THE INCULCATION OF CRITICAL THINKING IN THE TEACHING OF BASIC SCIENCE EDUCATION IN SELECTED SCHOOLS IN NIGERIA

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by

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ABSTRAK

Tesis adalah penyelidikan penyiasatan berdasarkan kajian kes kualitatif deskriptif manifestasi pemikiran kritikal dalam tahap pendidikan sains asas dari perspektif falsafah. Data kualitatif dikumpulkan daripada temu bual, pemerhatian dan analisis dokumen, menggunakan protokol wawancara, nota lapangan dan analisis dokumen yang kemudiannya dipetik, dikodkan, dan bertema. Perbincangan lanjut telah dijalankan dan dilakukan selaras dengan analisis tema. Lima guru sains asas, sengaja dipilih untuk kriteria kemasukan tertentu, mengambil bahagian dalam kajian daripada tiga kategori sekolah awam yang berbeza di Nigeria, yang berfungsi sebagai tapak penyelidikan. Tema-tema telah dikenalpasti dan dibincangkan. Secara amnya, tema mendedahkan bahawa tidak ada objektif pemikiran kritis dalam kurikulum pendidikan sains asas, guru kelas menyatakan objektif soalan pentaksiran/penilaian; ia mendedahkan sains asas sebagai subjek sains asas; dan sesetengah guru tidak jelas dengan objektif kurikulum. Tema-tema selanjutnya mendedahkan bahawa kurikulum hanya mempunyai peruntukan yang jelas untuk objektif tingkah laku; Objektif pemikiran tidak kritis. Tema-tema tersebut mendedahkan pedagogi pemikiran tidak kritis guru; Guru - kelas berpusat; Sumber yang tidak mencukupi (untuk pengajaran di tapak penyelidikan); Tiada latihan mengenai pemikiran kritikal (untuk guru-guru dalam praperkhidmatan dan latihan perkhidmatan). Selanjutnya, tema mendedahkan bahawa penilaian guru dipandu oleh kurikulum; Bukan penilaian pemikiran kritikal dan strategi pertanyaan yang tidak sesuai.

mengenai implikasinya, tahap kematangan kanak-kanak tidak boleh dianggap sebagai kekangan dalam membangunkan kemahiran berfikir secara kritis sepadan dengan tahap rasional mereka. Tesis ini mengesyorkan kemasukan pemikiran kritikal dalam objektif dan peruntukan kurikulum pendidikan sains asas dan pendidikan guru di Nigeria serta penerapan seterusnya dalam pengajaran. Guru perlu dilatih dalam pedagogi pemikiran kritikal selaras dengan teori tesis untuk memperkaya pernyataan objektif bilik darjah, pedagogi pengajaran dan penilaian kemahiran berfikir secara kritis. Kajian serupa telah dicadangkan untuk tahap pendidikan lain. Penyelidikan eksperimen selanjutnya juga disyorkan untuk melatih pelajar, guru, dan perancang kurikulum mengenai perkembangan pemikiran kritis.

THE INCULCATION OF CRITICAL THINKING IN THE TEACHING OF BASIC SCIENCE EDUCATION IN SELECTED SCHOOLS IN NIGERIA

ABSTRACT

The thesis is an investigative research based on the descriptive qualitative case study of critical thinking manifestations in basic science education level from the philosophical perspectives. Qualitative data was collected from interviews, observation and document analysis, using interview protocol, fieldnotes and documents analysis which were later excerpted, coded, and themed. Further discussion was carried and performed in line with themes analysed. Five basic science teachers, purposely selected on certain inclusion criteria, participated in the study from three different categories of public schools in Nigeria, that served as research sites. The themes were identified and discussed. Generally, the themes revealed that there are no objectives on critical thinking in the basic science education curriculum, teachers' classroom stated objectives and the assessment/evaluation questions. The themes further revealed basic science as simply a foundational science subject; and some teachers' non clarity with curriculum objectives. In addition, the themes revealed that the curriculum only have clear provisions for behavioural objectives; Noncritical thinking objectives. It revealed that, no training on critical thinking (for the teachers at the preservice or in service training); the teachers' noncritical thinking instructions; Teacher - centred classes; Non reflection of high Bloom's or 5 E's model; Inadequate resources (for teaching in the research sites). Further, the themes revealed that the teachers' assessment is guided by the curriculum; Non assessment of critical thinking; and inappropriate questioning strategies. On the

implications of the study: the curriculum has serious neglect for critical thinking; the teachers are grossly lacking in pedagogy and content knowledge training for teaching critical thinking; children's maturity level should not be considered as a constraint in developing their critical thinking skills corresponding to their level of rationality. The thesis recommended the inclusion of critical thinking in the objectives and provisions of basic science education curriculum and teacher training education in Nigeria and its subsequent inculcation in the teaching. Teachers should be trained in contents knowledge and critical thinking instructions in line with the thesis' theories to enrich their statement of classroom objectives, teaching instructions and assessment of critical thinking skills. Similar studies have been suggested for other levels of education. Further experimental research was also recommended for training students, teachers, and curriculum planners on development of critical thinking.

CHAPTER 1

INTRODUCTION

1.1 Introduction

Thinking-talents are important for learning and intellectual development since they feed the mind and the intellect. There are different types of thinking skills developed in schools that involve higher order thinking skills of analysis, creation, and synthesis, such as critical thinking, scientific and creative thinking skills. For instance, Critical thinking involves asking the questions how, what, and why of information, its sources, and its significance. The distinctive features of scientific thinking also relate to the nature, place, and handling of experimentation, including the place of hypothesis formation, as according to Al-Ahmadi (2008, p. 142). Creative thinking is involved with the development of anything original that is appreciated in some manner by someone. This new creation need not be an artefact; it could be an idea, a fresh perspective, or a different approach to a challenge. There are also verbal, mathematical and Systems thinking, which is related to the creation of a thorough comprehension of the systems being studied. Mathematical thinking is related to numbers, statistics, or quantifiable indicators is encouraged by quantitative reasoning. While verbal reasoning improves students' capacity to comprehend and assess issues utilizing words or written expressions. However, currently, only verbal and mathematical thinking skills are encouraged to be learned and acquired in Nigeria's basic educational system (Okunuga et al., 2020; Samba et al., 2020; Umate et al., 2021).

Students in basic one through six are taught verbal and numeric aptitudes at elementary schools all around the nation. Students are taught addition, division, and subtraction as examples while teaching quantitative thinking (Okunuga et al., 2020).

The tasks are designed to encourage students to think of solutions. Additionally, in verbal aptitude, students are taught how to construct, spell, and define words. During tests and examinations, students are required to provide these definitions. But providing solutions to exercises in verbal or mathematical thinking is only a small part of what cognitive capacities include (Okunuga et al., 2020). Humans are exposed to events, mathematical concepts, and textual sentences far too frequently, which pique their curiosity and unquestionably insatiate the intellect. Some students may question why two plus two also equals four, as two times two equals to four, in the quantitative thinking category. Some students in verbal reasoning classes inquire as to why the singular and plural forms of sheep are the same. This clearly underscores the place of critical thinking skills in schools.

There also exists a dilemma on the best approach for the inculcation of critical thinking particularly at the basic elementary level and what's the best approach and strategies for the teaching and assessment of the skills. According to Presseisen (1988), a coordinated strategy for developing critical thinking abilities can serve as a foundation for education in all fields. This was dubbed the "infusion approach" by Swartz and Park (1994). Kong (2005) asserts that this strategy offers a number of benefits, one of which is that the teachers' lesson plans will only need minimal adjustments. Many teachers also argue that teaching critical thinking as part of the curriculum rather than in separate sections is more effective (Kuhn, 1999; Aloisomi, 2013). This seems to be the best approach and a workable strategy for fostering critical thinking skills given the overstuffing of the curriculum and the length of the school day (Aloisomi, 2013). This is because adding critical thinking as a separate topic would add to the already demanding curriculum and extracurricular activities for students and teachers. Because critical thinking is integrated into the subject, the

infusion technique simply requires minimal adjustments to teachers' teaching strategies and does not call for more time than is already allotted to that subject.

There has also been a considerable debate on the appropriate level for developing critical thinking in learners. It was argued that children are more inquisitive when they are younger. Therefore, it is appropriate age to start the teaching for critical thinking. (Okunuga et al., 2020; Samba et al, 2020; Umate et al., 2021). This is true because critical thinking sharpens people's minds and equips them with the skills they need to analyze concepts, solve problems, and navigate a complex and confusing environment. In critical thinking classes children can ask questions, point out errors, and identify gaps in texts that instruct in quantitative and qualitative reasoning. This kind of thinking is crucial for the development and improvement of society because it encourages a thought process that is focused on social change, creativity, and transformation. Students who are involved in critical thinking learn better to recognise problems and resolve challenges in daily life (Adeyemi, 2012). It equips students with the skills they need to spot problems, gauge the situation, and find solutions.

Understanding and solving problems as the objectives of students learning, learning of facts, procedures and principles, and how to think critically and creatively are central to the conception of teaching by Shulman (1986). From his understanding, learning of subject matter is a means to an end in achieving other goals, not an end in itself. Knowledge of the subject matter is a secondary and universal means for instruction in achieving whatever ultimate goal of teaching (Shulman, 1986; 1987). Critical thinking is therefore very crucial in the teaching and understanding of every school subject. Moreover, considering the strong place of science education in

problem solving and resolving the daily life challenges the place of critical thinking in the teaching of basic science education could not be over emphasised.

When compared to professions like law, medicine, and engineering, teaching is sometimes seen as a non-professional field, which is the factor that motivates Shulman established PCK. In our recent times, to address the shortage of qualified teachers in the schools, people without any formal teaching training were employed as temporary teachers in many countries like Malaysia (Shing et al., 2015). Such actions further demonstrated a teacher's non-professional status. This is also the case in Nigeria (Samba et al., 2019). According to the proverb "those who can, do, those who can't, teach" (Shaw, 1903), those who are skilled in one area can earn a living in that area, while those who lack that skill teach for a living (McGraw-Hill Dictionary, 2002). The phrase was used to make fun of teachers. According to reports, teachers in Malaysia like their counterparts in many other countries across the world, lack certain pedagogical preparation, which exacerbates the situation (Lee, 2014). Based on several research findings, this problem was more pronounced in the Nigerian context (Ogunniyi & Jegede 2019; Olatunde-Aiyedun & Ogunode, 2021).

Shulman further suggested that to elevate teaching to “a more respected, more responsible, more rewarding and better rewarded occupation” (pp. 3) it was indispensable to clearly articulate and raise education standards of teachers and their performance. This need urgently resulted to the renewed research to establish a missing link and paradigm in the studies on teaching and teacher knowledge (Shulman, 1986; 1987). Pedagogy, content knowledge (PCK) was identified by Shulman (1987) as one of the seven categories of teachers’ knowledge base. He defined it as “that special amalgamation of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding” (p. 8).

Content knowledge, pedagogical knowledge, curriculum knowledge, knowledge of educational contexts, knowledge of learners and their characteristics, and knowledge of educational ends, purposes, and values, and their philosophical and historical grounds were the other six categories (Depaepe et al., 2013).

The missing questions about taught lesson are on its content, evaluation questions, and the students' responses. A prerequisite to teaching begins with a teacher's understanding of learning content and how to teach it (Shulman, 1987). The teaching proceeds with a series of activities to provide the students with specific instruction and learning opportunities because the act of learning itself is the student's responsibility (Shulman, 1987). However, some traditional methods of instruction and conception of teaching suggest that education is reduced to the passing of information to a passive learner through knowledge transmission, from an active teacher. The information is considered as product of teaching rather than process. Shulman's (1986) definition of teaching is not limited to direct classroom instruction because of his strong regard for discovery learning and inquiry teaching. However, even in student-cantered teaching instructions, where many initiatives lie in students' hands, there is still room for teacher's knowledge. Teacher comprehension for the inquiry-based classroom is sometimes more critical than for its conventional classroom situation (Shulman, 1987).

There also exists a strong historical relationship between technology and content knowledge. The development of new technologies that coincided with advancements in areas of medicine, physics, history and archaeology has enabled the data representation and manipulation in new, fruitful and advanced ways (Mishra & Koehler, 2006). Roentgen's discovery of X-rays, for instance, or the technique of carbon-14 dating are some examples of the influence of these technologies in

medicine and archaeology, respectively. Also, the digital computer has transformed the areas of physics and mathematics placing greater emphasis on the importance of simulation in understanding of any phenomena. Technological changes have led to new understanding of the world (Mishra & Koehler, 2006). By comparing the heart with a pump, and the brain with an information processing machine (like a computer) technologies have created new ways for understanding phenomena. The metaphorical and representational connections are not superficial because they often led to fundamental changes in the disciplines and their nature. Central to the development of appropriate technological tools for educational purposes, is the understanding of the technological impact on knowledge and practices of a given discipline (Mishra & Koehler, 2006). The types of content ideas to be taught is greatly influenced or constrained by the choice of technologies. Certain content decisions can, likewise, constrain the types of technologies to be used. Technology can limit the possible representations but can also influence the development of new and varied representations. Technological tools can, furthermore, provide greater flexibility across these representations (Mishra & Koehler, 2006). There exists strong interrelationship between technology and content as both influence and constrain one another. Teachers need to have a sound understanding of the way an application of particular technologies in a specific subject matter (or its representations) can be changed or constructed, not just to simply master the subject matter they teach (Koehler & Mishra, 2009). Teachers need to understand appropriate technologies best suited in their domain's subject-matter learning and how the content determines, dictates or even changes the technology and vice versa.

The researcher draws his motivation for the research from studies related to teachers' content knowledge, pedagogical skills and technologies for inculcating

critical thinking with particular reference to basic science students, because teaching and learning have been changing with the global best practices in teaching generally focusing on developing students thinking and critical thinking in particular (Muhammad, 2020). In many developing countries, like Malaysia, there are ongoing efforts to incorporate higher order thinking skill in teaching through content instruction (Rajendran, 1998). Teachers in Nigeria, particularly the basic science teachers, are also expected not to be left behind their counterparts in other worlds in embracing the current and conventional methods of critical thinking teaching strategies (Ogunode et al., 2021). It is therefore very important for basic science teachers to teach children how to think critically and include this intellectual skill into their regular academic pursuits. This is particularly true given how knowledge is presented to pupils in fragments and in ways that pique their curiosity (Muhammad, 2020). Early in their academic careers, children should study subjects that encourage them to challenge what they see, hear, read, or touch. This is strongly influenced by the teacher's understanding and competence in classroom instruction for achieving the targeted educational goal and objective. In all areas of human endeavour, students should be taught that asking questions boldly rather than holding them quiet is a sign of learning (Ijaiya et al., 2011). It is important for the teachers and students to understand that asking insightful questions—or, even better, challenging and questioning everything—is a sign of intelligence, wisdom and sterling learning character (Ogunode at al., 2021). This underscores the descriptive qualitative case study of this nature aimed at studying the teachers' understanding, preparation, efforts and instructional strategies for inculcation of critical thinking in their teaching of basic science education subject.

1.2 Background of the Study

There has been a shift in both research and policy circles some decades ago. Most research on teaching, teacher evaluation and teacher certification are cantered on content and pedagogy in the search for missing paradigm (Shulman, 1986).

The literature of research on teaching, puts more emphasis on teacher's classroom management, organization of activities, time allocation, assignment's structure, reward and punishment, constructing their different level questions, lessons plan, and evaluation of the students understanding (Shulman 1987).

The missing questions about taught lesson are on its content, evaluation questions, and the students' responses. This raises several questions from the perspectives of teacher education and development. What is the source of teachers' explanations? Who decides for the teachers what to teach, how to teach, present, ask student assessment questions about it and how to manage the issues of misunderstanding. Teachers' capacity to teach revolves around the stated factors. Teaching for higher order thinking skills and critical thinking also is centred on these issues. However, there appeared to be some background constraints basic science education teachers faces, which limit their roles in the development and promotion of critical thinking at the basic science education level in Nigeria (Ali & Ajibola, 2015). These are regarded generally as the background challenges for the development of critical thinking teaching skills in schools. This is because their teaching and other activities in schools are guided by the policies and curriculum in operation. These should be discussed extensively under the review of related literature.

The constraints could also be translated into the four components of educational goals—administrative structure, textbooks, and teaching objectives—were chosen to shed light on the issue of who oversees schooling in Nigeria (Nwosu et al.,

2015; Ogunyinka et al., 2015; and Okunuga et al., 2020). The Ministry of Education's influence on educational goals, the administrative structure, textbooks, and teaching objectives is evidence of the Ministry's dominance over basic school education in Nigeria. Dysfunction, dehumanisation, and depersonalization become the barriers to personal growth under such a dominance.

Additionally, according to Ali and Ajibola (2015), there is no structured educational plan or curricular framework for teaching or developing critical thinking. But if the capacities for self-realization, self-reflection, and self-actualization are crucial for one's own personal development, then school education in Nigeria fall short in that regards which also set some controls and obstacles and difficulties, according to them.

The assertion that the educational process is defined by preparing students for the subsequent stage of education (Jimoh, 2009) can also be used to analyse the skewed functions of education in Nigeria. As a result, textbook knowledge is highly valued by learners, teachers, and parents alike (Usman & Zaid, 2017; Jimoh, 2009). Because students' talents must be demonstrated through the examination results, the entrance examination procedure depersonalises students by forcing textbook knowledge upon their minds.

Apart from teachers' dispositions, basic school teachers in Nigeria lack critical thinking for different reasons caused by three factors: i) a negative worldview that controls teachers' capacity for reflection; ii) the social value system that enhances their instrumental goals; and iii) the burden of survival necessities that prevents them from fighting for autonomy (Thompson, 2011).

It is also possible to criticise Nigeria's traditional methods of instruction and learning since they make it very difficult to foster critical thinking. in the teaching

learning process in two ways, i.e. curricula and the teaching method (Olatunji, 2017; Kalusi, 2016). In the first instance, it is very difficult to teach for critical thinking through formal teaching with formal contents and overstated learning outcomes in Nigeria (Enoh, 1996; 2013). There is emphasis on the learners coginitive domain to the neglect of other domains of learning. Thus, students' memory becomes the most crucial skill that students must learn and develop in school (Olatunji, 2017). This type of bookish education, which was at first decried as a hangover of colonial education in Nigeria after independence, makes the assumption that learning success must be measured by the amount of information that children can recall or repeat from the material they have learned in class reflected from their ability to replicate what they may have memorised.

The second point is that conventional authority is clearly visible in the manner in which instruction is delivered and in the design of the learning environment (Kalusi, 2016). Traditional teaching and learning methods, which are typically utilised to accommodate the enormous volume of content, would make it very difficult to attain the enlightenment of reason and rationality of mind. (Olatunji, 2017). Simply forcing educational stuff into students' heads won't enlighten their thoughts. Instead, it is necessary to encourage their scepticism, as well as their capacity for self-reflection and autonomy. The objective of teaching for critical thinking, however, is far from being attained in Nigeria by conventional forms of teaching and learning.

As was previously mentioned, teaching for critical thinking involves more than just imparting knowledge from textbooks; it also involves teaching and learning via self-realization, self-reflection, and self-actualization. Critical thinking is not taught in Nigerian elementary and secondary schools due to the dysfunction, depersonalization, and dehumanisation of education. Traditional authority influence students, but teacher

overload and social pressure force teachers to impart knowledge mindlessly, and coupled with the teachers' epistemic authority and the curriculum structure stifles their critical thinking (Tsui, 2002). Any educational reform would amount to nothing more than the transfer of education from one constraint to another if it is only used as a tool for politics, society, and the state. Education can set its own goals while achieving the larger goal, particularly for personal development and growth.

There are three outcomes that could come from instruction and learning. These are: i) Students merely learn textbook knowledge or political propaganda, for instance. ii) Students develop their reason as well as knowledge from textbooks or political spin. iii) Students consider what they learned in class or political spin using their enlightened reason.

The concept of "dysfunction" as used in this context does not refer to a function that has been corrupted, but rather to a process that has been influenced or warped by political or economic desires, potentially defeating the intended outcome. On the other side, the term "dehumanisation" denotes the dominance of the instrumental desire, in which man may become estranged from himself. To be more exact, the administrative framework of Nigeria's schools leaves little room for school autonomy, and the process of teaching and learning is constrained to knowledge found in textbooks (Samba et al., 2020). In a similar vein, self-reflection is discouraged while self-realization and self-actualization are confined to the instrumental level. All of these events demonstrate that critical thinking instruction has not been provided in Nigeria. Additionally, there aren't any curriculum items or formal educational programmes that promote or teach critical thinking (Umate, et al., 2021). Therefore, schooling in Nigeria needs to change if the capacities for self-realization, self-reflection, and self-actualization are crucial for personal life, particularly at the

foundational level of teaching basic science education, to address the identified challenges of controls and obstacles.

From the above discussions therefore, critical thinking is still a little-known concept in Nigerian educational practice (Samba et al., 2020; Umate, et al., 2021) even though the National Policy on Science and technology stated that science education in the country must be lavish and intricate enough to promote the learners' attention and interest while also encouraging the development of the necessary mental and physical abilities and competences in them as demonstration of successful learning outcome (FGN 1986, revised 2009). The federal government's goals for education policy are to reorient society towards scientific thought so that new technologies may be developed and existing ones can be modified to enhance social security and well-being. (FGN 1986, revised 2009). The National Policy on Education (2014) also stated that it has recognised education as an "instrument per excellence" to achieve its national goals. Although critical thinking concepts have a long history of being taught in schools in some countries, such as the United States of America, there is no indication that they have ever appeared in Nigeria in any meaningful way (Okunuga, et al., 2020). They have appeared as creative thinking, inquiry, assessment, information processing, and reasoning and they are all extremely implicit in the National Curriculum (Olatunji, 2017; Nwosu et al., 2018). Thus, reasoning is comprised of the following skills: providing justifications for beliefs or actions, inferring, drawing conclusions, making informed judgements or decisions, and utilising exact language to reason. Although it is not explicitly mentioned, one can assume that such skills can be used to a variety of subjects (Thompson 2011; Olatunji, 2017). The assumption of the curriculum planners although not explicitly stated is that such skills can be applied in various subject matters (Nwosu et al., 2018). From a

close examination of the underlying assumptions of our curriculum one can make the inference that this is the planned outcome. Grouping them as unique, non-subject specific talents and skills would be pointless if they were intended to be different abilities in different settings.

While in some cases like that of Nigeria it is assumed by the curriculum planners that these skills could be indirectly developed through teaching subjects, the national curriculum acknowledges that teachers will require guidance when introducing these critical-thinking abilities within their particular subject areas though it does not provide clear instructions on how to achieve this in the form of concise case studies about certain topics, particularly in the sciences (Olatunji, 2017). Thus, the groundwork is laid for a study to determine whether such a strategy is worthwhile and, more generally, whether critical thinking skills have a place in the teaching of basic science education in Nigeria. And to what extent do the abilities promote learning and understanding of sciences.

Perkins et al (1993) have drawn from the opinion of several philosophers (McPeck, 1981; Schräg, 1988; Siegel, 1988: Ennis, 1989; Paul, 1990) and the psychologist, Baron (1985), who extensively wrote on the centrality of dispositions to good thinking using well-developed arguments. From few teachers (Barell, 1991; Ennis, 1989; Baron, 1987), concerned with the teaching of thinking, Perkins et al. (1993) have also gotten influenced, on the importance of thinking dispositions in educational process, by the several taxonomies of thinking dispositions. Perkins et al. (1993) dispositions to the teaching of thinking provides a substitute to traditional skills-centred approaches. It extends the philosophical and educational perspectives by adding psychological perspectives for thinking dispositions through some psychological literature on human development connected with contemporary theories

of human intelligence. Thus, the elements of critical thinking to be emphasized in the study centred around the philosophical and psychological definitions of the term critical thinking which could also be supported by subject domain teaching of the elements of critical thinking as emphasized in the following definitions: Critical thinking is purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criterio logical, or contextual considerations upon which that judgment is based (Facione 1990; Aloisomi, 2013).

As a process, it is the intellectual process of actively conceptualizing, applying, analyzing, synthesizing and or evaluating information gathered from, or generated by observation, experience, reflection, reasoning or communication, as a guide to belief and action (Center for Critical Thinking, 2004).

1.3 Statement of the problem

There has been growing interest in thinking and how it can be enhanced in the classroom instructions over the years (Akpur, 2020; Perkins, 1993; Rajendra, 1998; 2008). The idea of teaching thinking, for a long time, has been on different forms. The promotion of critical thinking for instance has been the major concern of philosophers and psychologists in education (Rajendra, 1998). The renewed interest in critical thinking has been provoked by the advancement in the information and technology era and comparison in the students' higher-order cognitive skills at the international level (Akpur, 2020). The cultivation of critical thinking abilities has been considered a major objective in education for increasing the students' ability to use their minds more effectively. However, teaching in Nigeria schools is still mostly focused to encourage students to give answers rather than ask questions and to memorise facts

rather than reflect (Samba et al., 2020; Umate et al., 2021). The educational system does not give students adequate opportunity to question conventional thinking and engage in critical inquiry according to Mgboro (2006), Ejide (2006), Udose (2011), and Nwosu et al. (2015). Excellence in studentship, at its core, relies on giving prepared responses as opposed to posing problems or pointing out mistakes. Instead of encouraging the development of further questions and problems for inquiry, the educational approach encourages memorization of previously written solutions and rote learning. In this type of learning environment, students are more likely to lack inquiry skills, have blind faith, and be gullible (Nwosu et al., 2015). They contend that it leads to the graduation of pupils who fail to think critically or analytically beyond the scope of the course material and who are content to take information and knowledge at face value.

In recent years, there have been various calls among scholars, educationist and various stake holders on the need to introduce critical thinking in our education to address some of the above-mentioned challenges, particularly at the basic and foundational level of education. Intensity of these calls reach to the extent of drawing the attention of the Philosophers of Education Association of Nigeria (PEAN) to organize a conference with the theme tilled: Critical thinking, Education and Sustainable development in Nigeria, in 2017. The conference communiqué urges governments at various levels to give attention to the need for developing the critical thinking abilities of learners at various educational levels and it also challenges scholars, philosophers of education in particular, to come up with further researches on how to develop these skills and abilities among Nigeria students as there were lack of studies in that area.

There is a shift in both research and policy circles with most research on teaching, teacher evaluation and teacher certification cantered on content and pedagogy in the search for missing paradigm (Shulman, 1986). Teaching and learning have been changing with the global best practices in teaching generally focusing on developing students thinking and critical thinking in particular (Akpur, 2020). Teachers in Nigeria, particularly the basic science teachers, are also expected not to be left behind their counterparts in other worlds in embracing the current and conventional methods of pedagogy and content teaching for critical thinking. It is therefore essential for the teachers to teach children how to think critically in their subject area and include this intellectual skill into their regular academic pursuits.

However, serious concerns have been raised concerning the quality of teachers being produced in Nigeria, particularly due to their persistently inadequate knowledge of teaching strategies and content (Ijaiya et al., 2011, Nwosu et al, 2015; Muhammad, 2020). In Nigeria, according to Aboluwodi (2016) The majority of teachers are still committed to the colonial educational legacy, where the main focus of instruction is on preparing students for tests. He continued by saying that under a system of this kind, the pupils serve just as passive recipients. He added that the passive nature of education in Nigeria is supported by the culture of passivity in the larger community, which glorifies conformity, explaining why pupils are unable to challenge the beliefs of others or interact with teachers in a constructive manner. The teacher teachers are also overloaded due to inadequacies of personnel resulting to role conflict while they still have to battle with much overloaded subject contents (Ogunniyi & Jegede 2019; Olatunde-Aiyedun & Ogunode, 2021). Because of this, majority of them are forced to assess their pupils using factual questions and traditional teaching techniques in the classroom. According to Aboluwodi (2016), doing so makes it relatively simple for

teachers to assess their pupils and also enables them to meet the various dates for submitting the students' scores., at the expense of students critical thinking. He claims that critical thinking abilities are one of the main things missing from the pre-service teacher education curriculum in Nigeria. This is so that they may select relevant subject, methodologies, provide educational resources, pose challenging questions, and respond to inquiries. He pointed out that creating effective lesson plans and schemes of work requires critical thinking skills from teachers.

Considering the strong place of science education in problem solving and resolving the daily life challenges, the place of critical thinking in the teaching of basic science education could not be over emphasised. However, like other teaching subjects in Nigeria, teaching of basic science education is also affected by the challenges of teachers' poor pedagogical strategies (Omorogbe & Ewansiha, 2013; Ezechi & Ogbu, 2017; and Ogunode et al, 2021) for development of learners critical thinking abilities. A science subject is typically described by its body of knowledge or the manner in which it advances our understanding of the world. According to Driver et al. (2000), science is concerned with more than only the connections between laws and observations to include problem solving exercises. This is because solving problems is a component of scientific discovery. "Inquiring" is given more weight in critical thinking, including its more analytical and methodical aspects (solving and breaking down the problem, etc.). The primary mentality of critical thinking is curiosity, or detective thinking. It entails generating alternate hypotheses, counterfactuals, justifications, and actions (forming a judgement). Unfortunately, teaching and learning in Nigeria, are centred around simple recall of information verbatim (Emaikwu, 2012). Basic science education teachers, like their counterparts in other subjects, have assumed a role of retailing Knowledge, while students are

considered as the raw consumers of knowledge (Saad & Ibrahim, 2019). The purpose of school teaching is to promote the giving of answers rather than the asking of questions and the memorization of facts rather than their contemplation. The teaching approach encourages rote learning and memorization of facts and information (Mgboro, 2006; Ejide, 2006; Udosen, 2011; and Nwosu, et al., 2015).

National Policy on Science and technology (1986, revised 2009) stated that science education in the country must be rich and elaborate enough to provoke the love and interest of students and develop in them the acquisition of appropriate skills and competencies both mental and physical as demonstration of successful learning outcome. The policy statement on the purpose and goals of basic science and technology education in Nigeria goes on to clarify that the goals of science and technology subject are to encourage learners' creativity and critical thinking (FRN, 2014). However, the question is how was this policy statement translated into reality and acquisition of higher order thinking skills like critical thinking inculcated in the basic science education teaching at the classroom teachers' level of basic science education? The gap therefore exists in the disparity between the policy statement and the actual classroom situation. Many scholars and educationists have also expressed their concern and doubt in the realisation of this policy outcome in relation to thinking skills and abilities (Samba et al., 2020; Umate et al., 2021). Secondly, to investigate the explicit or implicit inclusion, interest and provisions for critical thinking from the curriculum guiding documents and how it's understanding might foster or constrained the effective teaching of basic science education for critical thinking through the challenges of teachers' instructional strategies (Ezechi & Ogbu, 2017; and Ogunode et al., 2021) for development of learners critical thinking.

Therefore, there appears a gap in the inexplicit inclusion of critical thinking in the objectives of basic science education in Nigeria and a clear meaning of the term critical thinking within the context of basic science education curriculum in Nigeria, despite the policy statement on that (Samba et al, 2020; Umate, et al., 2021). Secondly, there is a gap in the teachers understanding and preparedness in employing the current and conventional methods of content teaching for critical thinking for realisation of the policy statement (Aboluwodi, 2016' PEAN, 2017; Ezechi & Ogbu 2017; and Ogunode et al., 2021). Thirdly, there also exists a gap on how critical thinking skills could be best assessed by the classroom teachers being the term critical thinking both cognitive & attitudinal concept leading to lack of adequate literatures on that and consequently poor understanding of teachers on how to assess their learners critical thinking skills (Jonassen, 2010; Olatunji, 2017).

Thus, the thesis is set to address the gaps. As descriptive qualitative case study research, the study is primarily set to investigate the focus and approach of classroom teachers' strategies to inculcate the elements of critical thinking in the teaching and assessment of basic science education in Nigeria, if there is any. Its therefore set to investigates how the teaching of basic science education introduces critical thinking to leaners in Nigeria? The teachers understanding of the stated objectives of basic science, the subject's curriculum provisions, basic science teachers' preparedness through lesson planning, methods of teaching and assessment for the inculcation of critical thinking.

The thesis makes two contributions to knowledge, one in the area of critical pedagogy and the teaching of basic science in Nigeria, and the other on conceptualization and assessment of critical thinking by infusing the philosophical and psychological perspectives of the concept and distinct areas of agreement that could

be promoted in the teaching and learning process. This is the gap the study stands to fill, and it directly leads to the following research questions which form the basis of this discussion.

1.4 Research Objectives

1. To investigate the understanding of basic science teachers on the subject's curriculum objectives for the inculcation of critical thinking to the students.

2. To investigate the understanding of basic science teachers on the subject's curriculum provisions (in contents, strategies and resources) for the inculcation of critical thinking to the students.

3. To investigate how prepared are the teachers for the inculcation of critical thinking through their lesson planning for teaching basic science education.

4. To investigate how the teachers inculcate element of critical thinking in their method of instruction in teaching basic science education

5. To investigate how the teachers inculcate elements of critical thinking in their assessment process in teaching basic science education.

1.5 Research Questions

1. What is the understanding of basic science teachers on the subject's curriculum objectives for the inculcation of critical thinking to the students?

2. What is the understanding of basic science teachers on the subject's curriculum provisions (in contents, strategies and resources) for the inculcation of critical thinking to the students?

3. How prepared are the teachers for the inculcation of critical thinking through their lesson planning for teaching basic science education?

4. How do the teachers inculcate elements of critical thinking in their method of instruction in teaching basic science education?

5. How do the teachers inculcate elements of critical thinking in their assessment process in teaching basic science education?

1.6 Scope and Limitation

The work is limited to the study of inculcation of critical thinking in the teaching of basic science education Nigeria. Thus, the researcher does not intend to develop any new curriculum or assess the existing one. It is only the aspects of curriculum implementation in classroom that would be discussed as it relates to the teaching of basic science education for critical thinking. It does not also intend to produce a guidebook or teaching/ learning more but rather suggests and recommends some existing pedagogical strategies that are more compatible with the explored and identified operating system and teaching conditions of basic science teachers in Nigeria, in line with the current and global best pedagogical practices from philosophical and psychological contexts accessible to the teachers base on their levels of training and education, that can be practicably implementable in their classes, which could also be generalizable in the Nigerian context. The scope of the thesis covers the basic education level (upper basic science education in particular – class 7-9), being it the foundational level of education and an approved terminal level of education for those who could not further their studies to the higher levels of senior secondary or tertiary educational levels.

Other related concepts of thinking generally do not fall within the scope of this study unless where the researcher feels it could be relevant with the concept of critical thinking under study. Concepts like scientific thinking, independent thinking, creative

and innovative thinking, etc could be discussed as it relates to critical thinking not as independently in this study. Other related aspects of teacher training, teacher education progammes, supervisory services as well as role of examination bodies in setting questions that appeals to critical thinking ability of learners (instead of current trend of asking questions which simply assess and evaluates the students' ability to recall information verbatim) does not fall within the scope of this study.

1.7 Significance of the Study

The work is aimed at promoting critical thinking for improving the teaching and learning of basic science education there by studying teachers understanding, approaches and classroom strategies and how students' critical thinking could be improved and developed through the teaching of basic science education curriculum provision in Nigeria. Hopefully, this would significantly help teachers to effectively teach their subject, improve the understanding, active classroom participation of their basic science students and improve their level of critical thinking and learning motivation to reduce the rate of examination malpractice and high level of school dropouts at this level, thereby solidly preparing its products for furthering their education and prepare them as future scientists in the country. Specifically, this study is significant to:

(1) Policy Makers: It helps the policy makers to responds to calls by Nigerian teachers (educationists, scholars, teachers, and other stake holders) to reconsider students' thinking: how they think, in setting the aims and objectives of basic education during the policy formulation process. There is need for clear policy statement on the inclusion of critical thinking in the basic education in Nigeria.

(2) Curriculum Planners: A good comprehension of the operational definitions of critical thinking and a better understanding of the desired outcomes are helpful to curriculum planners. Additionally, it has the potential to improve the basic science education curricula in Nigeria by assisting teachers in creating plans and resources that will help students at the basic education level in Nigeria learn more effectively and in accordance with international trends in science education.

(3) Teachers: it helps to reposition the teachers planning and teaching instruction, assessment and evaluation methods in our basic education schools by guiding the teachers in the practical strategies for the inculcation of the elements of critical thinking among their students in the teaching-learning process there by applying appropriate teaching approach in selecting relevant teaching materials and setting relevant assessment/evaluation questions that measure students ability in critical thinking,

(4) Students: Are the primary beneficiaries of this study. The study acknowledges that many scholars have accurately urged for the promotion of critical thinking abilities at the school level, but regrettably, there aren't many studies that have produced materials and methodologies that can be used to demonstrate the skills' improvement in Nigeria. It is therefore hoped that the study will enhances the critical capacity of students particularly the basic science students; increase their chances of autonomous learning and furthering their education without dropping out of school and prepare them well for future studies and career in the area of science and technology.

Generally, the two sections of this thesis's contribution to knowledge are its contributions to the field of critical pedagogy and teaching of basic science education in Nigeria and conceptualizations of critical thinking and by blending the

psychological and philosophical perspectives of the concept, critical thinking, through identifying some common grounds that could be promoted at once in the teaching and learning process.

1.8 Operational Definition of Terms

Key concepts that are used throughout the study are defined operationally in this section. Since the terms may have a variety of meanings, there is therefore need for their operational definition as the researcher used the definitions throughout the work to prevent ambiguity.

1.8.1 Meaning of Inclusion

Within the context of this study, inclusion means the inclusion of critical thinking elements (which includes judgement resulting in interpretation, inference, application, analysis, synthesis and evaluation) in the basic science education contents and/or methodology. The study attempts to investigate whether these elements were explicitly or implicitly stated in the contents and methods of teaching basic science subject and how the subject is designed for the critical thinking components to be realized by the classroom teachers from the planning stage of teachers' selection of learning contents, general preparation of lesson and objectives to be achieved to the final assessment and evaluation of the lesson.

1.8.2 Meaning of Inculcation

Inculcation within the context of this study means the instructional processes of promoting or developing students' critical thinking in the classroom instruction and learning process. It is a step further for implementing what the teachers prepare at the inclusion level above in the teaching of basic science. Thus, it simply means the classroom teachers' ways, approaches and methods of promoting the identified