented personnel who are to be initiators, facilitators and implementers of technological development of any for economic and social welfare of the citizenry. Technological education has direct impact on national welfare and its contribution range from electrical / electronic technology, metal work technology, mechanical / automobile technology, building technology etc.

Development (Dienye, 2017) is a positive improvement in the overall lifestyle and circumstances of the citizens of a society. Science educators are supposed to solve societal problems in sustainable ways, through contributing to the national development. But they need theatrical and practical knowledge acquirable through science and technological education to be able to solve the societal

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problems. Our inability to embrace quality science and technological education has put Nigeria at a low level of technological development and perpetually a developing nation. The difference between developed, developing, and underdeveloped countries lies on the ability of the developed countries to translate scientific ideas into useable technology while the developing and undeveloped countries are yet to effectively achieve such feat.

The term sustainable development means the development that can be sustained over a period of time. The report of the world commission on environment and development (1987) sheds more lights on it. It describes it as the development that meets the needs of the present generation without compromising the ability of the future generation to meet their own needs. According to Ballara (1991), cited by Ige Akindele (2013), it is the human's ability to survive by means of rational use of renewable resources, by their restraining from disrupting the ecosystem, societies and instead allowed them to reach their potentials. Taking into cognizance these definitions, sustainable development can also be described as the development that builds on the present and provides enabling environment for the future generations to develop and meet their needs.

There can be no doubt that scientific literacy is what all Nigerians need in order to continue to profit from the products of science and technology. Hence, more Nigerians should be motivated to study science and science related courses in our secondary and tertiary institutions. All science laboratories in our secondary and tertiary institutions should be well equipped so as to support effective teaching of science at all levels. A combination of these efforts by all concerned is bound to place science as an effective instrument that will ensure the rapid transformation of Nigeria into an "industrial giant" in Africa. Science and technology has become the key to progress. Scientific research which nourishes and serves as to enable us to increase our knowledge which when put into coherent shape, paves the way for the innovations needed to work out appropriate solutions or technical

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procedures that are more efficient in solving problems of society (Olunloyo, 2014). Today, science and technology are driving a wedge between industrialized and developing nations. This gap is becoming wider and wider and we need to devise a strategy for the appropriate technology to meet the cultural demands of our people.

The recommendation of VISSION 2010 committee on Nigeria's future policy and strategy for national development are being implemented. It is however observed that scientist have made significant impact to the

i. Health care delivery process (medicine)
ii. Agriculture
iii. Industry and
iv. Education

However, the question often asked is whether this will continue to ultimately benefit mankind.

Technological Skill Acquisition

Acquisition of the right type of skill to socio-economic problems and needs is inevitable for nation hopeful of meaningful industrial development. Thus, the knowledge of science education (chemistry, physics, biology, agricultural sciences) is indispensable. It has been the goal of Nigeria to acquire scientific knowledge, technological development and industrialization as has been reflected in most of the national development plans. Thus, all national development plans stressed industrial and technological development. These developments can only be realized through sound knowledge of the basic sciences. For example, professional disciplines such as medicine, engineering, architecture etc. require basic knowledge of science education. In the seventies and early 80s, some Nigerians thought that money could not be our problem, rather how to spend it.

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We therefore embarked on massive importation of goods /services and transfer of foreign technology.

The attempts of developing nations to acquire foreign developed technologies have had limited success. This is because it has become apparent that technology transfer is a much more complex and costly process, the ultimate success of which is contingent upon a number of technical and economic factors. Prominent among these factors is the level and direction of indigenous technological efforts in the recipient country. Science has played a major role in the development of technology around the globe. The correct application and utilization of organized and accumulated scientific knowledge for proper enhancement of living standards is a pre-requisite for national development and economic wellbeing. Thus, the role of science education in the technological and industrial development of Nigeria is tremendous. Abubakar (2014), suggested that, physics education plays a significant role in the field of manufacturing and production of different devices and machines that would be of great important in production services for almost all the industries in Nigeria, therefore, physics education serves as a tool for national development in the field of industries. Ogunniyi (2016), identified the following characteristics of scientifically literate person.

1. Ability to recognize that science is a human enterprise primarily concerned with the study of nature.
2. Ability to learn how to acquire necessary knowledge / skills and attitudes relating to science.
3. Ability to distinguish as well as see the relationship between science and technology.
4. Ability to read scientific literature of a general nature.
5. Ability to recognize the limitations of science.
6. Ability to distinguish between facts and superstitions.
7. Capability to use rational processes to solve problems.

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8. Ability to appreciate the role of science and technology in the society.
9. Ability to search for objective facts rather than rely on rumors, taboos, superstitions and other authoritative generalizations.
10. Capability to develop inquiry skills and problem-solving attitudes.
11. Ability to use scientific knowledge and skills for responsible social actions.
12. Capability to develop vocational competence in science. Etc.

The Use of Technology in Education

Educators can use technology in the class room in many different ways. These can range from using smart boards to show simple power point slides or videos during a lesson and providing online support such as technical aids to the spectacular massive open online courses (MOOCs) that universities are currently using to allow tens of thousands of students of students worldwide to follow the same studies through video lessons, self-testing and discussion forums. Much research has been carried out and still being carried out to investigate the best way to make use of technology for learning purposes both inside and outside classroom (Rosenberg, 2016). He noted as follows:

1. The use of graphic images with text work better than text alone. This depends on the topic being presented and expertise level of the learner. Minimize the on-screen text you use and supplement it with clear images that clarify and enhance the most important content.
2. Stick to the most relevant materials since students are usually distracted by details like irrelevant subtitles and nonessential illustrations as well as animations with narration and interesting but essentially irrelevant information.
3. If you are using images in online lesson material or apps, it is better if accompanying text is spoken rather than written. This allows the learner

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to concentrate better on the visual information contained in the image or graphic without being distracted by too much written text.

4. Work without relatively small amounts of learning material not large chunks. Divide the content to be learned into short segments. Four segments of five minutes each will work much more effective than one long video of 20 minutes.
5. If you want to give learners control allow them control over stopping going back and repeating dynamic images (video, animation, etc.) and not the content order of the lesson.
6. Build in plenty of opportunities for students to practice what they are learning through your technology-based lessons at least as many as in traditional lessons.

Science as a Tool in the Socio-Economic Development of Nigeria

Balogun (2016), opined that socio-economic development is essentially development of human and material resources of a nation. As well as fed, physically and mentally healthy and generally educated people constitute other things being equal, an asset to any nation. The problems of social change are basically that of information and resources. For example, if people generally know what to do to improve the quality of their lives and are in a position to do so, they will in all probability do it. Some countries have natural resources but not the qualified personnel to tap them for the benefit of their people. On the other hand, some countries like Japan have limited natural resources but with highly competent people, have managed to improve the quality of the life of their people. It is truism to state that political independence without economic independence is a sham. However, economic independence can come, giving the material resources through transfer or importation of technology. The technology can then become "indigenized" through the development of appropriate

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manpower. This might involve the integration of experience of the peasantry with science and technology (Okoye, 2017).

At all level of events, the realization that the wealth of a nation depends on its extensive use of science and industrialization has led governments throughout the world to develop science policy alongside socio-economic policies. Indeed, this level of awareness of the importance role of science led the United Nations to organize a world conference in 1979 on the role of science in National development.

Consequently, structures have been developed for government administrations of science and technology in many places of the world. Specifically in Africa, such structures include the organization of African Unity Scientific, Technical and Research Commission (OAU-STRAC) with its scientific council of Africa (SCA) and scientific committees in various fields (e.g. Inter-Africa Committee on Agriculture and the Mechanization of Agriculture, Panel of Scientists on Medical Sciences and Pharmacology, Panel of Scientists on Biological Sciences and Panel of Scientists on Science and Technology etc.).

A review of our national development plans will reveal why we need science in all aspects of our developments. A look at our public sector plan makes it clear that we need science for the economic, social, administrative and financial sections of the programmed. We need science to develop our agriculture. In the areas of mining, industry, transport and communication, water supply and other services, we need scientists and their knowledge to fully maximize the realization of our development plans. It is therefore no accident that the federal and state government have been trying to establish more technical schools, Polytechnics or Colleges of Technology, Federal Colleges of Education (Technical) and the Universities of Science and Technology. Part of the expectations in all these efforts is to produce more scientists and technologists in the hope that many of

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them will be the highest quality that give the nation the expected scientific and technological revolution (Okoye, 2017).

It is noteworthy to observe that National Policy of Education intends:

i. To inculcate in the child, the spirit of enquiry and creativity through the exploration of nature and the local environment in pre-primary education.
ii. The laying of a sound basis for scientific and reflective thinking in primary education, and
iii. To equip students to live effectively in our modern age of science and technology in secondary education. Hence, science education in the 6-3-3-4 system of education was conceived to be activity based to enable the children acquire scientific process/skills necessary for problem-solving.

Suggestions on How to Revamp Science and Technology Education

There is urgent need to revitalize science and technology education in Nigeria as a way of curbing massive unemployment ravaging the country and for our national development. Below are ways of raising the standard of science and technology education in the country.

1. Training and retraining of science teachers: The training of academic science teachers/ staff should be a continuous exercise to ensure improvement in the quality of their output.
2. Improved power supply: The present administration should endeavor to improve the nation's electricity generation, transmission, and distribution to every parts of the country. Availability of power in the training institution will ensure the practical are conducted as enshrined in the programme curriculum even with a limited number of equipment.

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3. Improved funding: Funding of education sector in Nigeria should be raised from its pitiable start now to UNESCOs standard of 26% of the country's total annual budget. Increased funding will ultimately lead to an improved condition of service in terms of infrastructural development, acquisition of instructional materials, scholarship and professional development.
4. Teachers' motivation: There are many ways science teachers can be motivated to put in their best; prompt payment, of enhanced salaries, allowances, entitlements and research grants. A motivated work force will operate with commitment and dedicated to duty. With the right incentives, the issue of brain drain or nonchalant attitude of first class graduates towards teaching will be a thing of the past.
5. Implementation of quality curriculum: There should be a standing committee for the review and update of our school curriculum regularly. In reviewing the curricula, the technological needs of the industries must be given a priority.
6. Establishment of more science and technology institutions: This is very important to eliminate the overcrowding been witnessed today in the few available institutions and to enhance capacity of science and technology institutions to accommodate the crowding population of the country.

CONCLUSIONS

The role of science and technology in national development (as keys to sustainable development), cannot be overemphasized. In all aspects of human activities such as health, agriculture, communication, food, security, transportation among others, science and technology are applicable. We recognize that science remains the bedrock of national development and together with technology have entirely dictated the trend of societal growth. Nevertheless, more scientific and technological advances must be continuously made for the

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benefits of mankind. The application of science must be related to our national needs and thus deliberate and planned scientific efforts should be made to find the means of satisfying the needs of our citizenry. The people and the leaders must view the effective use of scientific and technological advances as the key to successful and sustainable development. Technological literacy has to be emphasized in the schools and encouraged throughout the population. The effective use of science and technology means "matching solutions in search of problems to problems in search of solutions" Research laboratories must focus on the specific needs of the country. In developing countries, this means emphasizing applied research and development while maintaining a core of basic researchers who can follow and participate in world advances. Acquiring new technologies requires a system receptive to innovation, with incentives and mechanisms for translating knowledge into action. The process of diffusion implementation is greatly strengthened if there is feedback from the users of technology to generators of knowledge. The education system must therefore give students practice in understanding the systems, manipulating them, talking about them to one another, and envisioning the function from many viewpoints. The use of tools for managing information complexity needs to become part of schooling for an ever-increasing portion of the population. Preparing them to use technology requires a combination of skill-development, practice with complexity, and the development of adaptive problem solving capabilities.

Recommendations

1. All stake holders in science education from policy makers to implementers including parents must have input in national development.
2. The government should demonstrate its political will in working to rebuild the Nigerian economy through science and technology education.
3. The government should make science and technology education a priority in its broad national development strategy.

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4. Science and technology education should be supported by foundations, business, NGOs and international development agencies.
5. The gaps between science, technology and the public should be bridged. The government should encourage and support the establishment and development of professional science and technology organizations, especially teacher organizations nationwide.
6. There should be effective and proper monitory of educational practices from pre-planning stage through planning stage to post-planning stage (implementation).

References

Abubakar S. (2014). Role of Physics Education for Technological Development for Employmentand Self Productivity in Nigeria. Journal of Education and Social Research, 2(10), 166.

Adebola, H.E. (2017). Standard in Mass literacy. Adult and Non-Formal Education.Capacity building and sustainable Development in Nigeria, UNIZIK Orient Journal of Education. 3(1). 129-133.

Afforma, G.C. (2015). Curricula for Wealth Creation. Paper presented at the seminar of theworld council for curriculum and Instruction heled at Kano Nigeria.

Ahlam, I., and Deepika, P. (2014) Rabindranath Tagore, a Visionary: His ideas on Education and Rural Reconstruction. J. Scholarly research journal, 1(3), p. 472-485.

Arogunded, B.B (2014). Entrepreneurship education: An imperative for sustainable developmentin Nigeria. Journal of Emerging Trends in Education Research and Policy Studying. 2(1) pp.26-29.

WEBSITE: https://globaljournalhub.com
ISBN: 978-978-798-430-7

Babalola, S. (2018). Determinants of the uptake of the full dose of diphtheria-pertusis- vaccines (DPT3) in Northern Nigeria: a multilevel analysis. Matern child Health J.

Balogun, T.A. (1982). Science Society and Science Teaching Effectiveness in Nigeria. Journal ofScience Teachers Association of Nigeria.

Biggs, J., & Tang, C. (2017). Using constructive alignment in outcomes-based teaching and learning. Teaching for quality learning at university (3rd ed.). (pp. 50-63).Maidenhead: Open University Press.

Borisede, A.B. (2018). Restructuring the Education System as a long term solution to the unemployment problem in Nigeria. Bullion, 25(4): 15-19.

Dabaleen, A., Oni, B. &Adekola, A O. (2018). Labour Market Prospects for University Graduates in Nigeria. Background study conducted to inform the design of NigerianUniversity System's Innovation project Washington D.C world bank.

Dabo (2018). Addressing Youth's Unemployment, Nigeria Tribone.

Damachi, N.A. and Shell, R.L. (2007). Acquisition of Foreign Developed Technology in Development Outlook. Vol. 1, No. 10 PRIL 1987, Wilfred Eko (Ed), Lagos.

Dienye, V.U. (2017). Education and Societal Development: The Quality Imperetive. African Journal of Education and technology, 1(3): 15-24

Goodyear, P. (2002). Psychological foundations fornetworked learning. In Steeples, C. et Jones, C. (Eds). Networked Learning: Perspectives and Issues, London: Springer-Verlag.

WEBSITE: https://globaljournalhub.com
ISBN: 978-978-798-430-7

Gorghiu, G., &Ancuta Santi, E. (2016). Applications of experiential learning in science education non-formal contexts. The European proceedings of social &behaviouralsciences, 16, 320-326. DOI:

Gusen, J &Olarinoye, R. (2017). The Politics and Policy of Information and Communication Technology in Educational System in Nigeria. Proceeding of the 21st AnnualCongress of the Academy of Education. Bauchi. http://www.nislt.gov.ng/docs/ministers%20paper.doc

Ibe, (2019). Training Guideline on Incorporating Education for Sustainable Development into the Curriculum.

Ige, A.M. (2016). Myths and realities of falling standard of education in Nigeria: The way forward. Nigerian Journal of Professional Teachers, 2:36-48

Ivowi, U.O. (2019). Struggle for Nigerian Curriculum. Curriculum theory and practice. Ibadan: A publication of the curriculum organization of Nigeria.

Nathan, M., & Pearson, G. (2014). Integration in K-12 STEM education: status, prospects, and an agenda for research. 121st ASEE Conference and Exposition.15-18 June, Indianapolis, Indiana.

Ogunkunle, A.R. and Mbelede, N.J. (2018). Problems and Prospects of Science, Technology and mathematics (STM) Curriculum Development in Nigerian schools, proceedings of the 49th Conference of Science Teachers Association of Nigeria Conference, held at Yenegoa, Nigeria.

Ogunniyi, M.B. (1986). Teaching science in Africa. Salen media, Ibadan.

ISBN: 978-978-798-430-7

Okebukola, P. (2001). Redesigning University Education Curricula as a long term solution to Graduate unemployment in Nigeria. Bullion, 25(4):20-25.

Okeke, E.A.C. (2014). Making Science Education Accessible to all 23rd Inaugural Lecture of University of Nigeria, Nsukka.

Okoli, J.N.&Onwuachu, W.C. (2019). Preparedness of Science Technology

Okoro, O.I.(2014). Implementation of Technological Education: The Bene of Nigeria Development.

Okoye, N.S.(2017). Promoting Science as a Vehicle for National Development in Nigeria. 36th Annual Science Association of Nigeria. 7th-11th April, 1997.

Olunloyo, O.A. (2014). The Role of Scientist and the Place of Science and Technology in National Development. 36th Annual Conference, Science Association of Nigeria. 7th-11th April, 2014.

Orobosa, U. (2019). Education and National Development in Nigeria: Vanguard Newspaper January 20, 2019.

Osuofor, A. M., Okeke, S.O &Nnorom, N. R (2019). Strategies for and challenges to entrepreneurship education in science for sustainable development.

Owoeye, J.S. (2016). The Effect of integration of Location, Facilities and class size on academic achievement of secondary schools students in Ekiti state, Unpublished PhD Thesis, university of Ibadam, Nigeria.

Oyinola, O.A.(2014). Corruption Eradication in Nigeria: An Appraisal. Library Philosophy and Practice.

WEBSITE: https://globaljournalhub.com
ISBN: 978-978-798-430-7

Rosenberg, A. (2016). Philosophy of science Routledge. ISBN 0-415-34317-8.

Schafield J.W. (2018). Racial and behavioral Cues in Black and White Children's perceptions of ambiguously aggressive acts. Journal of Personality and Social Psychology, 39(4), 590-598.

Smyth, L., Davila, F., Sloan, T., Rykers, E., Backwell, S., & Jones, S.B. (2016). How science really works: the student experience of research-led education. Higher Education, 72(2), 191–207.

Udofia, N.A.,& Salami, O.S. (2014). Appraisal of the UBE curriculum using the basic science as an example. Paper presented at the 53rd Science Teachers Association of Nigeria(STAN) Conference, held at Ondo State, Nigeria.

Ugoh, S.C. (2018). Oil politics and crisis of developmentin the Niger Delta. Journal of sustainable Development in Africa. 10, (2) 19-115.

Ugwu, A.N. (2018). Current Issues on Implementation of Senior Secondary School Science Curriculum in Nigeria. Paper presented at the 49th Science Teachers Association of Nigeria.

Uwaifo,V.O. (2016). Technical Education and its Challenges in Nigeria in the 21st Century. Department of Vocational Technical Education, Ambrose Ali University, Ekpoma, Edo State Nigeria.

Yekini, O.L. (2013). Education as an Instrument for Effective National Development: Which Way Nigeria. Business & Entrepreneurship Journal, 2(2): 27-38.

ISBN: 978-978-798-430-7

7
IMPLEMENTATION OF FLIPPED CLASSROOM MODEL FOR SCIENCE INSTRUCTION

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INTRODUCTION

There is always need for improvements in the field of science and technology. This has leads to important changes and innovations in the field of science such as in Biology, Physics, Chemistry and mathematics. Another field that has been deeply influenced by the improvements in technology and expected to show paradigm shift is in pedagogical approaches in science instruction. The 21 century students otherwise called digital citizens are mostly affected by the changes especially in the field of education. These students have the ability to integrate technology in their daily activities much faster. It is therefore apt and necessary that educational technologies should be actively used and efficiently implemented during science instruction. Learning theories have shown us that there are differences in the learning style and learning speed of individuals, it therefore becomes imperative to make use of learning environments that vary according to individual needs instead of model where all individuals are given the same education (Faut & Fatih, 2021).

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There is therefore need for learning expenses in which learners can transfer the knowledge they have learnt through active learning activities to their everyday lives. Active learning according to Ude, 2020, is a process where students engage themselves in activities like discussion, debate and other process that require them construct the knowledge through higher order thinking as applying, analyzing, evaluating, synthesizing and verbalizing concepts. Hence the need to implement flipped classroom model to meet educational needs of science teaching and learning.

Flipped Classroom Model

Flipped classroom is a pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter (The Flipped Learning Network, 2014). It is an instructional strategy and a type of blended learning which aims to increase student engagement and learning by having them complete reading at home and work on live problem-solving during class time. A flipped classroom is therefore structured around the idea that lecture or direct instruction is not the best use of class time instead students should encounter information before class, freeing class time for activities that involved higher order thinking. Flipped classroom model consists of two main components which include "out-of-class implementations and in-class active education activities", (Kara, 2016).

Flipped Classroom Model and Traditional

Flipped classroom practice is confused with online education, blended learning and distance education programmes (Hamdan Mcknight & Arfstrom, 2013). When evaluating in terms of the presence and interaction of the teacher and the learner in the same environment, the model closest to the flipped classroom practice is the blended learning models. Event though the blended learning also

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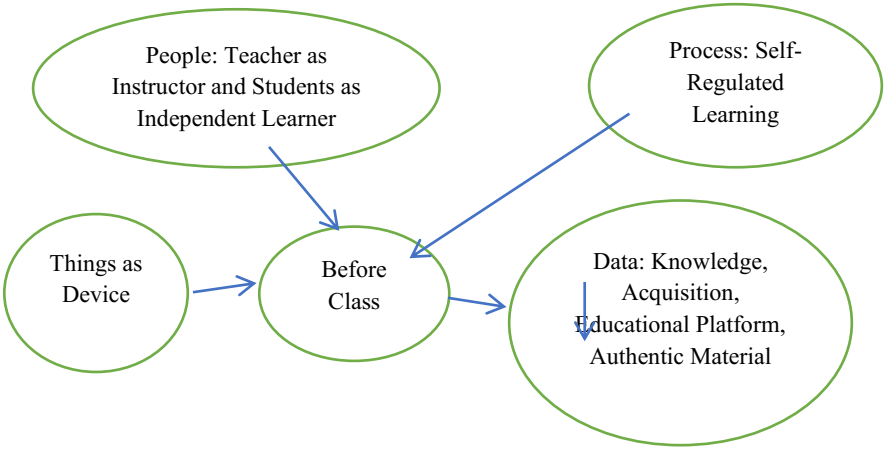
includes an online element, activities done using information technologies are mostly done in the classroom environment with the framework of teacher-student communication (Allen, Seaman & Garrett, 2017). In online education students and teachers are not in the same environment while in distance education, teacher-student interaction is very limited. In traditional classroom summarily, the teacher stands between the students and the knowledge. Flipped classroom model is a pedagogical model developed to utilize the time spent in the classroom in the most efficient way by using educational technologies.

Here, tasks such as acquiring knowledge are performed by students before they come to class. Hence more time is allocated for the in-class active learning activities (Rochl, Reddy & Shannon, 2013).



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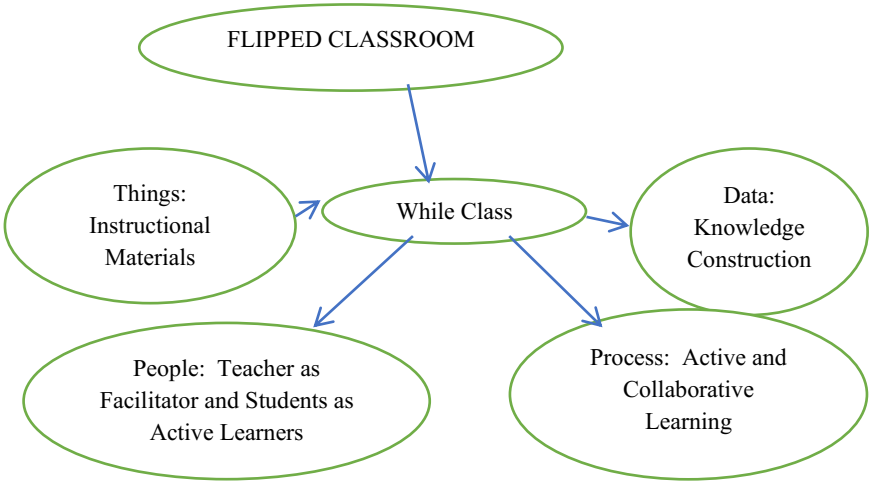

Figure 1: Conceptual Framework of Flipped Classroom

Figure 1 shows the conceptual framework of flipped classroom with active delivery of information before the class so that the students will have extra time to do activities in class. The teacher becomes the facilitator to guide the students rather than dispenser of knowledge while students become active learners rather than passive learners. This gives the students opportunity to learn independently and have extra time for activities in the class.

In traditional classroom, desks are arranged in rows with the teacher in front of the room lecturing about a topic such as Genetics, Evolution, photosynthesis etc. while some students take notes, some play on their phones while some may even doze off. The class is quiet as only the teacher's voice can be heard. Now compare this with the same biology class with students working in groups, having been assigned to either molecular structure of DNA or segregation of genes. The teacher goes about the room meeting with each group, offering probing questions and encouraging deeper thinking. Certainly, it is louder in this classroom and might seem to visitor a little chaotic but the students appear

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engaged and on problem – solving. This is flipped classroom and learning is taking place because here the students are having real conversation about the content and not listening passively to the lecture. They are engaging in higher-level thinking skills and processing the content at a more rigorous level.

In this engaging biology class, students had previously completed a lesson by watching a pre-recorded video and answering questions about the topic in genetics. This helped the prepared for the expectations of the next day's task-where they engage in deeper level discourse through the group activities. Hence many teachers have embraced true flipped learning lesson where at home learning aided by technology allows students engage more deeply in activities inside the classroom for a longer period of time.

The Flipped Learning Network

The Flipped Learning Network is the leading education organization in studying and providing resources about flipped learning. it explained the model as where the teacher initially deliver lesson content to their students out-of-class and students work independently to learn the content. They then come back to the class and engage in activities in which they creatively apply that new knowledge and often work in cooperative groups. This network even coined the acronym flip to outline, define and explain the four core pillars of true flipped learning thus;

F – Flexible Environment

The "F" in flip stands for flexible environment which refers to the obvious classroom space. In a flipped environment, classroom space is rearranged as needed and other spaces as computer laboratory, libraries, or outdoor area are used as needed. The flexibility of an at-home environment where students can use technology to learn important information on an upcoming lesson in order to prepare them for more rigorous activities is included. Flexible environment also

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refers to flexible timing for students to work at their own pace at home. Even the actual work done by the students is also flexible because their classroom tasks are hands-on, engaging and rigorous thereby encouraging them to apply their knowledge through high – level thinking.

In addition, assessments often take the form of a practical mastery task where they demonstrate their knowledge in a creative manner. This is in contrast with traditional classroom environment which typically involves a low level of rigor and do not require high level – thinking.

L – Learning Culture

The "L" in flip represents a learning culture. A true flipped learning experience offers a learner-centered classroom culture. Here, the teacher serves as a facilitator and providing feedback to students and guiding questions to encourage critical and deeper thinking as well as student engagement.

I – International Content

The "I" in FLIP stands for International Content: Content refers to content standard which the standards set by a state that describe the knowledge and skills students need to master. The teacher carefully analyzes content standards to determine what students are capable of learning independently, and what should be learnt in class through the application of that knowledge. He then plans for rich learning experiences to take place in-class to increase conceptual understanding and then work hard to ensure that out-of class lesson delivery, in-class activities, and assessment are all clearly aligned with the content standards.

P – Professional Educator

The "P" in FLIP represents a professional educator. A professional educator sets aside time to regularly reflect on his practices, and they seek constructive feedback from colleagues in order to improve their practice. They also accept that noise and movement are inevitable when students are frequently working

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cooperatively. This is in contrast with the traditional classroom teacher who does not make time for regular reflection of his practices. That teacher might have rigid classroom expectation, rarely give students a choice and often limit the level of instructions between students.

Students actually benefit academically from flipped learning by using the out-of-class time to learn the basic content knowledge, all of the in-class time dedicated to really applying that knowledge and engage with their peers through discussions to analyze and evaluate ideas, thereby solving challenging problems. Teachers are able to spend more time interacting with their students, helping them see connections to prior knowledge and encouraging critical thinking. This is so because the direct instruction piece has been taken out-of-class, thereby freeing up class time for more engaging activities.

Planning the Flipped Model

Utilization of information technologies for educational activities, in out-of-classroom settings and allocating more time in the classroom for activities, projects and experiments with the flipped classroom application is another important factor in terms of both interactive learning and effective use of materials (Kahramanoglu & Senel, 2018). However, it is critical to make good planning before the implementation of the model. Miller (2012) stated that there are five basic elements to be considered when planning flipped classroom model:

- **Why one should learn**: Learners should be told why they should learn this content and their willingness should be ensured;
- **Accommodation of the Models**: Learning effectiveness can be increased with conjoint implementation of the flipped classroom model with another model game-based learning, project – based learning etc.
- **Technology**: The technology to use with the flipped classroom model should be selected.

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- ❖ **Reflection**: It should be ensured that the learner shows the content they have learnt and their learning behaviours are seen perceptibly with the Flipped Classroom Model.
- ❖ **Time and Place**: It should be determined in what settings and how it will be implemented.

1) Implementing a Flipped Class in Biology

Professional educators need to be reflective and collaborative when implementing the flipped classroom model. There should be a coherent online lesson for the students to access in preparation for the in-class activities. A layout and sequence should include;

- Introduction to the topic
- Lesson map
- Lesson value, expectations and directions
- Learning objectives and outcomes
- New instructional materials and resources
- Incentive activity that prepares students for in-class activity

2) Review Students Work Prior to Class

The pre-class incentive activities can provide information about how to tailor the in-class activities to focus on the elements those students find challenging.

3) Establish your role as a teacher before heading into the classroom:

Think about moving your role from leading the discussion to letting your role from leading the discussion to letting your students take accountability for their learning and you become a guide, coach and facilitator. Ways of becoming more of a guide include;

- ❖ Walking around the classroom and observing

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discussions

- ❖ Ask questions to confirm students understanding and elicit more discussions
- ❖ Answer questions that students bring to the class or raised during the class
- ❖ Moderate a debate or facilitate a group discussion
- ❖ Challenge students individually and give room for brainstorming

4) Gather your Materials for Class:

Plan ahead for any technology or devices you need for the class. Use your checklist to gather all your materials and be sure to contact school media before the semester starts in order to get clickers, video conference requirements or other special classroom needs.

5) Start of Class

Take time at the beginning of class to answer any questions the students might have brought in preparation for class. Address areas students had the most trouble based on your review of their work.

6) Implementing your in-class Activity

Implement your in-class activity plan by providing students clear directions and access to the materials they need to complete the in-class activity. Keep a close eye on the time line you developed to keep students on task. Then end the class by communicating the next steps students need to take after class.

7) Implementing Post-Class Activity

Post class activity requires you to observe the directions for continuation of learning, extended learning activities that follow the in-class work and survey students motivation, confidence and emotion.

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8) Evaluate and Assess the Plan

Evaluate the effectiveness of the model from various perspectives after implementation. There should be a product which is representative of students work which can be used for evaluation and ensure conscious, secure, manageable and measurable IT utilization (Fatih Project, 2017).

Flipped Classroom Benefits for Teachers and Students

The benefits of flipped classroom approach are of the following advantages to both teachers and students;

- Teachers spend less time introducing new topics. Studies have shown that traditional teaching models allocate a large portion of time to the dissemination of information, which can often leave a very limited amount of time for deeper exploration and application of knowledge. In the flipped classroom the students received introductory information through self-study prior to class, allowing teachers, who are experts in their fields to spend less time covering the basics and more time exploring topics in far greater depth.
- Students develop independent learning skills: Independent learning is undoubtedly a valuable skill for any learning to develop, especially in senior secondary schools students. With the flipped classroom approach, students obtain the initial information independently at home, often through video content. This helps them to get used to the process of self-study and allows them to learn at their own pace. Nevertheless, teachers need to be aware that not all students take to the concept of self – study equally and active steps need to be taken to support those who struggle to meet up.

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- Teachers can create more engaging lessons: A variety of studies have demonstrated the importance of fun within education, and it can help to improve knowledge retention and recall. With the flipped classroom model, students attend each class with the basic information, meaning that there is more time to be dedicated to interactive learning, investigations, experimentation and practical application.
- Students who are absent do not fall behind: Absenteeism at a school level is common, yet the effect this can have is often over looked. While the flipped classroom cannot fully counter the problem of absenteeism, it can help to reduce learning gaps as introductory information will always be available online for students to catch up on their own time.
- Teachers can re-use the content they create: With the flipped classroom approach, teachers may wish to disseminate information through third party content. However, many teachers instead of creating their own videos, making the initial learning experience more personalized. This has the added benefits of being able to optimize and reuse content, enabling teachers to spend less time on lesson preparation for basic information and more time on tailored lessons for deeper exploration which requires critical thinking.
- Students are able to build a deeper understanding: Another major benefit for students when learning in a flipped classroom is the ability to build a deeper understanding of the topic at hand through active learning. This is in contrast with more passive learning experiences such as lectures, because students are actively involved in the construction of the knowledge they acquire.
- Students find classroom time more interesting: Finally, flipped classroom approach can help students find their time in the classroom more interesting. This in turn can assist with student's engagement, allowing them to become more emotionally invested in the subject while

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typically increasing overall class attendance too. This is because classroom time is spend on more meaningful discussions rather than simply listening to information from the teacher.

Conclusion

The flipped classroom model is gaining serious attention within schools, colleges and universities. Students take in information at home and then attend the classroom to put their knowledge into action. Essentially the various benefits of a flipped classroom approach extend not only to students but also to teachers. With students, this model can help them develop independent learning skills, build a deeper comprehension of topics in science and catch up more easily when they are absent. For teachers, the approach allows them to make better use of their expertise and skills by spending less time lecturing and more time helping to develop students' understanding.

We therefore recommend that there should be provision of hardware and softwares infrastructure for effect IT utilization in educational programmes and in service training for science teachers to manage educational e-content in their implementation of flipped classroom model in science instruction.

References

Allen, E., Seaman, J. & Garrett, R. (2017). Blending in the extent and promise of blended education in the United States.

Faith, Projesi (2017). Faith Projesi Websites, 19Haziran 2019 tarihinde.http;//fatihprojesi.meb.gov.tr/projehakk-inda/adresinden ahnmistir.

ISBN: 978-978-798-430-7

Findlay-Thompson, S., & Mombourquette, P. (2014). Evaluation of a flipped classroom in an undergraduate business course. Business education nd accreditation, 6, 63-71.

Flipped Learning Network (FLN), (2014). The four pillars of F-L-I-P.

Fuat, B. Fatihm S. (2021). Flipping the mathematics classroom affordances and motivating factors. The mathematics Educator, 17(1 & 2), 105 – 130.

Gliboy, M.B., Heinerichs, S. &Puzzaglia, G. (2015). Enhancing students engagement using the flipped classroom. Journal of nutrition education and behaviour, 47, 109 – 114.

Hamdan, N., Meknight, K. &Arfstrom, K. (2013). A review of flipped learning. George Mason Universities Pearson.

Kahramanoglu, R. &Senel, M. (2018). DisiplilerarasiEgitinArastirmalariDergisi Journal of Interdisciplinary Educational Research. 2(3), 28-37.

Kara, C.O. (2016)>TersYuzSinif. Tip EgitimDunyasi.Sayi 45.

Miller, A. (2014). Flipping for mastery, Educational Leadership, 17(4), 24 – 29.

Rochl, A. Reddy, S. L., & Shannon, G.J. (2013). The flipped classroom: An opportunity to engage millennial students through active learning. journal of family and consumer sciences, 105(2), 44.

Tomory, A., & Watson, S. L. (2015). Flipped classrooms for Advanced Science courses. Journal of science education and technology, 24(6), 875 – 887).

Ude, V.C. (2018). Promoting students engagement in biology laboratory through active learning. Emerging issues in science and vocational

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education department of science and vocational education. Godfrey Okoye University. 1, 42 – 48.

Yestrebsky, C.L. (2015). Flipping the classroom in a large chemistry class research university environment. Procedia-social and Behaivoural Sciences, 191, 1113 – 1118.

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8
APPLICATION OF NON-TEST TECHNIQUES IN EVALUATING STUDENTS' PERFORMANCE

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INTRODUCTION

The focus of this paper is on non-test techniques that can be used to assess or evaluate students' learning or performance. Teacher can evaluate students' performance using several techniques. But these techniques can be classified under test (cognitive domain) and non-test (non-cognitive domain). Tests and non-tests techniques are needed to assess students' performance. There are different types of tests, but the interest of this paper is on non-test techniques that can be used to evaluate students' performance in the classroom. Therefore, it is important to look at the meaning of the term 'technique.'

Understanding the Term Technique

The Britannica Dictionary (2023) defines technique as a way of doing something by using special knowledge or skill. Nasrudin (2019) defines technique as a method of doing a task or doing something. As a noun, it refers to the skill or way of performing a task with certain fundamentals of understanding. In applying these definitions to the topic under discussion, non- test techniques are those methods or tools that can be used by the teacher to assess students' learning progress and evaluate their learning outcomes. A technique could be considered as an implementation which takes place in a classroom. It is a method or tool used to accomplish an immediate objective. Students' progress in the three

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domains of learning (cognitive, affective and psychomotor) can be evaluated using different non-test techniques.

A test is a tool, technique, or method that is intended to measure students' knowledge or their ability to complete a task. In this sense, testing can be considered as a form of assessment (Rhalmi 2018). Testing, therefore, is one of the significant and most usable technique in any system of examination or evaluation. It envisages the use of instruments or tools for gathering information or data. In written examinations, question paper is one of the most potent tools employed for collecting and obtaining information about pupils' achievement. Testing as a technique required for evaluation processes.

What is Evaluation?

Evaluation is linked to measurement. While measurement looks at numbers and being able to quantify the performance or the abilities, evaluation assists with using the data and information to judge success or failure. Although, evaluation can take place without numerical measurement as it measures performance (Wither, 2018). Evaluation, therefore, is concerned about given value judgement. It uses methods and measures to judge student learning and understanding of what is taught for the purpose of grading and reporting.

The term evaluation means checking the 'value' of something or somebody. In education, evaluation is conducted to find out what worked, what did not work, what needs changing before you reiterate the course. Evaluation could be understood as the systematic process of collecting, analyzing and interpreting of information to determine the extent to which learners are achieving instructional objectives. Evaluation can also be the value judgement about a learner's level of performance by means of different assessment instruments (NTI, 2006).

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Evaluation uses the measurements gathered in assessments. For example, teachers use the information to judge the relationship between what was intended by the instruction and what was learned. They evaluate the information gathered to determine what students know and understand, how far they have progressed and how fast, and how their scores and progress compare to those of other students (online.stu.edu, 2018).

Fig. 1.1. imported image from info4mystery.com

The above representation shows us the interconnectivity between evaluation, assessment, measurement and test.

Evaluation can take different forms. It can be formative, summative, diagnostic, placement, impact, outcome, and process evaluation. Evaluation uses assessment data to make judgement on the student being assessed. As shown below in the assessment process, the results of assessment are used to make value judgement of the learning outcomes.

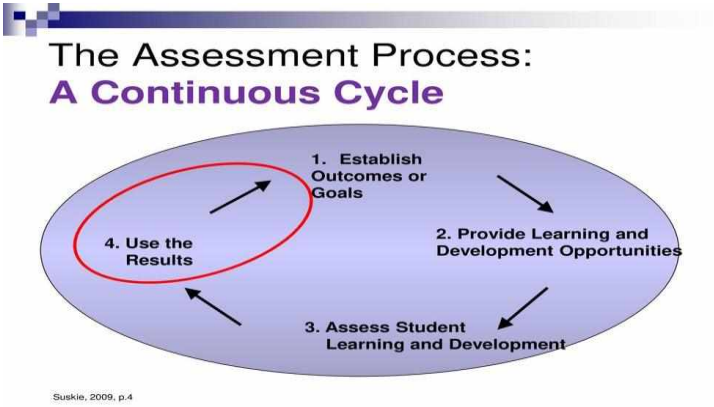

Fig. 1.2 The Assessment Process Cycle

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The role of evaluation is essential in teaching and learning. It is not only the knowledge of the student/learner that is being considered but rather all the aspects which are important for his /her developments are taken into consideration. Evaluation covers four different aspects; these include (Dishap 2022):

- Objectives
- Learning Experiences
- Learner's appraisal
- Relationship between the above three

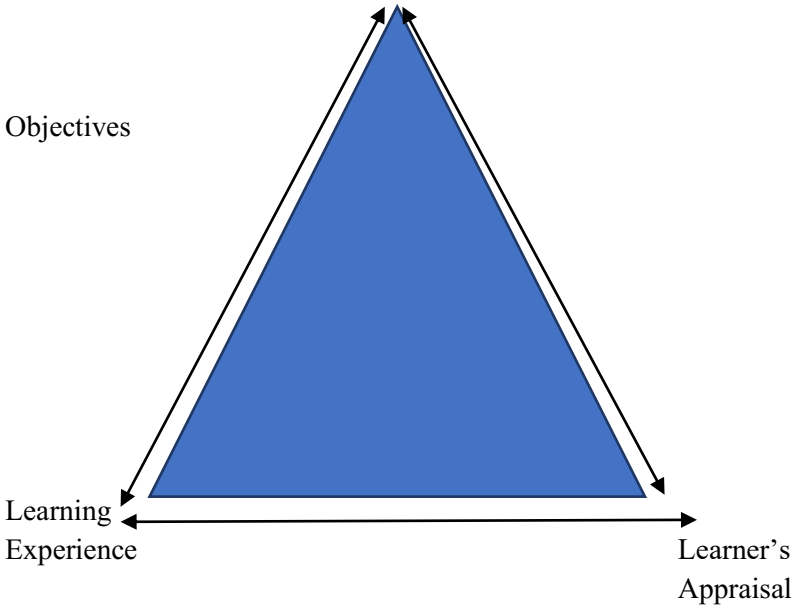

Fig. 1.3The role of evaluation

To accurately evaluate students' performance, certain techniques or instruments/tools/devices can be used to achieve a better result.

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The Meaning of Test

Test is a measuring instrument for knowledge, skills, feeling, intelligence or aptitude of any individual. It can be used to assess a testee's level of performance or achievement in order to find out what he/she has learnt and what he/she did not learn (Iketaku, 2013). Therefore, a test can be defined as an instrument, tool, or procedure that is used to obtain information about a particular outcome (Frey, 2018). Teachers assess students to discover how well they understand the information taught and to determine how much growth they are making in developing their academic skills. Testing is a common assessment technique, but it is far from the only assessment option at teacher's disposal. By assessing through alternative means, teachers can ensure that test anxiety or an inability to perform on tests do not lead to a misunderstanding of a student's abilities.

There are two alternative approaches to educational testing: (1) criterion-referenced test and (2) norm-referenced test. Criterion-referenced test is concerned with the performance of an individual in terms of what he/she can do or the behavior he/she can demonstrate. In this evaluation, there is a reference to a criterion but not to the performance of other individuals in the group. It is used to determine an individual's status with respect to a defined achievement domain. The aim of criterion-referenced evaluation or test is to assess the objectives. It is an objective based test, where objectives are assessed in terms of behavioural changes among the students. Therefore, this type of test assesses the ability of the learner in relation to the criterion behaviour (Dishap 2022).

On the other hand, norm-referenced test is the traditional class-based assignment of numerals to the attribute being measured. It means that the measurement act relates to some norm, group or a typical performance. It is about interpreting the test results in terms of the performance of a certain group. This group is a norm group because it serves as a referent of norm for making judgements. Here, test scores are not interpreted in terms of an individual (self-referenced), of a standard of performance or a pre-determined acceptable level of achievement called the criterion behavior (criterion-referenced). Instead the measurement is

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made in reference to a class or any other norm group. Examples of norm-referenced tests are classroom tests, public examinations and standardized tests (Dishap 2022).

Example of criterion-referenced test: Obi got 80 marks in a test of Biology.

Example of norm-referenced test: Obi stood first in Biology test in his class.

Test can be classified according to purpose, methods of interpretation of scores, quality, and level of performance.

Test can be classified according to purpose, methods of interpretation of scores, quality, and level of performance (Iketaku 2013).

Purpose/use	Methods of interpretation of scores	Quality	Level of performance
Formative test Placement test Diagnostic test Summative test	1.Norm-referenced test 2.Criterion-referenced test	1.Teacher-made test or classroom tests 2.Standardized tests	1.Maximum performance test: *i. General mental ability test* *ii. separate ability test* *iii. Achievement test* 2. Nature of administration *i. individual test* *ii. group test* 3. Nature of

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response:
i. verbal test
ii. non-verbal test

In the field of education, tests are instruments designed to measure cognitive abilities. According to Kurma (n.d.), tests are those tools and methods by which the measurement of mental abilities and educational achievement of the students is carried out. These tests have their own definite form. In the tests questions which are related to mental ability or educational achievement to be measured students are asked to reply or respond to related problems. The mental abilities and educational achievement of the students are measured based on these answers and responses. The main mental ability tests are— intelligence tests, aptitude tests and personality tests, and the main educational ability tests are achievement tests and diagnostic tests. Educational tests, therefore, "are those tools and methods of measurement of various abilities of the students in which related problems about measurable ability are asked and of which the students have to answer and related problems are presented to which the students have to respond" (Kurma n.d.).

Non-Test Instruments

Non-test instruments are those instruments used to measure the domains of educational level, especially the affective domain. Measurement in the affective domain can be qualitative (interviews, observation) or quantitative (Likert, semantic differential scale), projects, oral assessment and portfolio assessment. Non-test instruments or techniques for evaluating performance are discussed below:

1. **Self report**: This measurement tool is used in the affective domain. It requires an individual to provide an account of his/her attitude or feelings toward a concept or idea or people.

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2. Observational Technique

Observational technique is a process of looking out for and recording the presence or absence of verbal and non-verbal behaviours of students in a natural or simulated setting in order to make valid inferences of the students observed. In observing, attention is given to the overt behaviour of students (Oji 2003). Observation should follow an established plan or checklist organized around concrete, objective data. Observation needs to be tied to the objectives of the course. Oji (2003) noted that there are two types of observation: controlled (perceived) and actual (naturalistic) observation. In controlled observation, the observer records the impressions of behaviours that are assumed to have been demonstrated by the learners. While in actual observation, the observer records what he/she sees or hears within the stipulated period of observation. In either case, the observer may not be noticeable and yet records the typical behaviour of the learner. Oji (2003) also noted that observers must pay particular attention to:

- Careful observation of specific events
- Recording events as soon as the observation is made
- Organizing the data in a meaningful form
- Analyzing and interpreting the data.

Types of Observation, its settings and styles (imported from researchgate.net): According to Oji (2003), there are five types of observational tools, namely

(a) Systematic observation
(b) Rating scale
(c) Check list
(d) Anecdotal records
(e) Interview

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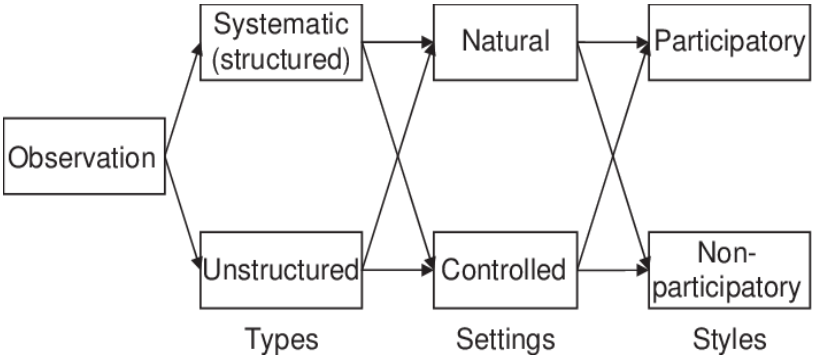

(a) Systematic Observation

In systematic observation, the behaviour of the students are recorded as soon as they are observed. The observer may decide which of the behaviour category he/she expects are to be exhibited by the students. For example, punctuality and regularity, student individual work, student group activity, carelessness, teaching facilitating learning. Forms used for recording should contain the following identification information (Oji 2003):

Observer's Name_____

Name of Student_____

Date _____ Time_____

Name of Teacher_____

Class _____ School _____

Title of Observation _____

_____

Behavior Category	***Specific Behaviour***	***Frequency of Behaviour***
A. Punctuality and regularity	1. Present before 7.00 am	

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	2. Present before 7.30am
	3. Present before 8.00am
	4. Absence in school
B. Student individual work	1. Ask questions
	2. writes assignments
	3. Observes events
	4. Manipulate data

(a) Rating Scale

Rating scale is used to indicate the status or quality of behaviour being assessed. It is organized to provide summary information of the behaviour of individuals or group (Oji, 2003). There are different types of rating scales such as numerical, graphical, comparative and ranking.

Numerical Rating Scale:

This contains value description of traits or behaviour.

Example:

5 = Excellent
4 = Very good
3 = Good
2 = Fair
1 = Poor

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The rating scale above is Likert type scale which can be reduced to several points depending on the opinion of the observer.

Below is an example of *Summated* or *Likert-type rating scale* which entails generating a list of statements about what is being measured and providing a set of graduated response options. There are variations of the Likert scale. There are also other rating scales like the *equal-appearing interval scale or the Thurstone scale,* and the *cumulative scale or Guttman scale* (Nworgu 2015).

5-point Likert scale:

Strongly Agreed = 5	SA = 1
Agreed = 4	A = 2
Undecided = 3	U = 3
Disagree = 3	D = 4
Strongly disagree = 1	SD = 5
For positively cued statement	For negatively cued statement

However, it is not a sound logic to label "undecided" with such numerical value, because undecided means having no opinion/attitude. Having no opinion cannot attract a score of 3 on a maximum value of 5. Therefore, to resolve this problem, "undecided" should be dropped. Undecided is equivalent to zero. Hence, a 4-point scale ranging from "strongly agree" to "strongly disagree" seems more appropriate (Nworgu 2015).

Modified Likert-type scale:

SA = 4	or	U = 0
A = 3		SD = 1
D = 2		D = 2
SD = 1		A = 3
		SA = 4

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Graphical Rating Scale:

Graphical rating scale describes behaviour and activity along a continuum the points along the continuum are described to aid rating. The scales could be horizontal or vertical and the line is not broken (Oji, 2003).

Example: how punctual is Obi to school?

Always on time	Frequently on time	Occasionally on time	Rarely on time	Never on time

Comparative Ratings:

In this type of rating scale, the behaviour being assessed is compared against an existing standard. This type of rating scale is preferable for activity centered behaviour rather than affective behaviours. The reason is that affective measures are difficult to obtain a model sample for matching (Oji, 2003).

Ranking:

In ranking method, behaviours are rated from highest behaviour performance to lowest occurrence or verse versa. It is a method used for rating individuals on the same set of traits.

Example of a ranking scale:

Rank your most favourite subject. Enter 1 through 5 to rank these features

Mathematics	
English	
Christian Religious Studies	
Economics	
Civic Education	

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(b) Checklist

Checklist consists of a prepared list of behaviour, traits or characteristics to be observed. Checklists are very useful in measuring complex behaviour that can be divided into more segments. When checklist is used to analyze behaviour, we mark the presence or absence of a trait by +1 or 0. Undesirable behaviour is scored -1. At the end of assessment, the individual score is summed up.

(c) Anecdotal Records

These records are continuous factual written descriptions of meaningful events in the behaviours of students as they occur at a given time, place and circumstance. They are continuous in the sense that sequential records are kept of the child's behaviour over relatively long periods of time such as a term, semester or academic session. The records are objective and are recorded as soon as they occur. In anecdotal records, interpretation and evaluation are kept separate from descriptions of the behaviour (Oji, 2003).

(d) Interview

Interviews are primarily done in qualitative research and occur when researchers ask one or more participants general, open-ended questions and record their answers. Audio tapes can be used to allow for more consistent transcription. The researcher transcribes and types the data into a computer file, in order to analyze it after interviewing. Interviews are particularly useful for uncovering the story behind a participant's experiences and pursuing in-depth information around a topic. Interviews may be useful to follow-up with individual respondents after questionnaires to further investigate their responses (Quad, 2016).

Interview is also a face-to-face meeting between the pupil/student and the teacher in which the child answers questions by the teacher. Interviews can be used to support written tests in the classroom. Interview as a tool for assessment

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gives the possibility of clarifying the questions or probing to get at the actual status of the child (Anigbo 2014).

The following according to Nworgu (2015) are the guidelines for conducting a good interview:

ii. *Rapport*: A good rapport must be established between the interviewer and the interviewee through a short conversation at the beginning of the interview. This will make the interviewee to relax and be open.

iii. *Avoidance of technical jargons*: the use of technical terms should be avoided but they are used, the interviewer should explain the meaning.

iv. *Context*: to avoid wrong interpretations of responses the interviewer should avoid asking e-contextualized questions.

v. *Probing questions*: it is advisable to probe further response given by the interviewee for more details, but this does not mean pressing on issues to avoid making your interviewee uncomfortable.

vi. Non-leading questions: avoid the use of leading questions.

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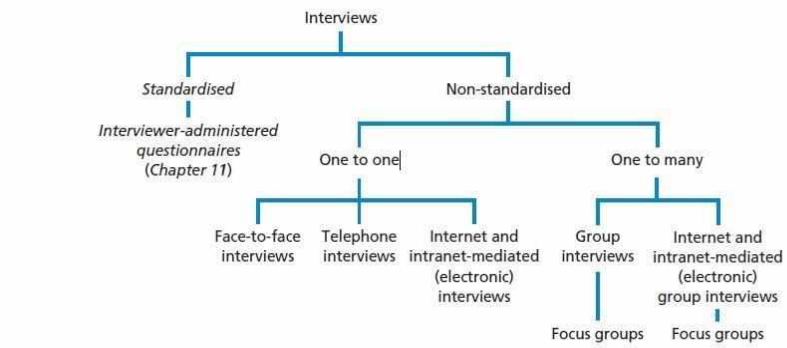
Forms of interview used in research purpose and strategy



Forms of interview. Source: Saunders, Lewis & Thornhill (2019).

Advantages of the interview technique

1. Interview technique provides a very useful and powerful means of collecting data
2. It provides flexibility or adaptability
3. It gives room for the collection of an in-dept data
4. The interviewee can seek and obtain clarification on any question that appears confusing as well as the interviewer because this helps to eliminate the possibility of misinterpretation.
5. The interviewer records the interview by himself/herself.
6. Extra information can be got during the interview (Nworgu, 2015).

Disadvantage of the interview technique:

1. It is time consuming
2. The validity of verbal responses collected during interview is questionable
3. Conducting an interview requires a lot of skill on the part of the researcher
4. Intra- and inter- interviewer variability can and do affect results of the interview

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5. Variations across different interview situations do affect the responses obtained. That is, the situations under which interview is being conducted can hardly be the same for any two persons (Nworgu, 2015).

Designing an interview format:

To design an interview, the planner must consider the format that is adequate for the type of research that is being carried out. The following are the interview format:

1. Formats in quantitative research:
   - Structured interview
   - Semi-structured interview
   - Unstructured interview
2. Formats in qualitative research:
   - Informational conversational interview
   - General interview guide approach
   - Standardized open-ended interview
3. Telephone interviewing

3. Socio-Metric Techniques

Socio-metric technique or test was first developed by J.L. Moreno and Hellen Jennings sometimes around 1960. It is a means of presenting simply and graphically the structure of social relations, lines of communication and the patterns of friendship, attractions and rejection that exist at a given time among members of a group (Kashyap, 2020). In education system, a teacher through this technique can measure students' social relationships that exist among them. There are students who always like to stay together, some students are more liked by all students, some students are not liked by anyone and so on. These social relationships existing among them influence all aspects of their development.

This socio-metric technique is a method of evaluating the social acceptance of individual students. It is grounded on individual student's choices of friendship for some group situations or activity. In this technique one can know which

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student would be congenial for a working group or companions for certain work (Kashyap 2020).

What are the essential features of socio-metric test?

(i) It is a simple and graphical presentation of data about the group.

(ii) It presents the structure of social relationship that exist among the members of the group.

(iii) It indicates the friendship pattern among group members.

(iv) It indicates the line of attraction and rejection among group members.

(v) It has always a time reference.

(vi) It indicates at the person most chosen as the leader and the person not chosen at all or the isolate (Kashyap 2020).

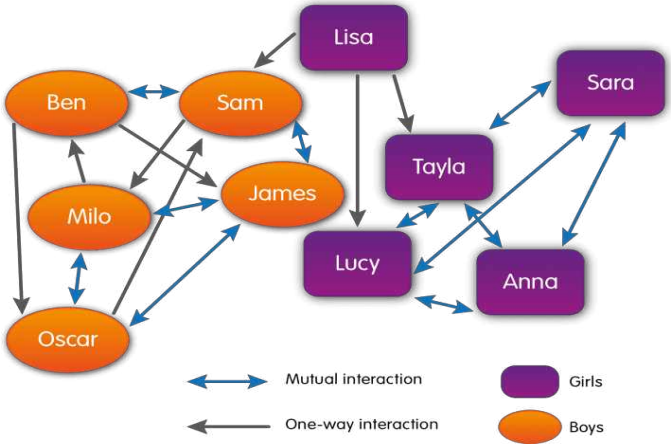

Fig. 4.1 A sociogram (*imported from 6seconds.com*)

The Techniques Followed:

i. If the group is large divide the group into smaller subgroups consisting of ten members each.

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ii. The members of each group or sub-group may be numbered from one to ten.

iii. Ask each member to write the name or the number of a student with whom he likes most to work, to play, or to sit etc.

Example of a sociogram describing choice patterns

The sociogram below describes how relationship in class can take place by examining the choice pattern (Oji 2003):

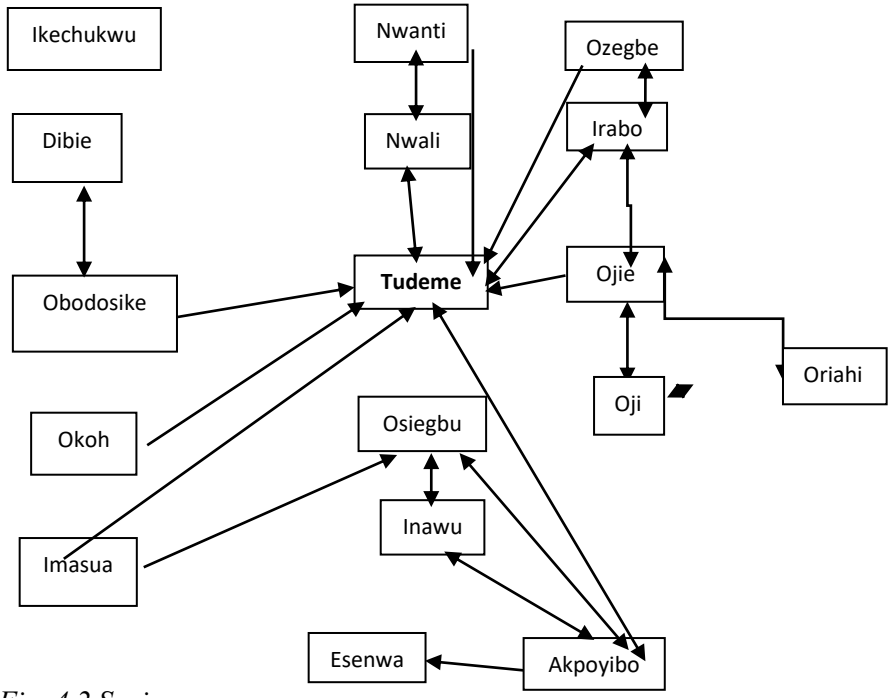

Fig. 4.2 Sociogram

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a). **Stars**: Stars are the most highly selected members of the group. In the fig. 4.2 of the sociogram, Tudeme is a Star, with 10 points. The next is Osiegbu with 4 points.

b). **Cleavage**: This is when two or more segments of a class fail to choose each other. It could be as a result of sex differences. Sex cleavage is majorly found in primary schools. In post primary and tertiary institutions cleavage can be based on race, religion or socio-economic status. As seen in the diagram, if Ojie, Ozegbe and Irabor had not chosen Tudeme, they would have formed cleavage with Oji, Elunwa and Oriahi.

c). **Cliques:** Cliques are students who will select each other and tend to avoid other members of the group. From the above diagram, Oji, Elunwa and Oriahi belong to a clique. In this type of relationship, the teacher should identify the leader to change the group structure and attitudes.

d). **Mutual Choices**: This is a selection of two individuals by each other. Dibie and Obodosike, Ojie and Irabor are mutual choices. In most cases, mutual choices or strong relationships are reciprocated friendship based on criteria of play, work or seating arrangements.

e). **Isolates**: Isolates are students that are not selected by any other member of the class. They are either new to the class or unpopular. However, if the number of choices increases the isolates may be chosen. In the sociogram above, Okoh, Imasua, Nwanti, Ozegbe and Ikechukwu are isolates.

f). **Rejectees**: Rejectees are different from isolates. To identify a rejectee, a teacher can ask members of the class to nominate students whom they actively reject, dislike, would prefer not to sit, work or play with.

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In view of the above description of choice patterns, sociometric data help the teacher in decision-making, organizing classroom groups and improving the social climate. Social climate in the class can be improved by breaking up cliques, helping isolates and rejectees become acceptable by their peers (Oji 2003).

Mehrens and Lehmann in Oji (2003) identified three teacher-made sociometric techniques – Peer appraisal method, "Guess who" techniques and nominating technique.

a. *Peer Appraisal Method*

This method is used to assess leadership ability, popularity and behaviour of students. In peer appraisal method, the members of the class are given a simplified rating scale. The traits to be rated by the students are decided by the teacher. The student doing the rating is requested to be anonymous and is assured that information given is confidential.

b. *"Guess who" technique*

In this technique, a student is given a list of description of traits and asked to name the members of the class who best fit each description. The description could be positive or negative and the students are asked to guess who the description refers to. They will write the name of the person who fits each description. Example: ……. is always friendly, happy and smiling

The teacher will score a positive role 1.0 point and a negative role -1.0. the sum of positive and negative is the student's score.

c. *Nominating Technique*

This is like "guess who" technique. the difference is that in nominating technique the teacher is interested in both the student who made the nomination and the student who was nominated. In this technique, students are asked to nominate the person they will like to sit by, work or play with.

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4. Projective Techniques

Projective technique is an unstructured task administered individually to a learner to assess his/her personality, needs, concern and motivation. It is designed to enable the learner to acquire specific skills or exhibit specific behaviour pattern. It is assumed that when learners are faced with ambiguous tasks, they tend to project their beliefs, attitudes and personality characteristics into these tasks. Projective techniques can be classified into five types (Oji, 2003): association, construction, completion, choice and expressive.

a. Association Technique

Association technique require the student to respond as quickly as possible to certain tasks such as words or pictures. Word-association test provides the student with a list of terms that are loaded with emotions. The test could be neutral, and the students are required to respond with the first word or the idea that comes to their mind. The teacher will record the time lapse to respond, the response itself and any evidence of hesitation and embarrassment. When it takes a student long time to respond, it shows there is inner turmoil. Administration, scoring and interpretation of association technique is complex (Oji, 2003).

b. *Construction Technique*

In this technique, the student is asked to tell a story demonstrating the scene after examining the picture. In this technique, time is not recorded but the respondent's theme and mode of responding are recorded. The student is instructed to construct a story indicating what is before, what is happening now and what will happen later. In this type of test, item could be a picture of a young boy and an old man placed together for the student to respond to. The construction technique responses are also complex to interpret (Oji, 2003).

c. *Completion Technique*

This technique comprises incomplete stories, cartoons or sentences that the students are required to complete (Oji, 2003). The responses are recorded for analysis and interpretation.

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d. *Choice Technique*

This technique provides the students with several options to select from or to rank. The students will rank set of pictures along a like/dislike dimension. This rank will show their personality (Oji, 2003).

e. *Expressive Technique*

This technique requires the student to play an active role in drawing, painting or expressing his/her personality. Expressive technique gives the student and the teacher or assessor relative freedom (Oji, 2003).

5. Oral Assessment Technique

In oral assessment, the teacher asks the student questions based on what he/she has learnt. This is done in the classroom during teaching and learning. The student may be asked to explain what he/she has understood from the lesson taught. Oral assessment technique helps the teacher to assess the extent of students' learning and performance.

6. **Portfolio**

Portfolio can be used to evaluate students' performance. Meador (2019) explains that portfolio is a collection of students' works that are associated with standards the students are required to learn. The teacher gathers it for a long period of time to reflect what they have been taught and what they have learned. Each piece in the portfolio is selected because it is an authentic representation of what they have learned. Also, it is meant to demonstrate the students' current knowledge and skills. Therefore, a portfolio by nature is a storybook capturing a student's progression of learning as they move through the year. There are different types of portfolios: ideal portfolio, showcase portfolio, documentation portfolio, evaluation portfolio and class portfolio. *Evaluation portfolio* can be used to evaluate students' performance and it is determined by the teacher or, in some cases, by the student. This portfolio is for grading students. The *class portfolio*

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(or classroom portfolio) contains student's grade, teacher's view and knowledge about students in the classroom (Birgin and Barki 2007).

Conclusion

In education, non-test techniques are important tools for evaluating students' learning process and performance. Non-tests techniques can be used to evaluate the three domains of learning (cognitive, affective and psychomotor). These non-tests techniques include self-report, observational techniques, interview, socio-metric techniques, projective techniques, oral assessment techniques and portfolio. Each of these techniques is unique and can be used to evaluate knowledge, skills, feeling, intelligence or aptitude of any individual.

References

Anigbo, L.C. (2014). Teachers' Handbook on Measurement andEvaluation. Enugu: Executive Press Resources.

ADJP Quad (2016). Research Tools: Interviews & Questionnaires.http//IIled500.trubox.ca

Bhandari, P. (2021). Questionnaire Design Methods, Question Types, Steps. scribber.com.

Birgin, O. I., &Baki, A. (2007). The Use of Portfolio to AssessStudents' Performance. *Turkish Science Education*, 4 (2), 75-90.

Dishap, M. (2022). Evaluation in Teaching and Learning Process | Education. **https://www.yourarticlelibrary.com**

Enyi, G.S. (2009). Introduction to Measurement and Evaluation in Universities, Polytechnics and Colleges of Education *(3rd edition*) Enugu: Linco Press.

WEBSITE: https://globaljournalhub.com
ISBN: 978-978-798-430-7

Kurma, D. (n.d) Test Construction. In Kulwinder, P. (ed.) Educational Measurement and Evaluation. New Delhi: USI Publications.

Kashyap, D. (2020). Socio-Metric Technique: Meaning, Uses and Limitations. https://www.yourarticlelibrary.com

McLeod, S. (2018). What is a Questionnaire? https://www.simplepsychology.org

Nworgu, B.G. (2015). Educational Research: Basic Issues and Methodology (*3rd edition*).Nsukka: University Trust Publishers.

National Teacher's Institute (2006). Manual for the re-training of Primary School Teachers on School Based Assessment. Kaduna: NTI Press.

Nasrudin, A. (2019). Technique. https://penpoin.com/technique

Oji, J.O. (2003).Educational Measurement and Evaluation. Benin-City: Ayo-Mat.

Rhalmi, M.(2018). Definition of testing, assessment, and evaluation. https://www.myenglishpages.com

Reddy C. (2013). Questionnaire: Types, Advantages and Disadvantages. http//www.content.wisestep.com

Schmitz, S. (2018). The SAGE Encyclopedia of Educational Research, Measurement, and Evaluation. Frey, B.B. (ed.) California: SAGE Publications, Inc.

ISBN: 978-978-798-430-7

Surbhi, S. (2021). Difference Between Measurement and Evaluation

Saunders, M., Lewis, P., &Thornhill, A. (2019). ResearchMethods for BusinessStudents, 5th Edition: Pearson.

Valenzuela, A., Gray, K., Airth, M. (2022). Achievement Test, Types & Examples. https://study.com

The Britannica Dictionary. (2023). Technique, definition and Meaning. In *EncyclopædiaBritannica, Inc.*https://www.britannica.com/dictionary/technique

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ISBN: 978-978-798-430-7

9
EVALUATION OF INSTRUCTIONAL MATERIALS

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Meaning/definition of instructional materials:

Traditionally, classroom teachers have relied heavily on oral teaching and the use of chalkboard method during their teaching. To help concretize teaching and enhance retention, the use of instructional materials became not only necessary but inevitable as instructional materials help to provide variations in the ways in which messages are sent across. Lewis (2018) views instructional materials as a collection of materials including animate and inanimate objects, human and non-human resources that a teacher may use in teaching and learning situations. In using instructional materials teachers and students do not only extend the range of sense organs we use but also extend the range of materials used for convening the same message through the same *organ.* For instance, in teaching a topic a teacher can manipulate real objects or use their stimulators. Instructional materials therefore constitute the media of exchange through which a message transaction is facilitated between a source and a receiver. In addition to extending the range of materials that can be used to convey the same instructional message to learners' instructional materials also facilitate the 'process' nature of communication. Here, the process nature of communication implies that both the source and the receiver of a message are actively involved in a communication encounter. Infact, it means that both the receiver and the source share and exchange ideas, feelings in any communication (Tyler, 2006).

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Ways instructional materials accentuate the process of communication

Instructional materials do so because they constitute tangible products, which can be used by learners thus reducing the abstract nature of teaching. During such usage, a learner interacts with the material. Such interaction may entail that a leaner manipulates the instructional material and expresses his/her views about the problem and idea encapsulated in the material. Then, any feedback obtained from such usage informs the teacher (which is the source) the extent to which a learner has attained an instructional objective. Besides, Nigeria is aware of the importance of instructional materials for effective communication in her school system. In 1975 for instance, the federal ministry of education organized an exhibition of improved instructional materials by classroom teachers all over the federation in four centers- Lagos, Ibadan, Kaduna and Enugu. During these exhibitions participants displayed various type of instructional materials, which they improvised to help learners concretive instruction in different subject areas. As for people that participated in this exhibition, they thought that a follow-up to these exhibitions could have been comp odium of all improvised instructional materials with a view to establishing infrastructure to encourage the mass production of suitable ones. Unfortunately, this follow-up was not encouraged. Despite, the federal ministry of education in keeping with its realization of the importance of instructional materials established a National Education Technology Center (NETC) in Kaduna. Also then, states ministries of education have also established units responsible for instructional materials many colleges of education, polytechnics and universities have set up Departments of Educational Technology, at training mechanics in the production and use of different software/hardware materials (Federal Republic of Nigeria, 2004). But despite these increased awareness on the part of educationists, an awareness that led to these establishments, I discovered

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Importance of instructional materials:

1. The essence of producing instructional materials, is to facilitate the teaching learning process. The essence is not to use such instructional materials as objects of decoration in our classroom or as objects to be presented during award wining national exhibitions on improved instructional materials. If the essence of producing instructional materials is to use such materials to facilitate teaching learning, it therefore seems logical that the best approach to adopt in any production exercise is to predict out production on research findings on how individuals learn. Besides, there are for instance, many factors that affect attention of human beings. There are also ideas about how we perceive objects. Hence, for a classroom teacher, who wants .to produce instructional materials, his production has to be on sound principles.
2. While presenting various learning theories, one has to be sure that a classroom teacher is guided by expert ideas during his production and utilization of instructional materials.
3. They supply a concrete basis for conceptional thinking and reduce meaning less work responses for pupils as it makes learning more permanent.
4. Instructional materials have a high degree of interest for the learner; for they offer a reality of experience, which stimulates self-activity on the part of pupils.
5. Instructional materials develop a continuity of thought, this is especially true of motion pictures, as they provide experiences not, easily obtained through other materials and contribute to the efficiency, department and variety of learning.

Therefore, the use of instructional materials in teaching/learning process exposes the learner to primary experiences and this enriches learning.

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IDENTIFYING AND EVALUATING INSTRUCTIONAL MATERIALS

Source: Jeani (2020)

Continuing with the backward design approach, once you have your outcomes and the assignments you'll use to assess those outcomes, you then need to look at the instructional materials you're providing your students to help them successfully complete your assignments. You may already have some of your materials identified such as textbooks, other books, articles, or online publisher materials/digital learning tools.

As you put together your instructional materials, if you're gathering materials that were not created by you or by the publisher of a text that your students have

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purchased, you should always verify the use and attribution requirements for those materials.

Evaluation Criteria for instructional material

As you evaluate instructional materials, the first things you normally consider are

- is it accurate?
- is it relevant? (Does it provide information that students need to complete your assignment?)
- is it understandable? (Is it at a level appropriate to your student's current understanding of the topic or concept?)

According to Jeani (2020), when evaluating instructional materials consider the extent to which each is **interesting, approachable, and engaging**. This isn't about materials being "entertaining." It's about whether it can **spark curiosity** and promote deeper thinking about the content. The more engaged students are with the materials you provide for learning, the more they will learn. To encourage engagement it is helpful to include a variety of types of materials in addition to text such as images, charts, diagrams, audio, video, or interactive activities. When you providing more than one way of learning a thing, it's more likely learners will find something that will engage them and help them learn. **Universal Design for Learning (UDL)** offers a robust framework for thinking about multiple means of representation as well as multiple means of expression and action.

There are some specific things to look for in both text and video materials that can increase the potential for engagement.

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Text-based Materials

As you look at text-based materials, there are a few things to consider.

- Are instructional materials with a teaching purpose (so not journal articles, primary sources, etc.) written in a **friendly and conversational tone**?
- Are materials written at an **appropriate reading level** for your students? Realize that this is going to be lower than your reading level so what sounds fine to you may leave your students struggling. If you aren't sure, you can run part of it through a **Readability Checker**.
- If it's a scanned document, is the quality of the scan good enough that it can be easily read? If it's skewed, blurry, or grainy it's best to go through the library and get a better version. If it's an article, it may be available through the library full-text databases.
- If it's a scanned document, is it actually made of text or is it **literally a photograph of the page**? If you click on the page and it turns blue, it's a photograph.

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- You'll also want to identify things in the material that need your explanation or commentary. If you normally talk through a resource in class, you'll need to provide that scaffolding to your students online.

Video Materials

Part of evaluating video materials is determining how much and what sort of video would be useful for your students. Here we are talking primarily about video that others have made. We'll look more specifically at video that you make later in this module.

If you want your students to be able to do something that someone can demonstrate, then video would be a very good option. If your content involves specific places or cultures, video can help to make them real to your students in ways that pictures and words on a page cannot. If parts of your content are especially challenging to your students, walking through these rough points with diagrams or a virtual whiteboard can provide clarification (Zhang, Zhou, Briggs & Nunamakar, 2006). If your students have difficulty engaging with the content, videos can offer a more approachable way in.

Considerations for Video

- **How well does the video align with your class?** Is it something that will directly help students reach a learning outcome or is interesting but not directly applicable.
- Is it **at the right level for your students?** Do they have the prerequisite background knowledge to get out what you want them to get out of it? Students will tune out if they don't understand what the speaker is talking about—especially if the video uses jargon, acronyms, and other technical terms the student doesn't know.

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- **How long is the video?** Research shows that people's attention begins to wander after a few minutes. Do your students really only need to watch part of the video? Identify that part and give them the beginning and ending times.
- **Does the video keep your attention?** If you dozed or multitasked while the video was playing, the odds are good your students will do the same.

GENERAL TECHNIQUES FOR EVALUATING LEARNING AND INSTRUCTIONAL MATERIALS

Introduction

Learning and instructional can be likened to two sides of a coin. One side is congruent with the other side. In a formalized system of education, the two variables are prominent and preeminent of other educational variables. The primary concern of an education industry is to produce learned people whose education and training will be useful for individual and societal development. In order to make this learning and instruction productive, instructional strategies must consider LIMS that may be at a teacher's disposal. These learning tools serve as support for knowledge acquisition. The quality and quantity of knowledge acquired by learners, *ceteris paribus,* have often been said to be highly consonantal with the quality and effectiveness of the instructional materials used. These LIMS fall under three major categories.

Taxonomy of Learning and Instructional Materials

For the purpose of convenience, one can define LIMS as all educational resources that serve as tools for knowledge transmission and acquisition in a formalized system of education. These tools or learning and instructional aids can be classified under the following categories.

Printed materials: These are the traditional tools of learning and instruction in formal educational systems. They are usually such professionally produced

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publications such as textbooks, workbooks, revision notes and exercises, educational journals, magazines, manuals and other periodicals. As a result of advanced technology, other materials have come under this category of printed materials. These later aids are photocopy, offset reproductions, easel sheets, photographic prints etc. All now play significant roles in the field of education and training.

Non-print materials: The adjective, non-print, is a misnomer here because LIMS often classified as non print actually contain in them, printed materials. In the field of educational technology, these non print materials are usually called software and hardware. This category of LIMS can further be classified into subgroups viz

(a) visual materials,

(b) audio materials

(c) audiovisual materials

(d) educational media hardware.

Each of these can also be subdivided into smaller classes. Whether or not a software is commercially prepared or locally produced by users, there is still need to be cautions of the way it is used. Its effectiveness in learning and instruction can only be well determined after it has gone through evaluative processes.

Community resources: Traditional bias for printed educational materials has made many educators unaware of the invaluable roles that community resources, if appropriately utilized can contribute to learning and instruction. These resources can be classified into two groups:

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(a) Educational visits or trips to places that can supply additional learning experience to that acquired under classroom environment. Community resources such as market places, religious instructions, historical settings, and amusement parks industrial concerns etc., all have specific roles that can play in education and training.

(b) Resource persons are often professionals and experts in their various fields of specialization. They may be legal practitioners, medical personnel, religious leaders, business entrepreneurs who are capable of enlightening students on specific learning experiences. Not until recently, many education industries were not conscious of the significant contributions that resource persons bring to education.

LEARNING AND INSTRUCTIONAL MATERIALS SELECTION AND UTILIZATION

The concept of LIMS selection has now become a household cliché in die field of educational communications technology. The concept refer to the modality for choosing an educational material for learning or teaching a specific topic. Be it a textbook, a video- disc or tape, there is need to appropriately select the material to be able to serve its intended purpose. Then a teacher is selecting an educational medium as an instructional aid to his teaching, it is pertinent to consider the pros and cons of making such a selection decision. This can only be achieved after a careful consideration of his instructional objectives. Before he finally selects one educational materials for teaching a curricular unit, he must be capable of effectively evaluating such an educational medium.

An Evaluation Process

Abolade (1998) notes that in the process of evaluation, four basic questions need to be asked on:

i. The concept of evaluation

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ii. Why is it carried out
iii. How it is done.
iv. When it is conducted particularly with regards to educational media utilization.

Simply put, evaluation is an appraisal of the intrinsic worth of object. It is making value judgments about the quality and usefulness of an object. In Jones' view in 1974, "An Evaluation is the carefully considered opinion of a qualified group or committee, as to the scope, usefulness, and quality of a given (educational material) the evaluation should state what the (educational material) is about, who could use it, for what purpose, and should give the evaluator's opinion of the value of the educational material..." (p.5). In evaluating an educational material, one is attempting to determine if there is any need to use that teaming and instructional material. One is also trying to determine, after it has been used, how effective the instructional material is vis-à-vis the curricula unit for which it has been used. Professionals in an educational industry must possess certain basic skills and know the techniques and procedures for evaluating a material. Failure to have these basic competencies may lead to a situation where one is prescribing vitamin B complex to cure a curricular epilepsy.

Techniques and Procedures for Evaluating LIMS

There are probably as many evaluative considerations to take note of as there are many educational materials. According to Abolade (1998), the under listed considerations are some basic generic needs to be satisfied before one can make useful decisions on educational material selection. Though they are in exhaustive, they constitute the basic minimal guidelines for educational materials evaluation.

1. **Subject Content Criteria**

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The subject content is the learning experience that a teacher or a curriculum developer wants the learner to experience or acquire. The subject content may be broad based or inelastic. For example, the subject content may be as broad-based as biology for secondary schools students or as inelastic as the digestive system of a reptile. A teacher who wants to use an instructional material must be able to determine whether or not such an educational medium is suitable for the topic to be taught. The LIMs, be they textbooks, a chapter in it, a slide or a video tape, a diorama or any other material, it is important that a teacher knows how to relate the material selected to the intended learning objectives. In his attempt to select a material for instruction, he must try to find answers to the following pertinent questions:

i. Is this material usable in direct relationship to a teaching point, to a curricular unit, to a specific learning experience or problem solving activity?
ii. Does the LIM contribute meaningful content to the topic or learning experience under study?
iii. In other words, it is important to assess carefully if the content to be communicated to the learners by the instructional material is useful and important to the users. It is possible for an educational material to be well prepared and yet unsuitable for that particular purpose simply because the material has failed to demonstrate any relationship between the instructional objective and the capability of the educational material. It is possible for a teacher or a learner to have, at his disposal, an excellently prepared television programme or a text written to serve a purpose, but the material may not be useful to a learning task desired. In considering whether an educational material should be used or not, the teacher must evaluate it in terms of the relationship of the specific materials to the specific curricular unit or learning task.

What is the degree of the relationship between the curricular content of the instructional material and the subject matter to be learnt? Here

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questions of appropriateness of educational material is crucial. The user must ensure that the content of the software matches the content of the topic the curriculum.

iv. Is the content of the material sufficiently rich in number of examples to warrant sound conclusions? That is, are both sides of an issue explored if not, is it insufficiently pointed out?

v. If the item duplicates content in material already owned, is it sufficiently superior to warrant supplanting the older item? These are a few of the gamut of questions to be posed and answered before a final decision is made on the selection and utilization of a LIM.

Utilization Criteria: One of the basic considerations here is to be able to evaluate an educational material and be able to determine if the material is good as a learning device, or an instructional apparatus or for both. The evaluation procedures come under three domains: viz

a) before the material is used
b) after the material has been used and
c) During the period of its utilization.

Evaluation of an educational material before utilization gives the teacher the opportunity to find out whether or not that particular medium is suitable for what he wants to teach. Since LIMS are not by themselves self-sufficient, it is necessary for one to know that a critical evaluation of the material is necessary. Unfortunately, many teachers are not aware of this important consideration. In selecting a textbook or a video tape to enhance instruction or learning, it is significant to know how to evaluate its suitability. Evaluation of an educational material is also important even during the process of utilizing that material. The material which appears appropriate through me subjective evaluation of the teacher may prove difficult for students after a few weeks of using it. Evaluation must not stop at the pre-utilisation and during utilization levels. It must also be

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conducted after it has been used. One of the mistakes that we make in our ministries of education and in our secondary schools is lack of CONSISTENT evaluation of the educational materials that we use to teach the children. Once the list of books has been recommended by the school, we seldom do year to year evaluation of the suitability of the material. As Erickson (1968) has rightly point out: systematic evaluation is important because of the tendency to lose sight of important long range goals in the presence of day-to-day problems. When a plan for making appraisals and his colleagues, a number of significant benefits are likely to result that are worth the time and effort involved (p. 599).

FACTORS THAT INFLUENCE THE SELECTION OF MEDIA RESOURCES

A number of factors have been found directly responsible for the selection of particular educational media resources for classroom lesson delivery. The resources must be selected in such a way that they must be relevant in order to facilitate for any particular lesson.

(1) **Choice of a Particular Instructional Method:** The teacher will carefully select the appropriate instructional method for the lesson topic. For example if the teacher is to use the discussion method, he must select the media resources that will enable the learners get feedback and make responses. Such resources may include overhead projectors and well prepared transparencies, slide projectors, and slides and even filmstrip projector and filmstrips. Any of these resources will enable the teacher present his information to both small and even large audience. The teacher can also control the resources at interval to emphasize his points, and also enable the learners make responses by asking questions and making their contributions.

(2) **The Type of Learning Task that Face the Students:** The ideals that are to be emphasized in any lesson determined the instructional method to be used. In a class where the teacher is emphasizing the acquisition of relevant teaching

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skills, then micro teaching theory and practicum will be employed. The use of video tape recorder and television monitors will be essential when the student teachers would have been taught the teaching skills; they will then practice in the micro-teaching laboratories which are already fitted with the necessary gadgets. This means that the student's performance can be relayed in a playback to enable him evaluate himself for necessary correction.

(3) **Learner Characteristics:** The three major constituents in any successful teaching-learning process include the teacher, the learner and the subject matter. In the absence of the learner, learning cannot take place. Amongst the various groups of learners are the fast learners, slow learners and the moderate learners.

The slow learners will not benefit if only the printed materials and conventional teaching methods are used in teaching. There is need to combine the printed materials with corresponding visual materials. No matter the size of the audience, weather large or small, they will gain maximally from the use of projected aids. On the other hand, the use of non-projected aids such as chalk board, flipcharts, or mounted displays cannot benefit any large audience.

(4) **The Visibility of the Material:** The materials should be used in such a manner that the learners will be seeing it without difficulty. They need not strain their eyes before they could isolate or identify relevant information in any material e.g chart, map, model or even flat picture. Every chart or diagram must have bold labeling and distinctive colours. For example it is a better to select charts that bold labeling and distinctive colours. For example it is better to select charts that have white background because it can accommodate all the primary colours.

(5) **The Audibility of the Material:** Any audio material that is to be used must be easily heard by all learners in the class without straining their eyes. Recorded programmes, weather audio or video programmes must be made in

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such a way that as much less noise as possible will be accommodated while recording. The sound output need to be distinct and clear.

(6) **The Attractiveness of the Material:** Materials for lesson deliver must be as attractive as possible to the target audience; Onyemezi (1990) as cited by Akude 2004 pointed out diagram with too many irrelevant details may not suit a particular group while the same material maybe seriously needed by an older learning group. Therefore a well-drawn and neatly labeled diagram will be more attractive, thus helping to stimulate and sustain pupil interest in the lesson.

(7) **The Relevance of the Materials:** There must be a close relationship between the subject matter, the lesson objectives and the media resources selected. The essence of the materials is to promote and stimulate learning in such a way that there shall be changes in the learner's behaviours and also that the media resources must be relevant to the topic of the lesson being taught.

(8) **Availability of the Material:** This involves the physical availability of the material and its affordability in terms of cost. It is necessary that a teacher should select materials that are easily at his reach. The materials could be located easily and their prizes moderate. Also the availability of their spare parts needs to be considered because it will help in their prizes moderate. Also the availability of their spare parts needs to be considered because it will help in their efficient maintenance and repairs for example a teacher should not select any of the projected aids when his school does not have electricity or local generating set. He shall therefore resort to cheap and improvised materials that are equally relevant.

(9) **Acquisition of Manipulative skills by the Teacher**: The teacher should select only the materials he can operate very well. As the teacher uses the materials in the class, he needs to exercise some measure of confidence in his

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ability to operate the gadget. The lesson can be boring and uninteresting if the teacher fails to operate the equipment successfully in the class.

(10) **The Durability of the Materials:** The materials to be selected for use must be such that are durable and can survive the wear and tear of frequent uses. The teacher should also make sure that there are appropriate means of preserving them. The teacher should also supervise the handling of the materials by both students and other teachers.

(11) **School Environment:** The size of the classroom and even the entire school environment determine greatly the type of resources to be used when the classroom are small in size, there may not be need for the projection of the aids charts, models, diagrams and flat pictures maybe more appropriate in a school that has no electricity may resort to the use of non-projected aids.

SELECTION AND UTILIZATION OF MEDIA IN TEACHING AND LEARNING

A particular media resource material maybe considered valuable and therefore recommended for use, if it satisfies the following conditions:

i. It must be readily available for and or return without much difficulty encountered before securing it for use. If a material is borrowed it must carefully handled with care and returned unfailing on the due date.
ii. Media material planned for use must be relevant, appropriate and related to the objectives of instruction for which the media material was chosen in the first place. Once there is possibility of instruction and the selected media materials for teaching, it is hardly to be expected that the objectives of instruction will attained in this way.

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iii. Cost of producing and using the media material will be measurable for the cost benefit from doing so. It will also guide the selection of an instructional material for teaching.

iv. Another set of selection criteria are the mental, age, interest, needs, abilities, and aspirations of pupils, who particular media material is meant for. If the materials are beyond their mental grasp, is not what they think they need, such material should not be selected for use in teaching the pupils.

v. The quality of instructional materials should guide its selection. Poor quality materials should be avoided in preference to high quality (fidelity, sharpness, of pictures, clarity of language etc) materials.

vi. Municipal facilities such as electricity, gas water, etc affect some weather materials which could be used. If needed support service is not available eg electricity, media materials, which require such services for operation should be avoided.

vii. The teacher must be sure that he can use a particular media material before selecting it for use. Better still, he may need to try it out to ensure that it works so that if it where faulty and failed to work to avoid embarrassing situation.

In conclusion the teacher has a major role to play in the selection exercise. He should therefore be familiar with the subject matter, the learners and their characteristics and the range of educational media resources available. He then can be in a better position to make effective selection of relevant resources for particular lesson topics and particular learners in a particular learning environment.

UTILIZATION OF EDUCATIONAL MEDIA RESOURCES

Educational media resources are used exclusively to enhance or enrich the teacher's presentation. Effective use of the relevant media resources will promote

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and stimulate learning by involving major part of the learner's sense thereby resulting to describable change in behaviour.

Brown, Lewis and Harderoad as cited by Akude (2004) designed a basic utilization plan consisting of five types they are:-

(1) Prepare Yourself: The teacher should study closely the materials he is to use before going to the classroom, e.g in the case of slides film strips or motion pictures, the teacher must preview the particular media resources, identify very relevant area for emphasis. The teacher should also design comments and questions to accompany the film or set of pictures serially. The teacher should also practice the use of a particular item. This will enable him perform maximally while delivering the lesson. Having watched the film or studied the material very closely, the teachers need to get himself ready to entertain questions from the learners.

(2) Prepare the Environment: The teacher should get the classroom ready for the use of any item. Then any projected aid or the public address system is to be used, effort should be made to see that the wall sockets in the projection room or classroom are all in good working condition, the equipment should be well set up and kept ready for use. The teacher should check to see that the particular equipment is functioning very well.

(3) Prepare the Class: The teacher should introduce the item and emphasize the great benefit of using it in that lesson. Endeavour to inform the students of what they are expected to do after using the aid. They may be expected to write a test or even engage in discussions or brainstorming exercises. Having got the students ready, the use of the media resource will likely create a stimulating learning environment. It will also help them to critically identify important facts or points as contained in the text.

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(4) Using the Item: In the case of projected aids, the teacher should switch on the gadget. He should make sure one that the images are well focused on the display screen. The volume should be adjusted in such a way that it does not constitute noise in itself in the case of an over head projector, the teacher should face the audience, use a pointer on the transparency use and progressive disclosure method where necessary.

(5) Follow-up: After the use of the gadget, the teacher need to engage the students in exhaustive discussions, probing questioning or even written test so as to emphasize the salient points. The students may be asked to dramatize the acquisition of the skill gained. The responses of the learner will reveal, the extent to which they have mastered the skills or even the value of the experiences into which they were exposed.

However, a number of guidelines have been suggested by different educators for the effective utilization of the media resources in the classroom. Some of the guidelines include:-

(1) Effectiveness: It is important that a teacher should always make provision for when and how to use the resources during lesson planning. While drawing a lesson plan, the teacher is advised to state clearly at which stage of the lesson each material would be used. It means that the use of a particular media resource should be matched with certain stages in the content development of the lesson. The reason is that certain gadget or items are better used in teaching certain facts.

(2) Educability of the Item: The teacher must make sure that the set objectives of the lesson are being achieved with the use of the media resource. The resources must be capable of passing on necessary information to the learners.

(3) The use of the Resources should be Systematic: The actual use of the media resources should be orderly and systematic. There are three major stages that must be followed.

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The teacher should check the adequacy of the equipment. He should design anticipated questions and their corresponding answers.

The second is the implementation stage where the material is used to illustrate, explain or even clarify concepts, theories and principals.

The third and the last stage involve the proper review of the whole instructional exercise. The adequacy and the relevance of the media resources are fully evaluated to determine the extent to which they have helped to achieve the set objectives.

(4) Purposeful: The teacher must ensure that the materials are used to clarify and explain concepts or facts or ideals and that their use must enrich the learning of the lesson. The adequacy of the material is to the extent that the learners should find them useful for comprehending their lessons.

(5) The environment where the actual teaching takes place is of significance in any teaching process. So, the nature of preparation for the environment will depend upon the particular media resource that is to be used. If projected aids (slides filmstrips motion pictures) are to be used, then the classroom curtains maybe spread out to darken the environment. This is because picture- :r images whether from motion pictures or still ones are usually clearer and sharper in darkened environment.

(6) Preparing the Learners: The teachers must endeavour to give a run down of the formation that is to be conveyed with the use of any resource. Such an exercise will help the learners to have a good grasp of the entire knowledge being sought. For example while using video cassette (motion film) in teaching a topic in biology such as "germination", the learners will be advised on certain key issues to look out for.

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Also in the teaching of English language where emphasis is on vocabulary building the teacher may use a collection of related pictures on charts where existing facts can be put into sentences etc by making sentences to explain different pictures scenes or illustrations in charts. The learners would have been acquiring the skill of vocabulary.

References

Abolade, A. O. (1998). General techniques for evaluating Learning and Instructional. *Ilorin Journal of Education* 18, 7-13

Akude, I. (2004). A Handbook of Educational Technology. Owerri: Bomaway publishers.

Ebuoh, M. M. (2015). Educational Technology for tertiary institutions. *Celex Printers.* Enugu.

Erickson, C. W. H. (1968). Administering instructional media programs Mcmilian, New York

Federal Republic of Nigeria (2004). *National Policy on Education,* Lagos/Abuja, NERDC.

Jeani Y. (2020) Outline Course Development Basics. *Trustees of Indiana University*.iu.pressbooks.pub/online2020/front-matter/introduction.

Lewis, B. (2018). TLM or Teaching Learning Materials Definition. ThoughtCo

Onyejemezi, D.A (1988) *Media in educational;* Ile-lfe, University of Ife Press.

Tyler, R. W. (2006). Basic Principles of curriculum and instruction. 7th Edition

Zhang, D., Zhou, L., Briggs, R. O. &Nunamaker, J. F. (2006). Instructional video in e-learning: Assessing the impact of interactive video on learning effectiveness. *Information & Management,* 43, 15-47

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ISBN: 978-978-798-430-7

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APPLICATION OF COMPUTER AUDIO ANIMATION IN TEACHING AND LEARNING OF ENGLISH LANGUAGE AT BASIC EDUCATION LEVEL: LITERACY IN FOCUS

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INTRODUCTION

The rest of the educational system is built upon the basic level, basic education is the key to the success or failure of the whole educational system. According to Federal Republic of Nigeria, FRN (2013), the goals of basic education are to;

i. inculcate permanent literacy and numeracy and ability to communicate effectively
ii. lay a sound basis for scientific and reflective thinking
iii. give citizenship education as a basis for effective participation in and contribution to the life of the society
iv. mould the character and development of sound attitude and morals in the child
v. develop in the child the ability to adapt to the child's changing environment

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vi. give the child opportunities for developing manipulative skills that will enable the child function effectively in the society within the limits of the child's capacity
vii. provide the child with basic tools for further educational advancement, including preparation for trades and crafts of the locality

Unarguably, these goals of Basic Education are laudable. Baraje (2015) stated that the goals of Basic Education cannot be attained without effective communication skills. Communication skills according to Baraje are instruments of thought which binds human society together in communities and linguistic groups. Official communication in Nigeria is hinged on English Language. English language in Nigeria performs many roles including but not limited to use in official government affairs, media, politics, social interactions, business, religion, law and legal documents, to mention but a few. Interestingly, FRN (2013) in the National Policy on Education recommended that language of instruction at lower basic education should be the language of the learners' immediate environment while use of English as language of instruction starts from the basic education level. Thus, from Basic Education level, English language is taught as a subject while it also functions as official language of instruction and language of educational evaluations. English language is also compulsory throughout Nigeria's educational levels. At least a credit pass in English language is a prerequisite for admission to study any course in any tertiary institution in Nigeria.

Consequently, proficiency in English language is very vital for both teachers and learners. It is therefore worthwhile to conduct a study such as this work, aimed at contributing to the improvement of teaching and learning of English language at Basic Education level. On the improvement of teaching and learning of English language at Basic Education level, Idogu (2017) hinted that, the most important

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aspect of English language needed at the Basic Education level is literacy. Idogu argued that Federal Republic of Nigeria showed the importance of literacy by placing the first goal of Basic Education as "inculcation of permanent literacy …. and ability to communicate effectively". Hence, inculcation of literacy ranks highest in the list of the goals of Basic Education in Nigeria. Nnamani (2018) submitted that, with permanent literacy in place, every other skill needed at Basic education can be harvested and harnessed. Perhaps, this may be the reason for introduction of literacy in basic education levels.

Literacy at basic education level, according to Akpan (2014) is the ability to read, write, handle information, express ideas and opinions, make decisions and solve problems in English language. This was the focus of this paper. George (2016) averred that teaching literacy to basic education pupils involves equipping them to communicate clearly and effectively and form the foundation for progress in the educational system. George further alleged that pupils that can't read effectively fail to grasp important concepts, score poorly on tests and ultimately, fail to meet educational milestones. Literacy skills allow pupils to seek out information, explore subjects in-depth and gain a deeper understanding of the world around them. Natshi (2016) observed that, when basic education pupils cannot read and write well, they may likely become discouraged and frustrated in school, resulting in increase school dropouts, poor performance on standardized tests, increased truancy and other negative reactions. All of these can have major and long-lasting repercussions. Ajom (2019) submitted that through innovative strategies, the teacher can contribute meaningfully towards helping literacy learners to be active in class, get engaged and develop such interest that can improve their achievement in literacy. This is why it is so important to think about the strategies of teaching literacy skills in classroom.

Unfortunately, many studies on Nigerian pupil's interest in literacy have yielded unsatisfactory results. Research evidence such as Olayinka (2015), Otobo (2018)

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and Olugu (2019) in their separate works reported poor interest and very low achievement in literacy among basic education pupils in Nigeria. Specifically, Agu (2016) hinted that greater percentage of basic education pupils could not comprehend literacy content they were taught, hence, they relied on their teachers to read question papers for them before they could attempt answering them. Olayinka (2015) found that many basic education pupils lacked interest in literacy and could not understand the contents of examination questions. Olugu (2019) also found poor interest and low achievement in literacy among basic education pupils. Olugu did not stop at the findings but went ahead to proffer possible solutions.

According to Olugu, a major cause of basic education pupils' poor interest and low achievement in literacy is teachers' non application of appropriate technologies for demonstrations and illustration of literacy concepts. Ramsey (2020) corroborated Olugus' views and found that the most appropriate technology for demonstration and illustration of literacy at basic education level could be computer based media such as the computer audio animation. It is based on this recommendation that this paper expounds the application of Computer Audio Animation in Teaching and Learning of Literacy at Basic Education Level. This is done with a view to define and explain related concepts, establishing the relationship among those concepts and Basic Education leaners' interest and performance in literacy. The next section addresses the teaching and learning of English language

Teaching and Learning of English language

English language is one of the world's commonly used languages. Historically, English language originated from England. George (2016) averred that English language is a West Germanic language of the Indo-European language family

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that is closely related to the Frisian, German, and Dutch (in Belgium called Flemish) languages. English language is the language of the United Kingdom and the dominant language of the United States of America, Canada, Australia, Ireland, New Zealand and various island nations in the Caribbean sea and the pacific ocean, (Julius, 2015). Julius further stated that English language is also an official language of India, the Philippines, Singapore, and many countries in sub-Saharan Africa, including South Africa and Nigeria. Natshi (2016) hinted that English language is the first choice of foreign languages in most other countries of the world, and it is that status that has given it the position of a global lingua franca. As a member of the Indo-European family of languages, English language is related to most other language spoken in Europe and western Asia from Iceland to India. This fact may have informed the claim of Natshi (2016) who estimated that a third of the world's population speak and use English language. In Nigeria, English language serves as the national language, that is, official language or lingua franca. It also serves as the language of instruction across all levels of the Nigerian educational system beginning from Basic education Level. Specifically, the use of English language as language of instruction starts from Basic education (Primary 4). At this level, English language is taught as a subject and also used to teach all other subjects.

Teaching and learning of English language therefore are a very important issue in the Nigerian Basic education sector. Teaching and learning of English language no doubt, is both exciting and tasking. Buckie (2016) enumerated broad topics that characterize the teaching and learning of modern English language in schools. Included in Buckie's list were phonology, morphology, composition, syntax and orthography. Phonology refers to the study of the way sounds function in English language, including phonemes, syllable structure, stress, accent, intonation and which sounds are distinctive units within the language. In English language, phonology refers to the way sound function within the language. According to Ferdinand (2017) phonology at Basic Education level has

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to do with pronunciation and listening. Ferdinand defined pronunciation as the standard way in which a word is made to sound when spoken. While listening refers to paying attention to a sound, or taking note of, hearing, harkening or giving ear to sounds.

Evidently, pronunciation and listening are major components of teaching and learning of languages in general and English language in particular. Interestingly, pronunciation and listening are among the literacy topics treated in this paper. El-Amin (2017) recommended that English language teachers at primary school level should emphasize pronunciation and listening skills because the two can hardly be separated. El-Amin argued that while pronunciation skills aid spoken English in standard sounds, listening skills must be in place so that learners can hear, harken, heed and pay attention to the sounds the teacher makes while pronouncing. This justifies the focus of this paper on literacy topics such as pronunciation skills and listening skills. Agada (2018) described English language morphology as the study of the internal structure of morphemes (words and their semantic building blocks) in English language. Agada averred that teaching and learning of English language morphology can enhance Basic Education learners' writing skills. Agada further submitted that good competencies in understanding English words and their semantic building blocks will facilitate good performance in English language composition. Learner according to Agada can only perform well in English Composition if they have basic literacy skills. Hence, teaching and learning of English language in contemporary time starts from teaching and learning of literacy. The next section focuses on Teaching and Learning of Literacy.

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Teaching and Learning of Literacy

In every nation in the world, education is considered as the fundamental element for National Development. Julius (2015) explained that educating the mind amounts to inculcating orderliness and capabilities for the utilization of human and natural resources for the betterment of the society. No doubt, literacy which commonly refers to the ability to read and write, is very vital in the education process. Hassan (2014) defined literacy as: "The ability to read, write and use numeracy, to handle information, to express ideas and opinions, to make decisions and solve problems, as family members, workers, citizens and lifelong learners. Ferdinand (2017) described Literacy Education as the process of transferring or teaching individuals, a group of people how to read, write and use literacy to handle information, to express ideas and opinions, to make decisions and solve problems, etc, under strict supervision and guidance of others such as a teacher, instructors or anybody with authority to educate others. Literacy education, that is, teaching and learning of literacy, is therefore, to a large extent, a predictor of progress across the entire formal education levels.

Literacy education (teaching and learning of literacy) plays important role in elimination of illiteracy which limits the attainment of sustainable human development. Illiteracy negatively affects labor force, economy and social wellbeing of the society. According to Imuno (2015), in this contemporary age, an illiterate person is considered to be circumscribed and hence incapacitated from playing his/her potential roles in the socio- political, economic and national development. An illiterate individual tends to live a marginal life and is vulnerable to exploitation by others. Olayinka (2015) observed that the high illiteracy rate in Nigeria today can be seen as one major factor responsible for slowing down national development. A nation cannot achieve sustainable development without good governance, strong economy and good education. It is a known fact that no nation can rise above the quality of its educated citizenry.

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Literacy Education aims at developing the individual who in turn is expected to contribute to the development of the society. When an individual is developed, by extension, the nation is developed. A major characteristics of literacy education is its emphasis on development. Baraje (2015) identified a positive correlation between quality of literacy and level of development.

The importance of teachers and the role they play in teaching and learning of literacy are, unarguably, central to basic education. Literacy according to Natshi (2016) refers to the ability to possess the basic skills of reading, writing and numerical computation for effective participation in the affairs of the society. Natshi averred that the teaching and learning of literacy involves the process of transferring the basic skills of literacy from a teacher to a learner or learners under supervision and guidance. Literacy is a fundamental human right and the foundation for lifelong learning. Akpan (2014) stated that literacy is fully essential to social and human development in its ability to transform lives. For individuals, families, and societies alike, literacy is an instrument of empowerment to improve one's health, one's income, and one's relationship with the world. The uses of literacy for the exchange of knowledge according to Akpan are constantly evolving, along with advances in technology. Consequently, the teaching and learning of literacy must respond to technological advancements.

Simply put, teaching and learning of literacy must embrace the newest technologies that have the capacities to promote and enhance learners' achievement and interest in literacy. Justice (2017) maintained that computer-aided instruction such as computer audio animation are very voguish and have all it takes to promote and enhance today's learners' achievement and interest in literacy. literacy avails the literate individual a wider opportunity for business, social, intellectual, cultural, regious and political participations. A literate

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community is a dynamic community which enhances National Development, one that exchanges ideas and engages in debate. Illiteracy, however, is an obstacle to a better quality of life, and can even breed exclusion and violence, (Derbuck, 2014). According to Derbuck, for over 65 years the United Nations Educational Scientific and Cultural Organization (UNESCO) has worked to ensure that teaching and learning of literacy remains a priority on national and international agenda as a catalyst for National Development.

Through its formal and non-formal literacy programmes worldwide, UNESCO works to realize the vision of a literate world for all. Obviously, this is in recognition of the importance of literacy to the whole world. Wale (2016) posited that literacy helps provide a basis on which people may come together and thoughtfully make decisions which enhances adaptability and National development. El-Amin (2017) noted that in a society where the adults are ill-informed, poor and diseases- ridden, dependent and crippled by illiteracy, the future of their children who themselves are future adults become precarious and susceptible to inheriting all the ills and damages accompanying illiteracy. Nnamani (2018) averred that the primary purposes of teaching and learning of literacy at basic education level in Nigeria are to enhance basic communication skills and elementary numeracy (arithmetic computations). Consequently, basic education literacy is taught as a component of basic education English language and as a component of basic education mathematics. As a component of basic education in English language, Basic Education literacy focuses on the following basic communication skills; listening skills, pronunciation skills, reading skills and writing skills. These topics of literacy formed the focus of this paper. Interestingly, listening skills, pronunciation skills, reading skills and writing skills can be facilitated using computer audio animation. This is discussed in the next section.

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Computer Audio Animations

According to Kim, Jex and Mogul (2012), animation is the rapid display of a sequence of images of two-dimensional (2-D) or three-dimensional (3-D) artwork or model positioned to create an illusion of movement. The effect is an optical illusion of motion due to the phenomenon of persistence of vision, and can be created and demonstrated in several ways. The most common method of presenting animation is as a motion picture or video program, although there are other methods. AL-Amin and Husseni (2012) defined animation as the techniques of filming successive drawings or positions of model figures, to create a film giving an illusion of movement. The word animation derives from Latin "'animatio" meaning "the act of bringing to life" from "animo" ("to animate" or "give life to") "atio" ("the act of").

Early examples of attempts to capture the phenomenon of motion drawing can be found in Paleolithic cave paintings, where animals are depicted with multiple legs in super imposed positions, clearly attempting to convey the perception of motion, (Ngoma, 2013). Historically, a 5,000-year-old earthen bowl found in Iran in Shahr-I Sokhna has five images of a goat painted along the sides. This has been claimed to be an example of early animation. However, since no equipment existed to show the image in motion, such a series of images cannot be called animation in a true sense of the word. (AL-GAZIR 2013). Michelle (2012) reported that a Chinese zoetrope-type device had been invented in 180 AD. The phenakistoscope, praxinoscope, and the common flip book were early popular animation devices invented during the 19th century. These devices produced the appearance of movement from sequential drawings using technological means, but animation did not really develop much further until the advent of cinematography. There is no single person who can be considered the "creator"

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of film animation, as there were several people working on projects which could be considered animation at about the same time.

According to Mbunda (2012), George Melies was creator of special-effect films; melies was generally one of the first people to use animation with his technique. Melies discovered a technique by accident which was to stop the camera rolling to change something in the scene, and then continue rolling the film. This idea was later known as stop-motion animation. Melies discovered this technique accidentally when his camera broke down while shooting a bus driving by. When he had fixed the camera, a hearse happened to be passing by just as Melies restarted rolling the film, his end result was that he had managed to make a bus transform into a hearse. This was just one of the contributors to animation in the early years. Mbunda (2012) also asserted that the earliest surviving stop-motion advertising film was an English short by Arthur Melbourne-Cooper called Matches: (An Appeal 1989), Developed for the Bryant and May Matchsticks company, it involved stop-motion animation of wired-together matches writing a patriotic call to action on a blackboard.

Hook and Charles (2012) stated that J. Stuart Blackton was possibly the first American film-maker to use the techniques of stop-motion and hand-drawn animation. Introduced to film-making by Edison, Blackton pioneered these concepts at the turn of the 20th century, with his first copyrighted work dated 1900. Several of his films, the Enchanted Drawing (1900) and Humorous Phases of Funny Faces (1906) were film versions of Blackton's "lightening artist" routine, and utilized modified versions of Melies early stop-motion techniques to make a series of blackboard drawing appear to move and reshape themselves, "Humorous Phases of Funny Faces' is regularly cited as the first true animated film, and Blackton is considered the first true animator. Zacky and Yound (2013) narrated that a French artist, Emile Cohl, began drawing cartoon strips and created a film in 1908 called Fantasmagoria.

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The film largely consisted of a stick figure moving about and encountering all manner of morphing objects, such as a wine bottle that transforms into a flower. There were also sections of live action where the animator's hands would enter the scene. The film was created by drawing each frame on paper and then shooting each frame onto negative film, which gave the picture a blackboard look. This makes Fantasmagoria the first animated film created using what came to be known as traditional (hand-drawn) animation.

According to Marcellio and Haroldei (2011), following the successes of Blackton and Cohl, many other artists began experimenting with animation. One such artist was Winsor McCay, a successful newspaper cartoonist, who created detailed animations that required a team of artists and painstaking attention for detail. Each frame was drawn on paper; which invariably required backgrounds and characters to be redrawn and animated. Among McCay's most noted films are Little Nemo (1911), Certie the Dinosaur (1914) and the Sinking of the Lusitania (1981). The production of animated short films, typically referred to as "cartoons", became an industry of its own during the 1910s, and cartoon shorts were produced to be shown in movie theaters. The most successful early animation producer was John Randolph Bray, who, along with animator Earl Hurd, patented the cel animation process which dominated the animation industry for the rest of the decade. El Apostle (Spanish: "The Apostle") was a 1917 Argentine animated film utilizing cutout animation, and the world's first animated feature film.

Traditional animation (also called cel animation or hand-drawn animation) was the process used for most animated films of the 20th century. The individual frames of a traditionally animated film are photographs of drawings, which are first drawn on paper. To create the illusion of movement, each drawing differs slightly from the one before it. The animators' drawings are traced or

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photocopied onto transparent acetate sheets called cels, which are filled in with paints in assigned colors or tones on the side opposite the line drawings. The completed character cels are photographed one-by-one onto motion picture film against a painted background by a rostrum camera.

The traditional cel animation process became obsolete by the beginning of the 21st century. Today, animators' drawings and the backgrounds are either scanned into or drawn directly into a computer system. Various software programs are used to color the drawings and simulate camera movement and effects. The final animated piece is output to one of several delivery media, including traditional 35mm film and newer media such as digital video. The "look" of traditional cel animation is still preserved, and the character animators' work has remained essentially the same over the past 70 years. Some animation producers have used the term "tradigital" to describe cel animation which makes extensive use of computer technology, (Terry, 2011). Example of traditionally animated feature films include: Pinocchio (United States, 1940), Animal Farm (United Kingdom, 1954), and Akira (Japan, 1988). Traditional animated films which were produced with the aid of computer technology include the Lion King (US, 1994) Sen to Chihiro no Kamikakushi (Spirited away) (Japan, 2001), and Les Triplettes de Belleville (France, 2003).

Mayo (2011) distinguished between full and limited animation as follows; Full Animation refers to the process of producing high-quality traditionally animated films, which regularly use detailed drawings and plausible movement. Fully animated films can be done in a variety of styles, from more realistically animated works such as those produced by the Walt Disney studio. Many of the Disney animated features are examples of full animation, as are non-Disney works such as The Secret of NIMH (US, 1982), the Iron Giant (US, 1999), and Nocturna (Spain, 2007). Limited Animation involves the use of less detailed and/or more stylized drawings and methods of movement. Pioneered by the

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artists at the American studio United Productions of America. Mayo asserted that full animation is better presented through the computer. The computer audio animation is a computer powered software that can be use to demonstrate and illustrate pronunciation, reading, listening and writing. It is designed with features it helps a learner to pronounce any word that is typed in. it can also confirm whether or not a learner pronounces correctly. It can be used to drill a leaner in listening skills, when it reads out a sentence it will prompt the learner to repeat the sentence, it then confirms if the learner listened well. It can also write sentences and instruct the learner to read to test the learners' reading skills. The last feature dictates a passage which the learner is expected to write. All these features of computer audio animation make it very useful for teaching literacy especially at the basic education level. The next section discusses basic education.

Basic Education

Federal Republic of Nigeria (2013) in the National policy on Education identifies education as an instrument par excellence for effecting national development plans. It also stipulates that education shall continue to be highly rated in the national development plans because education is the most important instrument of change. Universal Basic Education (UBE) aims at ensuring an un-interrupted access to a 9 year formal education by providing free compulsory Universal basic Education to every child of school age, reduce school drop-out and improve reliance, quality and efficiency and ensure the acquisition of appropriate levels of literacy, numeracy, manipulative, communicative and live skills. By mastery of the use of essential tools (reading, writing and computation) the learner is able to earn his living and satisfy his needs, including his responsibility as a member of the Nigerian society. He is thus formed to perform to the best of his ability. UBE is geared towards the preservation and reformation of Nigeria and also aims at

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providing access to and ensure quality of basic education throughout Nigeria. The improvement of the citizen leads of the improvement of the society.

The scope and objectives of UBE reveal the functionality of its curriculum. It must entail those basic knowledge and skills necessary for life-long education. Life-long education according to Faure (1972) in Okam and Bozimo (2002) covers the entire process of education from the point of view of the own life as he deserves but it is also designed to help the future adult prepare for various forms of autonomy and self learning. It covers formal, informal and non formal activities. Formal activities concern those activities planned and executed within a school setting. Informal activity refers to exposure to an unplanned course of activities taking place in anon-school setting. Non-formal activity is based on planned course of activities executed in a non-school setting (Uchendu, 2013). Life-long education, which is the target of UBE, is learning that leads to self-development and self-actualization. It presupposes that individuals should have access to training whether in school or outside. And that there should a link between the school and the community/home and that formal learning should be related to community realities. At present, Universal Basic Education in Nigeria is divided into three, namely, Lower Basic (primary 1-3), Middle Basic (primary 4-6) and Upper Basic (junior secondary 1-3).

Conclusion

Based on the discussions in this paper, the following conclusions were made; teaching English language generally and literacy in particular is not just transmitting an immutable body of knowledge that leaners have to accept as a perennial fact without any reasoning. Since teaching languages generally and teaching English language in particular is an empirical activity, learners are in position of constructing their own knowledge if well guided. The most tasking job of the English language teacher therefore is to identify how to lead the learners to discover facts. This can be done through use of effective and efficient

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instructional media. Such media will help the learners to see relationships between their past knowledge and the incoming information. Thus, with minimal guide, the learners will discover patterns, procedures, relationships and conceptual definitions imbedded in their lessons. Using Computer Audio Animation to teach English language particularly literacy implies making the work of the teacher easier and satisfying.

The use of Computer Audio Animation is a constructivist process. Thus, it is learner-centered. In learner-centered strategies generally, the learners are in charge. The teacher offers minimal guides and allows the learners to construct their own understanding by seeing relationships between incoming information and their previous knowledge. Learners thus, determine their own knowledge based on their own way of processing information and according to their beliefs and attitudes towards learning from the foregoing.

Recommendations

Consequent upon the conclusions afore stated, the following recommendations were deemed necessary;

i. Application of Computer Audio Animation for teaching English language at Basic Education level should be adopted by all schools to encourage activity based and leaner-centered class rooms.
ii. Application of Computer Audio Animation for teaching English language at Basic Education level should be adopted by all schools to promote leaners' academic performance.
iii. Application of Computer Audio Animation for teaching English language at Basic Education level should be adopted by all schools to make teachers' job easier and offer them job satisfaction.

ISBN: 978-978-798-430-7

References

Agada, J. O (2018). Effect of Computer Audio Animation on basic education pupils' interest in English Language in Benue state. *Journal of linguistics, 11(1), 115-138.*http://www.litedu.com.

Agu, H. S. (2016). *Computer use in Basic Education.* Abuja: Haske Press ltd.

Ajom, P. C. (2019). *Innovation in Teaching Literacy.*Makurd: Time-Line Ventures.

Akpan, J. (2014). Effect of Computer Audio Animation on Pupils'Interest in Literacy in Uyo Metropolis, Akwa-Ibom State. *International Journal of Research in Educational Technology, 22(17), 98-109.* www.edutech.net.

AL-Amin, C. M. (2017), Computer Animation use in Teaching andLearning. *http://www.wiley.com/cgibin/abstract/7832608288/ABSTRACT.*

Baraje, K. (2015). Effect of Computer Audio Animation on Pupils' Achievement in Literacy in Cape Town, South Africa. *Journal of linguistics, 7(2), 580-598.* http://www. litedu.org.com.

Buckie, O. (2016). Effect of Computer Audio Animation on Pupils' Literacy inMichigan, USA. *International Journal of Research in Educational Technology, 22(17), 713-720. www.edutech.net.*

Derbuck, K. (2014). Effect of Audio Animation on Basic Education Pupils' Achievement in Literacy in Southern Educational. *International*

WEBSITE: https://globaljournalhub.com
ISBN: 978-978-798-430-7

Journal of Research in Educational Technology, 22(17), 411-429. www.edutech.net.

El-Amin, Z. A. (2017). *Cognitive Interest in Education.* New Delhi: Myth Books.

Federal Republic of Nigeria (2013) *National Policy on Education.* Abuja: NERDC Press.

Ferdinand, K.I (2017). Effect of Computer Audio Animation on pupil's interest in Literacy in North East Sweden. *Journal of linguistics, 9(3), 29-50.http://www.litedu.com.*

George, S. (2016). Checkmating Pupils' Learning Outcome Through Computer Audio Animation in Washington D.C USA. *Global Journal for Studies in Education, 3(1), 205-223. www.global journal hub.com.*

Hassan, T. (2014). Effect of Computer Audio Animation on Pupils' Interest in Literacy in Auchi, Edo state.*International Journal of Research in Educational Technology, 22(17), 315-333. www.edutech.net.*

Hook, Y. C. and Charles, F. J. (2012), Improving Interest in BasicEducation. *http://www.wiley.com/cgibin/abstract/7832608288/ABSTRACT.*

Idogu, L. A. (2017). *Challenges of 21st Century Education.* Ibadan: Adejumo Press Ltd.

Imuno, G. (2015). Effect of Computer Audio Animation on Pupil's Achievement and interest in Literacy in Accra, Ghana. *Journal of linguistics, 7(2), 38-56. http://www.litedu.com.*

WEBSITE: https://globaljournalhub.com
ISBN: 978-978-798-430-7

Julius, Q. (2015). Effect of Computer Audio Animation on pupil's achievement in literacy in Scotland. *Journal of linguistics, 7(2), 128-144.* http://www.litedu.com.

Justice, O.T. (2017). Effect of Computer Aided Instruction on achievement and Interest of basic education pupils in English grammar in Dundee, Scotland. *Journal of linguistics, 9(3), 1731-1753.http://www.litedu.com*.

Mayo, R. T. (2011). *Computers in Teaching and Learning*. Winslow-Chesire: Sigma Technical Press.

Mbunda, S. D. (2012). *Dynamics in AfricanLiteracy*. Nairobi: Maraton Publishers.

Michelle, H. k. (2012). *Communication Skills Development*. Pretorial: Viewpoint Press Inc.

Natshi, S. (2016). Use of Computer Aided Instruction in Kenya, Central Africa. *International Journal of Communication, 7(1) 308-329. www.injocom.net.*

Ngoma, S.O. (2018) *Pedagogy in Basic Education*. Nairobi: Maraton Publishers.

Nnamani, C.O. (2018). Effect of Computer Audio Animation on Basic Education Pupils' Achievement in English language in Enugu state. *International Journal of Management, Social Sciences, Peace and Conflict Studies (IJMSSPCS).2(3). 474-489.*

Olayinka, M. (2015). Effect of Computer Audio Animation on Pupils' Achievement in Literacy in Ilorin, Kwara state. *Journal of linguistics, 7(2), 293-321.* http://www.litedu.org.

WEBSITE: https://globaljournalhub.com
ISBN: 978-978-798-430-7

Olinya, N. E. (2018). *Computer Science Education: A pedagogical Approaches.* Onitsha: Togo-Text Publishers.

Olugu, P. J. (2019). Computer Audio Animation And Pupils' Achievement and Interest in Literacy. *Journal of linguistics, 11(1), 515-538. http://www.litedu.com*.

Otobo, D. M. (2018). *Checkmating Pupils' Performance in Literacy*. *www.globaljournalhub.multi.com*.

Ramsey, V. (2020). *Constructivist Pedagogy*. *Philadelphia: New Era Books.*

Wale, P. (2016). Effect of Computer Audio Animation on Pupils' Achievement and interest in literacy in Ijebu-ode, Ogun State. *www.globaljournalhub.multi.com*.

Yound, E. L. (2013) Towards a typology of Computer use in Primary Education. *Journal of Computer Assisted Learning 2(7) 29-40. www.jocal.com*

ISBN: 978-978-798-430-7

11

INNOVATIONS IN COMMUNITY RESOURCES AND DEVELOPMENT

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INTRODUCTION

The world community is derived from the old French word "communite" which is derived from the Latin "Communitas" i.e (Cum, "with/together" + munus, "gift") a broad term for fellowship or organized society. The term community has two distinct commutative meanings: community can refers to a usually small social unit of any size that shares common values. According to Oxford Advanced Learners Dictionary, Community is defined as "all the people who live in a particular area, country etc. hence, and community are all about a group in a geographical area.

Community resources are materials in form of goods or services rendered with the aim of assisting a community to achieve a particular goal. Dada (2013) sees community resources are a group of services and/or assisted programme that are provided to the members of a community for free or at an affordable price. Each resources is made available to community members to help them become self reliant and maintain their human rights and wellbeing (Castek, 2012). A community can be many things; it is people who live in the same neighborhood or city, people with the same interest or background, or even organizations or

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communities that have something in common. Resources tangible and intangible, meet the need of the community by providing assistance, ideas and solutions. Depending on the community, whether it is a geographic area or a group with common goals or characteristics. Resources can cover a wide range of services or provided limited specialized assistance.

Community Resources

Community Resources development is concerned with building stronger communities through civil engagement and using resources in the best manner for desirable organizations or individuals Knight. Community resources vary from community to community. The opportunities which the teacher in an open rural area has are only slightly related to those of teacher in an urban area. But community study opportunities are available to every school and should be explored. As we contemplate the many sources of information that are open to investigation, we must no longer overlook those which lie within "walking distance" the local factory, retail shop, business office are real facts school children can see, hear, ask questions about them and examine them minutely. Dada Opined that it is the responsibility of the teacher to investigate the community, particularly those resources which seem to identify themselves with clear–cut full understanding of social experience Kochhar (2012) is of the opinion that the importance of community resources to the development of education can't be over emphasized. Resources which include factories, health institutions, culture, infrastructure business office religion institution, to mention a little are a veritable source of course content and experiences.

Extending the classroom into the community can make learning quite exciting, functional and relevant. Every community is an inexhaustible mine for effective instruction and training. The multisensory effect inherent in utilizing the community resources **"*in situ*"** facilitates the acquisition and evaluation of knowledge, skills and morals more than in most other media. A single visit to the museum, a cottage industry or a botanical garden can save hours of classroom

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teaching. It can produce even greater achievement if well planned and properly executed. One visit to the 'motherless Babies' Home can trigger off empathy beyond years of sermonization.

Community resources comprise people, place things, activities, festivals and ceremonies which are useful for instructing, educating and training. Brown, Lewis and Harcleroad (2007) regard the community **as "a great human laboratory and an influential instructional medium"** because whatever exists or happens in it affects everyone who lives there. Likewise, Clark and Starr as cited by Dede (2013) confirm that **"the best resources the teacher has is the community itself. It is both a source of subject matter and a source of instructional materials and resource persons."**

Although tapping community resources can help small instructional and training programmes to provide expanded learning experiences that may otherwise be unavailable, they are more often than not, neglected. Yet in austere times like now, we need to explore in greater details the possibility of taping more from the available community resources.

Kinds of community Resources

Two major kinds of community resources can be identified: These are phenomenal resources and resource persons. Phenomenal resources can be categorized into natural and man-made. Each of these is discussed below:

i. Resource Persons

People are the most important resources of any community. They can share wonderful learning experiences with a class of inquisitive learners when adequately mobilized and effectively utilized. Resource persons are well-informed people who, by virtue of their expertise, leadership roles, knowledge, travels, occupation, hobbies, talents or experience in special fields, can speak

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with unchallenged authority in their fields, They need be highly learned; sometimes they could be intelligent illiterates. Teachers, doctors, musicians, chiefs, herbalists, businessmen and women or blue-collar jobbers, among numerous others, may be capable and willing to share their knowledge and experiences through talks, illustrative lectures, demonstrations, tele-lectures, or teleconferencing.

ii. Phenomenal resources

These include processes, things, events, settings, activities or festivals that can be directly apprehended by the learner. They can provide much more than just the audio and / or visual stimulation. Aesthetics, tactile stimulus, identification with and attachment to nature and the particular learning situation can be developed and quickened through field trips and study tours; so also can socialization and acculturation. These resources can be sub-grouped into natural and man-made.

- Natural resources

Lakes, forests reserves, hills, waterfalls, mineral deposits, mine sites, caves and other special sceneries can be fully explored for instructional purposes through field-trips. They provide realistic avenues for studying real things, people and features in their natural environment. Eco-tourism can also be promoted if the natural and man-made resources are properly integrated, documented, advertised and utilized.

- Man-made resources
- Among the non-natural resources are transportation facilities such as airports, railroad stations, harbors, Festivals such as the new yam, sports, fishing, and others can also be important. Industrial, commercial and agricultural ventures, can also be invaluable for instruction and training purposes. The value of museums, nature corners, libraries, shrines, theatres, beaches, zoos, botanical gardens, planetaria, stadia and aquaria

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for training and instruction cannot be overstressed either. Learners can get the "feel of things" when they come on direct contact with the reality of life under controlled exposure. Learning becomes concrete and form a basis for abstract concept in future.

Hints on mobilizing and utilizing community resources

In order to realize the full potentials of the community resources, it is important to mobilize and utilize them systematically. Haphazard utilization of community resources can be very detrimental to the learner, teacher and society. Learner participation in the entire learning process and at every stage increases effectiveness and achievements. All these provide inner satisfaction that can be added incentive in the learning process. The following suggestions can enable the teacher to maximize the potentials of phenomenal resources.

a) **Mobilization:** This is the first stage in the enlistment process. It refers to the process of recruiting and shaping up the resources in such a way that the desired post-instructional needs can be adequately fulfilled. Administrative approval, political support, and proper specification of objectives are the essential demands that must be met before effective mobilization can be achieved. The mobilization stage consist of survey, identification, inventory and recruitment.
   - ***Survey and identification stage*** involves looking around, finding out, scrutinizing or mapping out the community resources that have relevance with specific objectives. This may require using the telephone directory (both the white and yellow pages), advertisement columns in newspapers, journals and magazines, maps, local almanacs, diaries and libraries. It may also involve asking questions around and meeting people. At this stage the teacher's public relations acumen can pay off very handsomely. The learners can also be an excellent source of useful information for this purpose.

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- ***Inventory*** involves a listing of the selected community resources. The list can be alphabetized for easy referencing. Community resources could also be grouped using a wide variety of criteria including their characteristics, functions, locations or utility values. Systematic documentation and arrangement can ease referencing and enhance utilization. Relevant data including names, titles, locations, telephone numbers, office hours, contact persons and briefs on educational value among others can be very useful information in the inventory.
- ***Recruitment*** refers to the process of enlisting and acquiring the services of the community resources desired. It involves personal contact, writing officially to or telephoning the personnel involved. Formal letter of acceptance is necessary in order to consolidate the required arrangement.

  At this level the topic, desired objectives, data, time and duration, venue, audience characteristics, mode of utilization, necessary equipment and transportation are arranged or acquired while other preliminaries are also taken care of. For field trips it might also be advisable to get written approval from parents or guardians.

b) Utilization

This is a process of bringing learners into contact with the community resources component s to facilitate and access learning and training. For optimum utilization, he following hints can be useful.

- ***Clarity of purpose:*** Objectives must be clearly and behaviorally stated in meaningful terms, defined and publicized. A list of likely questions from the learners for the resource person or guide could be gotten ready or possibly made available before hand to the resource person concerned. The educational level of learners, their general background, aspirations

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and characteristics should be clarified to the resource person. This enables him to have a clear concept of the anticipated audience.

- ***Preparing the class:*** The topic of the visit, talk or excursion, the objectives to be covered and roles of the various class members, documentation and other sub-committees, in clear precise terms, are defined and publicized to the class. Learners should be made to realize that projects, essays, reviews, maps and other assignments will be required of them after the presentation.

  For purpose of school journeys, route maps indicating important towns and features should be made available to the class. This could be referred to and discussed during the journey and on reaching the towns or features of interest.
- ***Presentation:*** Before presentation, introduce the resource person or guide to the class and vice versa. The actual presentation and interaction with the resource person should be within the time limits, allowing for discussion, relevant questions and contributions.

  The use of communication products and techniques of various forms can be very rewarding. It might also be necessary to record the presentation in various forms: writing, filming, taking photographs, audio-recording or video-recording. Where the resource person is inevitably physically absent but has the presentation in audio form, enlarged portrait along with amplified audio presentation in the class can provide the required rapport. Video presentation combines the audio and visual presentation including motion; it can be very exciting too.
- ***Ending:*** At the end of the presentation, a vote of thanks by a class member to the guide or resource person should not be forgotten. If on a trip, re-group the class, check attendance, and if practicable follow another route back.

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- ***Evaluation:*** Feedback forms should be designed to evaluate the whole exercise including the preparation, presentation, guide or presenter, objectives and general achievement in related areas. They should be responded to by the learners. Creative productions in poetry, prose, photographic stories, Projects among other related learning experiences can serve the needed evaluation purpose. The best productions could be preserved in the school museum, library or instructional materials unite.
- ***Follow- up:*** Photographs taken during the presentation, a summary of the documentation accompanied by a formal "thank you" letter to the resource person or guide can be memorable. Where commitment activities, there to result from such learning experiences, they must be carried out as planned and reported with adequate documentation.

Methods of Utilizing Community Resources

There are basically two ways in which the teacher may make use of community resources. One method is to take the school to the community; the other method is to bring some portion of the community to the classroom.

1. **Taking the School to the Community:** They say 'the emotions of children are most easily reached not by words but by sights and sounds. It is actually when they see the things, that they remember them (Ibeh, 2009). This is possible through field trips surveys, camping, services projects etc.

a. **Field Trips**: Few social teaching programmes are complete without a field trip. Field trips may be undertaken for securing information, changing attitudes, awakening interest, developing appreciation, promoting ideals, enjoying new experiences. They can initiate a unit of study, they can be a part of the core of it or they can give it the finishing touch. They are a very good means of getting knowledge first hand of confirming and supplementing second hand knowledge. They are a means for sharpening observation, testing principles and doing

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everything which social studies requires. Field trips are useful for educational purposes in ways more than one:

i. They stimulate imagination and learning by providing sensory perceptions e.g. the breath taking heat of a glass furnace, the metallic hum of a weaving room. The sights of real things in the real world of adults.
ii. They integrate classroom instruction by exposing the artificially of traditional subject matter divisions and enable the pupils to view facts and forces as they exist in their everyday relationship in living communities.
iii. Through the filled trips, the students may come to realize community in ways which bookish learning cannot by its very nature allow.
iv. They enable the pupils to learn the art of living with others such as travelling in the same conveyances, sharing rooms, sitting at the same table.
v. They expand emotional and intellectual horizons by making them acquainted with people whose manner, customs, living standards, outlook and interests may be quite different from their own.

2. **Community Surveys**: Community surveys can provide excellent educational experience particularly senior pupils. According to Arya (2022), community surveys enable students to learn about various aspect of the society they live in. They are one of the organized and systematic methods for an accurate determination of social or physical data. Survey foster comprehensive understanding of community structure and processes in their everyday operation interaction and complexity. They are extremely useful in stimulating depth of insight into vital community problems which should be met. Also, they suggest possibilities for student participation in the affairs of the community. Any aspect of the community which has meaning for young people may be considered an appropriate field for school survey (Dede 2013).

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3. **School Camping**: The opportunities to learn, work and play amidst the natural resources of the area stimulate interest and concern for the protection and wise use of the natural resources of the community. The drift to cities and the rapid tempo of modern living is creating a need for people in cities to find more opportunities for roots in the soil, thus developing a closer relationship between human beings and natural resources. School camping encourages directs learning experiences and has potential life – situations that are conducive to the most effective teaching methods, that is, through learning by done, seeing, hearing, testing, smelling and feeling with a minimum of answers givens by teachers and resource leaders. According to Dede (2002) The following service projects can prove quite useful:

i. Social service among the backward population of the town such as cleanliness, anti mosquito campaigns, bathing young children, attending on the sick.
ii. School labor service being organized on special occasions such as republic day, Independence Day, activities like planting of trees, road repairs and erection of platforms, cleaning of lanes, digging of manure pits and drains, may be taken up.
iii. Animal welfare through provision of water facilities, fodder and medical aid.
iv. Beautification of villages through planting of trees, lying out of avenues, clearing up of public places like streets, temples, drains, etc.

Importance of Community Resources for Education

Community experiences can enrich education in instructions in ways more than one. To achieve the purposes of education, the child must, become a real part of the community in which he lives, interact with it and contribute to it. To become an effective citizen, the child must become a responsible member of community with civic attitudes and ideals compatible with the spirit of democracy. There is

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no more effective way of becoming this kind of person than through practicing what such a person will do (Adegboye, 2010). A variety of community experiences offer the child the laboratory in which he may experiment with life in the community and begin to find his place in it.

Again, venturing into the community, gives children an opportunity to observe and sometime to participate in the basic human activities that characterize living in the social group. Children can go almost everywhere under the careful guidance of the school and of cooperating community groups – asking questions, gathering data and pooling information. They can investigate many phases of human activity in the community. Visits to radio and television stations, telephone, newspaper and telegraph offices clarify ideas about communication, study trips to airports and other transportation centre as well as rides in a variety of vehicles, show how people and goods are moved about. Production and consumption can be understood better when pupils see the stores, the markets and factories of the community. Education, government, religious activities, protection and conservation are all there for children as they venture forth, hearing, seeing and sometimes taking part in the life of the community. Kochhar is of the opinion that there are so many community problems which constitute the subject – matter of education. Traffic problems, protection of public property, community beautification, conservation and law of observation are but a few to which children can actually make a contribution appropriate to their level of development. A problem shared builds interest, concern and a feeling of kinship, the principle works well when pupils and community are thrown together in the consideration of vital problems. Pupils develop a sense of belonging and the community is benefited because of the sense of responsibility develop in the pupils. Thus, the classroom is as big as the community if teachers and pupils take advantages of all that the world outside the school has to offer. The wise use of community resources is a boon for vitalizing teaching. If the teacher is resourceful, pragmatic and the class is enthusiastic and clever, there will be no

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difficulty in preparing a catalogue for the available resources for proper and detail study. According to Kochhar (2012), cataloguing of the available resources may be done under the following heads:

- Resources of geographical interest such as hills and valleys, lakes and waterfalls, rivers, springs, sea-port, dams and river – valley projects, mines, rocks and fossils, tea gardens, etc.
- Resources of historical interest such as forts, pillars and monuments, gurdwaras, temples, mosques and churches, old relics and inscriptions, excavations and caves, etc.
- Resources of cultural interest such as art theatres and galleries, museum, zooms, cinema halls, radio stations, universities, firm studios, schools and colleges, Bal-Bhawans, Doll museums, Kala kendras, organization like boy scouts, girl guides, emporium, newspaper offices, etc.
- Resources of economic interest such as market places, commercial centres, brick kilns, dairies, banks, mills and factories railway junctions, post and telegraph offices, telephone exchanges, agricultural farms, water work, printing presses etc.
- Resources of scientific interest such as scientific laboratories thermal and hydro-power generating stations, radio transmission stations, workshop, factories, power transmissions, distributing stations, engineering colleges broadcasting and television stations.
- Government buildings such as municipalities, district board, hospital, law courts, police stations, fire stations, and parliament house Rashtrapati Bhawan, Assembly Halls, secretariats, military installations etc.
- Forms of social control such as traditions, customs usages rituals, mores, belief and attitudes of the local community.

COMMUNITY DEVELOPMENT

Community development (CD) has its root in several academic disciplines including Sociology, Economics, Psychology and even Architecture. The

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interdisciplinary approach of CD offers several advantages, such as providing a holistic view of CD. The United Nations (2014) defines community development as a process where community members come together to take collective action and generate solution to common problems. Though this may not solve all the problems faced by a local community, but it does build up confidence to tackle such problems as effectively as any local action can. CD looks at the level of local groups and organizations rather than with individuals or families. The range of local groups and organizations representing communities at local level constitute the community sector. Furthermore, CD is a skilled process and part of its approach is the belief that communities cannot be helped unless they themselves agree to this process. CD has to look both ways not only how the community is working at the grassroots, but also at how responsive key institutions are to the needs of local communities.

Principles of Community Development

Community Development has been previously defined as any action taken by any agency which is primarily designed to benefit the entire community. This defined by the following principles:

- Start with the people
- Build relationships, by introducing new ideas, showing how they meet identified needs
- Projects to be undertaken should be kept a simple as possible.
- There should be the involvement of as many community people as possible in all activities from the start of any project.
- Train people close to their home communities.
- Train in locally acceptable ways.
- Train trainers who can then in turn train others.
- Involve local leadership

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- Cooperate with governments.
- Encourage interdependent relationships vs dependent or totally independent relationships
- Planning services
- Servicing self help groups.
- Naming support and social action groups
- Building community networks
- Improving quality of life
- Working towards social justice

Here, CD should be the sole prerogative of the immediate beneficiaries. It should be people oriented. The communities should be solely allowed to decide on their immediate needs. A community as example may be in need of both water and good roads. But if they are allowed their choice, probably they would decide on water first before the road construction. Here, efforts should be intensified on the provision of water.

Community development should be people-driven and should embrace perceived community needs.

- Secondly, CD should build bridges and relationships, by introducing new ideas, showing how they can be able to meet identified needs.
- Projects to be undertaken on behalf of the community should be kept as simple as before.

It should be what the community will be able to afford. The technology a times when possible sheared be locally sourced. In case of training programmes, people should be trained within their communities to reduce transportation costs, and moreover, training should be done in locally acceptable ways, and if possible train those that can evenly retrain others.

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Community Development Processes

According to Sanders (2003) and Ngie (2013), in order to streamline our development, there are specific sets of guidelines that need to be followed. The development process consists of a set of seven steps. Depending on the situation not all the seven steps are necessary.

1. Presentation of the idea.
2. Unite requirements for idea execution
3. Design specification
4. Time and cost estimates
5. Implementation
6. Testing
7. Completion

- **Presentation of an idea** – Here a community who lacks electricity will want the community to be connected to the national and this may be referred to as rural electrification. Some other communities may need rural transformation through opening up of road networks for the evacuation of farm produce from the rural areas to urban markets.
- **The process** - uniting of requirements for idea execution. When a community presents an idea for execution, there is need to draw a road map for the execution of the idea. Here the community may need to form a committee on rural electrification as it concerns the community. Here members of the committee will now put heads together and see how that need can be achieved.
- **Design Specification**. This includes time and cost estimates. How much would be needed for its implementation and how the funds would be sourced. It would also determine the physical instruction in terms of how many poles to be created, points of erection and how many homes would be affected.

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- **Implementation stage** – the implementation stage launches all planned efforts and directly attempts to facilitate community change. Building on the previous three stages of community action. Throughout the precious stages, resources were gathered and assessed subgroups formed to focus on specific tasks and active citizens recruited. In this implementation stage, these resources are formerly committed and people are given tasks of going forward to achieve the goals established by the organization and its subgroups to maximize their impact, each subgroup should –

a. Meet to review goals, objectives and immediate steps for action as action efforts are launched, it is essential that all participants be clear about the planned goals and the methods for meeting these goals. It may be the case that some subgroups needs certain clarification on how to proceed and the resources available to support successful action.

b. Identify clear and measurable stages or benchmark for all objectives. While goals, objectives, and action plans have already been established, it will be useful to identify clear benchmarks or measurable impacts. This will serve to provide activists with feedback and to show that action efforts are making progress. Such measurable impacts will also show the general public that the organization is fostering positive changes on behalf of the community. As stated tasks are achieved, these can be promoted and marketed accordingly.

- **Testing** – Empowered with plans and a detailed background, subcommittees can move forward. As they take action, opportunities and mechanism for feedback and discussion should be presented. These opportunities can be through meetings, informal gatherings or established contacts can be arrived at to provide the insight and advice needed to adjust action plans. As achievements are made and measurable impacts achieved, it is important to celebrate and promote them through informal celebrations and other promotional awareness. It may also be the case that some action efforts have failed. The fact that these did not reach success is irrelevant, and should be celebrated as the first effort of

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what will be many valid action efforts. CD is achieved if diverse groups are brought together and channels of communication established. From this process, future efforts will emerge that will achieve success.

- **Completion** – CD and locally based actions are a never -ending process. Both need to be continuously cultivated. As progress in various forms is made, it is essential that mistakes, obstacles, and inconsistencies in application be identified and addressed. To fine tune actions, opportunities to effectively measure outcomes and provide feedback are vital to the long-term achievement of goals. To provide feedback, formal debriefing meetings should be established at the conclusion of action efforts. These meetings can evaluate progress, identify obstacles and explore new means of dealing with unforeseen problems. At these meetings, all subgroups / committees can report on their activities, progress, obstacles and methods for adjusting to challenges. The development of any community is not a onetime event in which success or failure is detailed. It is a process where the bringing together of actively interested and diverse community action process, channels of communication and interaction are established that cut across class and other lines. This is a remarkable achievement and represents Community Development.

PROBLEMS OF DEVELOPMENT AT THE COMMUNITY LEVEL

In community development efforts some problem areas are identified as that of finance, personnel, politics and leadership, community attitude intergovernmental relations, planning and ideology. This is one way of classifying these problems. It can also be classified as institutional problems, political problems and societal problems. The first classification is favoured as just to allow the many issues generation by each problem. SMS (2010) list the some of the problems as follows:

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1. **Finance:** Finance has been observed to be the area of focus in any developmental effort. It is the mainstay of local government, people talk move about finance, about how the competing needs in a community cannot be effective booked. Too much money is spent on recurrent budget sometimes up t between 80 – 90% leaving a smaller percentage for social and community services. This is not helped by the low interval revenue capacity of local government which amounts to, in average cases, not more than 10% of the local government revenue. The overdependence on statutory allocation has made the prospect of economic and social development painfully slow in local government coupled with this; leadership is slow to explore alternative sources of revenue in local govt. Despite the low level of finance, massive corruption takes place in local government. Both administrative and political officials are involved. Contracts are issued even to council staff and politicians see council as a place of rehabilitation and service to the community. Evidence of corruption surfaces from inspection reports and probe panels, into local government. Money meant for projects are embezzled.
2. **Personnel and Competence:** Surveys have shown that in recent years, the quantum of staff has increased. Also there has been more quality of staff in administration than the technical and professional fields in local government. A survey in 1997 by the UNDP shows that the planning and research unit of local government has been understaffed and staffs who manage this unit of local government do to receive any special training to prepare them for such jobs. One also hardly finds an economist or a statistician or a social scientist in this department. Many of the staff in the health offices is community health staff. Medical doctors are difficult to come by at the community level. Agriculturalists are largely those who have gone for only an ordinary diploma level of Education. The import of all these is the fact that planning for development is handicapped in local government because of the death of appropriate staff. Plans

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therefore become an incremental thing, a traditional muddling through, than an objective and data fed document. Professional advice to politician too suffers as a result of the quality of intellectual weight brought to bear on the exercise when it comes to its implementation. Targets and standards in plans may suffer as a result of poverty of professional requirements and competence. Even where there are qualified staffs to do this, they will still fall victim of the corruptive influence of society brought to bear by either the contractor or politician or community pressure. In summary, local government lack the executive, technical and professionals competence to formulate good plans and to implement them.

3. **Politics and Leadership:** The attitude of politicians to development may not coincide with established ways to doing community needs assessment by the local government bureaucracy. Some projects are outrageously cited even without assessing their utility. Political criteria override data based issues. The political imposes his will partly because of the impulse driven by his constituency needs and because of his party manifesto more importantly is his perception of the community and the going-on the other tier of government.
4. **The Community:** The communities often feel marginalized I development. Local government plans and executes them. Even community development efforts are not adequately supported by local government. Even where the intervention occurs it is not done in a participatory manner. The net effect of this is that the community feels marginalized from development programs and efforts. This also affects the sustainability of projects. The programme and project are community driven and participatory the more would want to own and sustain the programme. This is a far cry from what happened at the local level. This is why the community is not bothered when a health centre is burgled or the roof of a primary school is blown off. They see themselves removed

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from the process as the initiative and execution was all by the governments. Community attitude also reinforces the corruptive attitude of politicians instead of demanding for accountability from the politicians who amass lots of wealth and status symbols while in office, they perceived this as the ultimate objective of politics. Such polities actors are acclaimed they end up saying "this is our time" the actor who dies not seize such an opportunity is branded a "fool" Going into polities means going to cut ones cake from the government.

5. **Planning and Ideology:** Local government plans in Nigeria are supposed to fit into state and national plans. In the 1975 plans, the Federal Government came up with very catching phrases that defined the objectives of the plan such as a just and equalitarian society, a land full of opportunities these were supposed to also serve as the ideology of the plan. Since then subsequent plans built their overall objectives around these. However the implementation of plans since 1974 – 80 has not demonstrated any systematic effort to achieve these objectives instead plans have become more and more meaningless because they become mere documents of intentions rather documents of communications.

This attitude has spilled over too the state and local government. State government have not demonstrated any leadership planning neither have they showed any commitments; if plans are the instruments for development , which in reality they are, the lack of commitment to them means lack of systematized development. The type of development that takes place at the state and local government levels are impulsive, haphazard and un-coordinate. The cumulative effects of a plan or evidence of phased development is yet to be seen. Rolling plans ids yet to benefit the rural population. The state and local government are satisfied with the provision of social services and rural infrastructure. Their hope is that this attempt on their part to intervene in real economic development. Attempts have stopped in either agriculture or building of rural markets. Agriculture production is not enough to stimulate the rural economy. Even then it

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is faced with many problems. Markets can be seen as mere social and commercial entities that facilitates trade. The real problem is in the area of production. Agricultural production alone cannot improve the economic nature which ought to have been promoted by now so also glaring area like small scale industries of an agrarian nature and of nature relevant to community resources. Such direct interventions are lacking and unit more investment is planned in employment generating ventures in rural communities; the standard of living of the rural person will not appreciate. This is really the challenges for local government and other ties of government as they plan for rural development. The capitalist ideology which operates at the national level must also start penetrating the rural areas for concomitant development.

References

Adegboye, A. A. (2010). Issues in Citizenship Education. Barm Clem Publishers, Ikere-Ekiti

Arya, V. (2022). Importance of community resources in Education. Teachmint: Integrated School Platform/Smart LMS & ERP. www.blog.teachmint.com

Brown, B. W., Lewis, L. B. and Harcleroad, F. F. (2007). An Instructional Technology. *Media and Methods.* New York: McGraw-Hill Book Company

Castek, J. (2012). Ethowcutten, secutun and charities, priesise hall. New York.

Dada, S. O (2013).Utilization of Community Resources for Effective Sustainability of Social Studies Education. *International Journal of*

ISBN: 978-978-798-430-7

Science and Research (IJSR), 2 (6) 466-469 India. Online ISSN: 2319-7064

Dada, S. O (No date). Issues and Problems of National Development. Clem Ltd. Ikere –Ekiti, Nigeria.

Ibeh, E. H. (2009). Introduction to Psychology of Education. Greenwich. Ado – Ekiti

Kochhar, S. K. (2012). "The teaching of social studies". Sterling publishers. NilchoDelli

Mc-Knight, J. (1992). "Building Community" AHEC Community Parties Annual Conference Keynote address. Northwestern University: Centres for Urban Attain and Policy Research. Oxford Advanced Learners Dictionary 7th Edition, 1992.

Murray, G., Lappin B. (1958). Community organization theory principles and practice.

Ngie, S. (2003). Minority Policies and Rural Development in Nigeria, ABU Press, Zaria, (1994)

Sanders (2003). *Theories of Community development* rural sociology.

School of Management Sciences (2010). Community Development. *Module of National Open University of Nigeria.*

Warner B. (1958). *Community Organization" in Social Problems. A modern Approach*.

ISBN: 978-978-798-430-7

12
INCORPORATING INQUIRY-BASED LEARNING IN BIOLOGY CLASSROOM

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INTRODUCTION

Since the end of the Second World War in 1945, the world has seen rapid changes in almost every aspect of society. Science therefore has emerged as the most significant influencing field of study that has improved man's life. Science is knowledge based on verified facts. It is the rational procedure for arriving at the truth. Starting as a very refined method of investigation, it has through technology, transformed how man relates to his environment dramatically. For example, the application of the knowledge of science has helped to control and eradicate some diseases. Environmental awareness as a result of science has culminated in more rational use of resources to aid better living. Folorunso (2014) maintained that science provides the tools of industrialization and national development. The role played by science in development cannot be over-emphasied. It is for this reason that Government gives priority to science education. At primary, post primary and tertiary institutions, government has always laid emphasizes on solid foundation in science education.

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In the Nigeria secondary schools, one of the sciences being thought is biology and is one of the most popular science subjects in the senior secondary school curriculum. Biology is the scientific study of living things. Comparative Education Study and adaptation centre, CESAC (2004) maintained that biology provides an avenue for teaching students the ability to apply learned science concepts and principles in science related problems. Credit in biology is a prerequisite for studying other science related courses such as medicine, biochemistry, dentistry, pharmacy, microbiology, zoology, botany just to mention but a few.

The main objective of biology education in Nigeria is to enable every Nigerian child to be able to observe and explore the environment in which he lives and develop basic skills necessary for lifelong learning. There is equally emphasis on developing functional knowledge of biology concepts and principles which will enable the child explain simple natural phenomena and develop attitude towards biology which include critical thinking, creativity, communication, curiosity and objectivity. According to the Federal Republic of Nigeria (FRN, 2004), the objectives of biology teaching in secondary schools are to prepare students to:

a. Acquire adequate laboratory and field skills in biology.
b. Acquire meaningful and relevant knowledge in biology.
c. Apply scientific knowledge to everyday life in matters of personal and community health and agriculture.
d. Acquire reasonable and functional scientific attitude.

For the above objectives to be achieved the contents and contexts of the curriculum must place emphasis on innovative teaching methods such as field studies, guided discovery, inquiry-based learning, laboratory techniques etc. The future biologists therefore should be prepared to work within the fast moving and complex world. Biologist should know that the society of today has changed. It is no longer the same world our grandparents had to navigate. It is no longer sufficient to just prepare biologists within the traditional pedagogical modes of

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the past. It is imperative that future biologists should be prepared for a contemporary economy which enables them to consistently upscale their skill-sets, broaden their knowledge base, be re-employable as the needs of the market-change. According to Onyegegbu (2008) engaging and exciting students in biology is the key to learning. When students participate and get involved, they are excited and are fully ready and interested to pursue knowledge, prepare for life after secondary school and career ready.

Biology is very important to any growing economy; hence, for the learners to become competent future biologist and scientist, the learners are expected to acquire reasoning ability, hands-on- experience and scientific skills. One of the hands-on experience is inquiry learning/ method of teaching.

Despite the importance of biology, students' achievement in the subject in both West African Examination Council (WAEC) and National Examination Council (NECO) continues to deteriorate. According to Chief Examiners' Report in Biology 3 (Practical) for 2022 WASSCE, the performance of candidates was worse than that of last year with a raw mean score of 31 and standard deviation of 11.83 compared to a raw mean score of 42 and standard deviation of 12.21 for WASSCE 2020. The total number of candidates that sat for the examination was 1,023,685. The observed weaknesses of the candidates include: poor spelling of technical terms and one-word answers e.g neutral spine instead of neural spine. Drawing of wrong view of specimen C lumbar vertebra, instead of the anterior view, making wrong diagrams. This could be attributed to didactic traditional approach of teaching biology (Nwagbo 2006).

Biology curriculum emphasizes inquiry, hence, the need to try its efficacy on students' learning in a topic where they do not normally do well, as in the skeletal system. (WAEC, 2012, 2021). This chapter presents issues in incorporating inquiry-based learning in secondary school biology classrooms teachings. It focuses on:

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a. What is inquiry based learning
b. Forms of inquiry based learning
c. Theory behind inquiry based learning
d. Why should we teach using inquiry based methods (advantages and disadvantages)
e. How can a biology teacher use inquiry-based learning in the classroom.
f. Conclusions and the way forward.

WHAT IS INQUIRY BASED LEARNING (IBL)

Inquiry is seeking information or truth through questioning. Inquiry is an official process to find out the course of something or to find information about something Nwosu (2015). presented science inquiry as "Engaging students in the intentional process of diagnosing problems, critiquing experiments, distinguishing alternatives, planning investigations, revising views, researching conjectures, searching for information, constructing models, debating with peers, communication to diverse audiences and forming coherent arguments". This definition of 'inquiry' shows the role of science inquiry for a dynamic world and so its attributes have to be reflected in Biology Education instruction for it to be effective.

Inquiry based learning approach is a teaching method that allows students learn and experience biology first hand, by doing. Students use the inquiry process to develop explanations from their observations by integrating what they already know with what they learnt. They learn discrete Biology concepts and skills and how to solve problems using practical approaches.

In summary, IBL is a teaching method/approach that combines the curiosity of students and scientific method while learning biology.

According to Galileo Educational Network Association (2005), inquiry is a fluid process and one step may lead back to a previous step. Cyclic inquiry model

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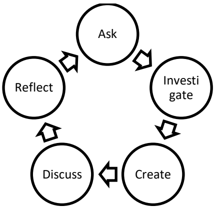
adapted from Carin, Bass and Contant, 2005 will be used to explain further the inquiry cycle.

THE INQUIRY CYCLE

The inquiry cycle has 5 global steps namely: Ask, investigate, create, discuss and reflect as can be seen below:



Cyclic Inquiry model adapted from Carin, Bass and Contant, 2005

The inquiry cycle begins with learners asking meaningful questions which are inspired by genuine curiosity about the subject matter. For example in studying the respiratory system of humans, the students may come out with questions like; how does air move through the lungs and how does carbon dioxide go out of the lungs, how does oxygen move from the lungs into the bloodstream, what do you think happens to the gases that the body cannot use?, which organ do you think is made up of air-carrying tubes and tiny sacs? e.t.c. in studying the vertebral column as well the students may come out with questions like why are all the bones having a hole? What are the features of a typical vertebra? From what part of the body of the animal are the bones taken etc. Next, the learner investigates and gathers information by researching, studying, observing or interviewing an expert in the field, it could be their teacher or any other person.

In the create part of the cycle, as the subject matter becomes clearer, students begin to make connections and shape their thoughts and ideas out of their prior

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experience. They begin to compare and contrast the bones and bring out more distinguishing features like centrum, neural canal, neural spine etc. In the discus session, the learners are allowed to share their ideas with others by mixing up, with this they gather more information and deeper understanding of the topic. Most important aspect of the inquiry cycle is the reflect stage where learners step back and take time to look at their initial questions, the investigations and conclusions made. At this point new questions might crop up and the cycle may continue. The teacher can then evaluate the lesson to determine the extent to which the specific objectives have been achieved.

KINDS/FORMS OF INQUIRY- BASED APPROACH

Inquiry-based learning can take so many forms, but National Research Council (NRC, 1996) classified it into three kinds:

a. Structured inquiry
b. Guided inquiry
c. Open inquiry

Structured inquiry: Structured inquiry is the most teacher-centered. The teacher provides fairly structured procedures for the inquiry-activity, and students carry out the investigations. Structured inquiry could be described as the most traditional approach to inquiry (NRC, 2000). Here, the teacher provides the students with procedures on how to find the answer. The disadvantages are that lessons taught with structured inquiry are sure.

Guided inquiry: In this type of inquiry, the teacher poses a question and provides the students only with materials to be used in their investigation. The students must design the experiment themselves. Many topics work well with guided inquiry. Guided inquiry requires that students are familiar with the main steps of scientific inquiry-based assessment to monitor students.

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Open inquiry: In open inquiry, teachers supply students with the materials to investigate, but students must come up with the questions and methods for investigation, to ensure the success of this strategy. Colburn (2000) suggests that teachers can provide carefully planned inquiry-based assessments, create well established classroom rules for interaction and the handling of materials, offer guidance to students who show frustration and prepare guided questions following the activity that tie into standards. This approach provides a great opportunity for students to develop inquiry skills and articulate scientific reasoning through an inquiry-based teaching in biology (National Research Council, 2000). The use of inquiry-based learning approach allow students time to use their imagination, and originality, so as to develop divergent, convergent, associative and analytical thinking skills and attitudes needed to solve real life problems.

WHAT IS THE THEORY BEHIND INQUIRY-BASED LEARNING

Inquiry-based learning approach based on John Dewey's theory of learning (1910). John Dewey was a philosopher, psychological and educational reformer who contributed to and influenced education and social reforms especially in such issues like inquiry teaching and learning among others. Dewey states that 'knowledge emerges only from situations in which learners have to draw them out of meaningful experience'. Dewey argued that education and learning are social and interactive process and that the school as a social institution provides an environment in which social reforms can and should take place. He sees the classroom as a social context where student can take part in manipulating materials and thus form a community of learners who construct their knowledge together. Dewey believes that education should give every child the chance to grow up spontaneously, harmoniously, and all-sidely. Science should be practical oriented. An average child is inquisitive and so john Dewey believes in

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discovering science. He emphasizes engagement in work which yields worthwhile qualities.

According to him, progressive education is simply a child centered education whose aim is to produce a total child. It is a philosophy based on experience which is the best teacher. In progressive setting, the duty of the teacher in the learning is to provide a challenging and problematic situation while the learner must be given the freedom to find solutions to the problem. Hence, there is no spoon feeding of the learner by the teacher. Learning of science is thus by problem solving, not imparting of subject matter. Children should be engaged in works-hands-on, minds-on activity.

The obvious implication of Dewey's theory in this study is that in the learning process, students must be engaged in meaningful activities that induce them to apply the concept they are trying to learn. The teachers' role should be to provide enabling environment for active learning to take place. Such an environment could be through inquiry-based learning approach. The use of inquiry-based learning approach will provide the enabling environment in which the students will actively participate in classroom learning activities. This study therefore aims at applying the propositions of Dewey's theory through the use of inquiry-based learning approach which is activity oriented.

BENEFITS OF INCORPORATING INQUIRY-BASED LEARNING IN BIOLOGY CLASSROOM

Inquiry-based learning has numerous benefits:

- It helps to stimulate and sustain students' interest in biology.
- Inquiry-based learning approach allows students time to use their imagination, and originality, so as to develop divergent, convergent, associative and analytical thinking skills and attitudes needed to solve real life problems.

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- It increases student' ability towards critical thinking and better understanding since the students are in more control of the learning.
- Inquiry based learning combines the curiosity of students and scientific method while learning biology.
- It provides a great opportunity for students to develop inquiry skills and articulate scientific reasoning through an inquiry-based teaching.
- It makes the students active participants rather than merely passive listeners. Students are constantly interacting with the material and making personal connection to the content. This enables them to retain what they have learnt in long term memory.
- Inquiry based learning increases knowledge since the method poses a challenge for the students.
- The training acquired in finding out things for one self independently can be applied to new learning and problematic situations.
- The joy of discovering something through inquiry provides the students with intrinsic motivations.
- Inquiry science classroom helps students develop skills for lifelong learning and cultivate responsibility because they become decision makers while learning. For instance, the students may decide what interesting questions they will investigate and where they will go for information. Berecter (2012) described the inquiry classroom as knowledge building classrooms where students gain greater satisfaction in working with other science students
- Inquiry based learning inculcates in the students the usage of the same ideas as scientists do when they are conducting research. In practice students will be familiar with the process used by scientists and knowledge results.
- Research has shown that hands-on-course work bolster skills and confidence in both male and female students, and to close achievement

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gaps between young men and women(Burkman, Lee & Smerdon, as cited by Folorunso, 2014)

- Inquiry based learning approach creates collaborative learning environment. Such environments have been shown to be more attractive to women than highly regimented classrooms and creating an inviting science classroom.
- Inquiry based learning operates at the highest levels of the cognitive domain; it encourages analytical and synthetic thoughts as well as intuitive thinking.

DISADVANTAGES OF INCORPORATING INQUIRY-BASED LEARNING IN BIOLOGY CLASSROOM

- Inquiry method is time-consuming and progress comparatively slow.
- Inquiry method is ineffective for students of low intellectual ability.
- Inquiry method is only good for a small class where effective teacher supervision is possible.
- Inquiry method leaves open the possibility of not discovering anything. Students may end up discovering things other than what was intended to be "discovering". This could be highly demoralizing to them particularly if great efforts have been expended.

HOW CAN A BIOLOGY TEACHER USE INQUIRY-BASED LEARNING IN THE CLASSROOM

An example of how a biology teacher can effectively teach using inquiry-based approach can be illustrated using the lesson plan below:

Topic: The ribs and the vertebral column of a rabbit.

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Behavioral objectives: At the end of the lesson, the students should be able to:

1. Identify with or without reason the bones of the vertebral column.
2. Identify the five main features of a typical vertebra.
3. Recall from memory the number of vertebrae in each region of the vertebral of column.
4. Differentiate between a true rib and a false rib.
5. Explain the term floating rib.
6. Raise questions on the observed features of any vertebra.

Instructional materials: Rib bones of a rabbit, bones of the vertebral column of a rabbit such as cervical vertebra, thoracic vertebra, lumbar vertebra, sacral vertebra and caudal vertebra, practical biology text books, charts on mammalian skeleton, marker board, marker and duster

Entry behavior: The students have studied the skull, atlas and axis vertebrae of rabbit. They have idea of what a vertebrate is.

Instructional Procedure:

Content development	**Teacher's Activities**	**Students' Activities**	**Strategies**
Step1 grouping the students	The teacher puts the students in groups of six depending on the population.	Students respond quickly to the grouping arrangement	Organization of IBL approach.

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Step 11 Introducing the IBL approach	The teacher asks the students to attempt the meaning of inquiry-based learning (IBL) approach. She then coordinates the students' responses and ensures that the students get the concept of 'IBL' as a student-centered and student-lead process with little or no guidance from the teacher. Students are engaged in active learning based on their own questions. Learning activities are organized in a cyclic way called the inquiry cycle. It has 5 global steps. She shows the steps diagrammatically on the board thus:	The students attempt the teacher's questions, and rehearse the steps with the teacher	Introduction

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	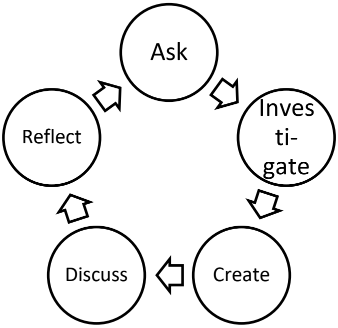 Teacher ensures that students understand what is involved in each step by asking and answering their questions The teacher asks the students to define a vertebrate. From their definitions, she ensures that the students understand the relationship between the backbone and the vertebral column by asking the students to touch each other's back from the base of the skull to the hip bone. This is the vertebral column. She writes the topic on the board	The students attempt the teacher's questions. They touch each other's back from the base of their skull to the hip.	Introduction

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	and asks students to state the function		

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Step 111 practicing the IBL approach	The teacher gives the following bones and materials to each student-cervical vertebra, thoracic vertebra, lumbar vertebra, sacral and caudal vertebrae, rib bones, practical biology textbooks, charts on vertebral column of a rabbit. The teacher instructs each group to go through the texts and charts, study identify the bones and react on their findings by following the steps of the IBL approach critically. She warns that each step should not take more than 10 minutes. The teacher ensures that students 1.Ask meaningful questions among themselves in order to find out the parts of the body where each vertebra come from and the number of bones that make up each region of the vertebral column, for example cervical- neck region, thoracic-chest region.	The students collect the bones from the teacher namely the cervical, thoracic lumbar, sacral and caudal vertebrae practical biology textbooks, charts o vertebral column of a rabbit. Using the above, students critically observe, identify and study the bones. They react by following the step involved in the IBL approach thus:	Reading Questioning Observing Identifying Monitoring Reflecting

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	Lumber-upper abdomen, sacral-lower abdomen, caudal-tail region etc. 2. Investigate and gather more information about the bones of the vertebral column by reading, observing, identifying and interviewing an expert in the field as the teacher or any other person. 3. Connect and shape important thoughts and ideas out of their prior experiences by comparing and contrasting the bones of the vertebral column taking note of the distinguishing features like the centrum, neural canal, neural arch, neural spine, transverse process and anapophyses. 4. Enter into discussion by stepping out from their	1.Asking meaningful questions amongthemselves in order to find out the distinguishing features of each vertebra and parts of the body where each vertebra comes from, the number of bones that make up each region of the vertebral column etc. 2. Investigating and gathering more information about the	Explanation Investigating Compari

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	various groups, mixing with other groups, sharing ideas and experiences like the articulation of the ribs with the vertebral column (thoracic vertebra) at the back and the sternum in the front, the last two pairs of the rib (floating ribs) do not touch the sternum. 5. Reflect by returning to their individual groups and taking time to look at their original questions, the investigations and conclusions made. At this point new questions might come up and cycle may continue. Using the inquiry cycle, the teacher ensures that students learn accordingly in their groups. She corrects their mistakes and puts them through the important points. She answers their questions	bones of the vertebral column by interviewing an expert in the field either their teacher or any other person. They note their findings. 3. Connecting and shaping new ideas with old ones by comparing and contrasting the cervical from the thoracic and lumbar vertebrae etc. 4.Most importantly, the students	ng Contrasting Drawing Labeling

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	where and when necessary.	enter into discussion by stepping out and mixing with other groups, sharing ideas and experiences with each other. They identify the features of a typical vertebra such as the centrum, neural canal, neural arch, neural spine, transverse process, articular surfaces, metapophyses and anapophyses etc.	Discussion Exchange of ideas Reflecting Monitoring

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		5. Reflecting by return to their individual groups, they take time to look at their original questions, the investigations and conclusions made. This might prompt new questions. As the inquiry cycle goes on, the students ask and answer the teacher's questions where necessary.	
Step IV Drawing of the cervical,	The teacher ensures that students draw and label the anterior view of the cervical, thoracic and lumbar vertebrae	The students draw the anterior view of the cervical, thoracic, and	

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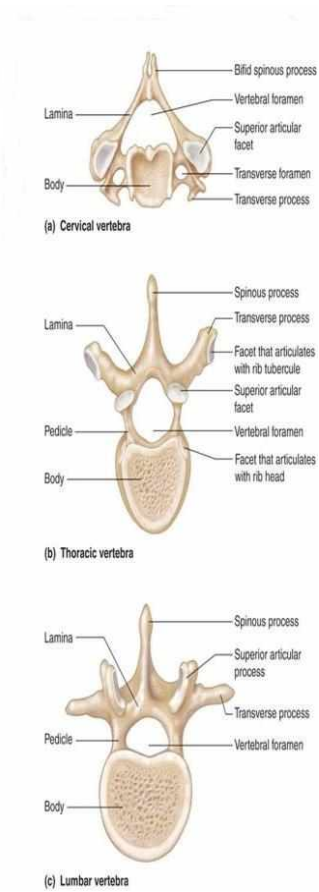
thoracic, and lumbar vertebrae	of a rabbit thus  Teacher gives the students the following questions to	lumbar vertebrae	Drawing

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	evaluate themselves Briefly compare the structures of the cervical vertebra and the thoracic vertebra in rabbit. State five features of a typical vertebra. Mention three characteristics of the lumbar, cervical and thoracic vertebrae of a rabbit. Name the bone that articulates with the head of the rib. Differentiate between a true and a false rib. Explain the term floating rib. The teacher monitors the students, evaluates the extent to which the stated objectives have been achieved. The teacher ensures that they take corrective measures by correcting and answering	The students attempt the questions and note the corrections.	

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	their questions where and when necessary.		

CONCLUSION

In conclusion, inquiry science classroom are places where students inquire by asking questions, seeking resources, sharing information and formulating theories. Students develop skills for lifelong learning and cultivate responsibility because they become decision makers while learning. For instance, the students may decide what interesting questions they will investigate and where they will go for information. No wonder Bereiter (2012) described the inquiry classrooms as knowledge building classrooms where students gain greater satisfaction in working with other science students. Note however that when implementing the inquiry approach in the classrooms, Willoughby (2013) suggested the following strategies for the science teachers: teachers should

- Help students become aware of each phase of the process. Once the students are comfortable with each phase, they can move toward integrating all phases into the investigative process.
- Be aware of and correctly interpret students' behaviors and comments. Most students will occasionally need a nudge or hint to point them in a productive direction. Teachers should help students work as independently as possible, while being available to keep them moving in the right direction.
- Monitor their responses, because most students are familiar with traditional instructional approach. They are accustomed to being told the answer, but inquiry-based learning requires a different approach. If the teacher gives too many hints, provides too many answers, or asks too

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many leading questions during an inquiry exercise, students' interest is stifled. Teachers should rather supply what the students need to move forward with the investigative process, but should not ruin the process by letting the students know what will happen before they have the opportunity to find out for themselves.

- Establish, enforce and model high standards for work, communication and behavior.

THE WAY FORWARD

The curriculum planners, in the area of biology should develop student-centered and activity oriented curriculum in which students are allowed for greater participation in the teaching-learning process with students being in charge of their own learning.

The textbook writers should also write biology textbooks that include more students' activities, with related quizzes and teachers' guide.

Government agencies and professional associations whose responsibility it is to design and revise the curriculum for secondary schools should incorporate and emphasize the use of inquiry-based learning approach in teaching and learning of biology. Specifically, the inquiry- based learning approach should be emphasized as a teaching approach in biology.

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ISBN: 978-978-798-430-7

References

Bereiter, C. (2012). Education and mind in the knowledge age, Mahwah, N. J: Eribaum.

Burkman, D; Lee,V; &Smerdon, B.(1997). Gender and science learning in early high school; subject matter and laboratory experiences. American educational research journal, 3-4(2),297-331.

Carin, A.A., Bass, J. E., &Contant, T.L.,(2005). Methods for teaching science as inquiry (9th ed),upperraddleriver, N.J: Pearson prentice hall.

Colburn, A. (2000). Inquiry and the national science education standards. Washington: National Academy Press.

Comparative Educational Studies and adaptation centre CESAC (2004). National curriculum for secondary school biology. Abuja: Federal Government Press.

Federal Republic of Nigeria (2004), National Policy on education Abuja: Federal Government Press.

Folorunso, O. (2014). Effect of argument –based inquiry on acquisition of skills and interest in biology. An unpublished Ph. D. Thesis, University of Nigeria, Nsukka.

Galileo Educational Network Association (2005), 'What is inquiry'? Retrieved December 2013 from wwwigalileo.ors/inquiry.what.html.

National Research Council (NRC) (2000), Inquiry and the national science education standards. A guide for teaching and learning. Washington, D.C. National Academy Press.

WEBSITE: https://globaljournalhub.com
ISBN: 978-978-798-430-7

Nwagbo, C.R.(2006). Effects of two teaching methods on the achievement in attitude of students of different levels of scientific literacy, International Journal of Scientific Research, 45,216-229.

Nwosu, A.A. (2015). Science Education for Life in a Dynamic World. 100th Inaugural lecture of the University of Nigeria, Nsukka. 44-49

Onyegegbu, N. (2008) Using New Technologies in Creating Excitement in Biology Educational Research and Review (Online Journal) (ERR) Vol 3(1) pp.010-013. Available online.

West African Senior School Certificate Examination WASSCE (2012) Chief examiner's report, Biology 1 & 2b. WAEC Publications.

West African Senior School Certificate Examination WASSCE (2021) Chief examiner's report, Biology 3. WAEC Publications.

Willoughby J. (2013). Using inquiry in science instruction. New York:Glencoe/McGraw-hill,inc.

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ISBN: 978-978-798-430-7

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ICT AS A 21ST CENTURY STANDARD FOR NIGERIAN TEACHERS

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INTRODUCTION

Education is the process through which society regenerates itself and hands down not just culture but also its discoveries and inventions, institutional memory and its entire wealth of expertise to younger generations. Education is therefore the soul of society and if we remove education the society decays and "withers" away, to use the words of Karl Marx (1848). Education itself is like a vehicle which has the teacher as driver. No factor of production or input is more critical in the education system than the teacher. The teacher determines the pace of progress of any educational system; and his or her actions can make or mar the system. The job of the teacher is so powerful that it can be said to be the reproduction of society. In this case, a society can only be as good as its teachers. This is what the National Policy on Education (2008) implies when it states that "no education system can rise above the quality of its teachers." In another sense,

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the school is said to be a microcosm of society meaning that a school cannot operate in isolation from the society - the school must be part and parcel of society by reflecting its culture, values, norms, aspirations and hopes.

In consideration of the great importance of the teacher in the society, it is expedient to have teachers who are best equipped to reproduce it. In talking of any particular society therefore, a key question is, what does the society require to perpetuate itself and to make maximum progress for its current generation? Also, does the society have teachers that possess the knowledge, competencies, attitudes and values required to bring about this perpetuation and maximization of progress? Since this paper makes reference to 21st century society and standards for teachers, the question therefore are, what does a 21st century society require to perpetuate itself and to maximize progress? The second question is, what knowledge, competencies, attitudes and values are required by a 21 century society to perpetuate itself and maximize progress? This paper answers these questions and further discusses the reasons why Nigerian teachers must play in accordance with international standards for knowledge, competencies, attitudes and values. The paper also highlights the ICT Standards for Nigerian teachers; the need to go beyond rhetoric towards solving Nigeria's ICT challenges; Teachers Registration Council of Nigeria (TRCN), efforts towards implementing the Standards; and the role expected of teachers, employers and other stakeholders in repositioning Nigerian teachers towards meeting internationally acceptable standard in ICT-aided teaching.

THE 21ST CENTURY: WHAT ARE THE HALLMARKS?

Generally speaking, the hallmarks for the 21st century are Orders - highly entrenched standards and systems of doing things as defined by the international community. Thus, we talk of the political, economic, social, intellectual, etc Orders. However, these Orders are primarily founded on scientific knowledge and spread by information and communication technology (ICT). Knowledge and

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ICT in turn propel globalisation. Taken together therefore, the 21st century is best known for scientific knowledge, ICT and globalization. Due to the preponderance of scientific knowledge, the 21st century is also called the knowledge society; and considering the pivotal role of ICT, it is equally called the information society.

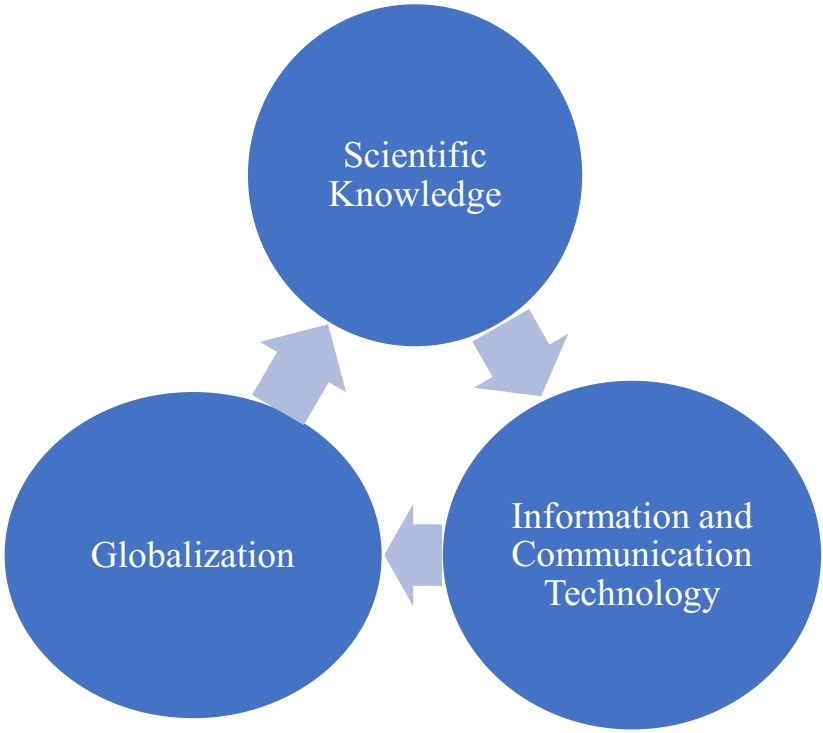

Fig 1: The foundations of modern society or the 21st century

Butcher and Associates (2011, p.3) in a commissioned thematic paper on "ICT, Education, Development, and the Knowledge Society" submitted to the Global e-Schools and Communities Initiative (GeSCI) of the United Nations ICT Task Force state that "knowledge society refers to a society where knowledge is the

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primary production resource instead of capital and labour." Quoting Evers (2003), Butcher and Associates outlined the characteristics of a knowledge society to include the following features:

Its members have attained a higher average standard of education in comparison to other societies and a growing proportion of its labour force are employed as knowledge workers, i.e. researchers, scientists, information specialists, knowledge managers and related workers;

- Its industry produces products with integrated artificial intelligence;
- Its organisations - private, government and civil society - are transformed into intelligent, learning organisations;
- There is increased organised knowledge in the form of digitized expertise, stored in data banks, expert systems, organisational plans, and other media;
- There are multiple centres of expertise and poly-centric production of knowledge; and
- There is a distinct epistemic culture of knowledge production and knowledge utilisation.

When modern society is referred to as information society, emphasis is laid on the pervasiveness and availability of information across geo-political borders. This information is often real time and made possible by ICT. ICT may be defined as "computer, ancillary equipment, software and firmware (hardware) and similar procedures, services (including support services) and related resources, any equipment or interconnected system or subsystem of equipment, that is used in the automatic acquisition, storage, manipulation, management, movement, transmission or reception of data or information (NITDA, 2001,). Similarly, according to the Techterms.com (2013), ICT "refers to technologies that provide access to information through telecommunications. It is similar to

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Information Technology (IT) but focuses primarily on communication technologies. These include the internet, wireless networks, cell phones, and other communication mediums."

Globalization may refer to "*the intensification of the world wide social relations which link distant localities in such a way that local happenings are shaped by events occurring many miles away*" (Held, 2014). According to Carpenter (2015), globalization "erodes and universalizes the characteristics of a local group." Similarly, Robertson (2013) sees globalization as "the compression of the world and the intensification of the consciousness of the world as a whole." As the process of globalization intensifies, more people, things and ideas move across international boundaries thereby creating what is today known as the global village. In the global village, space and time literarily shrink across the globe, people of different nationalities, cultures, polities, economies, ideologies and all forms of leanings interact and influence each other far more than ever imagined to the point that it is difficult to see a social or political entity that can successfully stand alone anywhere in the world.

WHAT HAS STANDARD GOT TO DO WITH TEACHERS IN NIGERIA?

The Oxford Advanced Learner's Dictionary defines the word standard as a "level of quality, especially one that people think is acceptable ... or a level of quality that is normal or acceptable for a particular person or in a particular situation." Basically, therefore, standard is a generally accepted point of reference and standards in the context of ICT in the 21st century, implies attaining a level of scientific knowledge, ICT and related features that places a country in advantageous position in the comity of nations. The implication of the 21st century characterized by scientific knowledge, ICT and globalization is that no nation can afford to be an island. Every aspect of the national life is interconnected with activities in other countries. Each country must therefore compete and seek to excel in scientific knowledge, use of ICT and the dynamics of globalization.

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Within the teaching profession, the continents and entire world are equally forging common fronts to see that the regulation of the profession has common yardsticks so that teacher qualifications, knowledge, competencies, values, rights and obligations are comparable across the countries. This is to ensure that the spirit of "teachers without borders" is realized. The aim is to make teachers global professionals, marketable worldwide, and globally competitive. It is also to ensure that the quality of teaching and learning in one country favourably compares with the quality of teaching and learning in another.

One instance of the need for Nigeria to have a standard is the Commonwealth Teacher Recruitment Protocol, a 2004 declaration of the Ministers of Education of the Commonwealth countries which states that teachers of the Commonwealth countries must be treated equally as their peers wherever they settle in the Commonwealth countries. This declaration which is now one of the world's most popular labour documents has inspired the Commonwealth countries to set standards for the teaching profession in the Commonwealth countries so as to have a concrete basis for equal treatment of teachers. A country that is not part of such standards cannot expect to be treated with respect or dignity by the foreign countries that subscribe to the standards.

Similarly, many countries in the last fifteen years have taken up the regulation of the teaching profession seriously depicted particularly by the establishment of teaching councils and enactment of laws and practices that make it mandatory for teachers to be registered and licensed before they can practice.

Nigeria, South Africa, New Zealand, England, Wales, Northern Island, the Republic of Ireland, and many other countries now have teaching councils. The Teaching Council for Scotland was set up as far back as 1966, South Australia (1976), Ontario (Canada) 1996 and in the United States of America (USA) the various States at different times created their own professional regulatory commissions. At the national level in the USA, the function of a teaching council

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is carried out by the National Board for Professional Teaching Standards (NBPTS) and the National Association of State Directors of Teacher Education and Certification (NASDTEC).

At the world level, the bodies that regulate the teaching profession in each country have come together under one umbrella called the International Forum of Teaching Regulatory Authorities (IFTRA) – visit www.iftra.org. The IFTRA headquarters is the General Teaching Council for Wales, United Kingdom.

Within the African continent also, the regulatory agencies of the various countries have formed a body called the Africa Forum of Teaching Regulatory Authorities (AFTRA), which has TRCN as the headquarters. The AFTRA operates as the Africa regional branch of IFTRA.

Both AFTRA and IFTRA have adopted resolutions part of which states that teachers wishing to teach in a foreign country must obtain what is called a *Letter of Professional Standing* from the country of origin before they could be favourably considered for registration and licensing in a foreign country. The Letter of Professional Standing is an attestation by the teaching regulatory authority of the country of origin regarding the quality of training that the teacher had, professional registration status, the level of the education system the candidate could teach and other vital information regarding the teacher.

Currently, TRCN has sent thousands of such letters in respect of Nigerians seeking professional registration and teaching appointment abroad. Without a positive report from TRCN, a candidate would find it difficult to get recognition, let alone a teaching appointment as a teacher abroad.

Based on the foregoing, Nigerian teachers could see that standards in the teaching profession is inescapable. To simplify the issue of standards for teachers, TRCN has published a landmark document which is one of the best not only in Nigeria but among the teaching councils in the world. The document,

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called Professional Standards for Nigerian Teachers contains 84 Standards that every teacher must aspire to meet (TRCN, 2012). The Standards are grouped into four such as:

- Professional knowledge
- Professional skills
- Professional values, attitude and conduct, and
- Professional membership obligations of the teacher

The knowledge and skills expected of teachers by the Professional Standards include the requisite ICT knowledge and skills that meet the standards of the world body (IFTRA) and other relevant international agencies. The document presented to the public in 2011 by Nigeria's Honourable Minister of Education, Professor (Mrs.) Ruqayyatu Ahmed Rufai, has instruments to be used by employers of teachers and other relevant agencies to assess each teacher's performance with respect to the 84 Standards. TRCN therefore issued policies to the effect that the promotion of teachers and appointment into leadership and sensitive positions within the teaching profession must be based largely on a teacher's performance in respect of the professional standards.

WHY IS ICT IMPERATIVE FOR 21ST CENTURY NIGERIAN TEACHERS?

The need to operate in accordance with global Orders and standards makes ICT as an indispensable standard for the 21st century teaching and learning in Nigeria. It has already been stressed that the modern world is an information society, driven by a complex set of digital devices and telecommunication networks and having the world wide web as an all-encompassing platform. The teachers can no longer credibly do their jobs without themselves being leaders in ICT. As teachers, they are leaders as well as flag-bearers; they are managers; they are opinion leaders and molders; they dictate the pace of learning and the

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direction of change; they evaluate learning and give verdicts about learners' abilities which shape the life chances of learners; their influences even go beyond the walls of the classrooms and schools and they could ignite and manage revolutions; etc. Such powers vested on the teacher by virtue of their jobs cannot be exercised responsibly and successfully when teachers wallop in ignorance and are themselves no better than the children whose character and intellect they are molding.

It has become a public scandal recently that many teachers cannot even pass the examinations set for students under them. Which direction is such educational system heading?

Teachers cannot give what they do not have. As stated by the National Policy on Education (2008), it is difficult for students to attain their highest academic potentials while being groomed by teachers who themselves are ignorant of the exploits they could do with the main driving force in modern times such as ICT. As the most important agents of change and the pivot of the education system, teachers ought to be master of the art in the use of ICT considering that the students they are teaching are "digital natives", born into the ICT culture and who can best be taught and groomed using ICT. Amazing number of students today are familiar with the internet (the world wide web), the search engines, many software applications online and offline, hardware, etc. They communicate through a variety of social media like Facebook, Twitter, Skype, Yahoo Messenger, LinkedIn; Skills Page; YouTube; etc. In a single handset they could have over 100 applications running live, informing and entertaining them. They also have electronic games to play with and during one of my studies in Israel, we have been taught by a Professor of Business Administration in Haifa University of California United State America how much profound games have become in intellectual and professional development. The Professor taught us that games could even be used to successfully simulate and operationalize any form of managerial, scientific and even warfare task before finally confronting

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them physically. While the students carry out such exploits, teachers cannot just remain complacent.

During a study to primary and secondary classrooms in the United States, Canada and the United Kingdom, the picture there is that a class is literarily run with ICT. There are of course no chalk boards, only electronic writing boards. Whatever is written on the boards is automatically recorded and uploaded in the intranet or the website. A student who is absent from class is truly not absent because he or she can tap into the lessons of the day and review the entire programme. Both lessons taught and assessments of students done by teachers are available online for parents and supervisors to access. The curriculum is not just one copy of a book tucked away in the principal's office as done in most Nigerian schools. Rather, the curriculum is running 24/7 on the internet and students, teachers and parents could well in advance understand the areas of coverage and the curricular standards for judging success. While Nigerian schools and teachers are far away from meeting such standards, it has become expedient for the Nigerian education system and teachers in particular to take the first steps in this direction.

According to Abanikannda (2011),*"ICTs are one of the major contemporary factors shaping the global economy and producing rapid changes in society. They have fundamentally changed the way people learn, communicate and do business. They can transform the nature of education - where and how learning takes place and roles of students and teachers in the learning process. The processing of information to build knowledge is one of the essential literacy skills vital for the workforce in the 21st century, which has still not been adequately utilized in our educational system. In order to function in the new world economy, students and their teachers have to learn to navigate large amounts of information, to analyse and make decisions, and to master new knowledge and to accomplish complex tasks collaboratively.*

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Futhermore, Olorundare (2011) listed eight potential benefits of the utilisation of ICT in curriculum and instruction by teachers. According to him, the benefits are:

- It accelerates and deepens students' basic skills in any schools subject especially reading, mathematics and the sciences;
- It challenges students to learn, be independent and hence be responsible;
- Helps update students' academic knowledge and instructional practices;
- Prepares the individual learner to economically survive and become productive in tomorrow's world of work which depends on ICT;
- Teachers are provided with efficient and effective tools to take care of students' individual differences;
- There are opportunities for close co-operation with colleagues in the same or even other fields though networking and internet services;
- Educators are challenged to new methods of acquiring knowledge through knowledge sharing and be ultimately connected to the world; and
- Unrestricted access of teacher and students to relevant information and developments in subject areas. Other experts' peers and policy making institutions can also be readily contacted.

Going by the above realities and benefits of ICT to the teacher, it can be emphatically stated that ICT provides an indispensable standard or platform for teachers in the 21st century Nigeria. Therefore, going by curricular provisions in the various teacher education national benchmarks for the Nigeria Certificate in Education (NCCE, 2008), Bachelors Degree in Education (NUC, 2007), Post Graduate Diploma in Education (TRCN, 2012), Professional Diploma in Education (TRCN 2012), Post Doctoral Diploma in Education (University of Ilorin, 2010), and others, Nigerian teachers are expected to be conversant with the use of computer, internet and internet resources, digital educational tools, hardware and software application packages and related telecommunications devices. TRCN has gone a step further to endorse an international computer basic

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certification course ran by Certiport, United States of America as alternative to the ICT curriculum prescriptions for teacher education in Nigeria. In the Certiport curriculum called "Internet and Computing Core Certification (IC3) Curriculum", which covers over 80 ICT topics are expected to deal with three key areas, namely, "computing fundamentals, key applications and living online." The Certiport certification is intended to take teachers beyond tasks in education to enjoying an all-round fruitful life as citizens of the information society.

IMPEDIMENTS TO ICT-BASED TEACHING IN NIGERIA: GOING BEYOND RHETORICS

It is now boring to see persons who speak on the integration of ICT in teaching and learning in Nigeria devote more time to chronicling and analyzing hindrances to ICT revolution in Nigeria and doing less research on how the ICT revolution in Nigeria could "silently" be achieved. For, it is said that "Rome was not built in a day" and that "journey of a thousand miles" begins with a step (Fafunwa). Nigeria must go beyond the palpable despair that "nothing works" to embrace the *"audacity of hope"* that a lot can work in Nigeria. For instance, rather than lament about poor electricity generation, the academia and industry should deepen research and sensitization about alternative energy sources - cf. Israeli experience where it observed that solar panel is found on virtually all roof tops in Israel to ensure alternative power supply. Rather than lament about the high cost of computers, scholars and industry through research should come up with mini and affordable computers. They should further help teachers and citizens to unlock the great potentials of the tiny gadgets and mini-computers already in their hands, pockets and environment such as the GSM handsets, pocket video recorders, still cameras, wi-fi, Bluetooth gadgets and dozens of other ICT facilities. Enough digital revolutions are going on even in the rural and illiterate parts of many advanced and advancing countries with these little ICT infrastructures.

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For instance, the handsets as much as any computer can, do give internet access, link up with e-books, allows the use of search engines, use of emails, video-calls, video-conferences, and other incredible exchange of data and information. Indeed, it does seem to me that I am conveniently meeting 80% of my digital needs as a teacher and world-class citizen with the small Blackberry phone in my pocket!

Similarly, hundreds of thousands of teachers could be taught to do even more with their Nokia, Samsung or any other sort of gadgets in their hands. This is in fact why the e-learning conferences and exhibitions such as this West Africa eLearning Conference and Exhibition are very essential because they help to expose the academia and citizens to emerging ICT solutions to traditional problems rather than wallowing in ignorance and endlessly blaming our past and present leaders or even the "gods" for making us Nigerians. This is by no means an exoneration of the failure of leadership in Nigeria but a call for resourcefulness and ingenuity.

TRCN EFFORTS AT BRIDGING THE DIGITAL GAP FOR TEACHERS IN NIGERIA

The Teachers Registration Council of Nigeria (TRCN) as the apex regulatory agency of the Teaching profession (Federal Republic of Nigeria, 1993) has taken the lead to launch the profession into the mainstream of the digital world. Several writers talk of the young generations of Nigerians as "digital natives" while the older generations where most of the Nigerian teachers belong as "digital immigrants".

The digital natives are born right into the ICT milieu and right from their infant days up to growing up, they are naturally, unavoidably and pervasively exposed to the use of information and communication technology - they are simply born into the ICT culture. Contrarily, the immigrants are having ICT introduced to them at the adult phase of their lives where the technology confronts them as a

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strange phenomenon. In that case, the immigrants experience either positive adjustment or mal-adjustment with varying success rates in the use of ICT. In helping teachers most of whom are digital immigrants to appreciate ICT and to catch up with their peers around the world, TRCN has driven some landmark initiatives some of which could be highlighted here just briefly:

TRCN declared 2007 as ICT Year for Nigerian Teachers

TRCN declared the year 2007 as ICT year for teachers in Nigeria during which it advocated that the greatest part of resources and efforts for professional development of teachers be dedicated to their ICT training. TRCN used all channels of communication within its reach to spread this message and embarked on advocacy at a national scale to ensure implementation among teachers, teachers unions, employers of teachers, development partners and general stakeholders. The outcome was profound because any scholar that carries out research into teachers' engagement in ICT could notice a rapid increase beginning from 2007 and that was strongly tied to the TRCN advocacy.

TRCN 2007 ICT Capacity Building for Teachers

TRCN did not only urge other stakeholders to step-up teacher development in ICT but also sourced for funds and mounted what is yet the most extensive training programme given to teachers nationwide by TRCN. TRCN created twelve ICT training centres (two in each geo-political zone i.e South-East, South-South, North-East, North-South North-Central and North-West, making a total of 12 centres).In each of the 12 centres, teachers nominated by the state governments were trained free of charge. The training lasted for one week and each centre had a minimum of 100 computers with live internet running and the best of ICT experts in Nigeria and USA were used as resource persons. At the end of the training, participants wrote examinations and the first three best candidates for each training centre were given computer laptops as prizes by

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TRCN. Over 3,600 teachers were trained in the twelve centres. Before that time, no organisation, government or employer in Nigeria has given ICT such attention in the training of teachers.

The 2007 attempt at introducing virtual management of classrooms in Nigeria

As part of the 2007 ICT Year for Teachers in Nigeria, TRCN also commissioned a USA-based ICT company, Skills4Industry Inc., to come up with classroom management software that integrates the American and Nigerian experiences into one of the best virtual classroom management software as well as create a dedicated website for the professional development of Nigerian teachers. These were achieved and teachers who took part in the 2007 ICT capacity building programmes were also trained in the use of the virtual classroom management software. The software working in conjunction with the website dedicated to teachers ensures that teachers and school managers could almost 100% do away with the use of papers and yet have a more effective data of students' performances. It also guarantees that teachers could hold their classes from anywhere on the globe and that students could effectively participate in such classes also from anywhere on the globe as long as they have access to computer and internet.

The UN ICT Award for TRCN Chief Executive and Director of Operations

The International Conference on Electronic Governance, ICEGOV (www.icegov.org) which held 10-13 November, 2009 in Bogota, Colombia, South America, adopted the 2007 TRCN ICT initiatives for Nigerian teachers as the very best ICT initiatives in the world for 2009 and therefore awarded the World's

Best ICT Practice (2009) to TRCN Registrar/Chief Executive and Director of Professional Operations. The ICEGOV is organised by United Nations

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University (International Institute for Software Technology, Macao China) and other United Nations agencies as well as the Centre for Technology in Government (University at Albany, State University of New York, USA) – see Wokocha and Nwokeocha (2009).

Curriculum Review for all categories of teacher education (PDE, PGDE, PDDE, B.Ed)

TRCN has collaborated with National Universities Commission (NUC) and the National Commission for Colleges of Education (NCCE) to ensure that the National Benchmarks for all categories of teacher education programmes have sufficient curricular provision for ICT.

Accreditation of teacher education programmes with particular emphasis on digital learning, quality academic staff and credible admission prerequisites for student teachers

In line with its statutory powers, TRCN for two years now has paid accreditation visits to over fifty teacher education institutions to monitor the quality of teaching and to accredit institutions that meet the National Benchmarks. During the accreditation visit, emphasis is laid on digital infrastructure and provision of e-learning opportunities for student teachers.

Actually testing the quality of Education graduates through Professional Qualifying Examinations (PQE) that has ICT as part of the core/mandatory domains

In 2008 TRCN introduced professional qualifying examination which has ICT knowledge and skills as part of the core emphasis. About 50,000 sat for the examination held in every state capital in Nigeria and Abuja, the Federal Capital Territory. TRCN collaborated with the Joint Admissions and Matriculation Boards (JAMB) in the administration of the examinations using the same

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technology used by JAMB to print, administer and mark the examination papers and results were released within 24 hours after writing the examinations. The PQE is a legacy that TRCN is currently fine-tuning and striving to institutionalize.

Online registration of teachers

The online registration of teachers is a novelty among the professional regulatory agencies in Nigeria. It is the first and up till date the only online registration of professionals in Nigeria. The creation of the online registration option and availability of many other online services to teachers have underscored the seriousness with which TRCN views ICT and have greatly motivated teachers to improve their ICT skills.

Promotion of eLearning Conferences, Workshops and Exhibition among Nigerian teachers (see www.elarningafrica.com; www.icwe.net, etc)

TRCN is also providing opportunities for Nigerian teachers to meet their peers and leaders in e-learning technologies by participating in elearning conferences and exhibitions. For this reason, TRCN has popularised e-learning conferences and exhibitions including the ICEGOV, eLearning Africa Conference (organised by the German firm called International Conferences, Workshops and Exhibitions, ICWE GmbH), and many others.

In 2012, TRCN ensured the co-location of the 1st AFTRA Teaching and Learning in Africa Conference with the 7th eLearning Africa Conference which held 23-25 May, 2012 in Cotonou, Republic of Benin.

TRCN adopts the Private-Public-Partnerships (PPP) Model to advance the ICT cause for teachers

Apart from having worked in the past with leading local and foreign ICT firms for the benefit of teachers, TRCN is currently working with several others for the

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same purpose. One of such firms is the Commit Technologies and Consult, Lagos which TRCN has endorsed to lead the implement of the Certiport (USA) Internet and Computing Core Certification (IC3) Curriculum through collaboration with teacher education institutions, ministries and agencies of education and other stakeholders throughout Nigeria.

Massive advocacy through policies at the National Council on Education

As a professional watchdog, TRCN is also constantly updating the National Council on Education (NCE) which is the highest policy making body in Education in Nigeria with the latest developments affecting the teaching profession and proposing plausible policies to keep Nigerian teachers at par with their peers globally.

SELF-HELP EFFORT AS KEY TO UNLOCKING THE ICT POTENTIALS OF TEACHERS

Teachers have a key responsibility for their professional development. They must realise that self-motivation and interest are the underlying factors for success in professionalism. Self-exoneration is unacceptable and self-defeating. Most great men and women that are today described as geniuses engraved their names in the sands of time, not because there were no difficulties at their time but because they had inner flame burning in their hearts to overcome the difficulties witnessed by their generations. We do often say that teachers or Nigerians who use ICT the most are not necessarily those given training opportunities by either their employers or other benefactors. Rather, such teachers and Nigerians had inner drive and motivation to learn and exploited every opportunity for self-education available to them. I challenge scholars here present to help investigate and refine this thesis by doing a good research work in this direction. Perhaps the findings of such research could help appreciate the role that self-motivation and socio-psychological factors play in helping humanity to achieve goals in life.

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Perhaps also this is where the role of motivational speakers are most relevant. Often times, people live and die with unfulfilled dreams because they kept searching for help from outside without realising how much power lies within them. Today, one can comfortably regulating the teaching profession with emphasis on ICT; however, standing in this conference as a guest speaker on ICT; one have won world laurels for ICT work done for Nigerian teachers; one can word process at the speed of any professional secretary; and one can navigate and find my way round about any emerging digital technologies; and one think one could do all these most importantly due to self-interest and self-motivation. Without teachers taking their own destiny in their own hands (without self-motivation) teachers may not attain the heights in digital revolution commensurate with their natural potentials no matter the amount of investment in training from the government and employers.

THE ROLE OF EMPLOYERS OF TEACHERS AND OTHER STAKEHOLDERS IN BRIDGING THE DIGITAL GAP

The fact cannot be argued that government and employers of teachers are not investing enough on the training and retraining of teachers - surely great efforts are being made by governments and employers but the efforts simply are not sufficient to enable the teachers achieve parity with their peers in the advanced countries. This is why most discussions on the capacity building of teachers end up with the same recommendations - call for more funding. However, there ought to be attention beyond mere call for more funding to focusing on some other real issues, for instance,

What happens to funds already released for teacher capacity building - are we spending or investing on teacher capacity building?

How are we utilising the facilities, resources persons and mentors within existing schools to impact positively on the quality of teachers? That is, how much school-based professional development is going on in the schools?

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The train-the-trainer investments: Are they working? What happens after the "trainer" is trained? Do investors follow up to evaluate the multiplier effects of their investments?

We can then discuss each of these three issues briefly.

Wokocha (2009) and others have consistently distinguished between "spending on education" and "investing on education". The first phrase has to do with the mere quantum or amount of money earmarked or announced as allocation to education or teacher capacity building while the latter has to do with the actual amount of the allocation utilized to accomplish the purpose for which it was allocated.

There is often a discrepancy between amount announced as allocation to education or teacher capacity development and the actual amount properly utilized to achieve educational and professional development objectives. This subject matter is again a real issue and threat to the development of teachers and should attract research by scholars. Since the education sector is not immune to corruption and misapplication of funds, the sector therefore cannot be less guilty of self-inflicted underdevelopment of the sector. In essence, solution to the underdevelopment of the teachers lies not only in increased funding but also efficient management of scare resources. Leadership is a key factor in this issue and calls for appointment of leaders with track records as heads of educational institutions and managers.

Also, professionalism cannot be overlooked because a leader cannot give what he or she does not have. Consequently, educational managers must be professionally trained, registered and licensed teachers.

Talking of school-based professional development, teachers and educational managers must realize that a lot of capacity building can go on in school using

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teachers as resource persons and available infrastructure rather seeing training as a phenomenon that goes on only outside the school. Peer reviews and mentoring could go a long way in improving the professional awareness of teachers. The World Bank (2005) funded a nationwide research on a number of strategies that could improve quality of teaching and learning and effective use of resources. Among the strategies were what the World Bank called "School Based Professional Development" and "Multi Grade Teaching Techniques". The research confirmed that so much learning could be accomplished by a school using the human and material resources available to it and that several classes can also be taught within the same classroom space where either teachers or classrooms are lacking. The lesson from this research is that schools must consciously focus on their inner potentials and should be able to account for a significant part of the development of their teachers and schools through internal re-engineering. This perspective is also in line with the advocacy for school based management - a perspective that wants schools to see and use the great potentials that they have inwards.

Many investors in teacher professional development including international development partners spend huge sums of money hosting "train the trainer" workshops. The expectation is that the trainers being trained would return to their schools and communities to replicate the same training and make materials given to them available to other teachers. But does this really happen? Experiences have shown that more often than not the training ends with the "trained trainers". Reasons for the inability of the trainers to train others may range from the usual lack of funds to conduct the training locally or even lack of political will on the part of the school managers to ensure that the training takes place. TRCN even constantly get reports of how educational managers accede slots for teachers to their cronies or political loyalists who may not even be teachers to attend professional development programmes especially when some allowances would be paid to participants or when it involves local travel allowances or international estacode. To some educational managers therefore and to some teachers,

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professional development is only a jamboree. For this reason, TRCN is stresses the importance of professional development by making it one of the criteria for renewal of teaching license. TRCN has therefore adopted strategies to accredit teacher professional development programmes in Nigeria and to keep accurate records of credits earned by teachers in professional development. The credits are being integrated in the records of all registered teachers in TRCN database.

Recommendations

Based on the facts discussed in this paper, the following recommendations are made:

1. The use of motivational speakers to inspire teachers to boost interest and motivation towards self help in the quest for digital skill advancement.
2. Laying greater emphasis on school based professional development.
3. Refining the concept and practices associated with the train-the-trainer model to give more value to teachers and investors.
4. The academia and industry should focus attention on research and development strategies that yield alternative sources of energy and cheap/affordable computers/mini computers.
5. Raising awareness and imparting skills on how available digital devices particularly handsets and other mini computers could best be utilised.
6. Exposing teachers to cheap sources of internet connectivity.
7. Monitoring and accreditation of teacher education programmes - which calls for improved budgetary allocation and financial assistance from international development partners to ensure qualitative implementation of ICT curricular prescriptions.
8. The full implementation of the Professional Standards for Nigerian Teachers by employers of teachers and other critical stakeholders.
9. Skewing the re-training of teachers in the years ahead in favour of ICT.

ISBN: 978-978-798-430-7

Conclusion

The paper has touched on the key features of the 21st century and the associated prominence of scientific knowledge, ICT and globalisation. It raised the point that Nigeria cannot stand alone in a globalised world driven by ICT. Therefore, it is imperative that all citizens, particularly teachers who are pivots of the education system to embrace ICT and participate effectively in shaping the modern world, that is the only way that Nigerians could be partakers in the advantages accruing to the 21st century nations.

References

Banikannda M. Oluwafemi (2011). Integrating Information and Communication Technology (ICT) into Teacher Education. D.O Durosaro and A.A Adegoke (Eds.), *Higher Education andGlobalisation,* Ibadan: Stirling-Horden Publishers Ltd, pp. 3-10.

Butcher Neil and Associates (2011). *ICT, Education, Development, and the Knowledge Society: A Thematic Paper prepared for the GeSCI*(Founded by the UN ICT Task Force).

Carpenter, John B. (2015). Puritan Missions as Globalisation. *Fides et Historia, 31:2, p. 103.*

Certiport (2013). *Internet and Computing Core Certification (IC3) Curriculum:Computing Fundamentals, Key Applications, and Living Online.* American Fork, UT: Certiport.(www.certiport.com).

Commonwealth Secretariat (2004). *Commonwealth Teacher Recruitment Protocol: Adopted by Ministers of Education at Stoke Rochford Hall*

ISBN: 978-978-798-430-7

Conference Centre, Lincolnshire, United Kingdom, September 1st. London: Author.

Evers, H. (2003). Transition towards a Knowledge Society: Malaysia andIndonesia in Comparative Perspective. *Comparative Sociology,* Vol 2, Issue 1, pp. 355-373.

Federal Government of Nigeria (1993). *Teachers Registration Council of Nigeria Decree No. 31 of 1993*. Lagos: Government Printer.

Federal Republic of Nigeria (2008). *National Policy on Education. Abuja:* NERDC.

Held, D. (2014) Political Theory Today. Stanford University Press.

Karl, Marx (1848). *Manifesto of the Communist Party (Reprinted).* Moscow: Progress Publishers.

National Information Technology Development Agency, NITDA (2001). *Nigerian National Policy for Information Technology.* Abuja: NITDA.

National Commission for Colleges of Education (2008). *Minimum Standards for Nigeria Certificate in Education: A Summary of Minimum Standards for N.C.E Teachers 4th Edition*. Abuja: Departmentof Academic Planning, NCCE.

National Universities Commission (2007). *Benchmark Minimum Academic Standards for Undergraduate Programmes in Nigerian Universities: Education.* Abuja: NUC.

WEBSITE: https://globaljournalhub.com
ISBN: 978-978-798-430-7

National Information Technology Development Agency (2001). *Nigerian National Policy for Information Technology*. Abuja: NITDA

Olorundare, A. Solomon (2011). Utilization of Information and Communication Technology (ICT) in Curriculum Development, Implementation and Evaluation. D.O Durosaro and A.A Adegoke (Eds.), *Higher Education and Globalisation,* Ibadan: Stirling-Horden Publishers Ltd, pp. 11-30.

Punie, Y. (2007). Learning Spaces: an ICT-enabled model of future learning in the Knowledge-based Society. European Journal of Education, 42: 185–199. doi: 10.1111/j.1465-3435.2007.00302.x

Robertson, Roland (2013). *Globalisatoin: Social Theory and Global Culture*. London: Sage. Teachers Registration Council of Nigeria (2012). *Professional Diploma in Education: NationalMinimum Standards (Revised).* Abuja: TRCN.

Teachers Registration Council of Nigeria (2012). *Professional Standards for Nigerian Teachers*. Abuja: TRCN.

Teachers Registration Council of Nigeria (2012). *National Benchmark for Post-Graduate Diploma in Education in Nigeria (Revised).* Abuja: TRCN.

Techterms.com (2013). ICT (Information and Communication Technologies)Definition. http://www.techterms.com/definition/ict (accessed 25/03/2003)

University of Ilorin (2010). *Post Doctoral Diploma in Education*. Ilorin: University of Ilorin

Wokocha, Addison Mark and Nwokeocha, Steve (2009). E-Governance: Lessons from the Capacity Building Project and Online Registration of

ISBN: 978-978-798-430-7

Teachers in Nigeria. Tomasz Janowski and Jim Davis (Eds.), *Proceedings of the 3rd International Conference on Theory and Practice of ElectronicGovernance*, 10-13 November, 2009, Bogota Colombia, pp. 265-270. New York: ACM Press.

Wokocha, Addision Mark (2009). *Professionalism in Teaching and Learning and School Excellence*, Guest paper at the national workshop organised by NAT COM UNESCO at NCCE Abuja, March 23- 25

World Bank (2005). *Findings of the Research on School Based ProfessionalDevelopment and Multigrade Teaching Techniques*. Abuja: TRCN

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ISBN: 978-978-798-430-7

14

PSYCHOLOGICAL IMPLICATIONS OF TEACHER CLASSROOM BEHAVIOUR

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INTRODUCTION

The main focus and basis for classroom business is that of teaching and learning. The teacher who pilots the affairs in the classroom has to make sure that he conducts successful teaching and learning and he should make sure that opportunity is offered the learners for effective learning. To achieve this, he has to understand the relevance of the implications of psychology to his behaviour in the classroom. These implications can have effect in the way and manner the teacher goes about performing these activities bearing in mind the learners who are expected to have the desired change in behaviour as a result of those classroom activities.

The concept of Psychology

People all over the world discuss, interact to understand one another and how they influence or are influenced by what others do, say, think, desire or feel and so on. The bottom line of what these people want to understand, exhibit, discuss or influence is behaviour (Menkiti, 2012). For Nwachukwu (1992) creatures that breathe do a variety of actions and these actions form the subject matter of psychology. Originally psychology was derived from two Greek words- psycho, meaning mind and logos, meaning knowledge.

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Psychology was initially part of philosophy and this influenced the earlier definition of psychology. Two men in the 19th century were accredited as being the founders of psychology as a science and academic discipline that was different from philosophy. Their names were Wilhelm Wundth and William James. Wilhelm is especially regarded as the father of psychology.

Defining psychology is not so easy because of the various ideas of different schools of thought and areas in psychology, putting forth different explanations and definitions. This makes it difficult to arrive at one accepted definition. The result is that there are as many definitions as there are different schools and areas in psychology. As stated above, the earlier definitions of psychology were influenced by philosophy. Blancard .S (1893) in Zareal S. (2019) defined psychology as the study of the mind and later as both the science of mind and soul, but the snag is that no one can see, feel, touch either the soul or the mind but the content of the mind. It was later defined as the conscious activities an individual carries out every day in his working environment. But the first definition of psychology as the study of soul and mind and that of psychology as the study of conscious activities were eventually rejected, since the first was regarded as subjective and the second on the ground that consciousness is negligible in relation to the totality of man's action and behaviour.

Various psychologists searched for definition that can be measured and quantified in scientific terms .J. B. Watson (1913) in Menkiti (2012) came up with one such definition. He defined psychology as that division of natural science that takes human behviour-actions or doings, sayings both learned and unlearned as its subject. He thus became the father of 'behaviourism' after the renaissance or rebirth of learning, a great revolution occurred in the field of psychological thoughts and which helped to redefine the science of psychology. From this time onward, many new definitions have emerged from various psychologists in various areas of psychology, For instance, James (1890), in

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Russell (2019) defined psychology as the science of mental life both of its phenomena and the content. Wood and Wood (1993) In American Psychological Association (2003) defined. psychology as the scientific study of behaviour and mental process. Obidigbo (2003) conceptualized psychology as the science of human and animal behviour and how they can be modified. Boyack, keavans & Borner (2005) defined psychology as the scientific study of mind and behaviour. They see it as 'Hub' science connected to medicine, science, social sciences and education. Skinner (1974) in Menkiti (2012) defined psychology as the science of behaviour and experience Psychology is equated with observational learning characterized by elements of observational learning such as attention, reciprocation, and motivation (Bandara in Marks and Cambell (2021).

Currently, the study of the mind and cognitive process has started gaining ground in psychological field. However, what is studied is not the mind because of its abstract and subjective nature but the content of the mind and which manifest phenomenally as vision, sound, smell, emotion, thought and so on that humans experience mentally. The basic functions of the mind are thinking, (thought), feeling and wanting (desires) and these can be guided by our conscious rational capacities or by ones native egocentrism which tend to act automatically and unconsciously.

Goal of Psychology

The goal of psychology is to understand, describe, explain, predict and improve behaviour. Thus, contributing to our basic understanding of how people think, feel and behave- some within the applied setting to solve real world problems that have an impact on everyday life (Cherry, 2016). There are many branches of psychology– experimental, abnormal, development, clinical, personality, industrial, education and soon. Here the focus will be on one of the branches of psychology which is psychology of education. This is because this branch looks at teaching and learning situations, conditions of learning, the learning process, the learner's background characteristics (which examine the family condition, its

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dynamics and impact on the academic and social life of the learner, level of the learner's intelligence quotient, opportunities available to him for school activities and his disposition to learning). So much is involved in this branch of psychology that has implications for almost all aspects of human life. The title of this book chapter focuses on how psychological principles should be applied to education to bring about better teacher classroom behaviour for effective teaching and learning.

Scope and Contents of Educational Psychology

Educational psychology is that branch of psychology that focuses on how best learning can take place in order to produce well-rounded students/individuals to help them arrive at the achievement of their full potentials. Chauhan (2004) defines educational psychology as an applied discipline which combines the different fields of education and psychology in a scientific study of human behaviour, which can be understood, predicted, controlled and directed by education to achieve both educational and life goals. It is also the application of psychological principles to the practice of education, it is concerned with scientific study of human learning_ Menkiti (2012)

Educational Psychology has wide scope and contents: (a) To assist the teacher to understand the development of his students, (b) For the teacher to understand himself better –his strengths and weaknesses, assets and liabilities and how to improve on his/her weaknesses and utilize the assets for effective learning to take place (c) For the teacher to understand the learners, their background characteristics, the process through which they learn, their social relations /interactions among themselves in and outside the class, at play, at work, and how they interact and socialize with the academic and administrative staff in the school (d) Educational psychology gives the teacher a wide scope in research work and how to utilize the research work in the improvement of teaching and learning.(e) It helps the teacher in the understanding of the nature of classroom

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learning and the individual differences in learners. Also teachers are exposed to procedures for formulation of curriculum, and for measurement and evaluation procedures too.

Principles of Educational Psychology

Principles are guidelines that help to direct how things should be done. Therefore, understanding these principles of educational psychology will assist to make teaching and learning, meaningful and effective. The principles are the understanding of:

1. Student's differences in learning which the teacher has to utilize.
2. Learning styles through different senses: some learn simply through sight, in this case gestures and teaching materials are of utmost important, yet others through hearing and well articulated and well modulated voice is needed. For those who learn through both styles, the teacher has to combine the teaching strategies for the two styles.
3. Define learning and make it relevant: This means that what is being taught and learnt must be clear so that learners understand exactly what the topic is all about. It must be relevant to the needs of the society and learners themselves.
4. Kinetic learning can be used when its need arises, for kinetic learners need their body to be activated with the use of hand, leg, head motions, songs, music, and dancing, other physical exercises can take place.
5. Failure can motivate certain learners to be serious with their school work. Experience of failure may be a source of motivation and reinforcement and this may drive them to more serious academic work, thus improving their learning and overall results.
6. Integrate curriculum. This is where what is learnt in biology for instance can be integrated into agriculture, health study, or what is learnt in mathematics can be profitable in businesses of different dimensions e.g. Business Management, Business Accounting and so on.

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7. Caring for the introvert. There are learners who are shy, reserved and introverted. They keep to themselves in the class, can only answer questions when they are asked. Teachers should not forget or overlook such learners. Always be mindful of them and integrate them academically, more especially in social interaction in the class.
8. Create space. Class teachers from time to time should create time in course of teaching to allow students to make their own contributions to class activities, let them exercise their creativity in dealing with events in the classroom. Allow for brainstorming in proffering solutions to problems and finding correct answers. Create 'gaps' for the above to be achieved.
9. Organize meaningfully. Any class event, lecture and other activities should be systematically organized, whatever that is happening in the class should be organized by the teacher in such a way that learners understand every aspect of it, their own role, the role of the teacher, benefit derivable by learners and the results or the outcomes.
10. Use of proper methods for each subject. It is of utmost importance that there should be proper method for each topic since there are varieties of topics even in a particular subject. One may require activity method or discussion method while another may require the use of dramatization. Teachers should be well grounded in the use of these methods and their proper applications.
11. Use of modern technology; This is necessary so that learners will be able to use the gadgets to source for any information needed to enhance learning. This will afford learners the opportunity to do less memorization or cram work. This also saves teachers time. These modern technology gadgets include smart phones, video computers, I-pad. Conventional instructional materials can be used by the teachers
12. Feedback is crucial in teaching and learning situation. The learner deserves to have knowledge of results to understand and evaluate his

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strengths and weaknesses lie, and what to do to further improve on his strengths to breakthrough his weaknesses and learn to accept/receive criticisms (Commins & Fagin (1954) in APA 2002).

Benefits of educational psychology

These are some of the benefits of educational psychology.

1. Utilization of psychological principles, concepts, theories, models in growth and development, motivation, intelligence, working memory, thinking and problem solving by the teacher.
2. Determining the best strategy of teaching and learning, proper and adequate, relating it to uniqueness of individual student.
3. Understanding individual differences of students and how the teacher should utilize it to achieve successful learning (Menkiti, 2012).
4. Building conducive learning environment: there should be all things needed for all class activities, decoration of the class, good ventilation, adequate size and number of seats creating an environment of less stress, well disposed atmosphere, freedom of expression but should be well supervised.
5. Providing proper guidance which will help learners to learn well and overcome obstacles and difficulties within and outside the school.
6. Evaluating learning outcome: There should be constant evaluation of what has been learnt at every stage of teaching the learners, chance to see their mistakes where they do not understand and acquire more knowledge of the topic. The teacher can also evaluate his/her method, strategies; materials used for teaching, and seek for improvement.
7. Helping teachers to maintain at the beginning of the teaching proper psychological atmosphere by varying their set induction process and topics. The learners at this stage are being attuned to be psychologically present in the class and be ready to learn Prerna, S. (2022), (Possel, Rudasell, Adelson, Bjergi, Ann, Wooldridge, Black, 2013).

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Education: education is the process of receiving or giving systematic instruction especially at a school or university. It is a body of knowledge acquired while studying in a formal setting to obtain a deeper knowledge and understanding of a variety of subjects to be applied to daily life which cannot be obtained through experiences outside the classroom. Education is also referred to as a process through which a whole human being is developed, shaped or formed-socially, physically, emotionally, intellectually, morally and spiritually so that an individual can function effectively in the society (Menkiti2012). It is a purposeful activity directed at achieving certain aims, such as transmitting knowledge or fostering skills and character traits. Education from its inception, has been conceptionalized came to be seen as the transmission of cultural heritage from one generation to another. Currently, educational goals have increasingly encompassed new ideas like liberation of the learners, skills that are needed for modern and successful living in a modern society and other complex skills for variety of vocations.

Education can be seen as a process a product and as a course of study. As a process it refers to ways and means, methods, strategies employed to acquire required knowledge, and as a product (individual learner) who has waded through the process, the mental states and dispositions possessed by educated people. As a course of study, education focuses on various courses, programmers and disciplines people study and structures put in place to make available necessary information and materials for the courses. There are three aspect of education; formal, informal and non-formal. Formal education is acquired through schooling and training institutions, usually structured by curricular aims and objectives and learning is typically guided by a teacher. Informal education is where children learn informally from parents, significant individual, parent substitute and peers. This is usually obtained outside the school environment. Non-formal education occurs as additional or an alternative to formal education. It may take the structure of educational arrangement but has to operate in a

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flexible form. It takes place in community base, work place or civil society base-settings. Examples of the settings include Red Cross, Man O War, Girls Guide, Boys Scout (Menkiti 2003).

Goals of Education

1. Mandela (1994) Saw education as the engine of personal development. Through it, the daughter of a peasant can become a doctor, /son of a miner can become the head of the mine, child of a farm worker can also become the president of a great nation.
2. Provides opportunity for acquiring knowledge and skills that will enable individuals to develop their full potentials and become successful member of their society.
3. Prepares learners for a competitive world after school.
4. Creating an authentic and conducive classroom environment where learners can apply their learned skills and knowledge to solve real world challenges and come up with meaningful solutions.
5. Promotion of student's achievement and preparation for global competitiveness by fostering educational excellence and ensuring equal access.
6. Helping to become a full member of the society.

Need for Education:- There is always need for one to acquire education for the following reasons;

1. Provides stability in life and once knowledge is acquired, it cannot be taken away from whoever that possesses it.
2. Provides financial security:- Higher paying job and higher standard of living.
3. Makes oneself -dependent, no longer relying on other people.
4. Foster self confidence, high self esteem/ self efficacy and self determination

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5. Gives one the opportunity to become part of society, boosts one's upward movement in any sphere of world of work and social setting and to have the feeling of self satisfaction.
6. For better employment opportunity:
7. Affords employment opportunity for all in all spheres of life. The individual can give back to the society and community by offering and making available his time, money, skills, talent, expertise to help improve the community in any sphere of world of works and social setting.

The Teacher

In its accustomed sense, teachers are seen as a professional person who conducts classes, this probably is his main job. He works in schools providing education for pupils and students in educational institutions. It includes only the academic or tutorial staff (Senge 2000).Many scholars refer to teachers as a person who teaches or facilitates learning. Olayinka (2019) defines a teacher as an expert who is capable of imparting knowledge that will help learners to build, identify and to acquire skills that will be used to face the challenges of life. He is a person who provides education for learners by guiding, directing, facilitating, giving instruction and teaching.

The Roles of a Teacher:

Teachers play many but vital roles in the academic and social life of learners. Apart from other roles, they set the tone of the classroom environment whether conducive or not, they are role models, mentors and do observation of any behavior especially one that can disrupt class activities.

1. Teachers impart knowledge: - This is the basic role of any teacher, to teach what is provided in the curriculum and put learners through it and

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make sure that all pertinent knowledge is dispensed to them. According to Ebuoh(2006). teachers transmit information from senders to receivers and from receivers back to sender. Teaching therefore is a two -way traffic

2. Creating proper classroom environment: - It is a mandatory role of teachers to create warm, happy and joyful classroom environment so that student will always enjoy learning. The social environment of the class should be positive not negative, otherwise learning may be impaired. Conducive classroom environment breeds successful class events.
3. Role models:- Teachers most of the time play their role indirectly or inadvertently. The student watch teacher's behavior and there is either a kind of identification or imitation of teachers. Teachers should therefore be mindful of how they behave in and out of school. They should show love, empathy and care for them.
4. Mentoring: This is a way of assisting students to strive and become the best they can. Teach them to appreciate the efforts and progress they make and to enjoy learning. Let them take active part in what goes on in the class. Reinforce their positive efforts and point out where they need amendment.
5. Observe signs of trouble in order to nip it in the bud so that it does not disturb the class or cause injury to the problem shooter. The teacher should understand each learner's behavior to identify the sign of trouble as they begin to manifest.

Teacher Production:

The steps are as follows by Dunkin and Biddle (1974) in Menkiti & Chidobi (2003):

a. Teacher formation experience: Formation experience of teachers involves how teachers are produced. This step looks at the effectiveness of teachers.

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b. Teacher training at various levels which include Colleges/Institutes of Education for training of teachers to acquire National Certificate in Education (NCE)and Faculties / Institutes of Education for producing graduate teachers.
c. This step involves how teachers are formed or trained--the quality of training received by the student teachers while in training.
d. What is looked into here is the level of formative experience; this means the level of attainment. Does one stop his/her training at NCE, or does he/she obtain a degree certificate?
e. This last one has to deal with teachers' personality- what makes him unique which affects the way he behaves in the classroom. Is he/she democratic, autocratic, laissez faire. It points to the teacher's outward appearance, inward make or inner disposition, his age, intelligence, social class and level of attainment.

2. The next stage to consider is pupil/student characteristics. First it looks at the learner's experience that is their level of attainment. Secondly the socio-economic levels which affect experiences and interaction in the class should be considered. Thirdly their level of intelligence should be brought to focus and made use of in the class to make sure all learners are taken care of. Lastly, the school should collaborate with the community where the school is located to make sure that the school environment is conducive for learning and all necessary materials are provided. This stage is known as context variables.

3. The next consideration centres on the process through which the teacher does his/her teaching. This focuses on learner/teacher interaction which involves the level and quality of interaction in the class, the methods employed, instructional materials and use of them, techniques employed and learning experience learners are exposed to. In this level, the process variables are focused on.

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4. The fourth variable examines the children who are the products of the education system and the envisaged changes which should manifest in them. These are behavioural changes in the area of cognition, affective, psychomotor, attitudes and values (Menkiti & Chidobi, 2003).

Teacher Qualities/Attributes:

Some of the attributes that are expected that a good teacher should possess are good sense of humour, good listening skill, dependability, integrity, firmness/fairness, trustworthy, objectivity, effective communicating skill, personal attractiveness, sympathy/empathy, good composure, exhibit good health and vitality. There are other certain characteristics that have direct implication for classroom event. Some of them are stated below, possession of teaching attributes which can help another attribute to manifest. Those others are ability to plan for instruction, selection of statement of objectives, provision of opportunities for learning experience, resourcefulness initiative, appropriate use of teaching aids, provision for individual needs and possessing proper evaluation techniques.

Teacher Classroom Behaviour

Most of the time the events of teaching and learning take place in the classroom especially in formal setting; this is where the major learning activity takes place. Whatever, that takes place in the classroom, how and when it takes place has the expected objective of learning taking, thereby producing a change in behaviour. For learning to produce the expected change. The teacher has to exhibit some kind of classroom behavior that should promote and energize learners to learn. There is every necessity to take cognizance of teacher classroom behaviour because it has consequence (either positive or negative) for any event that takes place in the class especially on the part of the learner. Above all, the teacher must possess sufficient idea of educational psychology and this must colour

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every activity he carries out in the class and any behaviour he exhibits. How can one explain what teacher classroom behaviouris?

It entails all the activities he carries out, what he says and how, gestures, facial expressions and demonstrations that are part of his teaching behaviour in the class. Teacher classroom behaviour though may not be exhaustive are stated below.

1. Engaging classroom presence – make your students feel your presence in the class and see that you are in control of the class.
2. Strong communication – he should be a good communicator including modulating of voice. He should also make sure of the level of language to suit the level of the learners stage of developments. He can communicate through non verbal gestures, expressions and body language but has to make sure that the learners understand what he is communicating to them.
3. Good listener a behaviour that gives the teacher opportunity to take in and understand what each learner is communicating. This will go a long way in helping the teacher to identify learner problem areas and be able to deal effectively with them. Listen carefully to them.
4. Be engaging: - meaning that both the teacher and the learners should be actively engaged. Brain storms them with challenging questions, quizzes and write ups and other locomotive activities. An assertive and responsive teacher can conveniently provide an engaging environment in the class, can conveniently response to the challenges they expect to be tackled and needs they would expect the teacher to fulfill - Assert your knowledge, authority and your teaching skills, but no intimidation.
5. Humour: - a classroom teacher is supposed to create opportunity for pleasurable experiences in the class, atmosphere of laughter, amusement

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and relaxation. Not tensed up environment. Students will feel relaxed and learn better.

6. Clear content presentation – there should be clear content presentation so that students should not be put to confusion. If this is done students will follow the presentation step by step and if there is need for clarification, they will be aware of what needs clarification. In this way there should not exist anxiety, fear and apathy toward learning.
7. Relevant examples – whatever examples any teacher should give or present in the class should be relevant to what is being taught and familiar to the learners. Examples should have to be from and within the community where the learners come from. This will make more sense to them and provide opportunity for effective learning.
8. Appropriate method has to be used for each lesson and should appeal to all the senses of the learner.
9. Appropriate use of instructional materials- this is necessary since it accompanies any method the teacher uses at any given lesson. The materials should be well produced and should be presented in such a way that they do not disrupt the class activity / lesson that is going on. They should appeal to all the senses to take care of individual differences and how each learner learns.
10. Questioning is very important because it produces a quick evaluation of the lesson going on- whether at the beginning, in the middle or at the end of teaching. Questioning is a two-way traffic. So try and ginger your learners also to ask questions and answer questions put to them by the teacher. The teacher should use appropriate questioning techniques (Adopted from American Psychological Association of Higher Education. 2022).

All the above teacher classroom behaviour takes place as in course of teaching and learning events. These events are centred on the learning process, the learner,

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the curriculum (learning experiences) classroom environment and the teacher. Let us take these one after another.

(A) The Learning Process:

For effective learning to take place educational psychology must be put into practice. For this to be done, the teacher has to make use of learning process. Learning process is a series of actions or steps taken to achieve a particular objective or end or a series or set of activities that interact to produce a result.

Some learning processes are?

The principle of learning

(1) Perception: This is a process that determines how the information provided by senses are organized and interpreted. It is how the individual perceives or organizes and interpret any information delivered by the teacher. It is how the individual perceives or organizes his external environment that he responds to it.

(2) Motivation: This process is concerned with those factors which affect our learning and performance. It is the concept used to describe what energizes behavior, sustains it and directs it to a goal or purpose so that a state of equilibrium is attained or maintained (Maslow 1951) in (Menkiti 2012). It is an incentive which incites, inspires and produces learning. Motivation includes will power, determination, inspiration and drive. Some motivating factors as used by teachers include marks, rewards, punishment, competition, reinforcement.

(3) Intelligence:

Some common conceptions of intelligence are: being bright, being smart, obeying and respecting constituted authority, rules, elders, being sensible and others. Psychologically, it is a construct that determines the rate at which an

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organism will form new stimulus – response connection of a certain kind. Intelligence is referred to as the ability to perform well, judge well, reason well, solve problems and acquire and use knowledge. (Binet and Simon 1916) It is very much needed for class work and for everyday life outside the classroom. It is the capacity to acquire and apply knowledge.

(4) Personality: - Personality is the dynamics organization within the individual of those psychological systems that determine his unique adjustment to his environment. "It is what marks one individual different from another. It is a process which accounts for individual differences in organisms and this accounts for the way learners learn and the behaviour they exhibit in the classroom.

(5) Memory: (Store house of information)

Memory is a process that determines how changes in other processes are stored and later reactivated. It is an evidence of previous learning in other words you store information the memory which we make use of when the need arises. There are two kinds of memory – long and short, long-term memory is for storing information over a long period and short-term memory is the working memory we make use of as we immediately receive information in the class.

(6) Reinforcement:

A process that increases the probability that a given response will be initiated. If For instance, an individual or learner gives a correct answer and you clap for him, you make him repeat the action that is reinforcement.

(7) Inhibition:

This works in opposite direction with reinforcement. It is a process that decreases the probability that the given response will be initiated. If, for instance a child is punished for fighting, there is every likelihood that he may not initiate the response again that is fighting again.

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(8) Remembering and forgetting – when some information is stored in the memory, there is every likelihood for the information to be either remembered or forgotten. Retrieval process can trigger remembering of the desired information.

B. The learner:

It is proper that every organized program of education should take account of the learner. So any educational system must have to bear the learner in mind. That is all the variables which effect the learner must be noted both biological and environmental e.g. his background, maturation/development -physical, intellectual, his ability, interest, aptitude, and school variables.

(C) The Curriculum (The Learning Experience)

This word derives from a latin word meaning "a running course which in its original usage meant a 'runaway'. Even today, the word curriculum still has the connotation of 'a race track,' particularly when it is used to refer to a course of study. Curriculum must embrace objectives, selected tool in the form of subject matter or learning experiences, the method adopted to realize the objectives or goals and a means of evaluating the procedure.

(D) The Classroom or the Learning Situation

This is a place where learning takes place in a formal setting. It is one of the most important factors in learning. The teacher should make it his business to create a classroom environment that will foster effective teaching and learning. To achieve this, both the physical and psychological environment of the classroom must contribute to effective teaching and learning. The classroom must be clean and sanitary. There must be displays and decorations which must be changed when necessary. The classroom should be properly lighted and ventilated. There should be proper sitting arrangement and sufficient accommodation; such room should as far as possible be free from noise and disturbance in order to create a

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conductive atmosphere for learning. All the learners need should be provided. It must be realized that there is a close affinity between the physical environment, the emotional climate of the morale of the whole class.

(E) The Teacher:

The teacher is the manager in any classroom, a person that teaches especially a person whose occupation is to instruct. For a good psychological environment, it is proper that a balance is struck between the radiator of authority and the recipients of authority for a frictionless relationship to be achieved (Amalaha, 1979) in (Nwachukwu & Pkolvia 2021).

In exercising his managerial powers, the teacher in addition has to be a reservoir of knowledge. He has to be a master in his own field and be able to impart the knowledge effectively to learners. Finally, for a teacher to become effective in the classroom, he has to combine suitable models. Principles of Educational psychology are at his disposal to achieve successful teaching and learning.

(F) Methodology:

The definition of the term methodology can be done from two perspectives: first as a science and as a way of teaching. As a science, methodology is the study of teaching methods. As a way of teaching, it refers to method which are “the types of activities pursued by teachers and pupils together in discussions, group work, surveys, demonstrations and so on. Educationally, it is the study and practice of various ways by which teaching can take place.

There are various method of teaching used in educational institutions. These are: the lecture method, the discovery method, the discovery method, the play-way method, the Socratic or question method, co-operative method, project method, problem- solving method, the inductive and deductive methods. To avoid monotony in our learning situation it is very necessary to vary the methods employed in teaching the learner. The teacher must try very much to see that the

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method he adopts helps to promote learning and to sharpen their mental power. This involves the judicious application of psychological principles in teaching.

Psychological implications of Teacher Classroom Behaviours

Implication is something that inferred a meaning that is not expressly stated but can be inferred. Inferred means something that can only be seen or noticed as the behaviour manifests itself. The psychology implications are only seen from how teacher activities or behaviours in the classroom manifest in effective learning in the learners. These psychological principles that implicate teacher classroom behaviours are;

1. Better understanding of the psychological implications of learning will help the teacher to design more engaging lesson and classroom experience to make the learners more active and avoid boredom.
2. Foresting in teachers better understanding of how learning environment, social factors and learners' motivation can influence learning. He should therefore take care of all favourable factors in the class to achieve his objectives.
3. Proper use of techniques of measuring learning outcome and understanding the need for feedback in fostering learning will aid effective teacher classroom behaviours.
4. There is every need for the teacher to help in the promotion of emotional well-being of the learners so that they will be ready and emotionally attuned to the classroom activities and be happy to learn.
5. Never give up on any child because each of them has some latent potentials waiting for manifestation. It is the responsibility of the teacher to help towards their manifestation. If the teacher does not do this such a child may feel rejected and learning becomes a burden.
6. The teacher should create avenues in the classroom for co-operation and social relationship and at the same time understand their social and

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motivation context in the classroom, this gives the learners a sense of belonging which can affect learning positively.

7. No preferential treatment based on expectations. A teacher has to understand that the learners are different and their learning outcome will never be the same. He therefore has to accommodate all shades of expectations he holds for each learner and make sure there is no discrimination against any child in the class. This may promote active learning.
8. Boost learners' self-worth (self-efficacy, self-perception and well-being) which in turn will motivate and psychologically attune them for active participation in the class.
9. Do not create stress and anxiety for the learners for this is not mentally healthy for them. This can facilitate emotional and cognitive well-being that may promote learning.
10. The teacher has to source for and make use of multiple models that can appeal to different shades of learners. This will help to improve their mental and social well-being and promote classroom activities.
11. If any learner is prone to presenting disruptive behaviours in the class, use every reasonable means to help him to put an end to such behaviours. If there is no favourable result, appeal to that child's good nature in love and care through admonitions, discussions, stories of important successful people well known. Never treat such a case in anger, otherwise it will frustrate both the teacher and the learner. He may be surely won over. Nature has some goodies in every human person.
12. Never allow bullying intimidation and rudeness to any child. (Possell, Rudasell, Adelson, Bjergi, Wooldruedge, Black (2013).The implication is that such child will develop emotional trauma, lose interest in schooling and may become truant and worst still may drop out of school.
13. The teacher should encourage active classroom engagement and make sure that every child is carried along otherwise some will feel alienated and loose interest in their studies. Every classroom teacher displays

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varieties of behaviours in the class. The objectives of displaying the behaviours are to make sure that learning takes place and provides a change in behaviour in learners. For him to achieve this he has to have knowledge and use of psychological principles which have implications in what he does in the class in the area of teaching and learning. The knowledge of these psychological principles and their implications to teacher's classroom behaviours is an intrinsic part of education and pre-service teachers (most of time) do not receive sufficient preparation in psychology. Hence classroom teaching and learning do not often produce desired effect. Therefore, it is imperative that teachers should understand imbibe and make use of these psychological principles in his classroom activities and events to produce desired changes in learners. This is the ultimate goal of teacher classroom behaviours. (Attawell 2019)

14. The teacher will try to understand the collective, innovative, creative and dynamic relationship between psychological aspects of our experience (thoughts, emotion and behaviour) and our wider social experience, our relationships, family, community network, social and cultural values. This will encourage each learner to marry his emotion, thoughts and behviours with what the social experience, social values, cultural values represent in the family and community. If this is well articulated by each learner, a state of equilibrium is achieved for there exist minimum or no tension between his psychological aspects and social experience both within the school and outside of it.
15. The personality of the teacher which he displays in the course of teaching is very crucial. He should enter the class as relaxed as possible, be in good mood. Teachers sound mental health is important in creating an atmosphere that is conducive to learning. Teachers' classroom behaviours and dispositions affect teaching and learning and so teachers have to bear this in mind and create classroom environment favourable to learning. (York & Gubson 2021).So, the implications of psychology to

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teacher classroom behavior is a matter of fact. It is evident that dominant educational practices invariably are influenced by psychological theories and practice. The teacher therefore must have sound knowledge of psychological implication in education. It is the study of psychology that will help him achieve this.

Conclusion

Education is defined as "a process of acculturation through which the individual is helped to attain the development of his potentialities and their maximum activation when necessary according to right reason and to achieve thereby his perfect self-fulfillment". Therefore for "the whole person" to be developed, psychology must come to assist education to achieve this. To shape or modify the behavior of a learner or to help develop an all-round learner, it is important to study the science of behavior. The knowledge of individual differences, a learners intellectual ability, his personality, learning characteristics, measurement and evaluation of performance are areas where the knowledge of psychology is essential for effective classroom learning. For instance a teacher who is not aware of the fact that learners are different by nature will treat all of them alike without making any allowance for their peculiar individual characteristics; intellectually, socially and physically. The developmental stages of a human being, the learning process which includes motivation, reward, remembering and forgetting, transfer of knowledge, reinforcement and others. are very important aspects of psychology which the teacher has to grasp in order to understand the various principles which should be applied for meaningful learning to take place. Psychology helps to research further into educational principles and practice.

For educational administrators the knowledge of psychology is necessary since they deal with the learners, the teachers and the general public. It is better they understand how children learn, appropriate method of teaching and learning, what is worth-while to learn, the dynamic of behavior so that he can understand, predict and control the those under him and those who come into contact with

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him. This in essence will make their role as educational administrators, as supervisors, as managers, as principals and others. a lot easier and this will make for the good of their learners, their teachers, the public and their job.

References

Allison Academy (2022) Developing students' academic achievement, leadership and community involvement (U.S Department of Education) Alison Academy.com

Amalaha, R.O (1979) The teacher in the classroom in Nwachukwu, P.O &Pkolovia (2021). To Train or not to train Journal of teacher education for sustainability. 11(2) b4-76

American Psychological Association of higher education 2022. Boston University, centre for learning https:// www. Bu.edu. cu.behaviour

Attawell .M. & Bridgeland, J. (2019). Ready to lead. A 2019 update of principals perspectives on SEL learning https://www.script.org

Bandura,(1984) Social cognitive theory in Marks M.S. Donald B. Campbell(2021) Social psychology evaluation New York: Guilfordpress

Blancard, Steve (1893). The importance of psychological effect in life in Zareal .S (2019) The physical dictionary https:// ideas.repec.org

Boyack K.W; Klavan, Ria; Borner, K. (2005) Mapping the backbone of science. NY: Hol

WEBSITE: https://globaljournalhub.com
ISBN: 978-978-798-430-7

Cherry, K (2016) The origin of psychology. A brief history of psychology through the years. http://www.verywell/theoriginspsychology279545

Chauhan, S.S (2004) Advanced educational psychology. New Delhi: Vikas Publishing house Ltd.

Clifford, S.D. (2004) Principles of educational psychology. Warri-Nigeria: Octopus international Enterprises.

Communs N.D& Fagin B.(1954) 2nd Ed. Principles of educational psychology in AmericanPsychological Association (2000). Washington DC. 20002-4242.

Dunkin, W.J & Craw, L.D. (1974). The study of teaching in Menkiti B.U& Chidobi, R.U 2008. The teacher and the teaching profession Enugu. Joe Best Printing Press.

Ebuoh, C.N. (2006) Practical teaching guide for teachers. Enugu: Sky Printing Press.

Froh, Jeffery J (2004). The history of positive psychology. PDF NYS. Psychologist 16(3) 18-20

James, W. (1890).The principles of psychology. in Russell (2021). The letters of W. James. https://www.goodman@un.n.edu

Kumar, T.P. (2013) A study of classroom verbal behaviour pattern of secondary school teachers. http:hdl.handle.net

Mandela N.R. (1994) Long walk to freedom. London: Abacus.

ISBN: 978-978-798-430-7

Maslow, A.H. (1951). Motivation and personality in Menkiti (2012); Child development and education. Enugu: Chembus Communication Venture.

Menkiti, B.U. (2012) Child development and education. Enugu: Chembus Communication Venture.

Nwachukwu, A.T(2009).Understanding child development. Nsukka: Chulbson International Press.

Nwachukwu, A.T. (1992) Understanding child development. Nsukka: Chuibson International Press.

Obidigbo, GCE (2003) Psychology: The hybrid science. Enugu: Sage Publication.

Prerno, Sinha (2022), Psychology of the teacher. Bunch Microtechnologist. Noida, India: Private Ltd.

Possel, Patrick; Rudasall, Kathteem M; Adelson, J.L; Bjergi, Ann U.C; Wooldrudge, Don T; Black Stephanic W. International Journal ofEmotional Educational Vol.5 Psychology (2013)

Senge (2000). Schools that learn: The art and practice of learning organization. New York, Doubleday Currency.

Skinner, B.F. (1974). About behaviorism, in Menkiti (2012). Child development and education 2nd Edition Enugu: Chembus Communication Venture.

Uba, A (1987). Theories of personality, in Menkiti (2012) Child development and education. Enugu Chembus Communication venture

WEBSITE: https://globaljournalhub.com
ISBN: 978-978-798-430-7

Watson, J.B. (1913). Psychology as the behaviorist sees it in Menkiti (2012). Child development and eduction. Enugu: Chembus Communication Venture.

Wood, R.,& Wood, S.E. (1993) The world of psychology, in AmericanPsychological Association (2003) Washington DC 200024242. http:www.psyentsapa.og

Yorke, T. & Gibson, P. (2021). Defining and measuring academic success. Research Gate. Discover the world research https://www.researchgate.net

WEBSITE: https://globaljournalhub.com
ISBN: 978-978-798-430-7

15
IMPACT OF MATHEMATICS SCRABBLE GAME AS AN INSTRUCTIONAL TOOL FOR THE LEARNING OF TRIGONOMETRY

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INTRODUCTION

Education of secondary school level is supposed to be the bedrock and the foundation towards higher knowledge in tertiary institutions especially in Mathematics. Mathematics is a general subject that is applicable to all fields. It is the science of structure, order, and relation that has evolved from counting, measuring, and describing the shapes of objects. It deals with logical reasoning and quantitative calculation (Nekang, 2018). Obodo (2017) described mathematics as a precision tool used by all scientists in their search a clear understanding of the physical world. Decker (2018) viewed mathematics as the science that deals with logical shapes, quantity and arrangement. It further added that mathematics discovery has been at the fore-front of every civilized society and had been in use even in primitive societies. Mathematics plays an important role in developing the potentiality of logical reasoning in students which will in

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turn help them in pursuance of their higher education. Hence, its students' performance should be high. In secondary school level, Anibueze (2015) stated that mathematics is the subject that is mostly hated by students. Akanmu and Fajemidagba (2013) described mathematics as the subject in the secondary schools in which students' achievement in both external and internal examinations has consistently remained poor. Anibueze (2021) reported that the statistics of the West African Examination Council (WAEC) Chief Examiners' Annual Reports of 1999 to 2018 showed that for the past 19 years (1999 – 2018), the percentage of students that obtained credit passes and above in Mathematics is within the range of 23.83% to 52.97% for each year with the calculated average percentage of 32.19%. WASSCE Mathematics Chief Examiner (2016) reported that the causes of poor students' achievement in Mathematics are because the candidates exhibited weaknesses in the following areas:

1. solving problems involving geometry and trigonometry;
2. solving a three – set problem when the information given is in a set notation form;
3. using the concept of vectors to find the coordinates of points and the midpoint of a given vector;
4. solving problems involving longitude and latitudes;
5. constructing the locus of points equidistant from two intersecting lines;
6. applying the concept of probability of selecting an item with replacement.

From the reports of WASSCE Mathematics Chief Examiner (2016) as stated above showed that trigonometry was one of the major weaknesses exhibited by students. According to Kagenyi (2016), the poor achievement of students in trigonometric questions affected the students' overall achievement in mathematics. Kagenyi (2016) revealed that trigonometry is the branch of Secondary School mathematics that the students often forget so easily. Mathijs

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(2013) defined trigonometry as an aspect of mathematics that is used to calculate the lengths of the sides of triangles as well as the angles between those sides. Trigonometry is an important topic in the secondary school mathematics curriculum that is taught early and that links algebraic, geometric, and graphical reasoning (Vajiac & Snow, 2019). Trigonometry serves as a precursor to calculus as well as college/university level courses (Weber, Knott & Evitts, 2018). Unfortunately, many students do not experience the richness, connections or creativity that trigonometry allows, instead they often perceive it as another memory exercise where rules and formulae must be learnt by rote, along with methods for working out problems (Umar & Ibrahim, 2018), thereby making the students to achieve poorly in Trigonometry. One factor that could affect students in learning trigonometry is the instructional strategy used by the mathematics teacher (Andaya, 2014; Albert, 2018; Gurat & Sagun, 2018). Albert (2017) revealed that trigonometry is the branch of mathematics that secondary school students exhibit poor achievement when taught with expository method.

In line with Albert's assertion, Anibueze (2021) revealed that the expository method used by mathematics teachers to teach Trigonometry centered purely on cognitive domain, which results to students' poor achievement in Trigonometry. Andaya (2014) suggested that the method used by the mathematics teacher should in all situations develop the three learning domains of the learner; cognitive, affective and the psychomotor domains. The strategy must comply with Vygotsky's theory (Shayer, 2012). According to Vygotsky (1978), a student learns better in a social interaction environment where there are collaborative activities among the students. Vygotsky (1978) revealed that the teacher should be able to use strategy that can provide the students intervention and the intervention used by the students must ensure that it allows social interaction among the students. One method that fulfills these assertions of Vygotsky (1978) is mathematical game method (Iroegbu, Nkwocha &Onyemerekya, 2012). A game is regarded as mathematical game when the player can perceive and/or

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influence the course of the game on the bases of mathematical considerations (Eze, 2015). If mathematical games are effectively planned, they can be used to enhance creativity, encourage problem solving, introduce new mathematical ideas and improve study-habit (Eze, 2015), provide enjoyment, recreation and at the same time stimulate mathematics thinking (Anibueze, 2017). Many renowned researchers have opined that mathematics games are very efficient and effective in generating and sustaining the students' achievement in mathematics (Abraham, 2014; Imoko & Isa 2015; Anibueze 2017) except very few researchers like Smith (2013). According to these scholars in their respective studies discovered that students taught using Mathematics games significantly achieved better than their counterparts taught using Expository method whereas according to Smith (2013), there was no significant difference between the achievement of students that were taught mathematics using game approach and students who were taught mathematics using expository method.

The findings of most researchers give an indication that when students are taught trigonometry using mathematics games, there may be high tendency of students obtaining high achievement score in trigonometry. This necessitated the researchers to embark on this study. There are many types of mathematics games which are card, board, video, computer and ludo games (Anibueze, 2017). That is why the present study sought to employ mathematics Scrabble game in the teaching of trigonometry to see if it could boost students' achievement in trigonometry. Mathematics Scrabble game was ranked the tenth most played game in the United States in its manual form and nineteenth most played game in its electronic form (Forbe, 2018). Mathematics scrabble game is a type of board game which has been believed to develop learners' computational skills. Scrabble is a word/number game in which two to four players score points by placing tiles, each bearing a single character, onto a gameboard. The game is played by two to four players who are eight years and above. In classroom tournament, it can be between two to four players or, occasionally, between two

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to four teams each of which collaborates on a single rack (John, 2018). One unique characteristic that this mathematics game as revealed by Smullyan (2011) is that its rules can be altered a bit to suit the environment where the students exist and the mathematical topic to be taught and still maintain its oriented outfit, originality and uniqueness. These alterations of some rules make this game to have many types, such as Mathematical Scrabble game of different types (Smullyan, 2011). These little alterations still made this mathematics game to maintain their adaptive behavior that is instrumental in furthering students' mathematics thinking processes (Vygotsky, 1978; Smullyan, 2011). Anibueze (2017) discovered that the students taught using Mathematics Scrabble game performed better both in achievement scores than their counterparts in Control group. George (2015) discovered that kids taught with Scrabble game compute faster than their counterparts taught without it.

From the findings of these scholars revealed that there is positive indication that when students are taught Trigonometry using Mathematics Scrabble game that the students will learn Trigonometry better and there will be high achievement in Trigonometry. That is why the present study wants to how Mathematics Scrabble Game can be used to teach Trigonometry.

REVIEW OF LITERATURE

Concept of Mathematics Scrabble Game

Mathematics scrabble game is a type of board game which has been believed to develop learners' computational skills. Scrabble is a word/number game in which two to four players score points by placing tiles, each bearing a single character, onto a gameboard. The game is played by two to four players who are eight years and above. In classroom tournament, it can be between two to four players or, occasionally, between two to four teams each of which collaborates on a single rack (John, 2018). James (2014) reported that the game was ranked fifth of the

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games recommended for kids in the United States which was meant to increase kids' vocabulary and computational skills and allows parents to spend quality time with their kids. Forbes (March, 2018) ranked Scrabble game as the tenth most played game in the United States in its manual form and nineteenth most played game in its electronic form. Scrabble game is of two types; vocabulary scrabble and number scrabble game. The number Scrabble game is called Mathematics Scrabble game. Mathematics Scrabble games was developed purely for the learning of Mathematics. Currently, there are different kinds of Mathematics Scrabble game depending on the purpose of the game. One unique characteristic that this mathematics scrabble game has as revealed by Smullyan (2011), is that its rules can be altered a bit to suit the environment where the students exist and the mathematical topic to be taught and still maintain its oriented outfit, originality and uniqueness.

Fatsis (August 17, 2012) stated that the game was designed in 1938 by an American architect Alfred Mosher Butts and was called Crisis-Crosswords game. It was in 1948 that James Brunot who was one of the few owners of the original that bought the rights to manufacture the game in exchange for granting Butts a royalty on every unit sold and renamed it to be scrabble which means to scratch frantically. Though he left most of the game (including the distribution of letters) unchanged, Brunot slightly rearranged the "premium" squares of the board and simplified the rules. In 1949, Brunot and his family made sets in a converted former schoolhouse in Dodgingtown, a section of Newtown. They made 2,400 sets that year, but lost money. Donald (2010) stated that the game's big break came in 1952 when Jack Straus, president of Macy's, played the game on vacation. Upon returning from vacation, he was surprised to find that his store did not carry the game, he then placed a large order and within a year, "everyone had to have one." Brunot was unable to meet the increasing demand of the game, the manufacturing right was then sold to Long Island-based Selchow and Righter, one of the manufacturers who, like Parker Brothers and Milton Bradley

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Company, had previously rejected the game. In its second year as a Selchow and Righter-built product, nearly four million sets were sold (Edley and Williams, 2001). From then, the game has witnessed numerous modifications and adjustment. These adjustments gave birth to Number Scrabble game in 2011. The board is marked with "premium" squares, which multiply the number of points awarded: eight dark red "triple-word" squares, 17 pink "double-word" squares, of which one, the center square (H8), is marked with a star or other symbol; 12 dark blue "triple-letter" squares, and 24 light blue "double-letter" squares. In 2008, Hasbro changed the colors of the premium squares to orange for TW, red for DW, blue for DL, and green for TL. Despite this, the original premium square color scheme is still the preferred scheme for Scrabble boards used in tournaments.

Table 1: Premium Square colors

Square	Original and Mattel version	Current Hasbro version
Double letter	Light blue	Blue
Triple letter	Dark blue	Green
Double word	Pink	Red
Triple word	Red	Orange

The name of the game spelled out in game tiles from the English-language version. Each tile is marked with their point value, with a blank tile—the game's equivalent of a wild card—played as the word's first letter. The blank tile is

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worth zero points. In an English-language set, the game contains 100 tiles, 98 of which are marked with a letter and a point value ranging from 1 to 10 whereas a number/mathematics scrabble game has extra 20 tiles which has no marked value which carry equal and non equal signs. The game also has two blank tiles that are unmarked and carry no point value. The blank tiles can be used as substitutes for any letter/number; once laid on the board, however, the choice is fixed. Literary, James (2014) pointed out that scrabble develops the critical thinking of the learners, the computational skills, aids the learners to love mathematics practice, increases students mathematical vocabulary. Thus, scrabble game recreates and refreshes the mind, and by so doing, makes learning easier and non-monotonous. Steve (2018) outlined the advantages or role of using Scrabble game in the classroom as:

1. **Computational Skills:** One of the critical aspects of Scrabble play is building mathematics expressions in order to score the highest possible points. When the teacher plays Scrabble with the students, the teacher is not only helping the students to expand the students' computational skills, but also, the teacher practices higher order mathematics calculation.
2. **Improves memory**: While recreational table tennis tables are perfect for a rejuvenating experience for the body and the mind, scrabble is perfect to get your brain cells working as the student needs to constantly come up with **new** mathematics expressions keeping in mind the expression order used by the competitor. This essentially improves the students' memory and helps them to retain information for longer periods of **time**. This is especially useful for young students and older adults.
3. **Builds building skills:** Besides, Scrabble is also an excellent way to help you develop your strategy building skills. The basic rule for playing Scrabble is to pick out random letter tiles and form mathematics expression based on those formed by your competitors. Therefore, it puts

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the students on the spot forcing them to come up with mathematics expression that would follow a pattern. This results in rigorous use of your brain cells and therefore, it helps the students' strategy building skills in the real world as well.

4. **For Fun:** Scrabble Board Game is full of fun, which can be played with friends and family and does not call for the student to pay through his nose to enroll in a club that specializes in such activities. These benefits provided by Scrabble games are reason enough to get the old board game out.
5. **Critical Thinking:** Although an extensive mathematics expression can help give Scrabble players an edge, tile placement and mathematics expression selection are just as important. For example, the mathematics expression "5+7" is only worth 8 points, but it could worth 24 points if placed on top of a triple word score with the potential for more points. The student's strategy and critical thinking skills can play an important role in maximizing the overall score, and encourage the students to pay attention to tile placement in addition to mathematics expression selection, in order to maximize the amount of points each of the students' mathematics expressions can create.
6. **Mathematics Practice:** Scrabble game helps the students practice addition and multiplication. Since each mathematics expression in the game has a point value, and many spaces on the board can either double or triple your words, Scrabble presents the students with an excellent opportunity to practice math.

It is important to note that anything that has advantage also has disadvantage. Steve (2018) and Okafor (2015) stated that Mathematics Scrabble game also has disadvantages when used in the classroom. The disadvantages according to them are:

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1. **Waste of Time:** According to Steve (2018), Scrabble game can consume time if used in the classroom. 30 minutes are not even enough for a Mathematics Scrabble game to come to an end, it can take 1hour to 2hours and above for the game to come to an end. Okafor (2015) stated that the game can take away students' time of studying other subjects at homes/classroom or being active or participating in social events. According to Okafor (2015), there is need for the students to know that they need to finish their homework or studying, before playing the game and that the teachers of mathematics must always set time limit for the use of the game in order not to waste the time they are supposed to use in other valuable things.
2. **Physical Strain:** According to Steve (2018) and Okafor (2015), the use of Scrabble game can cause neck aches, back aches, repetitive strain injuries, eyestrain, headache, fatigue and mood swings if the students sit in a certain spot for hours playing the game. According to the authors, there is need for the students and the students to take breaks when playing the game. The teacher must also lay great emphasize to the students on the need for them to be taking break when playing the game (Steve, 2018).
3. **Dormant:** According to Steve (2018), scrabble game can cause students to be bored if constantly played, thereby defeating the aim of the game. Also, it discourages the students that has not been able to acquire certain computational skill from using the game thereby prevents them from further developing their computational skill. In other words, the Scrabble game method used by the teacher can even distance such students from learning mathematics (Steve, 2018). This assertion is in line with Smith (2013)' assertion and Smith (2005)'s assertion that the method used by the teacher can either motivationally force a student who has made up the mind not to learn mathematics to begin to learn mathematics or can even distance him further from learning mathematics. Therefore, the teacher

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must be creative enough to identify such students whose deficiency in Computational skill is below average and encourage such students (Steve, 2018). The author also stated that the teacher must be creative in changing the methods of using Scrabble game. This is because the Scrabble game method can cause boredom and heavy fatigue.

4. **Mental effect:** According to Steve (2018) and Okafor (2015), Scrabble game can cause low self-esteem or aggressive behavior in the students if the students keep losing at the game and can cause over high self-esteem or pride in the students if the students keep winning at the game. Therefore, the teacher must endeavor to let the students understand that the aim of the game is not all about winning or losing but it is all about understanding the mathematical concept, computational skill and logic behind the mathematics Scrabble game (Steve, 2018).
5. **Addiction:** The game can cause addiction if the students use the game more often or overuse the game (Steve, 2018; Okafor, 2015). According to Steve (2018) and Okafor (2015), it can also cause social isolation and even poor social, computational skill and negative rivalry behavior in the students. Therefore, it is important that the students are made by their teachers to understand that Scrabble game is not a do-or-die affair and the need for the students to interact with their fellow students and spend time with their friends and family (Steve, 2018; Okafor, 2015). Therefore, these negative effects of Mathematical Scrabble game will not prevent the researchers from determining its impact on the students' learning of trigonometry.

Procedures of the Mathematics Scrabble Game

The Mathematics Scrabble game is played by the following steps;

1. The players pick one tile at a time and keep it in the rack. The pickings must be done in a turn as determined by the players themselves. All the

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players are to expose their first tile. The player whose first tile has the highest score will be the first to start. The application of BODMAS in trigonometry must be applied if the operators are involved.

2. The first player must form a trigonometric expression/equation/inequality. Example:$\cos 45 - \sin 45 = 0$After the first player must have played, the game played will be scored. The second player must play a trigonometric expression/equation/inequality, but his play must be in conformity with the first player's game as specified in the rules of the game. Example:

$$\tan 45$$
$$\times$$
$$\cos 45$$
$$\|$$
$$\cos 45 - \sin 45 = 0$$

The second player's game must be scored before the third (if any) player plays till the fourth player (if any).

3. The game will continue being played in conformity with the rules until all or any of the three conditions happens. The three conditions are: (i) when the last tile is picked from the bag; (ii) when the players know nothing else to play; and/or (iii) when a player gives up. The give-up of a player is when he is in compound situation which must be confirmed by the rest of the players if not the player will be warned for possible sanction if such repeats itself.
4. A player is permitted to miss a turn if his rack is filled but still believed he has nothing to play.
5. When the game comes to an end, the scores of each player recorded on a paper are summed. The scores of the tiles in the rack of a player are also scored and subtracted from the total score recorded on a paper for the player. The result is the final score for the player.

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6. The player with the highest score is the winner of the game.

Rules of Mathematics Scrabble Game

The following rules will guide the Mathematics Scrabble game

1. Except as noted, game play is similar to normal Scrabble
2. A player is permitted to miss a turn if his rack is full and believes he has nothing to pick.
3. If the rack of a player is not full and he believes he has nothing to play, then he must have to pick and miss a turn. No penalty is awarded.
4. The trigonometric expression/equation/inequality played by each player must be determined valid and must be determined by the calculator if it is confusing to the players to determine. If the result of the game played by a player is confirmed false by the use of calculator, the player will collect the tiles back, and will miss that turn and will be scored zero for that turn. For example; $\cos 45 = \frac{\sqrt{2}}{2}$ is a valid computation equation but "$\times \cos 45$", "$/\cos 45$", any mathematical equation such as or related to this $\cos 45 = 0$ or any mathematical expression such as or related to $\tan 45 < \cos 45$ are wrong computation.
5. A valid mathematical expression/equation/inequality must be scored depending on the inscription on the board and recorded.
6. This mathematics expression such as "$\times \cos 45$", "$/\cos 45$" can be valid if inscribed properly. Example: one player may have played "$\sin 45 = \frac{1}{2\sqrt{2}}$" the other player once he did not violate the order of the other trigonometric expressions/equations/inequalities can add to "$\sin 45 = \frac{1}{2\sqrt{2}} / \cos 45$" with: "$\sin 45 = \frac{1}{2\sqrt{2}} = \cos 45$" or "$\sin 45 = \frac{1}{2\sqrt{2}} \times 2 = \frac{1}{\sqrt{2}}$" as the case may be.
7. Players keep 9 tiles in their hand at all times, not 7 as in normal Scrabble.

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8. A player can add to an existing equation on one side or both sides in a single turn. Example: A player can add to both ends of '$\tan 45 - \sin 45 = 0$ ' in a single turn to make '$2 \tan 45 - \sin 45 = 0 + 2$ '
9. A player may only use one new '=' sign per turn
10. Order of operation must be BODMAS

- Square and Square-root operators apply only to the immediately preceding or following number
- There is no implied multiplication. Implied multiplication is the multiplication involving brackets. Examples: '$2(9), 3(22 + 5), 48 \div 2(9 + 3)$'

11. Equations can have multiple equal parts.
    Example: '$2 \tan 45 - \sin 45 = 0 + 2 = 2 = - - 2 = \frac{8sin120cos120}{\sqrt{3}}$,
12. Redundant equations are valid
    Example: '1−1+1−1=0=0+0'
13. The '−' sign may be used either as an operator or before a number to indicate its sign.

- Example: '$- \sin 30 = \frac{1}{2} - 1$'
- Example: '$3 = -5 - -8$'

14. A player may or may not use leading '+' signs or leading '0' in front of a number.

- Examples: $+ \cos 180 - 3 = -2,$
- Example: $0 \cos 180 - 3 = -3$'

15. A player may not string together arbitrary symbols
    Example: '$3 + \times\times \cos 180 == 2$' is NOT valid.
16. In normal scrabble, a player can place one word alongside another if they create a valid cross-word. Here, a 2-character sequence can never be an equation. So this generally is not possible. As an optional rule, a player may choose to allow placing alongside when only numbers are formed as

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the cross-words, but the players still need to connect to an existing equation some other way.

17. As an optional rule, a player may choose to disallow the following "Identity" equation fragments:

- "×1" Example: A player could not turn '$\cos 225 = -\frac{1}{2\sqrt{2}}$' to '$\cos 225 = -\frac{1}{2\sqrt{2}} \times 1$'
- "+0" and "−0". Example: A player could not turn '$\cos 225 = -\frac{1}{2\sqrt{2}}$' to '$\cos 225 = -\frac{1}{2\sqrt{2}} + 0$'
- It is recommended that "identity equation fragments" can be allowed if playing in a learning scenario, but it is recommended that "identity equation fragments" should be disallowed with experienced players as a player gets into tedious '$2 + 2 = 4 + 0 + 0 + 0 \times 1 \times 1$' situations.

18. When the real game is played, number of equal signs (i.e. =) must be 8, greater than (i.e. >) 4, less than (i.e. <) 4, greater than or equals to (≥) must be 2 and less than or equals to (i.e. ≤) must be 2. But if it is in the trigonometric complement class, then the number of equal sign remains but if it is in trigonometric inequality class, then the number of inequalities remains as shown in table 1.

Scoring in the Mathematics Scrabble Game

The following rules guide the scoring of the game

1. The trigonometric expression/equation/inequality played by each player must be determined valid and must be determined by the calculator if confusing to the players to determine. If the result of the game played by a player is confirmed false by the use of calculator, the player will collect the tiles back, and will miss that turn and will be scored zero for the turn. For example; $\cos 45 = -1$

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2. Unlike ordinary Scrabble, when adding to an existing equation only the newly added tiles score points.
3. The scoring of the game played is the summation of scores of the tiles played and the bonus of the equation/inequality.
4. Double-letter, triple-letter, double-word, triple-word squares work as usual. Double-letter means that the value of the tile on it must be multiplied by 2, triple-letter means that the value of the tile on it must be multiplied by 3, double-words means that means that the sum of all the value of the tiles played must be multiplied by 2 and triple-words means that the sum of all the value of the tiles played must be multiplied by 3.
5. All equations/inequalities earn a bonus depending on the actual numeric value of the equation. This rewards equations of high value like '$25 \times 25 = 625$' compared to ones of low value like '1+1+1+1=4'.

- The calculation of the bonus is based on the equation value as follows:
    - Take the absolute value of the equation value (so that big negative equations are still rewarded!)
    - Take the square root of that number
    - Round off to the nearest integer
    - The player can use a calculator.
- The result is the bonus, which is added to the equation score before applying any double and triple word scores.
- Example: '$\cos 45 - \sin 45 = 0$'. Equation value = 0. Absolute value of that = 0. Square root of that = 0. Round off to get bonus points = 0.
- Example: '$\cos 45 = \frac{\sqrt{2}}{2}$'. Equation value = $\frac{\sqrt{2}}{2}$, Absolute value of that = $\frac{\sqrt{2}}{2}$, square root of that = 0.84, round off to get bonus points = 1.
- Example: '$-\tan 300 = -\sqrt{3}$. Equation value= $-\sqrt{3}$, absolute value of that =$\sqrt{3}$, square root of $\sqrt{3} = 3$, round off to get bonus points = 2.

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6. The scoring is done as follows; assuming a player played "$-\tan 300 = -\sqrt{3}$". If $\sqrt{3}$ lies on the "triple word" block and $-$ lies on the "double letter" block. It is calculated as follows:

The score of the tiles played: "since $-$ lies on the double letter" the score is double letter is "2 × (the value of $-$ is 1) i.e. $2 \times 1 = 2$". The value of "tan" is 3, the value of 300 is 2 and the value of tan is 3; the value of = is 0; the value of $\sqrt{3}$ is 2. Then the score is: (the value of $-$) + (the value of tan) + (the value of 300) + (the value of =)+ (the value of $-$)+(the value of $\sqrt{3}$) is $2 + 3 + 2 + 0 + 1 + 2 = 1$

- Since that $-$ or any other number lies in *triple word block* means triple the computation which is 10 × 3 = 30.

- The bonus of the equation: equation value = $-\sqrt{3}$, absolute value of that = $\sqrt{3}$, square root of that = 1.732, round off to get bonus points = 2.
- The Score of the game played is 30 +2 = 32

Table 2: Table showing Numbers and Symbol Distribution

Number/Operator	How Many	Score value
0	5	2
30	4	3
45	6	2

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60	4	3
90	4	2
120	3	3
135	3	3
150	3	3
180	3	2
210	3	3
225	3	3
240	2	3
270	2	2
300	2	4
315	2	4
330	2	4
360	2	4

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1	10	1
2	3	3
3	3	3
4	3	3
5	2	4
6	2	4
7	1	5
8	1	5
9	1	5
0	8	1
$\sqrt{3}$	1	5
$\frac{\sqrt{3}}{3}$	1	5
$\frac{\sqrt{3}}{2}$	1	5

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$\frac{\sqrt{2}}{2}$	1	5
$\frac{1}{2}$	3	2
∞	2	3
Tan	5	2
Cos	12	1
Sine	15	1
+ (add)	3	3
- (subtract)	10	1
× (multiply)	5	2
÷ (divide)	7	2
^{2} (square)	2	3
$\sqrt{\ }$ (square root)	2	4
Blank	3	0

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Optional if played alone	How many	Score value
= (equals)	20	0
> (Greater than)	5	0
< (less than)	5	0
≥ (Greater than or equals to)	5	0
≤ (Less than or equals to)	5	0

Sample Lesson Note for teaching of Trigonometry using Mathematics Scrabble Game

Subject: Mathematics
Topic: Trigonometric Ratios
Class: SSS 1
Age: 12 – 16years
Time Duration: 40 minutes per period (i.e. 80 minutes for 2 periods)
Date:
Period 1 and 2 (double period)
Instructional Objectives:
By the end of the lesson, the students should be able to:

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a. State the trigonometric ratio and their relations.
b. Recall and use trigonometric ratios of special angles and angles 0°-360°.
c. Solve simple problems using trigonometric ratios.

Entry Behaviour: The students are already familiar with angle and triangle as a plane shape.

Test of Entry Behaviour: The teacher asks the students to draw a right angled triangle.

Set Induction: The teacher comes into the classroom and will order the students to be quiet. After, s/he will order the students to stand, as the students do it, s/he will also say sit, the students will sit as well. The teacher will do this for ten times but will be increasing the speed at which s/he says it.

Instructional Materials: Mathematics Scrabble game, Lesson Note, SSS 1 Mathematics textbook, Comprehensive Mathematics, chalks and chalk board.

Instructional Techniques: Mathematics Scrabble game, Explanation, Questioning, Illustration and Expository strategies.

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Instructional Procedures:

Content	Teacher's activities	Students' activities	Strategies
Step 1: Introduction	As the teacher comes into the classroom, s/he will come with the relevant mathematics Scrabble game that suits the lesson trigonometric ratios. The teacher will call the four (4) selected students that s/he must have taught on how to use the Mathematics Scrabble game for the lesson and places them on where s/he wants them to referee on.	The students observe the teacher and those students called upon answer the teacher and comply with her directives.	Observation
Step 2: Introduction of Mathematics Scrabble Game	The mathematics teacher introduces it in the class and explains the rules of the game to the students. The teacher will ensure that the rules are written boldly on a Card board sheet that is hung in front of the class.	The students copy the rules and the game procedures.	Observation, Illustration, and Mathematics Scrabble game
Step 3: Grouping of the	The teacher will then group the students into groups in accordance to their sitting	Each student accept the team and the group that s/he is placed	Illustration, and Mathematics Scrabble game

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Content	Teacher's activities	Students' activities	Strategies
Students	arrangement in the class.	in.	
Step 4: Introduction of the Trigonometric ratios	The teacher will say and write that: Trigonometry is a word that is derived from the combination of two-Greek words, *triogõnom* meaning *triangle* and *metron*meaning *measuring*. Hence, it means the measuring of triangle. Trigonometry can also means the branch of mathematics that deals with the study of the relation of sides and angles of triangles and with the relevant functions of any angles. The major aim of trigonometry	The students listen to the teacher carefully and copy down the note.	Questioning and Explanation

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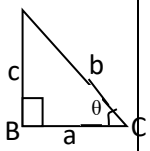
Content	Teacher's activities	Students' activities	Strategies
	is the manipulation of angles in relation to its functions whether the angles are elements of a triangle or not. Its functions are sine (abbreviated as *sin*), cosine (abbreviated as *cos*), tangent (abbreviated as *tan*), secant (abbreviated as *sec*), cotangent (abbreviated as *cot*) and cosecant (abbreviated as *cosec*). The teacher will explain and write the following on the Chalk board: Suppose that a right-angled triangle ABC where ABC are the angles and the sides facing angles A, B, C are a, b and c respectively, then the triangle follows;  		

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Content	Teacher's activities	Students' activities	Strategies
	Fig. 1.1 Let angle c be θ as indicated above. The trigonometric ratio can now be stated as follows: $\sin\theta, \cos\theta,$ $\tan\theta, cosec\ \theta, \sec\theta, \cot\theta$ NB: The side facing the right-angle is the hypotenuse b. The side that is facing θ is called the Opposite c. The side where both the angles lie is called the adjacent a. Hence, the trigonometric ratios for the trigonometric functions are as follows:		

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Content	Teacher's activities	Students' activities	Strategies
	$\text{sine}\,\theta = \sin\theta = \frac{\text{opposite}}{\text{hypotenuse}} = \frac{c}{b}$ $\text{cosine}\,\theta = \cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}} = \frac{a}{b}$ $\text{tangent}\,\theta = \tan\theta = \frac{\text{opposite}}{\text{adjacent}} = \frac{c}{a}$ NB: The acronym name used to remember the three basic ratios of these three trigonometric functions is SOHCAHTOA where S=Sine, O=Opposite, H=Hypotenuse, C=Cosine, A=Adjacent, and T=Tangent. Note that: $\tan\theta = \frac{\sin\theta}{\cos\theta} = \frac{\frac{c}{b}}{\frac{a}{b}} = \frac{c}{b} \times \frac{b}{a} = \frac{c}{a}$		

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Content	Teacher's activities	Students' activities	Strategies
	$\text{cosecant}\,\theta = \text{cosec}\,\theta = \frac{1}{\sin\theta} = \frac{1}{\frac{\text{opposite}}{\text{hypotenuse}}} = \frac{\text{hyp}}{\text{opp}} = \frac{b}{c}$ $\text{secant}\,\theta = \sec\theta = \frac{1}{\cos\theta} = \frac{1}{\frac{\text{adjacent}}{\text{hypotenuse}}} = \frac{\text{hyp}}{\text{adj}} = \frac{b}{a}$ $\text{cotangent}\,\theta = \cot\theta = \frac{1}{\tan\theta} = \frac{1}{\frac{\text{opposite}}{\text{adjacent}}} = \frac{\text{adj}}{\text{opp}} = \frac{a}{c}$ Note that: $\cot\theta = \frac{\text{cosec}\,\theta}{\sec\theta} = \frac{\frac{b}{c}}{\frac{b}{a}} = \frac{b}{c} \times \frac{a}{b} = \frac{a}{c}$		

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Content	Teacher's activities	Students' activities	Strategies
	Also note that: $\cot\theta = \frac{\cos\theta}{\sin\theta} = \frac{\frac{a}{b}}{\frac{c}{b}} = \frac{a}{b} \times \frac{b}{c} = \frac{a}{c}$ It is sometimes occurs that a particular ratio will be given, and the others or some of them may be required. In such occasion, it is suggested that a right-angled triangle is drawn and the given angle is located. The next step is to use Pythagoras theorem to find the unknown side. From there, the required ratio is gotten.		

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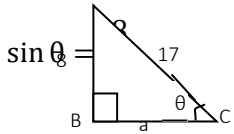
Content	Teacher's activities	Students' activities	Strategies
Step 4 (ii): Worked Exercises pertaining to Trigonometric Ratio	The teacher will write the following on the Chalkboard: Example 1: Given that $\sin\theta = \frac{8}{17}$ calculate the values of $\cos\theta, \tan\theta, \frac{\cos\theta+\sin\theta}{\cos\theta-\sin\theta}$ Solution:  By Pythagoras theorem: $a^2 + 8^2 = 17^2 \Rightarrow a^2 + 64 = 289$ $a^2 = 289 - 64 = 225 \Rightarrow a = \sqrt{225} = 15$ Therefore $\cos\theta = \frac{adj}{hyp} = \frac{15}{17}$; $\tan\theta = \frac{8}{15}$	The students will listen attentively, ask questions in the areas that they are confused and they would solve the remaining two problems that the teacher will write on the Chalkboard	Explanation, Demonstration, Illustration, Questioning methods

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Content	Teacher's activities	Students' activities	Strategies
	$\frac{\cos\theta + \sin\theta}{\cos\theta - \sin\theta} = \frac{{}^{15}/_{17} + {}^{8}/_{17}}{{}^{15}/_{17} - {}^{8}/_{17}}$ $= \frac{{}^{23}/_{17}}{{}^{7}/_{17}}$ $= {}^{23}/_{17} \times {}^{17}/_{7} = {}^{23}/_{7}$ The teacher will copy Exercise 15a, number 1 – 2, page 105 of the Comprehensive Mathematics to the students. S/he will ask the students to indicate the two questions that they would solve. The teacher will then solve the remaining one.		
Step 4 (iii): Corrections of the Last Class work	The teacher will ask the students to exchange their works. Then, the teacher will ask the students to do the corrections but will aid them in doing so. The students will mark according to the teacher's instruction.	The students will do the class work, mark their fellow class mate's class work and note the corrections.	Demonstration, explanation, questioning and use of examples.

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Content	Teacher's activities	Students' activities	Strategies
Step 4 (iv): Relations between the Ratios	The teacher will say that: There is another method that one can use to solve the above exercise which is by understanding the relationship between the relations. Basically, there are eight basic relationships that exist between the trigonometric functions. $\tan\theta = \frac{\sin\theta}{\cos\theta} = \frac{\frac{c}{b}}{\frac{a}{b}} = \frac{c}{b} \times \frac{b}{a} = \frac{c}{a}$ $\cot\theta = \frac{\operatorname{cosec}\theta}{\sec\theta} = \frac{\frac{b}{c}}{\frac{b}{a}} = \frac{b}{c} \times \frac{a}{b} = \frac{a}{c}$ $\cot\theta = \frac{\cos\theta}{\sin\theta} = \frac{\frac{a}{b}}{\frac{c}{b}} = \frac{a}{b} \times \frac{b}{c} = \frac{a}{c}$	The students will do the class work, mark their fellow class mate's class work and note the corrections.	Demonstration, explanation, questioning and use of examples.

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Content	Teacher's activities	Students' activities	Strategies
	$\sin^2\theta + \cos^2\theta = \left(\frac{c}{b}\right)^2 + \left(\frac{a}{b}\right)^2$ $= \frac{c^2}{b^2} + \frac{a^2}{b^2}$ $= \frac{c^2 + a^2}{b^2} = \frac{b^2}{b^2}$ $= 1$ NB: $c^2 + a^2 = b^2$(Pythagoras theorem) $\sin^2\theta = 1 - \cos^2\theta$ $\cos^2\theta = 1 - \sin^2\theta$ $1 + \tan^2\theta = \sec^2\theta$ $1 + \cot^2\theta = \text{cosec}^2\theta$		
Step 4 (v): Worked Exercises pertaining to Relations between the	The teacher will write the following on the Chalkboard: Example 2: Given that $\sin\theta = \frac{8}{17}$ calculate the values of $\cos\theta, \tan\theta, \frac{\cos\theta+\sin\theta}{\cos\theta-\sin\theta}$ using the Relations between the ratios Solution:	The students will listen attentively, ask questions in the areas that they are confused and they would solve the remaining two problems that the teacher will write	Explanation, Demonstration, Illustration, Questioning methods

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Content	Teacher's activities	Students' activities	Strategies
Ratios	Given that $\sin\theta = \frac{8}{17}$ But $\cos^2\theta = 1 - \sin^2\theta$ $\Rightarrow \cos^2\theta = 1 - \left(\frac{8}{17}\right)^2 = 1 - \frac{64}{289} = \frac{289-64}{289} = \frac{225}{289} \Rightarrow \cos\theta = \sqrt{\frac{225}{289}} = \frac{15}{17}$ $\therefore \cos\theta = \frac{15}{17}$ $\tan\theta = \frac{\sin\theta}{\cos\theta} = \frac{\frac{8}{17}}{\frac{15}{17}} = \frac{8}{17} \times \frac{17}{15} = \frac{8}{15}$ $\frac{\cos\theta + \sin\theta}{\cos\theta - \sin\theta} = \frac{{}^{15}/_{17} + {}^{8}/_{17}}{{}^{15}/_{17} - {}^{8}/_{17}} = \frac{{}^{23}/_{17}}{{}^{7}/_{17}} = {}^{23}/_{17} \times {}^{17}/_{7} = {}^{23}/_{7}$ The teacher will copy Exercise 15a, number 1 – 2, page 105 of the Comprehensive Mathematics to the students using the	on the Chalkboard	

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Content	Teacher's activities	Students' activities	Strategies
	Relations between the ratios. S/he will ask the students to indicate the two questions that they would solve using the Relations between the ratios. The teacher will then solve the remaining one using the Relations between the ratios.		
Step 5: Reintroduction of the Mathematics Scrabble Game	The mathematics teacher will ask the students do you understand the exercises. The mathematics teacher will then share the mathematics Scrabble game to each team. The mathematics teacher will reintroduce the game but this time, four members will be put as a group and each member will be entitled to have the mathematics Scrabble game and the relevant resources that suit the trigonometry lesson. The members of each group will compete among other teams in that group till the end of the	The students will say YES Each team will receive the full set of the mathematics Scrabble game. The members of each group will compete among other teams in that group till the end of the lesson. The four students earlier selected will be placed in	Mathematics Scrabble Game

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Content	Teacher's activities	Students' activities	Strategies
	lesson. The four students earlier selected will be placed in each of the region (a region contains more than two groups) to be the referees. They are the ones that will carry a calculator each to confirm the solution of a problem played by a student. *NOTE THAT THE RULES AND PROCEDURES OF PLAYING MATHEMATICS SCRABBLE GAME IS STATED ABOVE*	regions to referee over a certain number of groups. The referees will ensure that no foul play is allowed and that the game is strictly played by the rules.	
Step 6: Mathematics Scrabble Game continues	The teacher will tell the students that they are allowed to frame questions based on the mathematics Scrabble game. The teacher will supervise the students as the game is going on. At the end of the lesson, the student with the highest score in each group will be called the WINNER and members of the group will clap for the winning team.	The students will frame questions that are equal or equivalent to what is obtainable on the Scrabble board. The member in each group with the highest score in each group will be called the Winner for that	Mathematics Scrabble Game

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Content	Teacher's activities	Students' activities	Strategies
		group and will be clapped for by the other teams in that group	
Summary	The teacher will ask the students to submit their class works for him/her to mark. The teacher recapitulates all the salient points in the lesson.	The students listen	Explanation, Questioning and answering.
Evaluation	The teacher assesses the students with the following questions by giving the students the following as an assignment. If $\tan\theta = \frac{5}{12}$ Find (i) $\cos^2\theta$(ii) $\cos\theta - \sin\theta$ Given that $\tan\theta = \frac{21}{20}$; find (i) $\sin\theta$ (ii) $\frac{\sec\theta - \operatorname{cosec}\theta}{\sec\theta + cosec\,\theta}$ (iii) $1 + \sin^2\theta$using the Relations between the ratios If $\cos\theta = \frac{15}{17}$, find the value of	Attempt the questions.	Questioning, supervision and reinforcement.

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Content	Teacher's activities	Students' activities	Strategies
	(i) sin θ (ii) $\frac{\sin \theta}{cosec\ \theta}$		
Closure	The teacher goes round and observes students as the attempt to answer the evaluation questions. S/he assists them to correct any error they may make s/he allows them to ask questions while s/he clarifies them.	The students listen and watch their fellow students ask questions, do the assignment and those that have finish submits their notes respectively. Those in difficulty call for teacher's attention.	Supervision and reinforcement.

Conclusion

This study has exposed how the Mathematics Scrabble Game can be used as an Instructional Tool for the learning of Trigonometry. The findings of Anibueze (2021) have confirmed that if mathematics teachers use Mathematics Scrabble Game to teach the students, their students' achievement, interest and retention in Trigonometry will be improved. If Mathematics Scrabble Game is effectively planned, it will enhance creativity, encourage problem solving, introduce new trigonometric ideas and improve study-habit (Eze, 2015), provide enjoyment,

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recreation and at the same time stimulate trigonometric thinking (Anibueze, 2017). This finding is important for classroom mathematics teachers as the Mathematics Scrabble Game can be used to teach trigonometry despite the constraints a mathematics teacher may be facing in their individual schools. According to Fatsis (2012), Mathematics scrabble game develops the learners' trigonometric skill. Mathematics Scrabble game helps the students practice trigonometric addition, subtraction, division and multiplication repeatedly with the curious desire to win the game, thereby increasing their mental capacity to comprehend and think deep in trigonometry. It takes the students to the deep root of trigonometry because every student wants to win. Since each trigonometric expression in the game has a point value, and many spaces on the board can either double or triple the students' trigonometric words. This essentially improves the students' memory and helps them to expand their trigonometric skills for longer periods of time. This study concludes that mathematics teachers should adopt using the mathematics scrabble game more frequently in teaching trigonometry because it has proven to be more effective in making the students to retain better.

Recommendations

The study recommended the followings

1. The serving mathematics teachers in Senior Secondary Schools should adopt the use of well structured Mathematics Scrabble game in teaching Trigonometry.
2. In addition, the serving Senior Secondary School mathematics teachers should seek the cooperation of the school curriculum committee to ensure that the Senior Secondary School mathematics students are provided with mathematics Scrabble game in order to make the learning of Trigonometry easier and to reshape the students' Trigonometric abilities.

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3. Federal/State governments and other relevant professional bodies should sponsor seminars, conferences, workshops, refresher courses on the use of mathematics games particularly on the use of Mathematics Scrabble game in teaching Trigonometry since that the use of Mathematics Scrabble game has proven to be most effective in teaching Trigonometry.
4. Mathematics educators involved in the curriculum development should restructure the Senior Secondary School Mathematics Syllabus and textual materials that can create opportunities for out-of-school Mathematics activities and extra curricula programmes (like Mathematics Scrabble Game) that are rooted in Trigonometry.

References

Abraham, L.N. (2014). Pupils Motivational Factors in Computer Games and Simulations, Implications for the Design of Instruction. *Unpublished Doctoral Dissertation, University of Port Harcourt*

Akanmu, I.A. (2017). Integration of Geogebra software into teaching and learning of mathematics in Nigeria senior secondary schools. *Abacus*: *The Journal of the Mathematical Association of Nigeria,* 42(1), 1-11.

Albert L.N. (2017). Effect of Triangle Solver Game on students' achievement and retention in Trigonometry. *A Master's Dissertation of the Department of Science and Technology, Enugu State University of Science and Technology (ESUT), Enugu.*

Almlund, M., A. L. Duckworth, J. J. Heckman & T. Kautz (2011), Personality psychology and Economics. In E.A. Hanushek, S. Machin & S.

ISBN: 978-978-798-430-7

Woessman (eds). Handbook of the Economics of Education, Amsterdam: Elsevier.

Andaya, H. (2014).Teaching methodologies: issues, challenges and implications on the teaching and learning of mathematics in primary school, Nigerian. *Journal of Research in Primary Education (NJORPED)*, Ondo1(1),29-35.

Anibueze, C.O. (2015). Effective Use of Electronic Learning for Teaching and Learning of Mathematics in Secondary Schools in Enugu North LGA of Enugu State. *Association for Promoting Intellectual Property (APIP) 2015 Journal*, 9(1): 208 – 222.

Anibueze, C.O. (2017). Effect of Mathematics Scrabble Game on Junior Secondary School Students' Achievement and Interest in Computational Skills. *A Master's Dissertation of the Department of Science and Technology, Enugu State University of Science and Technology (ESUT), Enugu.*

Anibueze, C.O. (2021). Differential Effect of Mathematics Card, Chess and Scrabble Games on Senior Secondary School Students' Achievement, Interest and Retention in Trigonometry. *A thesis submitted to the Department of Science and Technology, Enugu State University of Science and Technology (ESUT), Enugu.*

Barrett, A. D. & A.F. Fisher (2011), Does chess training affect conceptual development of six-year-old children in Turkey? *Early Childhood Development and Care*, 182, 797-806.

Decker, J. (2018). Is mathematics a science? Retrieved from https://www.researchgate.net/post/Is_Mathematics_A_Science

WEBSITE: https://globaljournalhub.com
ISBN: 978-978-798-430-7

Donald Sauter (September, 2010). *Scrabble – a Brief History and Evolution of the Rules, 1949–1999*. Washington: Donald Sauter Press.

Dumontheil, I. & T. Klingberg (2011). Brain Activity during a Visuospatial Working Memory Task Predicts Arithmetical Performance 2 Years Later. Cerebral Cortex, doi:10.1093/cercor/bhr175 .

Edley J. and Williams, J. D. (Jr.) (2001). *Everything Scrabble*, US: Simon and Schuster. ISBN 0-671-04218-1

Eze T. A. (2006). *Introduction of Research Methodology*. Enugu: A G Publishers.

Eze, J.E. (2015). The effect of mathematical games on primary school pupils achievement in mathematics. *Multidisciplinary Journal of Research Development.* 15(1): 14 – 29.

Fatsis Stefan (August 17, 2012). The Case of the Stolen Blanks. *Fatsis Stefan*.

Forbes (March, 2018). *Forbes Magazines*. Http://en.forbes.com.us/march2018 Retrieved on 23th September, 2018.

George T.F. (2015). Effect of Scrabble game on the computational level of Children. *New York Mathematics Journal* 1: 15 – 27.

Gurat, M. & Sagun, M.J. (2018). Effect of study group on grade 9 students' achievement in solving trigonometric problems. *International Journal of Research Studies in Education* 7(4): 91 – 102.

Imoko, B.I., & Isa, S.A. (2015). Impact of computer Games on pupils achievement in mathematics in primary achievement in mathematics in primary school in Lafia Local Government Area: A tool for technological development. *Proceedings of September 2015 Annual*

ISBN: 978-978-798-430-7

National Conference of the mathematical Association of Nigeria 63-71.

Iroegbu, T.C., Nkwocha, P.C. &Onyemerekya, N.P. (2012). *Developmental Psychology.* Owerri: Versatile Publishers.

James F. (2014). *Analysis of the Edutainment Games in the U.S.* http://aanufb.com/resources/adfe.htm

John, T. (2018). *Humankind Battles for Scrabble Supremacy.New York Times*, May 24, 2018

Kagenyi D.G. (2016). Pedagogical factors affecting the learning of trigonometry in secondary schools in Gatundu North sub-county, Kiambu County, Kenya. *A Thesis of Master of Education (Mathematics Education) in the School of Education of Kenyatta University.*

Mathijs, H. (2013). Trigonometry for game programming. *http://www.raywenderlich.com*.

Nekang, F. N. (2018). The use of mathematical games and secondary school students' achievement in mathematics in the fake division, the southwest region of Cameroon. *Journal of Education and Entrepreneurship*. 5 (1), 20-31.

Obodo, G.C (2017). The Place of Mathematics in Contemporary National Development. *Journal of General Studies* 5(1), 13-19

Okafor, P.C. (2015). Effect of Some Mathematical Games on Primary School Pupils' Achievement, Interest and Retention in Mathematics. *A Ph.d. Thesis presented at the Department of Science and Computer*

ISBN: 978-978-798-430-7

Education, Enugu State University of Science and Technology (ESUT), Enugu.

Shayer, M., (2012). *Not just Piaget, not just Vygotsky, and certainly not Vygotsky as an alternative to Piaget*. UK: Open University Press

Smith, W.G. (2013). Comparative Effect of Simulation Game and Constructivist Approach on the Students' Achievement, Interest and Retention. *American-Malawian Journal of Scientific Research* 4 (2): 322-334.

Smullyan, R. (2011). *Chess misteries of Sherlock Holmes.* New York: Dover Publications

Umar I.O. & Ibrahim M.O. (2018). Effect of Science-Technology-Society on Trigonometry Performance of Senior School Students In Nasarawa State, Nigeria. *Abacus*: *The Journal of the Mathematical Association of Nigeria,* 43(1), 324 – 337.

Vajiac, B., & Snow, J. (2019). Mathematical roots: can a sixth grader do trig? *Mathematics Teaching in theMiddle School*, *15*(3), 176-180.

Vygotsky, L.S. (1978). *Mind in Society: the Development of Higher Psychological Processes*. Cambridge, MA: Harvard University Press.

Weber, K., Knott, L. & Evitts, T. (2018). Teaching trigonometric functions: lessons learned from research source. *The Mathematics Teacher*, 102(2), 144-150.

West African Examination Council (WAEC) (1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014,

ISBN: 978-978-798-430-7

2015, 2016, 2017, 2018). *May/June Senior Secondary School Certificate Examination Chief Examiner's Report.* Lagos: WAEC

West African Examination Council (WAEC) Mathematics Chief Examiner (2016). *Resume of Mathematics.* Accra: WAEC

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