

KARL POPPER, SCIENTIFIC METHOD, THE GROWTH OF SCIENCE EDUCATION AND DEVELOPMENT

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Introductory Note

Contemporary assessments on the advancement in science and technology have given room to value and evaluate some philosophical theories that have been adamantly influential to the conquest for the betterment of humanity. Such theories include: behaviourism, physicalism, particularism, reliabilism, modal principle of science, verificationism, logical atomism, parallelism, fatalism, consequentialism, falsificationism, conceptualism, structural intentionality, etc. It is against this platform that we evaluate the developmental temerity inherent in Karl Popper's theory of falsification¹ and collaboration, a theory that emphasised on the demarcation of sciences from pseudo-science, emphatically, in relation to the growth of science education.² In it, he affirms the uncertainty on the establishment of truth which is not fallible has the very evident of non-conclusion, and then, he demanded that no system should be taken as a paradigm for the measurement of what should be regarded as knowledge. Popper on his part with the theory of falsifiability says that any fact can be refuted, no matter the strength of the medium of its measurement, even science with its meticulous procedures of ascertaining facts. He tries to demarcate science and metaphysics, and systematically unified them, only, in the domain of complementarity in the certainty of truth.³

This demarcation is to foster the relevance of the distinguished, or rather, the distinctive disciplines in educational enterprise. It is on the

non-doubtable fact that “education is the crucible in which innovations are forged. Promoting creativity and innovations through the educational institutions, is a first step towards broadening and deepening the impact of innovations in the society and economy.”⁴ For this, anything is new in science, just only the formulation of new laws and theories from existing ones. The development of any theory, not excluding that of Karl Popper, is to solve problems inherent in society, may be within a particular time and space.

It is highly indicative to recognise that education has been judged to be a problem mechanism that humanity has recognised and constituted to liberate itself at all times. More straightforwardly, Karl Popper's theory of falsification, although important for the philosophy of science, has much wider application. In the 1920's and 30's logical Positivists were arguing that statement only had meaning if they could be verified by sense data. In other words, if you could not give any evidence for a statement, or say what would count for or against it, then it was meaningless. The exception, of course, was statements of logic or mathematics here the meaning is already contained within the definition of the words used.⁵ With the precision of logic and mathematic, Popper believes that the growth of science and technology is necessarily connected to the growth of human knowledge through the adaptability inherent in scientific methodology. It is on the prelude that emergence of new discoveries within steering wheel of scientific methodology, since it is about problem solving, and then producing another potential problem(s) that needs to be solved.

So purposefully, we may generally have to ask: what then is the scientific method or methodology? It is taken that scientific methodology is a way to make sure that experiment gives out good result or answer to a specific question, based on the available and corresponding facts. It is a logical and rational order of steps by which scientists come to conclusion about the world around them. When we refer to scientific method or methodology, it is simply the general properties and consideration that are used in the confirmation or refutation of a hypothesis in the various, that is, the common way in which hypotheses are assessed or researches are carried out in the sciences.⁶ The whole deal of scientific verifiability with the applicability of methodology centres on explanations of facts over facts. The development of sciences is on the explanation of facts over the known facts. Then scientific method helps to organise thoughts and procedures so that scientists can be confident in the answers they find. Scientists use observations, hypotheses, and deductions, through fact-rending explanations, to make the necessary conclusions.

Karl Popper and the Theory of Falsification and Collaboration

Popper aims at solving the problem of induction in scientific methodology; that is to solve scientific problem by induction as Rene Descartes wanted to solve Mind-Body problem. Incidentally, Popper ended up throwing away inductive method through the front door and accepting it through the back door. He therefore says that scientific method should be approached thus: firstly, by being aware of the problem. Secondly, proffer a solution to the problem. Thirdly, make deductive propositions to form a theory. Lastly; arrive at the theory from various examinations to get the best of the theories. In other words, the old scientific method was firstly to observe; secondly to take statistics of the observation; next, is to form a pattern from the statistics, formulate the theory and lastly; check from the formulation if it is valid or to stand the test of time and space.

Popper highly praises “testability” and “objectivity” as the hallmark criteria of scientific knowledge and explanation. He recognises that the vestment of all scientific knowledge must be justified by evidence or good reason that can stand the test of time, but in no way does this suggest that new proven theories cannot be found to falsify the pre-existing ones.⁷ The idea of “test of time” indicates the expiration of a particular theory for the wave of a more embracing theory or a development of the former for a better appreciation of past scientific exercises, something, depends on the interests of periodic scientists. As Rosenberg explains that; “the logic of falsification is particularly important because science is fallible. Science progresses by subjecting a hypothesis to increasingly stringent tests, until the hypothesis is falsified, so that it may be corrected, improved, or give way to a better hypothesis. Science's increasing approximation to the truth relies crucially on falsifying tests and scientists' responses to them.”⁸ It is on this ground of scientific development that Karl Popper built his scientific theory of falsification in seeing to the evolution of scientific methods in not getting too attached to dogmatic and traditional methods. Fencing against dogmatic scientific certainty has been the accelerating force for the development of science education, based on the constant scientific researches and explanations. It is with this respect that scientific knowledge, within scientific methodology, here, not considered particular but general, and not discriminatory, but universal. For this, analysing the differential notation between science and pseudo-science, in the term of linguistic applicability, Frederick Ferre⁹ put two characteristics of science method forward, that:

1. Scientific method requires an element of predictability or at least the specification of some experience which might in principle verify or

refute the proposed explanation. This requirement safeguards one of the prime characteristics of scientific explanation: its specificity.

2. Science method requires that a theory, if it is truly to explain, must permit expansibility; that is, application must be found for a would-be explanation beyond the data which originally demanded it. Without a capacity for explanation an alleged “explanation” becomes no more than an ad hoc label for a specific phenomenon offered in lieu of a real explanation.

For Ferre, science method tailors the specificity of scientific engagements, and without it, the development of theory or theories is not tenable. Science method, within the applicability of explanatory modelling of facts towards the establishment of theories, remains result-oriented venture, and this places it indispensably in science education and its development. Broadly put, Popper believes that explanation of facts is the hallmark of scientific expedition. It is from expectation that the theory of conjectures and refutation- that is, the conditioning of “trial and error” emerges. The theory from observation is either falsified or corroborated, corroborated is simply “support”. As Rosenberg puts it:

The attraction of an explanation that shows what happened had to happen as a matter of logical necessity which allows for no alternative, and the appeals of teleological explanations are based on very controversial philosophical theses claims which must philosophers have repudiated. If these two sorts of explanation rest on questionable assumptions, then it will turn out that despite the feeling that it isn't enough, “efficient” causal explanation will be the best science or any other intellectual endeavour can offer to assuage explanatory curiosity.¹⁰

From all scientific indications, logical necessity does not exact necessary connections to explaining the verifiable potency of events and reality. Verifiability must follow some certain laws within scientific methodologies. Rosenberg tries to explicate that causal propensity of “special sciences”, and renders the attestation for the dissatisfaction with causal explanations, the proprietary laws in the “special sciences”, the functional law and biological explanation, and the intelligibility to necessity in scientific modal theories. A theory, according to Popper cannot be cleared or claimed to be true. It can be only corroborated or supported. If it is falsified, then it is discarded. A theory, for Popper, is like a pack of piles which can give way when built upon because scientific theory is not permanent. It can be refuted just as we knew

before about the composition of elements by atom but now refuted to be electron, proton and neutron, and no longer atom.

Karl Popper and Modal Explication of Scientific Methodology

To put it directly, Karl Popper in his theory of falsification did not dispute the ideas of philosophical findings. He, as a matter of fact, tries to falsify the conclusion on the paradigm-driven in scientific researches.¹¹ Even though certain premises are the necessary steps to use in other methodologies in arriving at the truth or knowledge claim, however, in philosophy of science, philosophers hold different views as to what and how science ought to be, scientific method, the border between science and non-science among others. These different arguments are responsible for the emergence of different schools of thought in philosophy of science, for example: logical positivism, critical rationalism, falsificationism, methodological anarchism, etc.¹² But did Popper apply the falsification theory? He admits that all knowledge from the methods science has adopted from her findings is fitted within limitations, that is, he identifies the environmental and human errors in all methodologies that will necessarily engineer falsification and in some cases necessitate collaboration.

So positioned, Science education, based on the conceptual constructivism, promotes critical inquiries in educational development and scientific innovations. It questions universalism, transcultural rationality, scientific and objective truth, in order to find meaning in every natural reality or event. It is about the nature of knowledge and its relation to education,¹³ demarcation of human disciplines. Based on the classical recognition of the demarcation of continental philosophies in developing the authenticity of knowledge claim; C. S. Momoh asserts that,

A prime requirement of the scientific method is confrontation and contact with the object. This confrontation and contact is direct mainly in the realm of macro-science which deals with the things that are not perceptual objects. In the realm of micro-science scientists deal with things that are not perceptually regimentable and the confrontation and contact here is indirect. But, whether in the realm of macro-science or in that of micro-science observations and experimentation are the necessary trademarks of the scientist. Observation- direct or indirect- is necessary because that has to be contact with the object with a view to determining its "behaviour" or constituents, experimentations is necessary because there has to be a confirmation or falsification or rejection of some or all of the initial hypotheses.¹⁴

More emphatically, Popper in his inductive refutation arrives at what is called “Popper Hypothetico-Deductive Method” in the theory of falsification. With this, he has been breasted with some level of philosophical courage by his 20th century fellow scientists, like Paul Feyerabend with his anarchical epistemology where he propounded that in scientific engagement “anything goes” or that from any “nonsense” there is “sense”.¹⁵ Feyerabend sees that no theory is ever consistent with all the relevant facts. Then, he concludes that it is impossible to vie the progress of science in terms of one set of methodological rules that is always used by scientists which will necessarily limits the activities of scientific progress. In the same light, Thomas Kuhn faulted Popper in some ways with his “normal science” approach. There, Kuhn's paradox of incommensurable paradigms goes some way to explaining how science really does make progress by recognising the limitations in every systematic scientific research that give rooms for scientific advancements.¹⁶ And Imre Lakatos for his “Hardcore Science” approach. Lakatos who many see as a useful alternative between Popper and Kuhn, introduced the idea of “progressive research programmes”. These were progressive when they move toward greater consilience and explanatory power, either through supporting empirical evidence or though the noticed advances. In all these, to say a scientist reflects logically on the physical facts before him is not to suggest that scientist takes sides in philosophical fights. If, according to C. S. Momoh, anything is true it is that whatever merits there is in monism and dualism, or realism and idealism really do not bother the scientist during the course of his investigation and experimentation.¹⁷

Karl Popper and the Growth of Science Education

Highly stated, substantiating the popular image of science, the thrust of science education is centres on the meaningfulness of the philosophical movements: realism and pragmatism. “Realism as the name connotes a belief that things exist in reality whether human beings perceive them or not. This school has Aristotle as its founding father and most outstanding philosopher. It holds that there is absolute reality, regardless of whether or not it is perceived by human beings”.¹⁸ For the sake of development of the field of study, the teacher or an instructor would impart knowledge of this reality to students or display such reality for observation through methodical explanations. And, based on the popular image of science, according to Elvis Imafidon, scientists and science-oriented scholars have taken science as most reliable model for the inquiry and its method of all methods.¹⁹ Scientific concepts are programmed for understanding how science curricula can be meaningfully evaluated.²⁰ That the development of science is in

conformity of verifiable theories, and in *Logic of Scientific Discovery*, he asserts that;

The attempt has often been made to describe theories as being neither true nor false, but instead more or less probable. Inductive logic, more especially, has been developed as a logic which ascribes not only the two values 'true' and 'false' to statements, but also degrees of probability; a type of logic which will here be called probability logic....²¹

More succinctly, for the realist in most instances, the world is as it is, and the job of school would be to teach students about the world. For the realist, truth would be found in the laws of nature and the order of the physical world. Truth would be the simple correspondences of observation. Hence, the realist would favour a school dominated by subjects of the here and- now world, such as mathematics and science. For instance, in the Nigerian educational curricula formulation, science education means education in sciences (mainly in Chemistry, Physics, Biology and Agriculture), mathematics and technology. According to Livinus Odo; “in secondary school, science education has been fragmented into Biology, Chemistry and Physics, taught as Integrated Science or Basic Science in Junior Secondary and as separated subjects in Senior Secondary classes.”²² There, students would be taught factual information for mastery. The students of science education are met to have these convictions that: science is said to be a reliable form of reasoning; an objective inquiry into reality; retains the character of inter-subjectivity; subsumes the obedience to the general laws in accordance to the requirements of logical consistence and coherency in its hypothesis, laws and findings; and it is impartial or impersonal in line with the scientists' idiosyncrasies or dispositions.²³

We talk of science education contemporarily when the issues of rapid developmental growth are discussed in terms of technological and industrial advancement, philosophy always wants to evaluate the intricacies of these engagements of inventive skills and knowledge. Though, some scientific terms and concepts may be beyond what philosophy can clarify, but it continues to involve itself to understand the reasons and relevance of scientists' engagements in refutation theory. According to Michael Matthews, “philosophy is not far below the surface in any science classroom. At a most basis level any text or scientific discussion will contain terms such as “law,” “theory,” “model,” “explanation,” “cause,” “truth,” “knowledge,” “hypothesis,” “confirmation,” observation,” “evidence,” “idealization.” Philosophy begins when students and teachers slow down the science lesson and

ask what these terms mean and what the conditions are for their correct use.”²⁴ More explicitly, science education involves the pedagogical alteration of some basic scientific exercises in more methodological procedures, showcasing educational knowledge concepts learnt and verified.²⁵ For the realisation of meaningful development in terms of advancement of infrastructures, more governmental investments must be done in science education, and in case of recent Nigerian situation, Livinus Odo asserts that:

*Science education which is meant to only prepare students for further studies in science and science-related areas can best be describe as inadequate. It is only science education that can provide knowledge, technical and entrepreneurship skills that can be regarded as adequate.*²⁶

For proper internationalization of the developmental impulses of science education, it suggests that there should be adequate funding of scientific projects and initiatives; employment and training of qualified science teachers; having well-structured science-oriented curricula that are student-centred; providing needed instructional materials, and placing relevance on cognitive instruments as measure of students' performance and achievements. Analysing the pragmatic pedagogy in teaching sciences, Michael Matthews puts it that: “attempt to introduce students to scientific methods through laboratory work and experimental inquiries have been a staple of science teaching, and provide a basis for further elementary philosophical reflection on the nature of science.”²⁷ Consequently altered, the realist educational curriculum recommends technical and scientific education so as to make education practical and to enable it to survive in this world. It recommends logic, critical thinking and scientific methods so that through logical thinking, students may deduce or will be open to the ultimate reality. The ultimate goal of education should be to help the student to study and understand his environment (reality), to be conscious or open to things as they really exist in nature and to have confidence in things as they have real existence in nature.²⁸

However, Popper stresses on the point and need for a scientific education, which must be geared towards exposing the student to really face problem they care about solving themselves, by giving them what they need for independence, and for which on trying to solve them, they might encounter problem and therefore learning how to recognize both moral and intellectual honesty. A drip off from professionalization would not solve the problem of narrow-mindedness, but would in that case worsen the result. Therefore, certain steps and strategies which are referred to as scientific, and which necessarily should follow Karl Popper's falsification theory, therefore are to be put in place in the area

of education for a growth of what could be termed “scientific education.”

In all, Karl Popper had explained how an initial problem prompts the formation of a trial solution which undergoes error elimination before giving rise to a new problem and so on. This explanation has been developed into a Popper's theory of learning, a sense of “Progressive Educational Principle or Theory in Science”, as if Popper were a progressive scientist who supposed that the only form of useful learning must start with the person's own authentically realized problem. There is place for inducting children into a third world of ideas through what amounts to a kind of uncritical transmission. The progressive interpretation of his work suggests that children must be confident to face continual failure in the solution to problems they actually care about solving.²⁹ In all indicative actions of development, falsification and collaboration within the plausibility of explanations and clarity, remain necessary steps to adopt in the scientific process of research and innovations, a revolutionary culture of advancement of the power and products of the human minds and engagements.

Evaluation and Conclusion

On this epistemic fashioning, falsification as a theory that is related to verifiability theory which emphasises on the truthfulness of a theory in relation to another or most existing theory, and it could be seen as an edifying theory of the scientific endeavour.³⁰ To falsify is to root out the mean or the real thing, in epistemic forum, it was stated that no one can know everything for certain so there is no certainty of knowledge in the academic vineyard. As such, any theory can be falsified.³¹ Still philosophy questions the rationale of their methods and methodologies, findings and assumptions.³² In so far, as human reasoning is imperfect; any falsifiability gives birth to new ideas and it invents new understanding. It widens the academic boundaries, as falsification in its sense is good and healthy intervention in scientific discipline, because it increases the standard of knowledge and brings a better of a particular theory or theories it tends to falsify.

Nevertheless; Popper's concern for science seems to approve of that which can be tested as sufficiently what works to permit dependable expectations of results, is pragmatism. But he did not formally acknowledge that he was building on pragmatism, but that he is the originator of it. And it is clear therefore that Popper's philosophy challenges much current educational practice, particularly, that which encourages the wilder forms of progressivism, and denigrates traditional teaching.³³ It should be observed that his concern for scientific methodology on the growth of science education for the development of curricular has not been fully explored. It is clear also

that his philosophy has important implications for the ways that educational institutions are organized and the ways that educational research is carried out.

To be academically positioned and highly objective, Popper's thesis will remain very realistically controversial, and may not be acceptable to many thinkers because, there are some scientific discoveries and laws that have never been refuted in the course of history especially those that are rested on the law of nature. To understand the law of nature in science, there are indispensable needs to understand scientific concepts such as "explanation," "theory," "cause," "hypothesis," "knowledge" and the likes. As Michael Matthew puts it that : "all of these concepts contribute to, and in part arise from, philosophical investigation of epistemological and metaphysical questions: questions about what things can be known and how we can know them, and about what things actually exists in the world and how they are related to one another."³⁴ The philosophical thesis of Popper's falsification is based on the progressive proximity and propensity of the law of nature in influencing the growth of science education on the dynamic nature of these scientific happenings, possibilities and concepts.

Therefore, the growth of science through science education is a strong indication to the fact that reliability of the epistemic culture of absolute certainty needs more to be re-evaluated on the posited face of falsifiability and collaboration. So, there is a need to give the theory of falsification appraisal,³⁵ as a sense of academic referential footing for its enduring relevance. Growth is the culture of science, of which refutation and collaboration are key force that propels its developmental growth without which science will be somehow if not enormously limited in its findings. So falsification is of great value in scientific domain owing to the fact that no one's knowledge is holistic and certain, based on the limitations of human rationality.

Notes and References

¹ On this, falsifiability is an essential characteristic of scientific progress. It means the ability of scientific laws to be refuted due to new discoveries which eventually lead to reformulation of new laws and theories. It is for this mark of scientific attitude that no one can at any point claim that the last truth has been said in science field of study. Karl Popper prefers to refer to truth in science as *verisimilitude* rather than *veritas* (Cf. K. R Popper, *Objective Knowledge: An Evolutionary Approach*, Oxford: the Clarendon Press, 1972, pp. 14, 47-48, 52-60, as quoted in Ikenga K. E. Oraegbunam, "J. Obi Oguejiofor and the Use of Philosophy," *West African Journal of Philosophical Studies*, Vol. 8, 2005, pp. 1-14, see, p. 12).

² See, Karl R. Popper, *Conjectures and Refutation: The Growth of Scientific Knowledge*. New York: Harper Torch Books, 1965, as cited in Karo Ogbinaka, "Philosophy of Education: An Epilogue" in A. F. Uduigwomen and Karo Ogbinaka (eds). *Philosophy of Education: An Analytical Approach*, Lagos: JERP Ltd, 2011, pp. 433-443.

³ See, P. O. Isanbor, "An Appraisal of Karl Popper's Theory of Falsification," *Ekpoma Review*, Vol. 3, 2016, pp. 71-88.

⁴ Juliana N. Odo, "Innovation and Transformation in Teaching and Learning of Physics Education in Senior Secondary Schools" *Journal of Teacher Perspective*, Vol. 9, No. 2, 2015, pp. 431-447

⁵ P. O. Isanbor, "An Appraisal of Karl Popper's Theory of Falsification," *Ekpoma Review*, Vol. 3, 2016, pp. 71-88.

⁶ Elvis Imafidon, "The Popular/Rationalist Image of Science: An Overview of the Positivist View of Science," *Ekpoma Review*, Vol. 2, 2015, pp. 101-119. See, p. 103. More straightforwardly, for Popper, it is common to all that in science, every claim to knowledge must rest on the principles reliability, precision, objectivity, testability, comprehensiveness, and universality. And when therefore any knowledge-claim successfully passed the above principles, and then owing to the universal nature of this universal knowledge, then a scientific theory emerges.

⁷ By Falsification, Karl Popper tries to propose the necessary condition that empirically substantiate the endurableness of the theories in science, and which will make them stand the test of time and space, that is, withstanding the impending criticisms. See some comments on Falsification and Collaboration Theories in David Miller (ed.), *Popper Selections*. New Jersey: Princeton University Press, 1985, pp. 100-151.

⁸ Alex Rosenberg, *Philosophy of Science: A Contemporary Introduction*. NY: Routledge, 2012, p. 202.

⁹ Cf, Frederick Ferre, *Language, Logic and God*. New York: Harper & Row Publishers, 1961, p. 23

¹⁰ Alex Rosenberg, *Philosophy of Science: A Contemporary Introduction*, p. 99

¹¹ G. Stefano, *Karl Popper's philosophy of science: rationality without foundation*, UK: Routledge, 2009.

¹² Cf, Henry O. Ukavwe, *History and Philosophy of Science*. Abuja: Transport Watch Communications, 2013.

¹³ Sidel Erduran, Book Review: *Philosophy, Science, Education and Culture*. Robert Nola and Gurol Irzik, Springer Academic Publisher, 2005, xvi + 488pp. In *Eurasia Journal of Mathematics, Science & Technology Education*, 2008, Vol. 4, No. 3, 315-316.

¹⁴ C. S. Momoh, "On Cultural Philosophy", *Journal of African Philosophy and Studies*, 1(1&2), 1988, pp. 25-38.

¹⁵ See, Blessing O. Agidigbi, "Challenges and Prospects of Paul Feyerabend's 'Flight from Reason' for Science and Epistemology in

Africa.” 2nd Faculty of Arts International Conference. Ambrose Alli University, Ekpoma, 11-15th March, 2014.

¹⁶ For the revolutionary tendency and reality of science, the objectivity of interest and understanding of methodology become the hallmark of its advancement. According to Peter Omonzejele; “what Kuhn has done with his classification of science is to agree with K. Popper on the non-objectivity of science though there may be some disagreements in their methods of explaining the status of Science” (see, P. Omonzejele, “Philosophy as a Second Order Discipline”. *Philosophy and Logic (General Studies Text)*, General Studies Department, University of Benin, Benin City, Nigeria, 2005, p. 28.

¹⁷ C. S. Momoh, “On Cultural Philosophy”, p. 30.

¹⁸ See, Emmanuel J. Udokang, “Realism and Theoretical Entities.” *Journal of Philosophy and Related Disciplines*, Vol. 3, Nos. 1&2, 2008, 132-143.

¹⁹ Elvis Imafidon, “The Popular/Rationalist Image of Science: An Overview of the Positivist View of Science”, p. 102.

²⁰ Juliana N. Odo, “Innovation and Transformation in Teaching and Learning of Physics Education in Senior Secondary Schools”, p. 434.

²¹ Karl Popper, *The Logic of Scientific Discovery*, New York: Basic Books, 1961, p. 251

²² Livinus O. Odo, “Refocusing Science Education in Secondary Schools in Nigeria towards Science Education for All” *Journal of Teacher Perspective*, Vol. 8, No. 1, July, 2014, pp. 249-255. See, p. 250.

²³ Elvis Imafidon, see, pp. 104-6.

²⁴ Michael R. Matthews, “Teaching Science.” In R. Curren (ed). *A Companion to the Philosophy of Education*. USA: Blackwell, 2003, p. 346.

²⁵ Juliana N. Odo, “Innovation and Transformation in Teaching and Learning of Physics Education in Senior Secondary Schools” p. 434.

²⁶ Livinus O. Odo, “Refocusing Science Education in Secondary Schools in Nigeria towards Science Education for All”, p. 250.

²⁷ Michael R. Matthews, “Teaching Science,” p. 346.

²⁸ K. Popper, *The Open Society and Its Enemies, Vol. 2*, London: Routledge, 1945.

²⁹ J. Halliday, Popper and the Philosophy of Education, (UK: University of Strathclyde, nd.). Available at: http://cepat.net/doku.php?id=Popper_and_philosophy_of_education.

³⁰ Henry O. Akavwe, *History and Philosophy of Science*. Abuja: Transport Watch Communications, 2013, p. 124

³¹ Nicholas Dykes, “Debunking Popper: A Critique of Karl Popper's Critical Rationalism, Libertarian Alliance”, 2003, Assessed on 4/15/2016 from <http://www.libertarian.co.uk/lapus/philn/philn065.htm>.

³² Ikenga K. E. Oraegbunam, “J. Obi Oguejiofor and the Use of

Philosophy,” *West African Journal of Philosophical Studies*, Vol. 8, 2005, pp. 1-14, see, p. 13.

³³J. Halliday, *Popper and the Philosophy of Education*. UK: University of Strathclyde, nd. Available at, http://eepat.net/doku.php?id=Popper_and_philosophy_of_education.

³⁴Michael R. Matthews, “Teaching Science,” p. 346.

See, Henry O. Akavwe, *History and Philosophy of Science*, p. 125. And P. O. Isanbor, “An Appraisal of Karl Popper's Theory of Falsification,” *Ekpoma Review*, Vol. 3, 2016, pp. 71-88.