**Research Methods :**

**1-Quantitative Approach**

Research in science education is to discover the truth which involves the combination of reasoning and experiences. In order to find out appropriate teaching methods that are necessary, different research approaches are used by educational researchers based on the data collection and analysis used at a given time. Though qualitative and quantitative research methods lies on separate continuum, they all aimed at identifying educational problems using different approach. This study critically examined the usefulness of both qualitative and quantitative approaches..

**A-Philosophical Framework**

The essence of educational research is to improve educational programmes. Perhaps, research may be seen as an honest enterprise where reasoning, interest, critical thinking, experiences and expertise are combined with the purpose of discovering the truth so as to find solutions to problems confronting education through investigation and analyses. There are no standard procedures of carrying out research. In other words, research is not a routine.

Research designs are either classified as qualitative, quantitative research or mixed method. Method of research is generally believed to reside in paradigms and communities of scholars (Cohen, 2011, p4). Kuhn (1970) (cited in Hammersley (2012) examines paradigm as a “set of philosophical assumptions about the phenomena to be studied (ontology), how they can be understood (epistemology), and the purpose and product of research”. Kuhn’s work accounts for the understanding of the nature of qualitative and quantitative research approaches used in educational research today. The paradigms are characterized by the methods of data collection and analysis as well as methodological approaches to research which has been generating much controversy among researchers. Bryman (2008, p22-23) argues that qualitative and quantitative research differs in their paradigmatic approaches with respect to their epistemological (ways of knowing and enquiry in nature of reality) and ontological (what is to be known and assumptions about the nature of reality) foundations. In ontological orientations, qualitative and quantitative researchers are constructivism and objectivism respectively in terms of their strategies. However, in epistemological orientation, quantitative researchers are objectivists and positivists in their research approach while qualitative researchers are subjectivists and anti-positivists in their research approach (Creswell, 2009, p4- 17).

Johnson and Christensen (2012, p31) stated that a paradigm is an approach about research or doing research. The authors identified qualitative, quantitative and mixed research as the three major paradigms in educational research. The authors were however silent on the foundation or orientation on which these paradigms were classified. Guba and Lincoln (2005, p183), in their work, argue that paradigm are “beliefs that guide that guide one in his activity”. Guba and Lincoln acknowledged that paradigms are human constructions and therefore subject to change. The authors refer to paradigm as encompassing four distinct terms which are: ethics (axiology), epistemology, ontology, and methodology when dealing with positivist (quantitative researcher) and social constructivist (qualitative researcher). Guba and Lincoln (1994, p109) stated four distinct paradigms associated with social researches as being: constructivism, critical theory, positivism and postpositivism. Constructivism and critical theory are associated with qualitative research, while positivism and postpositivism are associated with quantitative research.

**B-Advantages of Quantitative Research Approach**

The first advantage of this research approach is the use of statistical data as a tool for saving time and resources. (Bryman, 2001, p20) argue that quantitative research approach is the research that places emphasis on numbers and figures in the collection and analysis of data. Imperatively, quantitative research approach can be seen as being scientific in nature. The use of statistical data for the research descriptions and analysis reduces the time and effort which the researcher would have invested in describing his result. Data (numbers, percentages and measurable figures) can be calculated and conducted by a computer through the use of a statistical package for social science (SPSS) (Gorard, 2001, p3; Connolly, 2007, p2-34) which save lot of energy and resources.

Secondly, the use of scientific methods for data collection and analysis make generalization possible with this type of approach. Interaction made with one group can be generalized. Similarity, the interpretation of research findings need not be seen as a mere coincidence (Williams and May 1998, p1-21). The study of problem-solving instruction in secondary school science education within one particular area or zone can be reflective of the wider society in terms of samples, contents and patterns (Shank and Brown, 2007, p28; Cohen and Morrison, 2011, p243).

However, replicability is another benefit derivable from the use of this research approach. Since the research approach basically relies on hypotheses testing, the researcher need not to do intelligent guesswork, rather he would follow clear guidelines and objectives (Lichtman, 2013, p4). The research study using this type of research tool is conducted in a general or public fashion because of its clear objective and guidelines , and can therefore be repeated at any other time or place and still get the same results (Shank and Brown, 2007, p27).

Moreover, this research approach gives room for the use of control and study groups. Using control groups, the researcher might decide to split the participants into groups giving them the same teaching, but using different teaching methods, bearing in mind the factors that he is studying. At the end of the study teaching, the groups can be gathered and the researcher can then test the problem-solving ability of the students and be able to access the teaching method that best impacts the problem-solving abilities amongst the students. (Johnson and Christensen, 2012, p34). Finally, Denscombe (1998, p173-176) describe quantitative research as “researcher detachment” research approach. When looking at the “researcher detachment”, it may be seen as a strength of quantitative research approach from one angle, yet from another angle it may seen as its weakness. The issue of researcher being bias with either his data collection or data analysis will be highly eliminated when the researcher is not in direct contact with the participants, that is, he collects his data through either telephone, internet or even pencil-paper questionnaire. There is full control for alternatives such as interpretations, explanations, and conclusions. In other words, the objectivity of the researcher will not be compromised. Secondly, this may perhaps guarantee respondent anonymity (Muijs, 2004, p7-45; Litchman, 2006, p8; Bryman, 2012, p408; Creswell, 2009, p4). 3.2.2. Disadvantages of Quantitative Res

**C- Disadvantages of Quantitative Research Approach**

Researcher detachment from the participants is also a weakness within the quantitative research approach. Researcher detachment means that he is an “observer” or an “outside looking in”. With this type of researcher/participant relationship, it will extremely difficult to get the in-depth study of the phenomena within its natural settings. He will neither understand the group or individuals working with him nor will he appreciate them (Shank and Brown, 2007, p63; Berg, 2007, p4; Christensen and Johnson, 2012, p35). In studying problemsolving instructions for science education in secondary schools, the researcher need not be an observer nor detach himself from the participants. It is dehumanising as well as undermining life and mind (Cohen, 2011, p14). The experiences gathered may not be that of the participants mind and opinion (Berg and Howard, 2012, p61). Quality and quantity are very important in any educational research since research is an instrument of change. Those two words cannot be neglected when explaining phenomena (Dabbs, 1982 cited in Berg and Howard, 2012, p3). In the quantitative research approach, the participants have no room to contribute to the study.

The researcher is at the “driver’s seat” (Bryman, 2001, p286). The linear and non-flexibility nature of a quantitative approach demands that the researcher follow a certain order. He starts by setting the research question and hypotheses, conducts a literature review, collects data, analyses the data and summarises the result (Litchman, 2006, p7-15; Creswell, 2009, p17). For educational studies such as problem-solving instruction for secondary school science students, the researcher may decide to observe the teaching methods first and see how the method affects students. Following his initial observation, he may repeat the visit for another observation, if necessary, before planning the main research. Input made by the participants can help form researchers’ point of orientation. This process is not possible within a quantitative research approach wherein its liturgical order of study does not support several ways of knowing. This is predicated through the use of variables to search for the meanings instead of patterns, as argued by Shank and Brown (2007, p61).

Researcher decides the orientation of the research even if participants have a significant point to make or not. A quantitative research approach is characterized as being structured with predetermined variables, hypotheses and design (Denscombe, 1998, p173; Bryman, 2012, p408; Creswell, 2009, p17; Christensen and Johnson, 2012, p34-5). As a result of using predetermined working strategies, the approach does not require or encourage imaginative, critical and creative thinking (De Vaus, 1996, p8). Any data collected is geared towards supporting or rejecting the predetermined paradigms. This, however, shows that the tool is effective for studying what is already known instead of assisting in unravelling the unknown and revamping the known. Perhaps, findings from the studies with this tool may lead to propounding laws and facts that can stand on their own regardless of it being true or not (Shank and Brown, 2007, p58). When considering the existence of social differences in the society and schools in particular, a quantitative research approach is not well “suited to examine the complex and dynamic contexts of public education in its forms, sites and variations” (Denzin and Lincoln, 2005, pxi). But are there true experiments in educational research? Certainly there is no true experiment in educational research (Gorard, 2001, p2).

**For Further Reading**

Hammersley, M. (2012). Methodological Paradigms in Educational Research. British Educational Research Association on-line resources. Available on-line at <https://www.bera.ac.uk/researchersresources/publications/methodlogical-paradims-in-educational-research>; last accessed: 10-01-2016.

**Task one :**

Give the definition of the following terminologies :

Reasoning, experience, method, approach, paradigm, research, epistemological, ontological, positivist, objectivist, research orientation, replicability, methodology