

Contextualizing Scientific Research Methodologies

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Abstract: *This article dissects the various research instruments currently employed, against the backdrop of the research design, methodology, population, sampling, and sample size. It highlights quantitative and qualitative research, data collection methods, as well as the validity and reliability of the investigations. The article adopted a qualitative research design that utilized documentation analyses to evaluate conventional approaches to research methods. The study concludes by recommending both qualitative and quantitative analyses in adding depth to an empirical scientific study.*

Keywords: *scientific research, research methodology, qualitative, quantitative*

I. Introduction

Research, research reports, and technical report writing have accumulated so many perspectives among researchers over the years, that views on technical scientific writing have become more and more divergent. Given these variations, decisions bordering on the best kind of investigative methodology to adopt have come to occupy the thoughts of many researchers [1] (Bowen, 2005). The primary aim of science is to discover and collect facts (data) and to understand the order that exists amongst the various facts, through scientific research.

Scientific research is an intellectual, systematic, organized and empirical activity that is designed to discover information about the natural world, as well as ways in which this information can be applied meaningfully. Approaches to conducting scientific research therefore refer to the different protocols used in research to gather and compile data, which is then used as a basis for inference, interpretation, explanation and prediction [2, 3] (Miles and Huberman, 1994; Mouly, 1978).

According to Robertson [4] (1987), research methodology is a system of rules, guidelines and principles that govern scientific investigation, provide a format and style for gathering evidence about what takes place and why it takes place, and accomplishes it in a way that enables other researchers to verify the outcome. It is hence the most important tool for advancing knowledge.

II. Procedures

In this study, a qualitative research method was used to evaluate various approaches to research methods. This approach was used because it not only facilitated the collection and interpretation of information, but also assigned appropriate meaning from a broad standpoint. Documented materials to evaluate approaches to the different research methodologies were utilized.

The study employed documents from both primary sources (reports and publications that have first-hand information on the theme of this study) and secondary sources (textbooks, journals, and reports of research carried out by other investigators, relevant to this study). These two main sources of documents are less likely to be affected by distortions since they are often generated alongside the events they refer to [5] (Bowen, 2009). In assessing these documents for relevance, emphasis was placed on validity and value to this research. Validation of materials was done using Scott's [6] (1990) overlapping validity criteria of authenticity, representativeness and relevance.

III. Conceptualization

3.1 Research Design

One important goal of science is description [7] (Hale, 2012). Descriptive research according to Best [8] (1970) often analyses the existing relationships; prevailing practices; beliefs, views, or attitudes; on-going processes; or developing trends. According to Hale [7] (2012) and Jackson, [9] (2009), descriptive research methods fundamentally describe situations. They do not make accurate predictions, neither do they determine cause and effect. It is not technically a research method, because it utilizes several individual approaches to data collection, each depicting a current position of any given situation [10, 9] (Verma and Beard, 1981; Jackson, 2009).

The process of descriptive research design does not only involve collecting and tabulating data, it is also an attempt to obtain facts about the current state of things, which involves elements of cross - comparisons

and relationships. Descriptive research is geared towards assigning meaning to, and providing useful data for further research [11] (Ololube, 2006).

Researches in general attempt to design studies that will yield evidence to either support or refute a claim. The research design therefore becomes a logical sequence that connects the study's research questions to the data and ultimately to its conclusions [12] (Yin, 1994). It is thus imperative and logical to include design features from broad theoretical perspectives in order to assess the quality of the research study.

Research design lays down the basis and foundation for assessing the inter-relationships between variables. The selection of a good research design is even more critical and relevant because it guides the plan, structure and strategic build up to obtain answers to the research questions, and affects the overall significance of the research findings. The type of statistical analysis to use and possible conclusions to be drawn is indicative of the particular research design adopted.

3.2 Survey Research

Survey research is a systematic method of data collection [13] (Borg and Gall, 1989). The purpose is to describe specific characteristics of the elements in a group. This method is not just concerned with characteristics of individuals as individuals, but it is concerned with providing information about population variables [10] (Verma and Beard, 1981). In surveys, researchers normally use a "flow chart" to outline the design and implementation of the survey. Using surveys, it is possible to collect data from large and small populations.

In survey research, the researcher or author selects a sample of respondents from a population, and administers a standardized questionnaire for analysis. The questionnaire can be a written document to be completed by the respondent, an online questionnaire, telephone interview, or a face-to-face interview.

The most important contribution of survey research has perhaps been the rigorous sampling methods, the design selection and implementation, the unambiguous research problem statements, and the data analysis. It allows for standardization in the type of questions asked and in the method of approaching subjects, thus ensuring higher reliability than some other techniques.

3.3 Case Study Research

It is a form of qualitative descriptive research focusing on a small group of participants, or the group as a whole. Data is collected using participant and direct observations, surveys, interviews, tests, protocols, examinations of past records, and collections of samples.

In a case study, the researcher cannot control the situation. Case study approach however does not necessarily require procedural data analysis and this allows for various interpretations of the research data. This interpretation could therefore introduce bias and affect the outcome of the research. Nevertheless, the case study approach allows for the deployment of multiple data collection methods such as questionnaires, interviews, documentary reviews, and direct participant observations [14, 12] (Okunoye, 2003; Yin, 1994).

According to Professor Paul Lawrence, a good case study is: "the vehicle by which a chunk of reality is brought into the classroom to be worked on by the entire class and the instructor. A good case keeps the class discussion grounded upon some of the challenging facts that must be confronted and addressed in real life situations." [15] (Christensen, 1981).

The case study research is considered as drawing on the interplay of the prevailing variables in order to provide a thorough understanding of a situation or an event [16] (Palmquist (1993). Unlike quantitative methods, case studies are the preferred approach when "how" or "why" questions are asked. Likewise, when the researcher has little control over the events, this method becomes the preferred approach. Further, case studies are best suited to using inductive logic - reasoning from specific to more general terms.

IV. Research Population

A population can be defined as the total of all the selected individuals with peculiar characteristics and which are of interest to a researcher. In a general sense, a research population includes all the elements of a well-defined group. It defines the scope by which the research is applicable. A research population is classified into target and accessible populations. A target population describes all the members in the group to whom the investigation is related, whereas accessible population represents those elements within the target population that are within the reach and manipulation by the researcher.

4.1. Sampling

A sample is a subset of the population, and can be considered as the smaller group of elements selected through a rigorous and definite procedure from a particular population; i.e. the elements that constitute the sample are those that are actually studied. Kerlinger [17] (1986) has offered a comprehensive definition of

random sampling as the method of drawing a portion (sample) of a population so that all possible samples of fixed size n , have the same probability of being selected. This is a generalized definition and thus satisfactory.

Simple random sampling is perhaps the oldest, easiest and simplest sampling technique in terms of application and conceptualization [18] (Ololube and Egbezor, 2012). It does not necessarily require knowledge of the exact composition of the population, only that we can reach all the members of the population. It is important to note that, simple random sampling has a demerit in extrapolating the result to characterize the general population, because it is unlikely to be representative of the population. Consequently, sampling error is likely to occur with this kind of sampling. Other probability sampling techniques include:

- Quota sample: the author sets a requirement to ensure a particular group is selected and represented.
- Stratified sample: where the population is divided into sub-groups based on characteristics, and thereafter selects from each group based on its size.
- Convenience sample: selection of the sample is based on ease of accessibility.
- Purposive sample: the researcher purposefully focuses on a particular subset or group of a population.

V. Data Collection Techniques

Interviews, questionnaires, and observations are three of the major ways to gather data. While data from interviews is intended to provide information for qualitative analysis, data from questionnaires is expected to provide information for inferential and quantitative analyses. Inferential statistics are concerned with making inferences about a population's characteristics based on information derived or collected from a random sample of the population. This type of statistics lend themselves to making conclusions beyond the samples studied, to cover the entire referenced population. Relevant statistics demand that conclusions are applicable and generalizable to an extended number of elements in a population instead of results that are applicable only to the actual elements under study.

5.1 Interview

The interview is a method in which the interviewer, asks a person being interviewed (the respondent) a set of questions designed to elicit answers pertinent to a particular research problem. Interviews may be used to evaluate a person for some characteristics, for assessing an employee for promotion, for evaluating the efficacy of a well defined therapeutic regime, (as occurs in psychiatric interviews), for gathering data, for testing hypotheses, for sampling respondents' opinions on a particular selection etc.

When the interview is completed, the first step for the researcher is to listen to the tape(s) in order to transcribe them. After the transcription, the researcher should write copious observational notes to be able to contextualize the strategies. It is imperative for the researcher to keep strict observations and memos throughout the entire analyses, as they not only capture analytical thinking about the data, but facilitate one's analytical insight.

The method adopted in the categorization will help researchers to generate relevant themes and titles for their data. The objective here is to organize the data into categories that will facilitate cross-comparisons. This can be followed by the contextualization strategy. Rather than segmenting the data, contextualization links the data, or looks for methods to identify peculiar relationships between can organize relationships that connect various variables like events, statements, and opinions within a context into a coherent whole.

5.2 Questionnaire

Questionnaire design is an approach involving any instrument that has questions or items to which individuals respond. Arguably, the questionnaire is the most frequently used instrument in social science research. Its popularity is demonstrated by the number of published studies and student projects that rely on this instrument for data collection. There are two main types of questionnaires:

- (1) Fixed response or Structured questionnaires
- (2) Open-ended or Unstructured questionnaires.

There is a lot of well-designed research on how questionnaires should be structured to minimise external influences on the process [19] (Braun et al., 2012). Nworgu's [20] (1991) characteristics for designing a good questionnaire is usually applied. These characteristics are: relevance, usability, consistency, quantifiability and legibility. If you are choosing respondents from a number of different categories of people, it is usually important to collect information on the demographics of the respondents. It is also important that a section of the questionnaire is dedicated to collecting information on the demographics of the respondents.

5.3 Observation

Arguably, observation is perhaps the most challenging of all research methodologies, necessitating a great deal of analyses, inferences, experience and practice. Observation can generally be classified into

participant and non-participant observation. The type of observation used should however reflect the scope and aim of the research. Descriptive observation involves concentrating on observing the physical set-up, the key participants and their activities, sequence of activities, particular events and their sequence, and the consequent processes and emotions involved [21] (Anyamele, 2004).

VI. Data Analysis Techniques

Data analyses involves methods of distilling and interpreting qualitative or quantitative data which requires a principal choice by the researcher [22] (Coffey and Atkinson, 1996). This should nevertheless involve a process of systematically organizing the materials collected, and assigning meaning to them so that they tell a story (applicable to the elements described or analysed), and presenting the results in a way that will enable other researchers buy into or relate positively to the findings.

6.1 Qualitative Analysis

In qualitative analysis, less structured research instruments are used in gathering data, and the findings are more in-depth since they employ mostly open-ended questions. Since the research is more flexible, it allows the researcher to probe because he/she has greater latitude. Qualitative research for the most part uses participant observation and in-depth interviews of the subjects, systematically recording their behaviors and perceptions, analyzing the verbal and non-verbal information offered, and then supplementing it with other materials, such as memoranda, journals, records, articles and photographs. Results emanating from such inquiries provide many more details about behaviour, motivation and attitudes. However, since the results are usually based on small sample sizes, they are often not representative of the population. Further, because of its low reliability owing to its subjectiveness, the results cannot easily be replicated.

Qualitative research has been identified as an inquiry process of understanding a social or human problem that is conducted in a natural setting and that is based on building a holistic picture from the words and views of informants, [23, 24, 25] Creswell (1994, 1998, 2003). Much like Creswell, Gay and Airasian [26] (2000) see qualitative research as the collection of exhaustive data on many and varying variables over an extended period of time, in a naturalistic setting, in order to gain insights not possible using other types of research. Gall, Gall and Borg [27] (1999), however, define qualitative research as “making sparing use of numbers or statistical analyses, but instead, relying heavily on verbal data and subjective analysis”. Collectively, for qualitative studies, the concern rather shifts to a consideration of how dependably and thoughtfully the researcher conducted the study, rather than if the results can be replicated. This standard of practice assesses another researcher’s agreement with the results of the study given the data assembled [28] (Rossman and Rallis, 1998).

Apart from the debatable issue of replication, critics have identified the following as what they perceive to be weaknesses of the qualitative method:

- The claim that qualitative research is unscientific;
- The claim that qualitative research is subjective, and therefore full of bias;
- The claim that qualitative research lacks the rigors of quantitative studies;
- The claim that qualitative research lacks inherent internal controls; and
- The claim that qualitative research lacks measures of validity and reliability (Silverman, 2001).

It has overly been argued that qualitative research is full of unquantifiable data that are not subjected to a statistical analysis, and that, without statistical analysis, a study loses its scientific appeal. However, it is worth mentioning that figures alone do not make much sense unless they are explained qualitatively. Indeed, it has been reported that mere figures do not render a study scientific [29] (Bogdan and Biklen, 1992). Further doubts about the reliability of qualitative research are based on the idea applicability or generalizability of the findings. However, not all studies are concerned with applicability or generalization. It is possible to employ other specific methods in order to have the findings of research replicated, verified, or even falsified [30] (Kamwendo, 2004).

6.2 Quantitative Analysis

Quantitative research has been described as a collection of numerical data in order to explain, control, or predict phenomena of interest [26] (Gay and Airasian, 2000). It has also been described as empirical research involving numerical data [31] (Punch, 1998). A more thorough definition is however offered by Creswell [25] (1994) who explains quantitative research as “an inquiry into a social or human problem, based on testing a theory composed of variables, measured with numbers, and analyzed with statistical procedures, in order to determine whether the predictive generalizations of the theory hold true”. Quantitative research is therefore viewed as relying very heavily on numerical data and statistical analysis. The analysis is built upon statistical methods relating to samples and populations, and data from either primary or secondary sources. The entire

process involves data-manipulation and decision making, guided by a mixture of intelligent ideas, insight, experience of the analyst and the complexity or otherwise of the data itself.

In summary, quantitative research provides less detail on behaviour, style and motivation, and are based on larger sample sizes that tend to be more reliable and representative of the population. This type of research is also amenable to replication, and the analysis of the results is more reliable, valid and objective. To further increase the accuracy, the sample sizes would have to increase to 500-2000 or more, depending upon the subject matter and complexity of questioning [26] (Gay and Airasian, 2000).

Finally, Bowen [1] (2005) proposes seven cardinal lessons for effectively conducting research using contextualized scientific tools, instruments and methods. These seven lessons have been modified to suit the purposes of the study under review as follows:

1. Read, Read, and Read
2. Consult Experts
3. Stick to Scientific Regulations
4. Pay Attention to Rigor and Reliability
5. Give Accurate Details of the Methodology
6. Dont Hesitate to Include Numerical Data
7. Publish

VII. Conclusion

This article provides, discusses, and analyses some of the key methods of qualitative/quantitative research. It discusses the usefulness and applicability of the research methodologies. It has contextualized the research methodologies, and further explained how they work and why a particular approach is selected during a research endeavour.

Any scientific research should endeavour to deploy an appropriate method aimed at improving quality and implementation. The arguments presented in this paper can serve as guidelines for both experienced, inexperienced, as well as would-be researchers who are likely to avoid some of the recurring mistakes and difficulties, while writing academic papers for international audiences.

It is recommended that authors are mindful of the Journal guidelines when submitting papers for publication. It is also helpful to browse articles and abstracts in order to know the types of articles the journals typically publish. Contacting the appropriate editor to determine the fit between the proposed article and the journal to which it is being submitted is also essential because this can save a great deal of time and resources. Choosing a research approach that suites the purposes of a research study is entirely the prerogative of the researcher. What actually matters in choosing a particular research approach is the ability to logically represent the idea in a sequence that tells the whole story [32] (Maxwell, 2005).

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