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Visually Hypothesising in Scientific Paper Writing: Confirming and Refuting Qualitative Research Hypotheses Using Diagrams

Uchendu Eugene Chigbu

Chair of Land Management, Technical University of Munich, Arcisstrasse 21, 80333 Munich, Germany; ue.chigbu@tum.de; Tel.: +49-(0)89-289-22518; Fax: +49-(0)89-289-23933

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Abstract: Qualitative research involves scientific narratives and the analysis and interpretation of textual or numerical data (or both), mostly from conversations and discussions, to uncover meaningful patterns that describe a particular phenomenon. It is important to know other ways of framing and explaining these nuanced scientific narratives so that they can convey scientific knowledge. A qualitative hypothesis can play this role. The testing of hypotheses in qualitative research—which does not strictly mean the same thing as testing of hypotheses in quantitative research—always comes with challenges that provoke concerns. The questions that scholars, especially undergraduate and postgraduate students, have had to deal with are: Is it possible to "test" hypotheses using a qualitative method? If it is possible, how can this be done? This study deconstructs the concept, notion, and use of the hypotheses. It presents the "how-to" aspect of hypothesising (in qualitative research and inquiries) by using creative diagramming within post-positivist research, and also contributes to the literature on visual communication and qualitative research. The study is a guide to early career scholars (including undergraduate and post-graduate students) on how to formulate and "test" hypotheses qualitatively using visual or diagrammatical approaches.

Keywords: Hypothesis; methodology; publication; qualitative research; qualitative study; research design; research method; research process; scientific paper writing

1. Introduction

It is normal in research studies that directly involve investigations into societal concerns or social challenges to employ methodological approaches dominated by verbal narratives. This is common in data collection methods (including interviewing, focus group discussion and observation)—analyses performed in qualitative research. This is understandable because scientists, especially those involved in qualitative research, are meant to employ many narratives in their studies. Skills are needed to grasp research data, contextualise the data and communicate its analysis and results in a scientific way. One of the most challenging tasks qualitative scholars face is the task of delivering "highly nuanced and technical stories designed to explicitly convey scientific results, delineate their limitations, and describe a reproducible plot so that any thorough re-enactment can achieve a similar conclusion" [1] (p. 1). Some time ago this challenge was identified and referred to as "the dilemma of qualitative method" [2] (p. 1). However, this methodological dilemma goes beyond data collection techniques. It is easily noticeable in the inability of some qualitative researchers to employ hypotheses in their scientific enquiries. This has led some scholars [3–5] to conclude that the use of hypotheses is not possible in qualitative research (a viewpoint this study differs from).

Qualitative research is a diverse area that involves, in most cases, the analysis and interpretation of textual or numerical data (or both) collected mostly from verbal (or textual) mediums in order

to uncover meaningful patterns that describe a particular phenomenon, event, subject or object. The notion of qualitative inquiry as a reflective process "underscores the strengths of a qualitative approach to research" [5] (p. 431), [6–8]. Central to qualitative research methods is the "microscopic" details of the social and cultural aspects of the subjects under investigation [9] (p. 10), [10,11]. This implies that unlike in quantitative research approaches, the qualitative researcher has to be able to deconstruct details of an event or about the subject "to reduce the puzzlement" surrounding the subjects and objects of research [9] (p. 16), [12–15]. For this reason, qualitative inquiries sometimes have to go beyond the mere construction and use of research questions into the use of hypotheses to ascertain human interactions.

Framing and testing hypotheses in qualitative research—which does not strictly mean the same thing as in quantitative research—always come with challenges that provoke concerns. These concerns manifest in two major ways. Firstly, difficulty in framing a qualitative hypothesis, such that the various variables (dependent or independent) are easily understandable and explainable to enable ease in the collection of data associated with them [16]. Secondly, the issue of bias, which may lead to a breach in research ethics, and which could lead to producing highly falsified hypothesis outcomes. The lack of ideas on how to tackle the aforementioned concerns plays a part in why many scholars (especially undergraduate and postgraduate students) encounter problems in their construction and use of hypotheses in qualitative research. This is evident in many scientific research articles or dissertations [12–15]. The questions these researchers have had to deal with are: Is it possible to test a hypothesis using a qualitative method? If it is possible, how can this be done? What are the merits and limitations of hypothesising in qualitative forms? This study deconstructs the concept, notion, and use of hypotheses. It presents the "how-to" aspect of hypotheses in qualitative research and inquiries from a social science perspective. By addressing ways of conceptualising, developing, writing and testing hypotheses in qualitative research, the study serves as a guide to early career scholars (including undergraduate and post-graduate students) on how to formulate and test hypotheses qualitatively. The author is aware that it is almost impossible to tackle all aspects of hypotheses within the scope of a single article. However, this study is motivated by experiences gained by the author from working with various students (from teaching undergraduates to mentoring doctoral students), reviewing journal articles and conference proposals over a period of ten years.

A starting point for this study was based on the author's experience as a lecturer in scientific paper writing at the post-graduate level. Also, the study derives its relevance from an internal survey conducted on the dissertations of students (MSc. students of the land management programme) at the Technical University of Munich in Germany. The survey found that 97% of the 168 dissertations surveyed were qualitative. Of these qualitative studies, 34% were studies that used hypotheses, and out of all these hypothesis-driven studies, only three of them tested their hypotheses. The rest of the sampled dissertations merely stated hypotheses (without testing them) in the study. Most of the writers of the surveyed dissertations indicated their lack of awareness of hypothesis-driven qualitative research as their reasons for either not hypothesising in their dissertation or not being able to test the hypothesis stated in their dissertations. This micro scenario reflects what is common at the macro educational level, where students (and early career scholars) avoid hypotheses in qualitative research by arguing that qualitative research studies are not hypothesis-driven. The result of the survey mentioned above is not the subject of this article. Instead, this article focuses on how to use hypotheses in qualitative research.

Based on its objective of creating an understanding of qualitative research to provide guidelines on how qualitative researchers can use (include formulate, write and test) hypotheses, this study uses the evidence available in the literature to explore and present arguments in support of hypothesis-driven qualitative research. It presents the how-to aspect of hypothesising (in qualitative research and inquiries) by using creative diagramming within post-positivist research. The study contributes to the literature on visual communication and qualitative research. It uses vignettes to support some of the arguments made. Furthermore, it uses qualitative hypotheses to demonstrate how to test a research

hypothesis qualitatively [16]. Apart from the introductory part of this article, the approach of this article is six-fold. First, it provides a theoretical context for the study by exploring qualitative epistemology and visual communication in post-positivist research. Second, it communicates an understanding of the variety of qualitative research, and importantly, the different epistemological underpinnings behind the different forms of qualitative research. Third, it goes into the conceptualisation of qualitative hypotheses and how they can evolve in the course of a study. Fourth, it describes the characteristics of good qualitative hypotheses. Fifth, it presents a diagramming method (with an example) of testing a qualitative hypothesis. Sixth (and finally), it ends with a discussion and conclusion.

2. Overview of Visual Communication and Post-Positivist Research

The philosophy of how researchers come to gain knowledge of a situation or event is the concern of epistemology [17,18]. Thus, epistemology is concerned with what constitutes valid knowledge (or the nature of knowledge) and what can be known by the knower. This study views the epistemology of research from the standpoint of post-empiricism (commonly referred to as post-positivism). As a philosophy or model of scientific enquiry, post-positivism is a metatheoretical stance that is not only critical of positivism but amends the ideology of positivism, which emphasises the independence between the researcher and his or her object of investigation (the researched) [17–20]. This study leans towards post-positivism. It acknowledges that concepts, theories, contexts, knowledge, skills, and approaches to investigations or methods (or even the values) of the researcher can influence the manner in which the investigation is conducted, including its outcomes. This means that this study embraces the ideals of objectivity, as well as the generalisation of outcomes of a research. It considers both quantitative and qualitative approaches to research (and enquiries) to be valid ways of investigating, building, presenting and disseminating knowledge. However, the study deals with the qualitative aspect of research, with a focus on visually communicating a hypothesis.

Visual Communication in Post-Positivist Qualitative Research

In terms of definition, visual communication is prone to varieties of interpretations. In the way it is used in this study, it is a communication technique that enables the research to textually present and symbolically or diagrammatically show the textual message in various viewable and understandable formats. It can be a way of expressing an idea or providing information with the use of signs, symbols, gestures, postures, and anything that can be viewably (visually) expressed. In the context of scientific research, the viewability of the message to be conveyed to readers must have the character of educating and informing the readers. The use of visual communication techniques in scientific research can manifest in the use of maps, symbols, pictorial images, photography or video (or an expressional combination of any or all of these), with or without texts. In whatever manner the use of visual communication is adapted in scientific writing, the researcher (in order to achieve specific research objectives) has to engage in planning the best ways to visually communicate. This can be in various forms. For instance, in one, two, three or four dimensional (re)presentations of data.

Using visual communication in critical areas of scientific research—such as in hypothesising—is necessary to reduce the current state of "information overload" plaguing the dissemination of scientific works [21]. It is also practical for researchers and the audience of the researchers because the human brain is visually wired [22]. More than 70% of all of the human sensory receptors are in the eyes and "almost 50% of the brain is involved in visual processing" [23]. In addition, humans can get the sense of a visual scene in less than 0.10 s [24]. Most importantly, it takes only 150 milliseconds for a symbol to be processed by the human brain, and only 100 milliseconds for humans to attach a meaning to it [25,26]. This situation is what makes visual communication a realistic tool for scientific paper writing.

Unlike an "organized subarea of academic communication scholarship", which is "relatively new" [27] (p. 1), the use of visual communication techniques in research is not new. Interest in the use of visualisation techniques in scientific research writing (and presentation) has been growing within, and outside of, communication scholarships. Scholars who have dedicated substantial parts

of their research to the use of visual communication in research include Mirzoeff [28], Prosser [29], Howells [30], Thomson [31], Jensen [32], Bestley and Noble [33] and Wilke and Hill [34], to mention a few.

Visual communication enables possibilities to enhance the imaging aspects of research presentation (as a positive addition to the research visualisation, as well as the use of the creative freedom of the researcher). In a post-positive context, applying visual communication to qualitative research is necessary to adequately fulfil the many objectives that qualitative research aims to achieve—of which illuminating and providing an in-depth picture of research outcomes (including events, scenarios, phenomena or situations) are major ones. Visual communication adds value to other tools of post-positivist qualitative research, including the value of narratives, the concept of discourse, content analysis, and the power of visualisation. Using visual communication as a tool for narration (or the presentation of narratives or quantities) in qualitative research has the potential to expand meanings and discursive understanding (of concepts, discourses and relationships) in scientific enquiries.

While there are several advantages of visual communication in qualitative research, this study focuses on communicating the possibility of applying visual communication in the use (and testing) of hypotheses in qualitative approaches. In order to achieve this objective, it is necessary to communicate an understanding of the varieties of qualitative research, and importantly, the different epistemological underpinnings behind the different forms of qualitative research.

3. Understanding Qualitative Research (and Hypotheses): Types, Notions, Contestations and Epistemological Underpinnings

Post-positivism, in the perspective of this study, is neither anti-positivism nor an extension of positivism by other methods. It is not "the rejection of all positivist ideas and postulations" [35] (p. 5). It neither rejects quantitative methods nor promotes qualitative methods. Post-positivism is "cautious concerning strong and one-sided interpretations, and restrained regarding the extensive (or obsessive) use of quantitative data and methods" [35] (p. 5). Epistemologically, post-positivism deals with three main questions relating to research. According to Adam [35] (p. 6), these questions relate to "the quality of the (input) data, the use of a more integrated approach, and the context of the studied phenomenon". The issue of hypothesising through visual communication (such as diagramming), as is the focus of this study, represents the use of a more integrated approach to testing and presenting hypotheses in qualitative research.

In discussing the epistemology of qualitative research, it is difficult to avoid mentioning or comparing qualitative (and ethnographic) methods with quantitative (or statistically survey driven) methods. A conscious effort has been made not to lump research methodologies into either qualitative or quantitative. Every scientific research approach—whether quantitative, qualitative or mixed methods—begins with some curiosity. They all follow a systematic application of a verifiable (and replicable and defensible) set of steps (or procedures) to collect and analyse data (or evidence), and present outcomes (or findings) that resolve problems (or challenges) or better explain or improve existing situations. Also, they share a similar structure regarding presentation and dissemination. They usually begin with research questions (to be investigated), then analyse data collected to answer those questions, then produce findings based on the answered questions and make conclusions from those findings. In writing scientific articles or dissertations, there is still some confusion (at least from the perspective of students and early career researchers) on what exact steps are applied to qualitative research. The use of hypotheses in qualitative research remains one of those areas of confusion. In order to explain whether a hypothesis-driven or hypothesis-led research study can be done qualitatively, it is essential to grasp what qualitative research means.

3.1. What is Qualitative Research?

Where qualitative research stands out from the other types of research is that it strives to establish multiple realities (of ideas, understandings, situations, issues, events, scenarios, to mention a few) within a social laboratory (society), where it is almost impossible to modify factors involved in the research [36,37]. From the context of social science, this means that qualitative research is any research that produces outcomes that were not arrived at using statistical procedures or other methods of quantification. This definition suggests that qualitative research can lead to outcomes or findings in the form of narratives, storylines, numbers or quantities, scenarios, theories, hypothesis, etc. What makes it qualitative in approach is that its procedures (before producing the outcomes) are not done using quantitative (or mixed) methods. It can take the form of grounded theory, narrative, ethnographic, phenomenological and case-based studies [6,38–43].

Many societal development, medical education, political science and economic development research questions cry out for a qualitative research approach. For instance: Why are women poorer than men? Why do developing countries suffer more economic crises than developed countries? How do teaching methods affect knowledge transfer? Why do students choose particular medical or engineering specialties? What makes politically stable countries more advanced than politically unstable countries? These kinds of research questions call for details when answering them. Qualitative enquiries tend to focus on why and how things work. That is why they are designed "to build understanding", such that the researcher interacts "with the study objects (learners) to collect observations, which are highly context specific" [44] (p. 449). A qualitative research study would most likely employ the use of focus group discussions, case studies and in-depth interviews to find the answers to these questions; whereas in quantitative studies (especially the experimental ones), there is a tendency to control observations or assume them to be stable. This is probably why two of the most contested controversies connected to qualitative research are the issues of whether the use of hypotheses is applicable to them and whether it is possible to test hypotheses in the course of qualitative enquiries. In order to understand the possibilities for applying hypotheses in qualitative research methods, it is necessary to first of all understand the various types of qualitative research methods and their epistemological underpinnings.

3.2. Types of Qualitative Research and Their Epistemological Underpinnings

Research studies broadly fit into one of either quantitative or qualitative methods (or a mix of both). Qualitative research, which is the focus of this study, comes in various types and are shaped by varied epistemological bases. Based on available literature [45–49], the various types of qualitative research can be broadly categorised into six types. They include narrative, case study, grounded theory, historical, phenomenological and ethnographic models [50–52]. These qualitative research types come in various kinds and forms. They are not always standalone types. They can sometimes conveniently or inconveniently overlap each other in their manner of applications. For instance, there can be narrative approaches to case studies, historical perspectives to ethnographic research, ethnographic (or phenomenological) models to case studies, to mention a few. All of these types of qualitative research can be founded on one, or a mix of, epistemological foundations, which can include objectivism, social constructionism, post-modernism, subjectivism, feminism, and constructivism [46,51,53–55].

Objectivism is the notion that meaning (and meaningful reality) exists in such a way that objective truth can be sought. For this reason, values and the understanding of values are considered objectified in what researchers study. Post-modernism questions assumptions. It views knowledge as relational, but generative. This is in contrast to the assumption that one person (or one paradigm or one discipline) generates knowledge in its particularity [50]. Social constructionism distinguishes between the knowledge and knower. Therefore, it takes a pluralist view of knowledge by dispensing with the notion that truth is absolute [53,54]. Feminism epistemology is gaining grounds as knowledge generation is increasingly viewed as a power dynamic that should be examined in relation to achieving equality between genders, particularly for marginalised groups (especially women), by providing a platform

from which their voices can be heard [50,53,54]. Subjectivism has structuralist, post-structuralist and postmodernist thinking and inclinations. It posits that meaning does not emerge as a result of the interaction between the subject and object. It asserts that meaning is imposed on the object by the subject. This implies a subjectivity in research. Constructivism views argue that meaning is constructed, rather than objective. This implies that the researcher has powers to construct meaning in different ways, even in relation to the same phenomena, because the research does not exist independently of the researcher. This implies that conceptual framing of research is key to attaining results. In general, qualitative research studies are usually flexible in their techniques, and can be based on a variety of methods (of data collection and analysis), structures of presentation and epistemological ideologies (Table 1).

Table 1. Qualitative research types and their methodological and epistemological features.

Types	Approach to Research or Enquiries	Data Collection Methods	Data Analysis Methods	Forms in Scientific Writing	Epistemological Foundations
Narrative	Explores situations, scenarios and processes	Interviews and documents	Storytelling, content review and theme (meaning development	In-depth narration of events or situations	Objectivism, postmodernism, social constructionism, feminism and constructivism (including interpretive and reflexive) in positivist and post-positivist perspectives
Case study	Examination of episodic events with focus on answering "how" questions	Interviews, observations, document contents and physical inspections	Detailed identification of themes and development of narratives	In-depth study of possible lessons learned from a case or cases	
Grounded theory	Investigates procedures	Interviews and questionnaire	Data coding, categorisation of themes and description of implications	Theory and theoretical models	
Historical	Description of past events	Interviews, surveys and documents	Description of events development	Historical reports	
Phenomenological	Understand or explain experiences	Interviews, surveys and observations	Description of experiences, examination of meanings and theme development	Contextualisation and reporting of experience	
Ethnographic	Describes and interprets social grouping or cultural situation	Interviews, observations and active participation	Description and interpretation of data and theme development	Detailed reporting of interpreted data	

All of the different types of qualitative research can fall partly or fully (or as a mix) within the epistemological foundations of objectivism, postmodernism, social constructionism, feminism and constructivism (interpretive and reflexive) in positivist and post-positivist perspectives. For instance, the grounded theory can take a constructivist path in explaining why a phenomenon evolves in a certain way and take an objectivist perspective in assessing a case study. The case study type of qualitative research (unlike the grounded theory) can take a combination of various perspectives (such as objectivism, postmodernism, social constructionism, feminism and constructivism) to provide in-depth insight into a specific case in research. The historical type of qualitative research can take both objectivist and constructivist lenses to describe past events as a means of grasping the current patterns of future scenarios. The phenomenological type of qualitative research can be influenced by various epistemological perspectives (including social constructionism and constructivism) to describe how group experience affects specific social conditions. The narrative type of qualitative research can

employ objectivism or subjectivism (or feminism) to compile (or review) information over periods of time. By way of output, it can outline findings in a story-like (narrative) manner to present learning points for improving a research problem (or situation). The ethnographic type of qualitative research is widely applicable to objectivism, postmodernism, social constructionism, feminism and constructivism. This is because it strives to gain insight into a situation (usually cultures) to learn and explain the culture's characteristics.

The many types of qualitative research mentioned above can be different, and yet be related in some ways. One of the questions this study discusses is whether the use of hypotheses is possible in any of them.

3.3. What Is a Research Hypothesis? Can It Be Used in Qualitative Research?

Scientific research studies usually begin with a problem posed in the form of questions to be answered in the course of the research. A hypothesis provides a tool for explicitly restating and clarifying the problem or research question under investigation. It has been defined in various forms by different scholars. Kerlinger [56] describes it as relational propositions made to clarify the direction of a research problem—usually in the form of a conjectural statement determining the relationship between two or more variables. Ary et al. [57] define it as a tentative proposition made to suggest a possible solution to a problem, or an explanation of a phenomenon or situation surrounding a problem. Creswell [58] describes it as a formal statement that presents the normal relationship between a dependent and an independent variable. All of these definitions provide ideas about a research hypothesis. They can be summarised to mean that a research hypothesis is "the statement created by researchers when they speculate upon the outcome of research or an experiment", or a specific situation in that research study [59]. These definitions describe what a hypothesis can be when applied in any form of research [60–62]. With this understanding of a hypothesis, the question that arises is whether it can be used in qualitative research. There is a myriad of scholars who have pushed the notion that qualitative research has little or nothing to do with hypothesis formulation [3–5,63,64].

Some scholars [3–5] have argued that the use of a hypothesis does not apply to qualitative research and went on to speculate that qualitative research is entirely inductive and only aims to understand the meaning or experiences embedded in events. They [4,5] further argue that the findings of qualitative research are bound to particular situations or contexts (and not generalisable to a particular population), and so lack the need to test or prove a hypothesis. These group of scholars [3–5] have made these arguments based on the premise that proving or testing a hypothesis is primarily based upon the positivist paradigm, and as qualitative research is mostly based upon interpretivism and constructivism, it lacks the need for the hypothesis. Also, there are even some scholars [63,64] who argue that hypotheses are usable in qualitative research enquiries but are not provable or testable. The problem with their argument is that these scholars assume that "testing" in qualitative research must be performed as in quantitative research methods. However, it does not have to be done the same way because both research methods (quantitative and qualitative) are different and backed by differing epistemological underpinnings. There are some researchers [44,65–67] who have completely differed from the above arguments—asserting that hypotheses can be used and tested in a qualitative enquiry. This study aligns with them [44,65–67]. The fundamental fault of the arguments of those scholars [3–5] who spread doubts over the use of hypotheses in qualitative research is the notion that qualitative research is merely inductive. Their argument tends to assume that all scientists must stick to a scientific culture that has become highly accustomed to specific procedures, including hypothesis testing. This should not be the case, as science is, in itself, ever changing. Researchers and their culture of research are also ever changing due to knowledge (and experience) gained from doing the same thing in the same way (or different things in different ways) over hundreds of years. Those who have used qualitative hypotheses at some point in their scholarly works and found it practical (in answering their research questions and achieving their research objectives) should not be discouraged from doing what has worked for them. Researchers should not deny that the use of hypotheses

applies to qualitative enquiries. Hypotheses used in qualitive research can be explained or perhaps questioned because explaining and questioning are the key tools used in carrying out qualitative research [3,64]. This study considers it illogical to expect qualitative researchers to strictly follow the rules of quantitative research methods. Qualitative research is a very flexible type of research; it can be either inductive or deductive [16,63–65].

In deductive qualitative research, Chigbu [16] used conjectural propositions (to build a hypothesis) to determine the relation between two or more qualitative variables. Chigbu's [16] (p. 100) approach was to "analyse the hypothesis of the research in order to refute or verify it." What Chigbu [16] did was to show that variables can be qualitative or quantitative, and that qualitative variables lack numerical hypothesis-testing but can be refuted, proven, confirmed or verified with the aid of other non-numerical tools. This means that the business of qualitative research with hypotheses goes beyond hypothesis-generation and into hypothesis-testing (in the form of refuting, proving, confirming or verifying). The use of hypotheses in qualitative methods can, therefore, apply "as ingredients of the preconceptions and as reflections, rather than applying procedures for testing them qualitatively" [63] (p. 484).

3.4. Analogical Arguments in Support of Using Hypotheses in Qualitative Research

This study argues fervently that the use of a hypothesis in science is not in any way limited to quantitative research. This can be presented in the following analogy. As a research scientist, imagine that you are making a scientific inquiry to conclude something, however, your research is not focused on using numerical values but words and their meanings (qualitative research). However, there is a need for you to make a proposition at the outset about what you suspect is the situation for your exploratory work (a tentative answer), which can be either proven, refuted, verified or confirmed at the end of your study. That initial or tentative answer is a hypothesis. So why do some researchers (see Auerbach and Silverstein [38]) aggressively speculate that qualitative research does not test a hypothesis? The above analogy indicates that a hypothesis is a vital part of qualitative research. Qualitative researchers most times work with it unstated (see Holloway and Galvin [68]), while few times they have it categorically stated as a hypothesis (see Chigbu [16]).

It is also possible that if the hypotheses of a research study are qualitative, the researcher may use both quantitative and qualitative data to prove, disprove, confirm, nullify, refute or verify the hypotheses. For example, if a hypothesis postulates that "access to land does not usually lead to the empowerment of women," a researcher could use either qualitative or quantitative data collected from the field to prove, disprove, confirm, nullify, refute or verify the hypothesis. The researcher does not necessarily have to use statistical tools to prove, disprove, confirm, nullify, refute or verify (or test) the hypothesis because in the social sciences, using statistical tools is largely dependent on the extent to which their usefulness fits within the context of the research [16,69,70]. The use of a hypothesis can be done in any form of research to predict scenarios that can be either confirmed or proved in the later part of a study to give direction to scientifically justified conclusions. Therefore, the use and testing of hypotheses is a fundamental part of any research work (whether qualitative, quantitative, or mixed research methods). It may be more popular in quantitative research because there is more need to use them there. This was what led Flyvbjerg [65] (p. 229) to categorically state that qualitative research studies are "useful for both generating and testing of hypotheses but is not limited to these research activities alone."

Every possible definition of a hypothesis [3–5,63–67,71–73] ends with a common understanding—that a hypothesis is simply an unvalidated assumption. This raises the question of if there are scientific assumptions that can be validated without numerical counting or mathematical quantification. The answer is, absolutely. For instance, an assumption about how children feel about a change in school can be based on a qualitative hypothesis rather than a quantitative one.

Furthermore, if a scientist assumes that there is water in a jar in the room, to confirm (or prove, verify, refute, etc.) this hypothesis, all the scientist needs to show is that there is (or there is no) water

in the jar in the room. The scientist does not necessarily have to (as could be the case in quantitative research) conduct a volumetric analysis to arrive at a zero or negative numerical result before him or her can conclude that there is no water in any jar in the room. From a qualitative perspective, if the researcher inspects the jars and finds no presence of water in any jar in the room, then there is a qualitative refutation to the hypothesis. It appears that those who lack the understanding of hypothesising in qualitative research do so due to the semantics in the debate, especially in the use of the phrase "hypothesis testing".

3.5. Can a Hypothesis Be "Tested" in Qualitative Research?

Testing in qualitative research may mean different things to researchers in quantitative research. The term "test" has never been about quantities or numerical calculations in science. It has been about examination [74–76], which can be either quantitative or qualitative, or a mix of the two. However, the image that science tends to conjure when testing is mentioned anywhere is that of testing as done in a controlled laboratory space enclosed within a building. This traditional sense of testing is different from the laboratory of a social scientist, which is the uncontrollable society in which humanity lives. In the context of social-sciences, hypothesis testing does not always mean quantitative calculations to prove or nullify (disprove) hypothetical assumptions. Hypothesis testing can imply the (in)validation (through verification, proving, confirmation, refutation, disproving, acceptance or rejection, among many other terms) of hypothetical assumptions (hypotheses) based on available data, which can be accessed through interviews, observations and various other means. It is important to note that whether a hypothesis can be usable and testable in qualitative research depends largely on how the hypothesis (to be used and tested) has been developed and written. It would be problematic to test a hypothesis qualitatively if it lacks qualitative variables or if those variables (where present) are not clearly stated and easily identifiable. Many researchers (especially students) have abstained from using hypotheses in their qualitative research (or inquiries), merely because of the difficulties encountered in formulating, writing (stating) and testing the qualitative hypothesis. It is not surprising to see that a lot of qualitative studies, especially in dissertations, consciously or unconsciously avoid the use and testing of a hypothesis [13–15]. The succeeding part of this article puts focus on the process of developing and testing qualitative research hypotheses.

4. The Process of Developing and Using Hypotheses in Qualitative Research

Every research starts with the identification of a problem. In qualitative research, a hypothesis is used in the form of a clear statement concerning the problem to be investigated. Unlike in quantitative research, where hypotheses are only developed to be tested, qualitative research can lead to hypothesis-testing and hypothesis-generating outcomes. Concerning how qualitative research works for hypothesis-generation, Auerbach and Silverstein [38] (p. 7) explained that it could, with the aid of grounded theory, allow the researcher to:

> *"Begin a research study without having to test a hypothesis. Instead, it allows them to develop hypotheses by listening to what the research participants say. Because the method involves developing hypotheses after the data are collected, it is called hypothesis-generating research rather than hypothesis-testing research. The grounded theory method uses two basic principles: (1) questioning rather than measuring, and (2) generating hypotheses using theoretical coding."*

However, when it comes to working with hypothesis-testing qualitative research, it is necessary that the hypothesis is formulated (and then stated) before the research and tested before reporting the outcome of the research. By formulating the hypothesis before conducting the research, it will enable the researcher to identify the objectives to be pursued and the questions to be answered in the course of the research. It will also enable the researcher to identify the key concepts to be unpacked, and most importantly to grasp the relationship between the problem to be investigated and the literature to be reviewed. Usually, a qualitative hypothesis will provide a tentative explanation of the problem

to be investigated. It provides the qualitative researcher with a relational statement that is directly contestable or testable to determine the direction of the research or enable a framework for making sensible conclusions about the problem investigated. The process of developing (and using) qualitative research hypotheses involves many steps (see Figure 1).

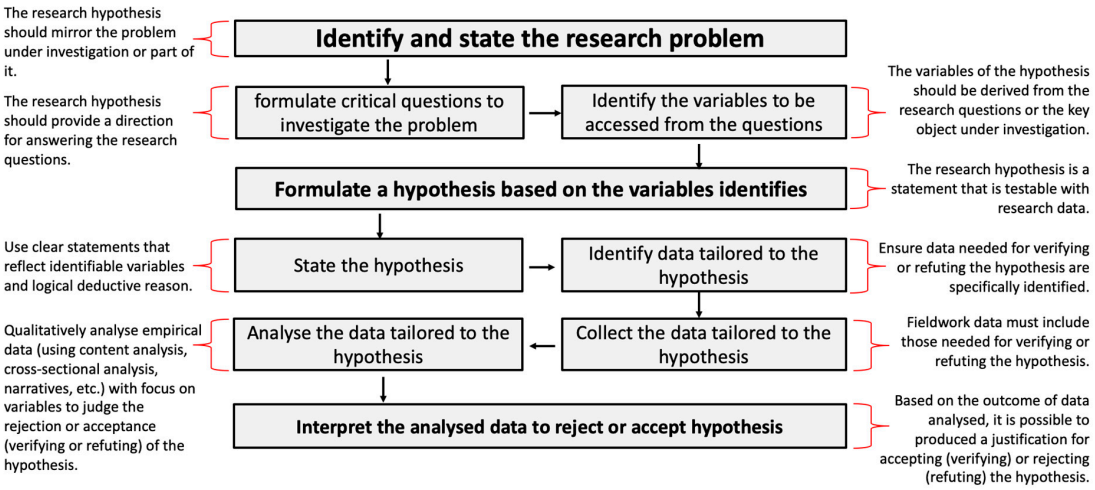

Figure 1. The general process of developing a qualitative hypothesis.

As Figure 1 shows, the process of developing and using qualitative research hypotheses begins right from the identification of a research problem (in the research design process). From the early stage of the research, the hypothesis should be developed to inform the problem and the data to be used should be linked to the variables. However, when all steps are followed, as shown in Figure 1, a significant area where skill is needed is in the formulation of the research hypothesis.

4.1. Formulating the Qualitative Research Hypothesis

One of the best ways to use a hypothesis in qualitative studies is knowing when (or when not) to use one. There is a need to identify variables to be investigated in the hypothesis. Many qualitative researchers have successfully used research questions without the use of a hypothesis, because a research question (in the context of qualitative research) is in most cases a hypothesis postulated in the form of a question. However, a standalone hypothesis should not be avoided by qualitative researchers because it brings extra clarity to the analysis of problems.

In general, hypotheses are classified into two kinds: null and research (alternate) hypothesis. On the one hand, null hypotheses are presented in the form of statements depicting that there is no actual relationship between the variables to be investigated. It usually reads in the form of, "There exists no difference between X and Y...." For instance, "There is no significant difference in the anxiety level of children of high IQ and those of low IQ" [59] (p. 35). On the other hand, alternate hypotheses are usually statements that suggest a possible outcome that a researcher expects (that is, the opposite of a null hypothesis). However, research hypotheses can be directional (when it specifies the direction of expected outcomes of the research) or non-directional (when it does not define a direction the research outcome). It is common to test the null hypothesis in statistical studies because "the research hypothesis does not specify the exact amount of influence expected in a given situation" [69] (p. 89). In qualitative research, it is common to test the alternate hypotheses because they usually suggest a possible outcome that a researcher expects.

The focus of this article is on a qualitative research hypothesis. In qualitative research, it is common to investigate research hypotheses that can be viewed in three possible ways: Attributive (meant to describe a scenario, situation or event), associative (meant to predict an outcome) and causal (meant to create an understanding of relationships). However, some qualitative researchers have tended to frame or formulate their hypotheses in either null or alternate, or combined forms. This is

possible in qualitative hypothesis formulation because of the use of non-numerically measurable variables. In order to formulate a qualitative research hypothesis, it is important to identify the variables to be tested later. Unlike in quantitative research, where variables usually differ in amount (quantity), qualitative variables usually differ in kind (state of affairs, situation or nature of situations). That is why the formulation of qualitative hypothesis demands some important steps and the following characteristics:

- The qualitative hypothesis should be based on a research problem derived from the research questions.
- It should be supported by literature evidence (on the relationship or association between variables).
- It should be informed by past research and observations.
- It must be falsifiable or disprovable (see Popper [77]).
- It should be analysable using data collected from the field or literature.
- It has to be testable or verifiable, provable, nullifiable, refutable, confirmable or disprovable based on the results of analysing data collected from the field or literature.

In order to present the research hypothesis clearly in written form, it is critical to ensure that its written statement reflects all elements of a scientific hypothesis. When well presented in written form, it becomes easier for a researcher to tackle the hypothesis-testing aspect of qualitative research.

4.2. Refuting or Verifying a Qualitative Research Hypothesis Diagrammatically (with Illustration)

The hypothesis can serve as a scientific instrument for all types of qualitative research (whether predictive, exploratory, investigative, and many others). It can be used by qualitative scientists differently. Testing a hypothesis means merely a process of examining data to crack a puzzle (or a part of the problem) related to the problem being researched. It does not in any way imply calculations or quantifications. Whether a qualitative researcher chooses to test, verify, prove, nullify, refute, confirm or disprove is a matter of semantics. The terms used may depend on the type of analysis being performed. It can also depend on the choice of terminology by the researcher. It is crucial to define whatever term is used (with justifications) in any scientific analysis. For instance, testing a qualitative hypothesis diagrammatically, as this study illustrates with Chigbu [16], has advantages for the researcher. It provides a strong visual effect, and if adequately backed by explanatory texts, it is a methodological tool.

This study uses Chigbu's [16] work to illustrate the "how-to" aspect of testing a research hypothesis in qualitative research. Qualitative hypothesis testing is the process of using qualitative research data to determine whether the reality of an event (situation or scenario) described in a specific hypothesis is true or false, or occurred or will occur. The question remains of what is required in actually testing a research hypothesis in a qualitative study. Below is a sample of Chigbu's [16] research abstract to allow for an understanding of the hypothesis demonstratively tested (diagrammatically) in this study.

> *"A core development concern in Nigeria is the magnitude of challenges rural people face. Inefficient infrastructures, lack of employment opportunities and poor social amenities are some of these challenges. These challenges persist mainly due to ineffective approaches used in tackling them. This research argues that an approach based on territorial development would produce better outcomes. The reason is that territorial development adopts integrated policies and actions with a focus on places as opposed to sectoral approaches. The research objectives were to evaluate rural development approaches and identify a specific approach capable of activating poverty reduction. It addressed questions bordering on past rural development approaches and how to improve urban-rural linkages in rural areas. It also addressed questions relating to ways that rural areas can reduce poverty through territorial development . . . "* [16], p. 1.

From the above research, Chigbu [16] (p. 101) postulated a qualitative research hypothesis that states that:

> *"Nigeria has legal and institutional opportunities for comprehensive improvement of rural areas through territorial development. However, due to the absence of a concrete rural development plan and area-based rural development strategies, this has not been materialized".*

In order to "test" the above hypothesis, it is vital to first unpack its components. The hypothesis consists of two propositions, which allows the reader to fully understand it in its wholeness, as well as to partially understand it in its parts. It was used by Chigbu [16] (p. 101) to investigate the possibility of devising a new rural development approach (called territorial rural development) from the existing rural development framework in Nigeria. It contains the following two propositions.

- Proposition 1: *Legal and institutional opportunities that can lead to comprehensive improvement of rural areas through territorial development exist in Nigeria*.
- Proposition 2: *However, due to the absence of a concrete rural development plan and area-based rural development strategies, this has not been materialized*.

Together, these hypothetical propositions (which together form the hypothesis) consist of the following four main variables:

- Independent variables: *legal and institutional opportunities; incessant structural changes in its political history; and policy negligence.*
- Dependent variable: *comprehensive rural improvements through territorial development.*

Having identified the elements (or the building blocks) of the qualitative hypothesis (its component propositions and variables), it is possible to test it. In order to test (or refute, verify or confirm, etc.) this hypothesis qualitatively, its component propositions (or assumptions) have to be subjected to the data collected from fieldwork. By sequentially refuting or verifying the two different propositions (sub-hypotheses) using data collected from the field, Chigbu [16] reached a factual conclusion (hypothesis testing). This is demonstrated here with the help of diagramming.

In order to confirm or refute the first hypothetical proposition (that is, "*Legal and institutional opportunities for territorial development exist*"), it was possible to provide evidence (proof) through literature and data (including the "*Nigerian constitution, legislation and its rural development policy*") to show that there are "*legal and institutional opportunities for territorial development*" (illustrated in Figure 2).

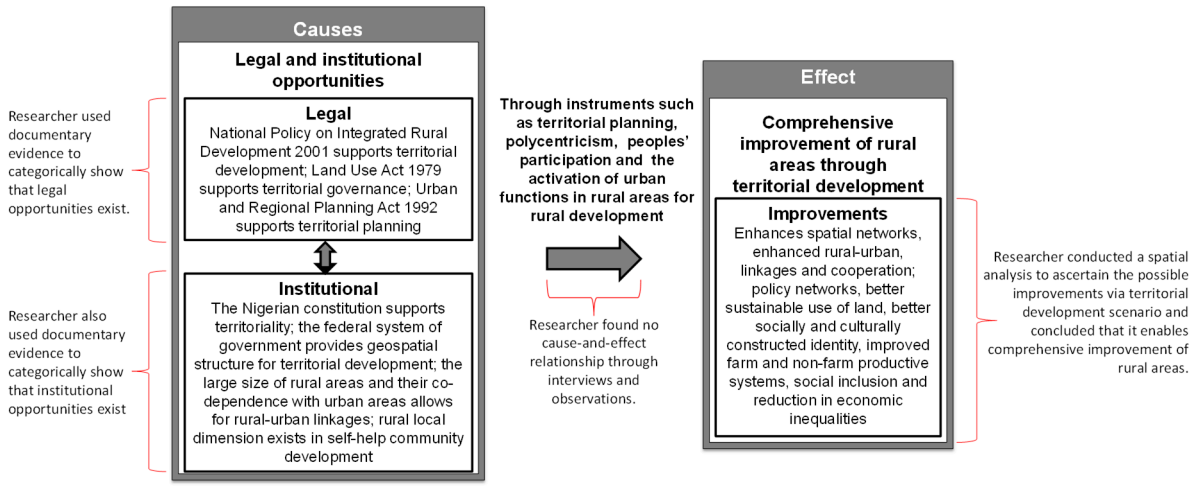

Figure 2. Cause-and-effect evidence of literature in support of the first proposition.

It was possible to confirm (by arguing with evidence) that the legal and institutional framework does not constitute a hindrance, but rather an opportunity for territorial development. It was

diagrammatically demonstrated by showing a cause-and-effect relationship towards achieving comprehensive improvement of rural areas through territorial development.

In order to confirm or refute the second hypothetical proposition (*"that concrete rural development plan and area-based strategies do not exist"*) with data from the field, it was possible to show that despite the opportunities provided by available legal and institutional frameworks for territorial development, the absence of a concrete rural development plan and area-based rural development strategies prevent the comprehensive rural development through territorial development (illustrated in Figure 3).

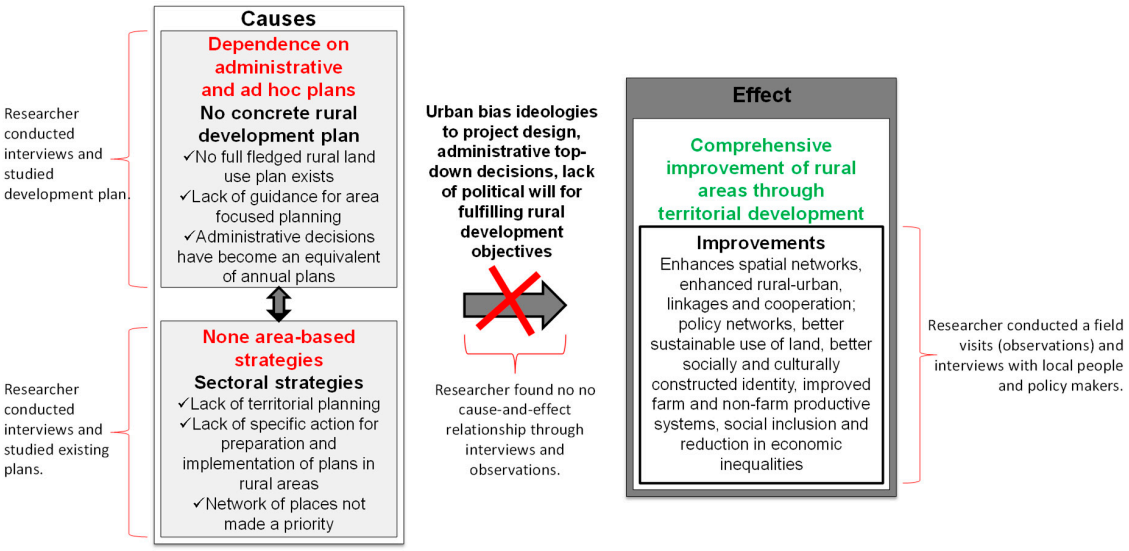

Figure 3. Cause-and-effect evidence of literature in support of the second proposition.

The second proposition in the research hypothesis is argued with evidence and shown to be factual in Nigeria.

Based on the various methods used by the researcher to collect and verify data, the research hypothesis is verified. This is because the available data provide evidence that fully confirm the two propositions that make up the hypothesis initially postulated by the researcher (as illustrated in Figure 4).

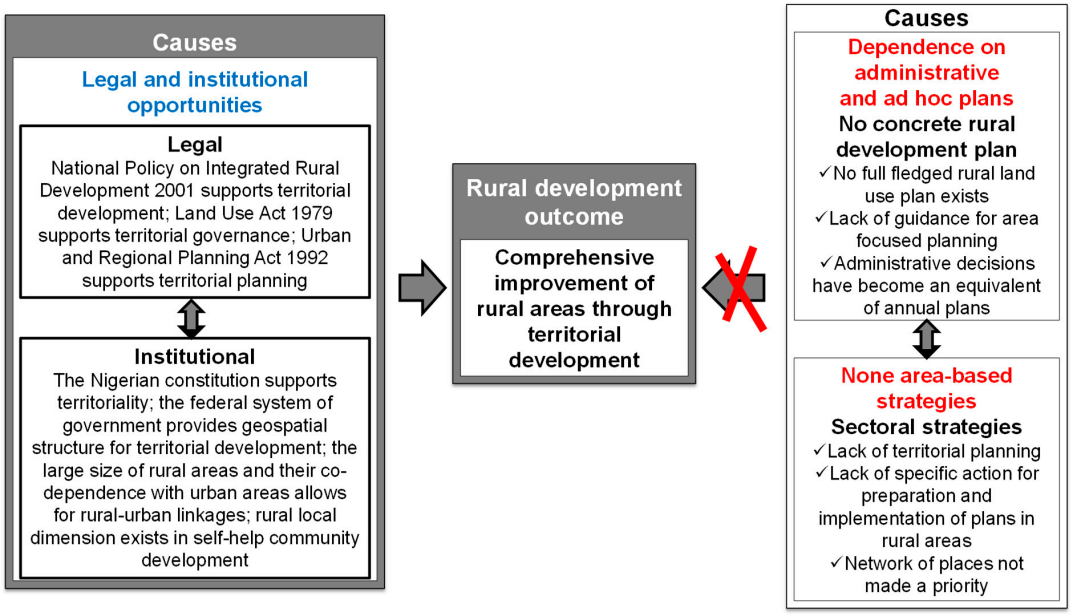

Figure 4. A diagrammatic representation of the verified or confirmed research hypothesis.

It is important to note the diagrammatic representation of arguments made in support of the proposition and based on the possible data used to demonstrate evidence in support of the hypothetical propositions made. Diagrams aside, the key to conducting qualitative hypothesis-testing lies in what Popper [77] called "explanatory power", and the validity of the data used to verify, confirm, nullify or refute the hypothesis.

5. Discussion and Conclusion

It is important to mention that this study does not in any way assume that post-positivist research is a standalone concept or approach to research. It acknowledges that there is no such thing as pure post-positivist research because post-positivism comes with a mix of positivist principles. The study agrees "that one only rarely encounters explicit (post)positivist principles, but we can ascertain the existence of a hidden frame of reference and an implicit epistemological position" [35] (p. 5). For instance, positivist and post-positivist paradigms commonly agree that the purpose of research (whether qualitative or quantitative in approach) include the testing of theories, prediction of outcomes, and determination of relationships between events, or variables or causes and effects [78–84], as shown in various research studies with mixed approaches [85–89]. The post-positivist perspective of this study has distinguished itself from positivist studies through its implied views that the quantification (particularly through the use of sophisticated statistical methods and mathematical models) do not necessarily "enable the attainment of scientifically relevant insights" [35] (p. 6). It recognises that "these methods and models are useful as research tools, yet they cannot be taken as a sufficient and necessary basis for the production of valid empirical evidence and a theoretically relevant interpretation of this evidence" [35] (p. 6). That is why it has argued for the use of diagramming approaches to hypothesis testing (confirmation, nullification, verification and refutation) and presentation in qualitative research, rather than the reliance on quantitative hypothesis approaches.

The presented approach to hypothesising in qualitative enquiries is aimed at university students that are eager to apply hypothesis usage in their qualitative research but do not know where to begin. The idea behind testing (that is, refuting or confirming) hypotheses qualitatively is not to replicate the traditional approach to hypothesis-testing in quantitative or statistical research. This particular approach is meant to explain (through a combination of textual and visual communication) a hypothesis framed about a population whose characteristics or conditions are typically represented by qualitative values. In testing such a hypothesis, appropriate methods of collecting and analysing data would apply in order to produce evidence capable of being used to convincingly explain the hypothesis. The steps presented in this study are, therefore, intended to serve as a guide for those who are eager to explore new approaches for testing qualitative hypotheses visually. While the method can be criticised for its subjectivity, it has been successfully applied to produce a Ph.D. thesis (see Chigbu [16]). It is hoped that it will raise further awareness on the issue of using hypotheses in qualitative studies.

This study has answered the questions of whether it is possible to test a hypothesis using a qualitative method. It has presented how to use (and hypothesise) data in qualitative research [90,91]. Conceptualising, formulating and testing qualitative research hypotheses are all parts of a dynamic qualitative research process. The use of qualitative research hypotheses can help the qualitative researcher in clarifying the goal of the research, as well as in identifying the data necessary for the research. Performing this diagrammatically brings in the power of visualisation and creative illustration into the science of hypothesis testing. It enables the researcher to organise (and present) complex relationships visually.

This study has presented a visual and diagrammatic step-by-step method showing how to refute or confirm a hypothesis. Although the approach has been developed subjectively (based on the author's own experiences) the method is flexible and can be easily adaptable to other researchers' preferences. The thinking behind this method is to motivate other qualitative researchers (especially undergraduates and postgraduate students) to engage innovatively in (re)framing their ways of using

and testing hypotheses qualitatively. The example shown in this article is only one of the ways undergraduate and postgraduate students can tackle the hypothesis-testing challenges they encounter in dissertations and scientific article writing.

A good qualitative hypothesis can be a significant tool that shapes research design and analysis. Although a lot of qualitative researchers tend to use research questions more regularly than they use a hypothesis, there is a need to combine the two. A well-formulated research question can "expand the inquiry through reflexive, iterative, and dialogic processes" [6] (p. 446). A well stated qualitative hypothesis will serve as a guide to the researcher in pinpointing the variables that will determine the nature of data to be collected to answer the research questions. In addition to helping identify the type of data to be collected, the variables of the qualitative hypothesis can influence how, where, and from whom those data can be collected. Such is the power of qualitative hypothesis.

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