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► **To cite this version:**

Benjamin Ogbole Abakpa, Abel Okoh Agbo-Egwu, Joshua Abah Abah. EMPHASIZING PHENOMENOLOGY AS A RESEARCH PARADIGM FOR INTERPRETING GROWTH AND DEVELOPMENT IN MATHEMATICS EDUCATION. ABACUS, 2017, Mathematics Education Series, 42 (1), pp.391-405. hal-01596581

HAL Id: hal-01596581

<https://hal.science/hal-01596581v1>

Submitted on 27 Sep 2017

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EMPHASIZING PHENOMENOLOGY AS A RESEARCH PARADIGM FOR INTERPRETING GROWTH AND DEVELOPMENT IN MATHEMATICS EDUCATION

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Abstract

Evidence from researches emanating from Nigeria in the field of mathematics education has revealed an over-reliance on broad methods of empirical inquiry. There seem to be a general stereotypical restriction on approaches to conducting investigation across the noble discipline, thereby stifling the spirit of innovation, open-mindedness and scholarly inquisitiveness. This discourse is premised on the possibility that obtaining better answers to inquiries may rest largely in qualitative approaches that rely more on the subjects of the inquiries than on the pre-conceptions of the inquirer. Phenomenology as a qualitative approach to research in mathematics education seek to interpret the multiple constituents of consciousness and the numerous cognitive and affective dimensions of the contending issues, trends, progress, prospects and challenges of the profession. In phenomenology, the aim of the researcher is to describe as accurately as possible the phenomenon, reframing from any pre-given framework, but remaining true to the essence as seen from the perspectives of the people involved. The fundamental submission of this paper therefore, is the need to extensively adopt empirical phenomenology to unearth and interpret the growth and development of mathematics education in Nigeria.

Keywords: Mathematics education, Qualitative research, Phenomenology, Bracketing

Introduction

Mathematics education has enjoyed a tremendous growth in Nigeria considering its transformation from a discipline midwived by a few pioneers some decades ago to its current professional status. As a profession, mathematics education is considered as an intersection of mathematics pedagogy with the nature of mathematics as a discipline (Osafehinti, 2015). With focus on teacher education, mathematics education considers the design, implementation and effects of curriculum and instructional interventions, and contemporary developments in learning theories and technology. While mathematics itself is an interdisciplinary tool and language (Moursund, 2014), mathematics education concerns the activity or practice of teaching mathematics (Ernest, 2014). According to O'Brien (2002), mathematics education is a good school of thinking. Doing mathematics entails building the right attitude for problems, ranging from simple to more complicated ones. One of the aims of mathematics education is to develop in society the general attitude of customization of mathematical principles to satisfy human needs (Dudley, 2010). Mathematics education prepares students to become innovative mathematics instructors, professionally prepared to communicate mathematics to learners at all levels.

Mathematics educators see mathematics not simply as a body of knowledge or an academic discipline but also as a field of practice. Kilpatrick (2008) emphasized that this is because they are concerned with how mathematics is learned, understood and used. As well as what it is, they take a comprehensive view. Mathematics education looks beyond applications to ways in which people think about mathematics, how they use it in their daily lives, and how learners can be brought to connect the mathematics they see in school with the mathematics in the world around them.

In Nigeria, mathematics education as a field of study has been charting the pathways for effective delivery of mathematics instruction since its inception some decades ago. Researchers in the field across all educational levels have been consistently contextualizing tools, methods and approaches that facilitate practice or the study of practice (Abubakar, Wokoma & Afebuame, 2012). Apart from regular debates at national conferences and participation in major educational programmes of the country, Nigerian mathematics educators have been consistently putting up impressive appearances at both continental and international professional events. According to Edu, Bessong and Okpa (2016), development in mathematics education in Nigeria has been severally projected via the context of the cultural environment and established in five (5) key related components, namely, the teacher, the learner, instructional methods, materials, media and activities, and organization for implementing instruction. Growth and development in Mathematics education have always been necessitated by the realization of the role mathematics should play in the nation's scientific and technological advancement as well as responses to societal needs and demands (Aguale & Usman, 2007).

Evidence from researches emanating from Nigeria in the field of mathematics education has however revealed an over-reliance on broad methods of empirical inquiry. There seem to be a sense of converging to certain established trend of research methodology. It has become normal practice for young mathematics education researchers to scavenge the World Wide Web for emergent instructional strategies with the intent of localizing same irrespective of cultural and technological inadequacies. The quest for statistical significance has driven many of such imported fabrications into obstinacy and eventual relegation to the dusty shelves of their authors. The practice of falling back-in-line to popular research approaches has not augured well for the spirit of innovation and scholarly inquiry our noble profession is known for. It is the audacity to venture into more diverse and promising paradigms of research that will ultimately position Nigerian mathematics educators on the path of global competitiveness. The top-echelon of our profession must demonstrate adaptiveness and guide young researchers on their exploration of meaning in mathematics education. Some critical issues in mathematics education within the Nigerian context cannot be simply reduced into theories and hypotheses. It is time to ponder other approaches that may yield in-depth interpretations that are beyond the confines of mere educated guesses. The possibility of getting better answers to inquires may rest largely on qualitative approaches that rely more on the subjects of the inquiries than on the pre-conceptions of the inquirer.

Qualitative research methods are a diverse set, encompassing approaches such as empirical phenomenology, grounded theory, ethnography, protocol analysis and discourse analysis (Elliott & Timulak, 2005). All these methods rely on linguistic rather than numerical

data, and employed meaning-based rather than statistical forms of data. Generally, qualitative researches place emphasis on understanding phenomena in their own right rather than from some outside perspective. Though common methodological practices apply to these qualitative approaches, this present discourse intends to single out the uniqueness of phenomenology.

In phenomenology, the aim of the researcher is to describe as accurately as possible the phenomenon, refraining from any pre-given framework, but remaining true to the fact (Groenewald, 2004). The principal concern of this approach to inquiry is the understanding of social and psychological phenomena from the perspectives of the people involved. The aim is to return to embodied, experiential meanings through fresh, complex, rich descriptions of a phenomenon as it is concretely lived (Finlay, 2009). When applied to mathematics education in Nigeria, phenomenology seek to interpret the multiple constituents of consciousness, such as the numerous cognitive and affective dimensions of the contending issues, trends, progress, key players and future prospects of the discipline (McPhail, 1995). Although exhaustive coverage and application of the phenomenological paradigm abound in Nigeria, available literature indicates prevalence in other fields of study (Mutema, 2003; Oluwole, 2012; Adekunle & Adisa, 2010; Oloruntegbe *et al.*, 2011). Consequently, this present discourse is a call for diversification in research methodology in mathematics education with a focus on qualitative phenomenology. The emphasis is on augmentation of data analysis with phenomenological reduction and the need to fully adopt phenomenology as a stand-alone approach to research in mathematics education thereby positioning the approach on an equal pedestal with the predominantly used descriptive survey and quasi-experimental designs.

This exposition looks at the historical roots of phenomenology before consideration of phenomenology as a research paradigm. This is then followed by an empirical review of specific usage of phenomenology in mathematics education. The discussion ends with a call for extensive adaption of the approach in Nigerian mathematics education.

Historical Roots of Phenomenology

The term “phenomenology” is derived from the noun “phenomenon”, meaning a fact, an appearance or an event in nature or society, especially one that is not fully understood. Today, phenomenology is seen as an umbrella term encompassing both a philosophical movement and a range of research approaches (Kafle, 2011). As a branch of philosophy, phenomenology was initiated by the German philosopher Edmund Husserl (1859-1938) as a radically new way of doing philosophy. Later theorists, such as Martin Heidegger (1889-1976) have moved the idea away from a philosophical discipline, which focuses on consciousness and essences of phenomena towards elaborating existential and interpretive dimensions (Finlay, 2009 in Kafle, 2011). Other major contributors to phenomenology are Sartre, de Beauvoir, Merleau-Ponty, Ricoeur, Garfinkel, Beryer and Luckmann, Bourdieu, Derrida, Giddens and Harbermas. Aspers (2004) noted that among these there are obviously differences, but also a common core.

This core, the heart of phenomenology is that analysis does not start with the objective world “out there” but with the “mental directedness” of active societal players. Such line of thought grew out of extensive refinement of the movement that started with Husserl’s publication of his *Logical Investigations*. Husserl was a mathematician, logician, epistemologist

and a philosopher interested in grounding theoretical and scientific knowledge (Giorgi, 2007). Heidegger, a student of Husserl, while teaching upon scientific thought and the arts in his works, was primarily motivated to think about the question of *being* and was interested in articulating issues related to fundamental ontology. While Husserl gave priority to careful description, Heidegger gave priority to interpretation, considering description as a type of interpretation. Thus, for Heidegger, phenomenology is primarily a method of articulating and clarifying the phenomenon of *being*, giving rise to what is now termed hermeneutic phenomenology.

Giorgi (2007) explained that Husserl's methods involve three steps:

- i. One assumes the transcendental phenomenological attitude. This means to adopt an attitude of consciousness that transcends the orientation toward the human mode of being conscious and that is also free from worldly and empirical assumptions. To do this means to put aside ("bracket") all knowledge of the phenomenon being explored or investigated that is not due to the actual instance of this phenomenon and to refrain from positing the existence of whatever is given. When the subject of interest is taken as just a phenomenon to be studied and not a reality, the researcher carries out a reduction from existence to presence.
- ii. One brings to consciousness an instance of the phenomenon to be explored, whether actual or fictional, and with the help of free imaginative variation, one intuits the essence of the phenomenon being investigated. The role of imaginative variation is to determine the essential features of the phenomenon for careful description. If the imaginative elimination of an aspect causes the phenomenon to collapse then that aspect is essential.
- iii. One carefully describes the essence that has been discovered.

Laverty (2003) puts the difference between Husserl's and Heidegger's phenomenological explorations thus:

The way this exploration of lived experience proceeds is where Husserl and Heidegger disagreed. While Husserl focused on understanding beings or phenomena, Heidegger focused on "*Dasein*", that is translated as "the mode of being human" or "the situated meaning of a human in the world". Husserl was interested in acts of attending, perceiving, recalling and thinking about the world and human beings were understood primarily as knowers. Heidegger, in contrast, viewed humans as being primarily concerned creatures with an emphasis on their faith in an alien world (Laverty, 2003 p.7).

Giorgi (2007) observed that most of Heideggerian philosophy is driven by his extreme focus on the question of *Beings*, making it difficult to seamlessly adapt to the level psychology-rooted disciplines. In this sense, analyses in mathematics education, for instance, are not ontological, though the discipline has a view of people and the world as indissolubly related in cultural, in social and in historical contexts (Munhall, 1989 in Laverty, 2003).

Despite the historical distinction between the two schools of thoughts, present-day practice could be said to be a marriage of both. Husserl's notion of phenomenology, which is now better termed transcendental phenomenology, is descriptive and focuses on the structure of

experience, the organizing principles that give form and meaning to live world. Hermeneutic research is interpretive and concentrated on historical meanings of experience and their developmental and cumulative effects on individual and social levels (Kafle, 2011; Lavery, 2003). Thus, broadly, the phenomenological approach does thematize the world as a life-world and is concerned as a counter-balance to the positive scientific approaches, but its goal is also, thereby, to bring the sciences back on track (Luft, 2004). The life-world is the subjective-relative world, the basis of all human actions, natural or scientific. Practically, the task of phenomenology is to recover this life-world by uncovering the abstractive strata that have become laid over it. The very origin of phenomenology revealed a sense of “opening up” real-life issues that may have been forgotten by modern man in striving for a scientific world domination (Luft, 2004). The “opening up” is as necessary now as it has ever been.

Phenomenology as a Research Paradigm

Since the early 1980s, there has been a sense of disenchantment with the limits of logical-empirical research methodologies. Lavery (2003) observed that increasing questions emerged about the focus of inquiry, as well as exploration of methodologies that emphasized discovery, discretion and meaning rather than prediction, control and measurement. These quests lead to the deployment of practices that better interpret reality, in particular, metamorphosing into a paradigm. A paradigm is the patterning of the thinking of a person; it is a principal example among examples, an exemplar or model to follow according to which design actions are taken (Groenewald, 2004). In literal sense, a paradigm can be perceived as a loose collection of logically related assumptions, concepts or propositions that orient thinking and research (Kafle, 2011). Thus, over the years, phenomenology as a research paradigm has come to be a composite way and procedure for conducting qualitative research.

The tenets of Husserlian phenomenology are easily transferred to the psychological level except the adoption of the transcendental attitude. Modifications to this approach ensure that while the objects of consciousness are still taken to be phenomena, the acts of consciousness to which they are related are seen as belonging to a human, world related consciousness. All of the modifications, which Husserl acknowledges to be a legitimate variation (Husserl, 1977) are responses to the demands of contemporary scientific practices. According to Giorgi (2007), the modifications to be added to the Husserlian method for psychological (and educational) purposes are:

- i. The descriptions to be analyzed are obtained from others, who remain within the natural attitude, but the researcher does assume the phenomenological psychological reduction.
- ii. One tries to determine the psychological essence of the phenomenon rather than its philosophical essence, or the psychological perspective is adopted first and then the essence, the most invariant meaning structure from a specific context, is determined with respect to that perspective.
- iii. The imaginative variations that are employed are done in dialogue with the empirical variations that are given in the descriptive data; and

iv. The eidetic structure that is discovered and described is considered to be typical rather than universal.

Apart from the foundational tenets of modern phenomenology, the research paradigm consists of four major components. Kafle (2011) listed these components as metaphysics, methodology, quality and ethics. These components are considered here, one after the other.

i. *The Metaphysics of Phenomenology*: The metaphysics of a research is constituted of ontology, epistemology and axiology. These considerations determine how a researcher undertakes his/her activities (Kafle, 2011). Ontology is concerned with reality which is considered as an individual construct that is dependent on different situations. Epistemology refers to knowledge and the notion that the research work is supposed to contribute to knowledge itself. With specific reference to phenomenology, epistemology is grounded on the belief that knowledge making is possible through subjective experience and insights (Kafle, 2011). Axiology refers to the involvement of the researcher's values and opinion in the process of knowledge generation. For the paradigm under consideration, practical form of knowledge generation goes beyond the enumeration of mathematical properties.

ii. *The Methodology of Phenomenology*: Though there is no fixed set of methods to conduct this type of research, as a variant of qualitative research the purposive sampling with information rich cases is suggested (Merriam 1998 in Kafle 2011). For data generation, multiple tools such as interview, observation and protocols can be used. Data analysis is often performed via reading, reflective writing and interpretation in a rigorous fashion.

iii. *Quality Assurance in Phenomenology*: Basically, in judging the trustworthiness of qualitative research, credibility, transferability, dependability and conformability are the key standards. But considering phenomenology as a pedagogic research practice, Kafle (2011) adopted orientation, strength, richness and depth as the major quality concerns. Kafle (2011) explains thus:

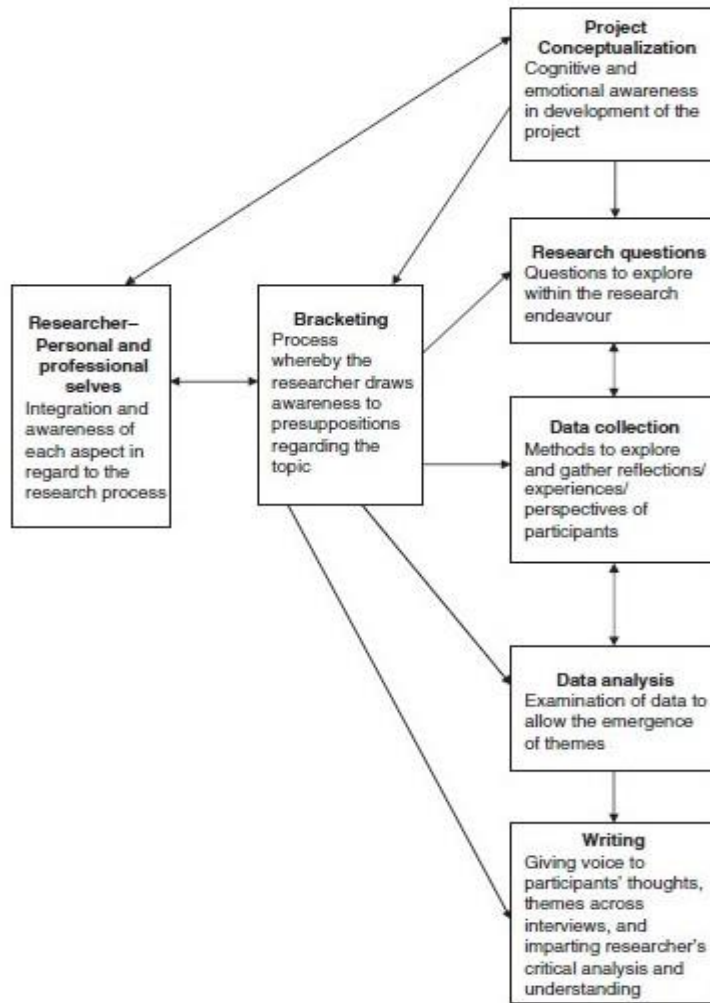
Orientation is the involvement of the researcher in the world of the research participants and their stories. Strength refers to the convincing capacity of the text to represent the core intention of the understanding of the inherent meanings as expressed by the research participants through their stories. Richness is intended to serve the aesthetic quality of the text that narrates the meanings as perceived by the participants. Depth is the ability of the research text to penetrate down and express the best of the intentions of the participants (p. 196).

Other quality assurance parameters include analytical rigor, pervasive account, participant feedback and a typical rhetoric.

iv. *Ethical Issues in Phenomenology*: To uphold high ethical standard, phenomenology attaches importance to confidentiality and sharing of research findings with the participants. It encourages assigning aliases to the participants to protect their privacy, clarifying the purpose and procedure of the research participants.

A seven-step summary of empirical phenomenological approach can be found in Aspers (2004). Other methodological consideration are provided by Beven (2014), Lin (2013) and Wimpenny and Gass (2000). However, a key methodological practice known as bracketing is worthy of mention here.

Bracketing is a method used in qualitative research to mitigate the potentially deleterious effects of preconceptions that may taint the research process (Tufford & Newman, 2010). It is a process of creating a distance from previously held theories and assumptions in order to become a non-participating observer of conscious experiences of the world (Bertelsen 2005 in Simon, 2011). One of the pivotal basis of phenomenology is the belief that only from a point of suspended judgment can inquiry proceed unencumbered from masked assumptions about the nature of the phenomenon and conditions that are observed (Simon, 2011). Chan, Fung and Chien (2013) posit that efforts should be made by researchers to put aside their repertoires of knowledge, beliefs, values and experiences in order to describe participant's life experiences. In phenomenological research, bracketing can be done by writing memos throughout data collection and analysis as a means of reflecting upon the researcher's engagement with the data (Cutcliffe, 2003 in Tufford & Newman, 2010). Additionally, engaging in an interview with an outside source to uncover and bring into awareness preconceptions and biases, could aid bracketing in phenomenology. Bracketing interviews can increase the researcher's clarity and engagement with participants' experiences by unearthing forgotten personal experiences; it also can protect researchers and participants in emotionally charged research topics, and simultaneously develop the researcher's capacity to understand the phenomena in question (Rolls & Relf, 2006 in Tufford & Newman, 2010). Another method of bracketing is a reflexive journal begun prior to defining the research question, in which preconceptions are then identified throughout the research process (Ahern 1999 in Tufford & Newman, 2010). In this respect, Simon (2011) suggested creating a bracketing mind-map on the journal to track all personal beliefs, perceptions, attitudes and views of the problem being investigated. Figure 1 depicts a representation of bracketing as it applies to qualitative research



Underlying the various bracketing approaches of memoing, engaging in interviews with an outside source, and journaling is the researcher’s commitment to surfacing his or her preconceptions both before and during the research process; and to ,maintaining the process as a priority that is fundamental to effective and meaningful phenomenological research (Tufford & Newman, 2010). When the researchers maintain their curiosity regarding what they might not know, the participants are allowed to express themselves freely (Chan, Fung & Chien, 2013).

Specific Usage

Phenomenology is a project of sober reflection on the lived experience of human existence, even in mathematics education. Van Manen (2007) posits that phenomenology is sober in the sense that reflecting on experience must be thoughtful and as much as possible, free from theoretical, prejudicial and suppositional intoxications. As such, several scholarly works have demonstrated the efficacy of the phenomenological research approach in mathematics education.

In a study introducing a framework through which mathematical work is seen as taking place via the filter of immediate perception, Brown (1996) describes the mathematics classroom from the perspective of social phenomenology. In providing an approach for structuring evolving mathematical understanding, Brown suggested that mathematical ideas are contained and shaped by the child's personal phenomenology, which evolves through time. According to Brown, ideas are never encountered directly but rather are met through a cyclic phenomenological process of reconciling expectation with experience. This line of thought is supported by Campbell (2001) who emphasized a pragmatic approach to mathematics education that is more concerned with the lived experiences of teachers and learners. This implies that phenomenology appropriately describes the origins of mathematical understanding in the phenomena of lived-experiences.

A comprehensive review of phenomenological research in mathematics education by Cho (2012) led to the conclusion that its uniqueness lies in the focus on lived-experience in mathematics education, the importance of recognizing life world in mathematics education, the essence of general phenomena, and the meaning of experience generalization in the discipline. In a specific account, Davies (2011) applied phenomenology to report observations in a Grade 7 classroom with emphasis on the pedagogical relationship that is often enacted by listening. Davies argued that students' interpretations of ideas are tangled in the web of their existences, making the teacher's listening become a truly hermeneutic activity, one that requires the virtues of openness, humility, caution and trust.

Mathematics is often viewed as an abstraction of reality or characterized important ideas representing the commonalities inherent in a wide variety of situations (Fi-Wiki, 2010). Phenomenology in mathematics education focuses on the connections between a mathematical concept and the complex world, which relates to it. In this respect, Megayon and Tan (2016) used phenomenological investigation techniques to reveal the inadequacies of differentiated instruction among Grade 7 students in the Philippines. The findings suggest that considering activities based on students' preference, modified learning activities and creating different groupings are not enough to ensure that differentiation results to an effective instruction. Megayon and Tan show that every feature of differentiation including variety of relating real-life situations, treated a wide range of experiences to students, falling short of expected outcomes.

A typical phenomenological study by Hogue (2012) analyzed the experiences of three mathematics teacher educators in a certain American university. Key points of transcribed semi-structured interview were reviewed in an effort to triangulate the interpretive process. Evidence from the study suggests that there are numerous factors related to the experiences and perceptions of mathematics teacher educators, which may promote a more thorough

understanding of the challenges they face in the light of preparing pre-service teachers to teach mathematical and statistical notions. Similarly, Jhagroo (2011) applied phenomenological approaches in a cross-cultural focus on the way perceived past and present lived experiences of immigrant students influence their transition in the mathematics classroom. The interpretations of how the ten (10) immigrant students in the study perceived their mathematics ability, from their own perspective and from their perceived teachers' perspectives provided an understanding of how they positioned themselves in the mathematics classroom. Additionally, an interpretation of the students' perceptions of how their parents would have rated their ability offered another dimension in understanding their academic self-concept. Other related works by Sozen (2013), Bleiler (2012) and Preciado Babb, Metz and Marcotte (2013) adequately corroborate the robustness of phenomenology as a research paradigm.

Evidently, students' learning and thinking about mathematics have been discussed by researchers through phenomenological ideas stressing the importance of communication and active argumentation. In a unique presentation, Moutsios-Rentzos and Spyrou (2013) expose the contribution of phenomenological ideas about students' appreciation of and need for mathematical proof which includes the coordination of logic and the axiomatic structure to investigate the validity of a statement. Consequently, all over mathematics education, it can be argued that phenomenology may contribute a coherent framework for addressing the whole spectrum of students' identified needs, thus contributing in pedagogies that are more effective.

The Call for Extensive Adoption

The power of the phenomenological approach in interpreting events in mathematics education cannot be over-emphasized. However, there seems to be a very low patronage among practitioners in Nigeria. The plethora of issues bedeviling the growth, and development of mathematics education in the country could be too dynamic for only surveys and quasi-experiments to unearth. There is a great need for more qualitative insight into the evolution process of the profession.

Phenomenology is often suited for research problems that are usually open-ended and exploratory in nature. Such research questions typically arise when there is little known in a particular research area, existing research is confusing, contradictory or not moving forward or the topic is highly complex (Barker *et al.*, 2002 in Elliot & Timulak, 2005). With respect to exploratory questions, Elliot and Timulak (2005) observed the following types:

- i. Definitional: What is the nature of the phenomenon? What are its defining features?
- ii. Descriptive: What kinds or varieties does the phenomenon appear in? What aspects does it have? (e.g. what is the pattern of storytelling used by Basic Mathematics teachers?)
- iii. Interpretive: What is wrong (or right) about the phenomenon? How could it be made better (e.g., what complaints do first year students have about the current timetable for lectures?)
- iv. Deconstruction: What assumptions are - made in this research? Whose social or political interests are served by it?

Any critical consideration of persistent issues in Nigerian mathematics education can unveil problems that easily lend themselves to the phenomenological research paradigm. If investigations into the state of affairs within the discipline are conducted in open-mindedness, it will not be survey and experimental research design every now and then. More importantly, such open-mindedness will put as error the practice of restricting graduate research work to predominant research methodologies. Faculties and thesis supervisors should be willing to explore depths that are previously unfamiliar and must not impose any stereotypical influence on the direction of post graduate research investigations. Graduate students should be allowed to openly discuss their worries, intrigues and interests with the assurance of adopting whatever methodology deem appropriate. In situations where a single design is not possible, a mixed-method approach can be adopted.

It is indeed high time professionals of mathematics education in Nigeria display a true sense of variety as seen in other climes around the world. The sample of phenomenological studies referred to in this discourse comprises valid socio-cultural investigations supervised by other professionals of mathematics education. Presently such research reports are difficult to come by in Nigeria, an indication of the widespread methodological restrictions that is seemingly in practice across Nigeria's institutions of higher learning. The fundamental submission of this discussion, therefore, is the need to adopt varied qualitative methods, including empirical phenomenology, to unearth and interpret the growth and development of mathematics education in Nigeria.

Conclusion

This discourse has attempted to highlight the need to deploy phenomenology in the study and interpretation of the growth and development of mathematics education in Nigeria. An in-depth view of the historical roots of phenomenology as a research paradigm exposes the contributions of Husserl and Heidegger with respect to their varied approaches and philosophy. Present-day tenets of empirical phenomenology were then considered with a particular emphasis on the practice of bracketing in qualitative research. Some empirical studies that adopted phenomenology in investigating problems in mathematics education were reviewed with a call for extensive adoption of the paradigm in Nigerian Mathematics education.

The issue exposed in this discourse holds serious implications for students and professionals of the discipline. Students of mathematics education at all levels of higher education must dig deeper into the existential problems of the field. There is the need to diversify the approach to conducting investigations into critical phenomena within mathematics education in Nigeria, and this should be done within the appropriate techno-cultural context. Professionals of mathematics education should shun stereotypical restriction on research methodologies in our institutions of higher learning. They should cultivate the virtue of open-mindedness towards investigating the problems of the field. In doing this, empirical phenomenology could be considered as one of the numerous qualitative approaches available for interpreting the true essence of progress, prospects and challenges of mathematics education in Nigeria.

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