EFFECT OF COGNITIVE MIND MAPPING ON THE ACHIEVEMENT OF ELECTRICAL TRADES STUDENTS IN TECHNICAL COLLEGES IN NIGER STATE

BY

AHMED NUHU
2016/1/60584TI

DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION
FEDERAL UNIVERSITY OF TECHNOOGY, MINNA

APRIL, 2023

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A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION FEDERAL UNIVERSITY OF TECHNOOGY, MINNA

IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF TECHNOLOGY DEGREE (B. TECH) IN INDUSTRIAL AND TECHNOLOGY EDUCATION

APRIL, 2023

DECLARATION

I AHMED NUHU Matric No: 2016/1/60584TI an undergraduate student of the Department of Indutrial and Technology Education certify that the work embodied in this project is original and has not been submitted in part or full for any other diploma or degree of this or any other university.

_____ _____

AHMED NUHU Signature & Date
2016/1/60584TI

DEDICATION

I humble dedicate this work to Almighty Allah (S.W.A) for his divine providence, love, and the blessing upon my life .then, evergreen memory of my beloved father late Alhaji Usman Adamu for bringing me to this word giving me the moral support, may May Almighty Allah grant him Al- jannahtul firdaus, and to my lovely mother Sayyeda Hauwa- Kulu Usman who has been there for me from scratch till end, caring and loving, may Almighty Allah reward her abundantly and entire families of Alhaji Usman Adamu

ACKNOWLEDGEMENT

Praise, glory and honor to Almighty Allah (S.W.A) the lord of the universe .With his infinite mercy guided, spared my life and also gave me wisdom, knowledge and understanding to this work.

My special appreciation goes to my able supervisor Dr. G.A USMAN for the guidance, patience, encouragement and all assistance I received from him.

I also acknowledge the Head of Department Dr. T.M Saba also Dr. E Raymond, Mr. I K. Kalat and other lecturers of in the department for their tremendous effort throughout my study.

I also appreciate Dr. M. Hassan the project coordinator for his tremendous assistance.

I also wish to acknowledge my Godly brother Alh. Adamu Baba for every support he gave to me throughout my study, may Almighty Allah reward you here and hereafter.

To my lovely brothers Hon. Judge. Ahmed B. Adamu, Suleiman Usman, Ndagi Buhari, Yajiya Mall.Yakubu and sisters too late Mallama Sa'adatu, Aunty Mama and entire family of Alh. Usman Adamu been a pillar of support, I pray that the Almighty shall reward you greatly.

ABSTRACT

This study was designed to determine the effect of mind mapping on students' achievement in abstract contents of Electrical trades in technical colleges. The study adopted the Taro Yamane formula for determination of sample size research design, precisely, pretest, posttest non-equivalent control group design which involved groups of students in their intact classes. A sample of 52 Electrical Trades Year II students drawn by multistage sampling technique, from a population of 150, in six technical colleges in Niger State was used for the study. Three research questions and three null hypotheses tested at 0.05 level of significance guided the study. Interviews and Observation Checklist is the instrument used for data collection. The study is of descriptive nature and it is carried out to determine the effectiveness of cognitive mind mapping in the achievement of electrical trade student in technical collages in Niger State Nigeria.Institution. Interview and Checklist for both control and experimental groups were all validated by three experts . Mean was used to answer the research questions, while Analysis of Relative Importance Index was computed to test the hypotheses. The study revealed that mind mapping instructional strategy was superior to the conventional method in enhancing student achievement in abstract contents. After pointing out some educational implications of the findings, it was thereafter recommended that mind mapping should be adopted in teaching abstract contents of Electrical Trades in technical colleges, among others.

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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Technical colleges are geared towards producing craftsmen in various disciplines. Their existence, (Olaitan, 1996), is to stimulate technological and industrial development by developing and utilizing technologies for industrial and economic advancement. Technical college is an integral part of the total educational system. It contributes towards the development of good citizenship by developing the physical, social, civic, cultural and economic competencies of the individual (Sanni, 2002). The goals of technical colleges, as stated by Federal Ministry of Education (2004) are, to provide trained manpower in the applied sciences, technology and business, particularly at craft, advanced craft and technician levels; provide the technical knowledge and vocational skills necessary for agricultural, commercial and economic development; and give training and impart the requisite skills to individuals who shall be self-reliant economically and in tune with latest technology. In technical colleges, students are trained to acquire relevant knowledge and skills in different occupations for employment in the world of work (NBTE, 2000). Electrical trades are among the skilled areas studied in technical colleges. The trade, as offered in the technical college, comprise Electrical Installation and Maintenance Work; Instrument Mechanics; Appliance Maintenance and Repairs; as well as Radio and Television Work (NBTE, 2011; UNESCO, 2011).

The trade provides learners with the practical skills and knowledge required for an electrical tradesperson employed in the manufacturing, mining, oil, and other industries. 14 The goal of the programme at the technical college level is to turn out graduates that will be enterprising and self-reliant, with skills in domestic and industrial installation, as well as having the ability to

operate, maintain and repair electrical equipment, among others. Studies, happenings, and opinion of experts show that electrical trade graduates do not have the full knowledge and experiences of what they claim to have studied, as most of them find it difficult to practicalise what they have learnt. Ogbuanya and Usoro (2009) noted that at graduation most of the students are deficient of employability skills, work place skills, and job generation competencies. Egwu (2009) also asserted that because good technicians are difficult to come by in Nigeria, expatriates working in the country bring in their manpower from abroad due to dearth of competent hands. The author further stated that the poor human resource situation is worse in the country, as it is difficult to get competent electricians, even at family level. Bakare (2012) even confirmed that most graduates often cause more damage to electrical gadgets contracted to them. Apart from the matter of impotent electrical trade graduates, another unpleasant issue is the incessant poor achievement of students that have completed their modules, in the annual national examination conducted by the National Business and Technical Examination Board (NABTEB).

Future electricians can begin apprenticeships without ever going to school. One benefit of this is that apprentices earn money while receiving their training. Apprentices make low salaries, but they can still count on a consistent income. Students at technical schools and college must pay tuition to learn the trade.

Individuals who choose apprenticeship programs receive immediate hands-on training and real-world experience. They learn what it takes to become an electrician. Apprentices may also receive a job offer from their supervisor at the end of their training. (Al-Jarf, R. 2009),

Students may still need to complete some type of apprenticeship or hands-on training. Electrician licenses have on-the-job training and professional experience requirements. Most college and technical school programs in electrical technology entail a partial apprenticeship. At other schools, students may

earn credit toward their apprenticeship. Both routes offer the right training and skills to become a licensed electrician.

A good Mind Map provides an arena in which to brainstorm creatively using a combination of words and images. In fact, Mind Maps are better than this, as they encourage “brain blooming” of electrical students through the combined powers of the imagination and association, creating the perfect conditions for a proliferation of ideas and the more ideas they generate, the better their overall quality is likely to be. Mind Mapping broadens the horizons of your thinking and will offer individuals the means to boost their mental accuracy, insight, creativity and freedom of thought as in the case of electrical trades. (Martin 2018)

Tony Buzan, who created the word "Mind Map" and has written extensively on it, describes it as a powerful graphic technique that makes use of the way the brains naturally work. (Mento, Martinelli & Jones 1999), He says it has four characteristics; The main subject is crystallized in a central image, The main themes radiate from the central image as branches, Branches comprise a key image or key word printed on an associated line and The branches form a connected nodal structure. It is an excellent tool for collaborating with others to develop plans or implement key projects and allows the harnessing the input of all members of a group in a dynamic and creative way. (Holland, Holland & Davies, 2004)

When used for group brainstorming sessions, Mind Mapping enhances critical thinking and co-operation as well as providing a solid basis for collaborative problem-solving. (Tony 2020).

A Mind Map can help students in thinking with greater clarity to explore relationships between ideas and elements of an argument and to generate solutions to problems. It puts a new perspective on things by allowing you to see all the relevant issues and analyse choices in light

of the big picture. It also becomes easier to integrate new knowledge and organise information logically as they are not tied to a rigid structure. (Toi, 2009),

1.2 Statement of the Problem

This study is motivated by the evidence revealed in literatures, together with researcher‘s experience that most electrical trade graduates are neither gainfully employed nor self-reliant, and also on incessant students poor performance in their final examinations. Electrical trade graduates do not have the full knowledge and experiences of what they claim to have studied, as most of them find it difficult to practice what they have learnt. Some find it difficult to repair a simple electrical circuits like extensions boxes, sockets or even troubleshoot minor electrical faults, let alone possessing the competencies that will drive the nation‘s quest for technological relevance. Continuous poor performance in final examinations, have also attested to the congruency of abstract contents mastery to improved learning outcomes.

The traditional teaching approach has been attributed to the problem encountered in the effective teaching and learning of abstract contents in electrical trade. In order to facilitate students‘ understanding of abstract concepts, in the quest to improve achievement, and also salvage the incessant production of ineffective electrical trade graduates, it is now imperative to investigate innovative strategies, such as mind mapping, that can replace the ineffective conventional mode of teaching the abstract contents in electrical trades.

1.3 Purpose of the Study

The general aim of this research is to investigate the effective use of cognitive mind mapping on the achievement of electrical trade students in technical college.

1. To determine impact of mind mapping on students' progress in electrical science fundamentals
2. To evaluate impact of mind mapping on students' electrical installation technology achievement
3. To examine impact of mind mapping on student achievement in wiring system installation and closure

1.4 Significance of the Study

The findings of this study is to benefit the policy makers, researchers, technical college students, ministry of education, industries and the society at large. The outcome of the study would be beneficial to the policy makers in planning and decision making in educational matters. If contents are observed to be better taught with this method, then it will be mandated in the policy for the implementers. The study will also be of great relevance to researchers in the world of academics in the sense that the findings generated from this study will contribute immensely to existing body of knowledge and also assist subsequent studies.

It is expected that this study will be one of the references for other researchers to get information about teaching through mind mapping. The students who are the recipients of the training will also benefit from this study. It is expected that this study would overcome the difficulties of students in internalizing abstract contents and consequently improve their performance. This will place value on them and their certificates; they will be confident and perform well at job interviews. They will be well equipped, up to date, ready to face modern technological challenges that will make them self-reliant and successful in life. The ministries at both federal and state levels are instrumental to policy formulation; the findings of this study might help the policy makers in making necessary reviews and further contribution in the policy formulation

process. Officials in the ministry of education (e.g. inspector of schools) can also organize conferences, workshops and seminars so as to communicate to teachers the alternative methods of teaching abstract concepts in electrical trades.

The researcher will also enlarge his knowledge and gather experience in the course of this study. Other stakeholders like the corporate organizations, and the nation in particular, will also benefit from this study, this is because well-equipped electrical trade graduates will contribute to organizations success and technological advancement of the nation. Theoretically, student cantered learning approach that fosters learners 'active construction of knowledge using mind maps supports constructivist theory. Constructivist theories are relevant to innovation and creative production, which are enhanced as learners actively involved in the teaching and learning process. The mind mapping process integrates actively the right and left brain cortical skills; this favours the theory of whole brain learning.

1.5 Scope of the Study

This study focuses on the effective use of cognitive mind mapping on the achievement of electrical trade students in technical colleges. It is the intent of the researcher to investigate the various forms of challenges that results in the poor performances of technical students in various electrical trade and improve on tackling those challenges. These challenges include poor mind set, lack of funds, unqualifiable skills acquisition, lack of equipment and other limitations that may lead to unproductivity in electrical trade.

1.8 Research questions

1. What are the impacts of mind mapping on students' progress in basic electrical science fundamentals?

2. What are the impacts of mind mapping on students' electrical installation technology achievement?
3. What are the impacts of mind mapping on student achievement in wiring system installation and closure?

1.7 Hypotheses

The following null hypotheses were formulated to guide the study and are to be tested at 0.05 level of significance:

Ho1: There is no significant difference between the mean achievement scores of electrical trade students taught the basic fundamentals of electrical science using mind mapping and those taught with conventional methods.

Ho2: There is no significant difference between the mean achievement scores of electrical trade students taught the electrical installation technology using mind mapping and those taught with conventional methods.

Ho3: There is no significant difference between the mean achievement scores of electrical trade students taught wiring system and closure using mind mapping and those taught with conventional methods.

CHAPTER TWO

LITERATURE REVIEW

2.1 Theoretical Framework

2.1.2 Semantic Theory

According to Semantic Theory, knowledge is stored in a network format where concepts are linked to each other (Katz & Fudor, 1963). The more interconnected the knowledge, the higher the probability that a person will recall information when required. From a constructivist's perspective, the learner attains new knowledge by integrating new information with existing knowledge structures. Therefore, the network mapping of concepts and their relationships externalizes how knowledge may be mentally integrated. These mental externalizations, or cognitive maps, are often termed concept maps, knowledge maps, and mind maps (Wheeldon & Faubert, 2009).

The mind mapping strategy refers to employing a graphic organizer where main categories radiate from a central idea. Subcategories are derived from the main categories. It is a visual strategy that is employed for generating ideas, taking notes, organizing thinking, and developing concepts (Al-Jarf, 2011, p. 4). It was developed by Tony Buzan during the 1970s (Abdulbaset, 2016). It serves as an graphic organizer, and a schema for presenting, organizing, generating, and classifying ideas, words, concepts and tasks)Abdulbaset, 2016). It contributes to improving

students' motivation to learn, and raise their achievement and expand their knowledge (Jones et al., 2012).

2.2.2 Kirton's adaption-innovation theory

Among the existing frameworks for cognitive diversity, Kirton's adaption-innovation (A–I) theory stands out in terms of its rigor and clarity in explaining cognitive diversity in ways that remain accessible to those outside the cognitive psychology field. Kirton's work has been recognized by experts in cognitive psychology as an important contribution, particularly with respect to his modeling of cognitive function and the assessment of cognitive style (Foxall & Yani-de Soriano, 2011; Zhang & Sternberg, 2009). The problem-solving context in which A–I theory was developed also makes its application in engineering education straightforward and appealing. Perhaps as a result of these combined qualities, the use of A–I theory in engineering education research has grown in recent years. Within A–I theory, an individual's cognitive style is related to the amount of structure he or she prefers when solving problems, making decisions, and processing information. These preferences vary across a wide spectrum that ranges from "highly adaptive" to "highly innovative" (using Kirton's terms), with mild and moderate degrees of preference in between. While A–I theory scholars often speak of "more adaptive" and "more innovative" individuals for convenience (as we will do here), it is important to remember that cognitive style is a continuous variable, not a dichotomy.

In general, individuals who are more adaptive prefer more structure (with more of it consensually agreed), whereas individuals who are more innovative prefer less structure (with

less concern about consensus). These differences lead to distinctive patterns of behavior based on each individual's cognitive preferences; however, an individual can and does act in ways that are not preferred, which Kirton called "coping behavior" (Kirton, 2011).

2.2.3 Bruner's Theory on Constructivism

Jerome Bruner's 1966 theory on constructivism encompasses the idea of learning as an active process wherein those learning are able to form new ideas based on what their current knowledge is as well as their past knowledge. A cognitive structure is defined as the mental processes which offer the learner the ability to organize experiences and derive meaning from them. These cognitive structures allow the learner to push past the given information in constructing their new concepts. The learner, often a child, will take pieces of their past knowledge and experiences and organize them to make sense of what they know, then base further concepts and solve additional problems based upon a combination of what they already processed and what they think should be processed next. The theory state that teacher resources used should be focused on that of encouragement, aiding and allowing the student to uncover the main principles on their own. The four major principles of Bruner's theory on constructivism encompass a predilection toward learning. The second, how a grouping of knowledge is able to be constructed to best be understood by the learner. The third is effective manners for the teacher to present said material to the learner, with the fourth and final aspect being the progression of reward as well as punishments.
This theory encouraged the learner to be inquisitive, explorative, initiative, and innovative and to engage in self-discovery in the process of learning. This theory is related to this work because the mind mapping instructional strategy focus on encouraging, aiding and allowing the student to

uncover the main principles on their own. Mind mapping is based on the principle of discovery learning which Bruner‘s theory advocate.

2.2 Conceptual Framework

Concept is an idea or principle that is connected with something. Anyakoha (2009) define a concept as an idea, thought or devolution of abstract system of thoughts, by which science investigates, interprets and understands particular segments of reality of phenomena. Anyakoha further stated that concept is a construct and constructs are theoretical creations. Eboh (2009) explained that concept is a logical construct derived from sense impressions, precepts (theory) and experiences (empirical). To conceptualize is to formulate concepts, that is, to communicate precisely the meaning of a term, one own‘s construct of that term. Conceptual framework is an organized way of thinking about how a project takes place and how its activities can be understood. In the view of Muller (2003), conceptual framework refers to as set of coherent ideas or concepts organized in a manner that makes it easy to communicate to others.

A conceptual framework for research purpose is a schematic description and illustration of the causative mechanisms and relationship deducible from the research problem; it is embedded in the definition of the research problem and the statement of hypotheses. Eboh stated that conceptual framework is used in research as outline of possible courses of action or to present a preferred approach to an idea or thought. Conceptual framework as cited by Michiko (2009) is needed in a research to help outline the possible course of action or to present a preferred approach to an idea or thought. Conceptual framework act like maps that give coherence to empirical inquiry, as used in the context of this study, it involves the explanation of the terminologies used for the purpose of the study.

2.1.1 Technical Colleges in Nigeria

Technical colleges are geared towards producing craftsmen in various disciplines. Their existence, as cited by Olaitan (1996), is to stimulate technological and industrial development by developing and utilizing technologies for industrial and economic advancement. Technical college is an integral part of the total educational system. It contributes towards the development of good citizenship by developing the physical, social, civic, cultural and economic competencies of the individual (Sanni, 2002). In technical colleges, students are trained to acquire relevant knowledge and skills in different occupations for employment in the world of work (NBTE, 2000).

According to Federal Ministry of Education (2004), a technical college is a segment of Technical and Vocational Education (TVE) designed to produce craftsmen at the secondary school level and master craftsmen in advanced craft. The goals of technical colleges, as stated by Federal Ministry of Education (2004) are, to provide trained manpower in the applied sciences, technology and business, particularly at craft, advanced craft and technician levels; provide the technical knowledge and vocational skills necessary for agricultural, commercial and economic development; and give training and impart the requisite skills to individuals who shall be self-reliant economically and in tune with latest technology.

Technical colleges are regarded as the principal vocational institutions in Nigeria. They give full vocational training intended to prepare students for entry into various occupations. Technical colleges train craftsmen in auto mechanics, plumbing, carpentry and joinery, cabinet making, painting and decorating, welding, electrical installation, radio and TV repair, building construction and a few other areas. On completion of the course of training, students obtain work in industries or established business on their own.

According to NBTE (2001) the list of available programmes in technical colleges is presented below.

1. Automobile trade: these trades comprise of auto electric works, motor vehicle mechanics, vehicle body building, agricultural implement mechanics
2. Building and woodwork trades: these trades cover block laying, bricklaying & concreting, carpentry and joinery, draftsmanship craft practice, furniture design and construction, machine wood working, painting and decorating.
3. Business trades: consist of business studies, parts merchandising, typewriting, stenography
4. Computer trades: contain computer maintenance & GSM repairs, computer studies
5. Electrical/electronic trades: encompass appliances maintenance & repairs, electric installation and maintenance works, instrument mechanics, radio, television & electronic work
6. Hospitality trades: contain catering craft practice
7. Mechanical trades: embrace fabrication and welding, foundry craft, marine engineering, mechanical engineering craft practice, plumbing and pipe fitting, refrigeration and air condition work
8. Printing trades: are ceramic, graphic arts, and printing craft
9. Textile trades: comprise garment making, leather trades, textile trades
10. General education courses: include biology, chemistry, entrepreneurship education, ICT, mathematics, physics, economics, technical drawing.

The programmes in the college were designed to train craftsmen and artisans for the profiting of the individual and the economy. The success of technical and vocational education programme in making substantial contribution to the economy of a nation like Nigeria depends largely on the success of the process of imparting the required knowledge, attitude and skills to the students.

2.1.2 Electrical Trades in Technical Colleges

Electrical trades are among the skilled areas studied in technical colleges. Electrical trade programme aim at producing craftsmen, technicians, and other skilled personnel who will be enterprising and self reliant with skills in domestic and industrial installation, as well as operate, maintain and repair Electrical equipment, among others. The trade, as offered in the technical college, comprise of Electrical Installation and Maintenance Work; Instrument Mechanics; Appliance Maintenance and Repairs; as well as Radio, Television and Electronic Work (NBTE, 2011; UNESCO, 2011).

The trade provides learners with the practical skills and knowledge required for an electrical/electronic tradesperson employed in the manufacturing, mining, oil, and other industries. The study encompasses contents that include electricity, electronics, electromagnetism, and communications, among others. Most of this content requires understanding of some abstract science content, which serves as the foundation upon which other contents are laid. The skills developed in this trade include fault finding, servicing, modification of machinery, and equipment maintenance.

The NTC and ANTC programmes are run by technical colleges accredited by NBTE. This is at craft and advanced craft level. For all craft programme, candidates must not be less than 14 years of age and should have successfully completed three years of junior secondary education of its

equivalent. Special consideration may be given to sponsored candidates with lower academic qualifications who hold trade test certificates and are capable of benefitting from the programme. Advanced craft programme candidate should possess the national technical certificate or its equivalent and should have had a minimum of two years post qualification cognate experience.

As spelt out by NBTE (2011), the curriculum of each Electrical trade programme is broadly divided into three components viz:

a. General education, which account for 30% of the total hours required for the programme,
b. Trade theory, trade practice and related studies which account for 65%, and

c. Supervised industrial training/work experience, which account for about 5% of the total hours required for each programme. This component of the course, which may be taken in industry or in college production unit, is compulsory for all full time students. All students who have successfully completed their modules will take a national examination conducted by NABTEB and awarded certificates.

2.1.3 Learning and the Mind Mapping Strategy

Various learning theories defined learning in different ways. For example, Gagne (1987) as cited in Fakorede (2010) defined learning as a change in human disposition or capability, which persists over a period of time and which is not simply ascribable to the process of growth. Okoye (1987) also defined learning as a relatively permanent change arising from human experience. The cognitive or information processing approach describes learning that occurs within the brain (Ashman and Conway, 2003). On a closer look at the cognitive approach, it lays emphasis on the way in which humans think and learn through the acquisition, organization, storage, retrieval, and evaluation of information, concepts, and reasoning skills.

2.1.4 Mind Maps

Mind mapping (or'idea'mapping) has been defined as 'visual, non-linear representations of ideas and their relationships (Biktimirov and Nilson 2006). Mind maps comprise a network of connected and related concepts. However, in mind mapping, any idea can be connected to any other. Free-form, spontaneous thinking is required when creating a mind map, and the aim of mind mapping is to find creative associations between ideas. Thus, mind maps are principally association maps. Usually contain general concepts at the top of the map, with more specific concepts arrayed hierarchically below. Connector lines usually contains keywords or phrases that summarize the relationship between the topics they connect. Topics may be cross-linked with each other to depict more complex relationships between topics. Topics in mind maps may only have one parent; in a concept map, a topic may have multiple connector lines, each one representing a different relationship.

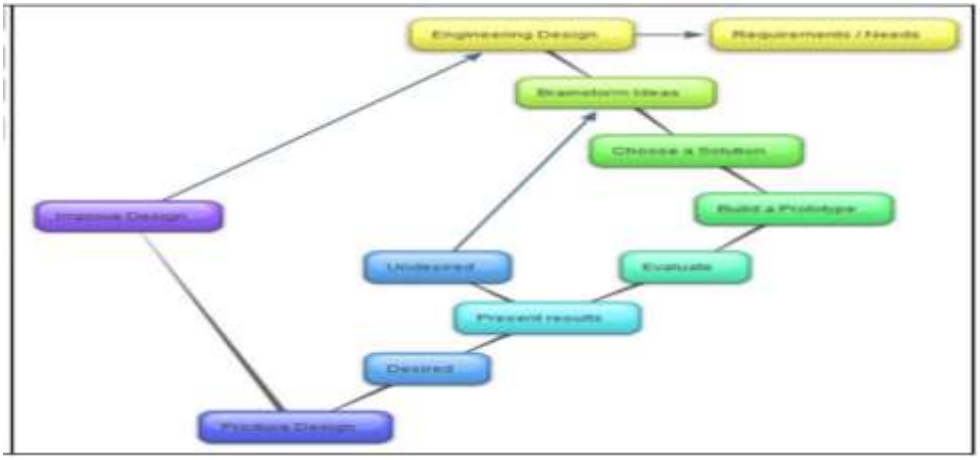


Figure 1: Showing a example of mind map (Dixon, 2014).

Mind maps were developed as a technique which was designed likewise the operation of the brain by using its right and left lobes together (Erdem, 2017) and which enables the ideas being

reflected on this research. Mind maps were developed by English psychologist, mathematician and brain researcher Tony Buzan at the late 1960s. Buzan and Buzan (2007) who make studies on note taking state that notes must have four main functions as being reminiscent, analysing, creative and interactive. Mind maps are a note taking technique which supports all of these functions.

Mind map which Buzan developed as a note taking technique is a technique which uncover the potential of the brain (Brinkmann, 2003; Erdem, 2017), which information is stored, arranged and organized in order of priorities by using keywords and key concepts (Buzan, 2009a). According to Michalko (2001), mind map is a technique which has the power of uncovering the thoughts which the brain has about a subject from different viewpoints and which the brain is operated as a whole as an alternative to linear thought. And Kokotovich (2008) expressed mind map as a note taking technique which people put their ideas and thoughts on paper excursively. Buzan (2005) as referenced by Erdem (2017) emphasizes four important features of mind map as:

- Attention to subject is provided by a picture at the center of the mind map.
- Main themes of the subject are formed thanks to the branches related with the picture at the center.
- Branches state a key picture or keyword on the connected lines.
- Branches have a structure which is related to each other.

2.1.5 Concept Maps

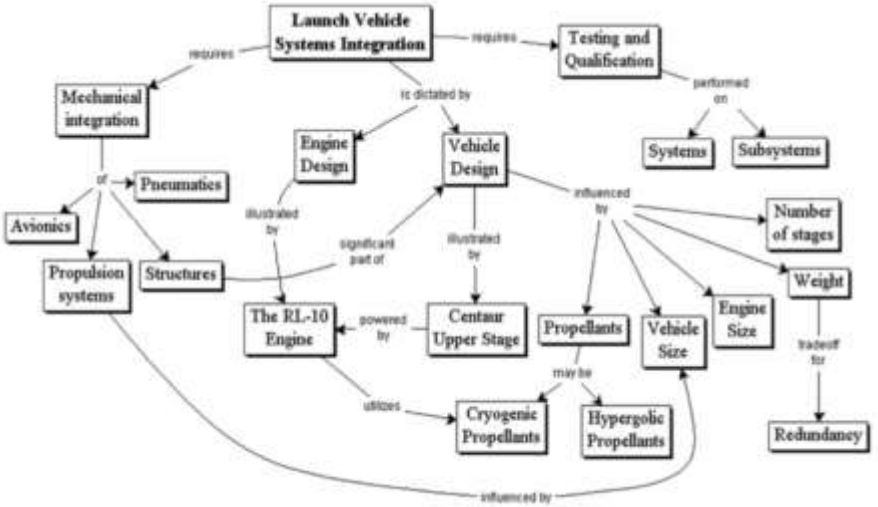
Concept mapping is a process of meaning construction. The concept maps (CMs) that result from this process are diagrams – usually bi-dimensional – that illustrate relationships between two or

more concepts. Concepts can be defined as regularities perceived in objects, events, situations, or properties (Novak & Gowin, 1984). Concept mapping is often confused with mind mapping (Ahlberg 1993, 2004; Slotte and Lonka 1999).

However, unlike mind mapping, concept mapping is more structured, and less pictorial in nature. The aim of concept mapping is not to generate spontaneous associative elements but to outline relationships between ideas. Thus, concept mapping is a relational device. A concept map has a hierarchical "tree" structure with super-ordinate and subordinate parts (primary, secondary and tertiary ideas). The map normally begins with a word or concept or phrase which represents a focus question that requires an answer (Novak and Can˜as 2006). Cross-links using connective terms (usually prepositional phrases) such as "leads to", "results from", "is part of", etc., are used to show relationships between concepts represented.

There are many ways to assess knowledge mastery in concept maps. For example, an instructor can systematically count relevant concepts used by the student, although this type of assessment does not address student understanding completely, because the concepts may not be linked appropriately. More thorough assessments compare a student's concept map (both concepts and links) to an expert map. In the literature, five concept map metrics are often used to assess a student's understanding, namely, the closeness index (Keppens & Hay, 2008); similarity (DeFranco & Neill, 2011; DeFranco et al., 2012); and the trio of metrics called correctness, comprehensiveness, and organization (Lakshmanan & Krishnan, 2011).

Figure 2: Concept map of vehicle system integration (emeraldinsight.com)



The closeness index compares each concept and its connections in the student map to the same concept and its connections in an expert map. These individual concept comparisons are averaged to calculate the overall closeness of the student map to the expert map. In contrast, the similarity metric uses the number of links in the student and expert maps, as well as the number of matching links between them, to compute the similarity between the maps. The three performance metrics of correctness, comprehensiveness, and organization are used to evaluate the quality of a map in a holistic way. Specifically, correctness reflects the accuracy of the connections between concepts, comprehensiveness reflects how completely the map topic is covered, and organization indicates how well the map is planned and arranged (Jablokow *et al.*, 2017).

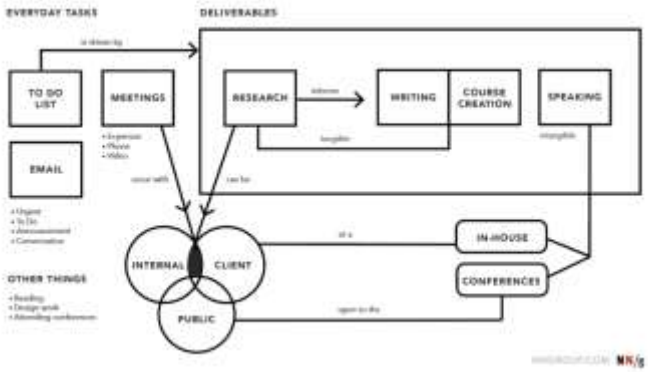
Jablokow et al. (2013) separated concept map metrics into two general categories in terms of their assessment approach: traditional metrics, which rely on counting specific elements or features of a concept map (e.g., number of concepts, links, hierarchies), and holistic metrics, which focus on the general quality of understanding represented in a concept map rather than the

number of elements or features. Traditional metrics also include computed map descriptors (e.g., map density or complexity, the closeness index) and organizational or semantic assessments based on map connectedness and other features (Jablokow *et al.,* 2017). To date, holistic metrics have typically focused on the dominant structural pattern represented in a map (e.g., hub/spoke, tree, network structure) or on integrated qualities such as comprehensiveness or correctness (Besterfield Sacre et al., 2004), which, as noted above, may be used to assess knowledge mastery.

2.1.3 Cognitive Maps

Cognitive maps are the umbrella term for all visual representations of mental models. A cognitive map is any visual representation of a person's (or a group's) mental model for a given process or concept. Cognitive maps have no visual rules that they need to obey: there is no restriction on how the concepts and the relationships between them are visually represented (Gibbson, 2019). The idea of cognitive map originates from the work of the psychologist Edward Tolman, who is famous for his studies of how rats learned to navigate mazes (Goldstein, 2011). In psychology, it has a strong spatial connotation cognitive maps usually refer to the representation of a space (e.g., a maze) in the brain. Cognitive maps have since been used in a range of fields; Colin Eden, an operations researcher, used the term in a broader sense to refer to a mental model representation of any type of process or concept (whether spatial or not) (NNG, 2019).

Fig 3: Concept of cognitive map



Cognitive mapping is free-form and can include numerous visualization methods, including bulleted lists, flowcharts, concept diagramming, or affinity mapping. Though the above example is digital (and thus high-fidelity), cognitive maps are often low-fidelity and created with paper, pen, and sticky notes.

Cognitive mapping techniques have gained traction in business and education as tools to stimulate creative thinking and problem solving. Cognitive mapping techniques such as concept mapping and mind mapping can aid the instructors and the student by providing a "glimpse" into learners' cognitive structure (Dixon, 2014).

2.3 Review of Empirical Studies

Studies on Effect of Teaching Method on Academic Achievement Methods by which science and technology education is taught to students have in recent times come under scrutiny. Studies have revealed that the teaching methods used in imparting knowledge on students have a great effect on their academic achievement. Several studies have been carried out mind mapping and other strategies that encourage students' active involvement, and that are capable of improving their thinking and problem solving skills.

2.4 Summary of Literature Review

With all Literature reviewed, it appeared to reveal that the need for cognitive mind mapping in all field is paramount but there exists very minimal research work on its impact on electrical trade students especially in Nigeria and as such, this research work would attempt to set a broader base and support to already existing research works on this very integral topic.

CHAPTER THREE

3.0 Research Methodology

3.1 Design of the Study

Due to the broad use and study of cognitive maps, it has become a colloquialism for just about any mental representation or model (Nielsen, 2020). They help us recognizing places, computing directions, distances and critical-thinking on shortcuts and supporting us in wayfinding in an environment and in this case achievement of electrical trade students in technical colleges. This study will therefore adopt a survey research design as surveys will collect data via questionnaire administration. One hundred and fifty questionnaires would be administered administered to students of two technical colleges in Minna Niger State so as to generate data for achievement of electrical trade students.

3.2 Area of the Study

The study was conducted in Niger State of the North-central geo-political zone of Nigeria. The zone habours numerous industries which need the services of well-trained Electrical trades craftsmen produced in technical colleges. The area is divided into three education zone which are Zone A, zone B, and zone C. In addition, the state has eight National Board for Technical Education (NBTE) accredited Technical colleges offering Electrical trades whose students were studied. The technical colleges are: Federal Science and Technical College, Shiroro, Government Technical College Bida, Government Technical College, New bussa, Government Technical College Suleja, Government Technical College Kontagora,

3.3 Population of Study

Population is a collection or objects from which the major focus for statistical measurement is taken from (explorable.com, 2009). The population for this study comprises of electrical trade students of two technical colleges in Niger state which currently has an estimated number of 600 students but a selected portion of 10% (60) was used to get the sample size for this study.

3.4 Sample Size and Sampling Procedure

The base was too huge to be questioned first because of researchers' financial backing and purpose of research. Therefore, 10% of this population was selected to be used for this study. This constituted 60 persons. The Taro Yamane formula for the determination of sample size was applied to generate the required sample size.

$$n = \frac{\mathrm{N}}{1 + N\,(e)^2}$$

Where: n = sample size required
N = total number of people in the population
e = allowable error (usually 0.05) at 95% confidence interval by applying the formula, we have.

$$n = \frac{60}{1 + 60\,(0.05)^2}$$

$$n = \frac{60}{1 + 0.15}$$

$$n = \frac{60}{1.15}$$

$$n = 52.2$$

Therefore, the required sample size (n) is approximately 52 respondent s.

3.5 Instrument for Data Collection

The instrument for data collection was the Interview and observation checklists . It consists of 21multiple-choice test items with three options. The itemsof the achievement test which includes each of the three topics considered in this study. In preparing the achievement test, the researcher prepared a table of specification to serve as a guide for the test development. The table of specification was subdivided into content dimension and ability process dimension as shown in Appendix . Content dimension contained the units that was taught in this study while the ability process dimension was subdivided into lower cognitive and higher thinking processes.

. The researcher also prepared two sets of lesson plans for teaching the units set out for the study. One set of the lesson plans was written based on the mind mapping strategy in teaching abstract contents to the experimental groups while the second set was written based on the conventional approach in teaching abstract contents to the control groups.

3.6 Validation of The Instrument

The instrument was validated by three lecturers in the Department of Industrial and Technology Education, Federal University of Technology, Minna. The comments and suggestions made by the validators on each of the instruments was incorporated into the final draft of the instrument.

3.7 Administration of Instrument

The instrument that was used for the data collection was administered to the respondents by the researcher in the study area.

3.8 Method of Data Collection

Data would be collected using Interviews and observation checklists.

Interviews: A semi structured interviewing approach was applied to getting responses from 52 students of these colleges. This interview structure provided the researcher with the ability to probe the respondent for additional details (Statistic solutions, 2022).

Observation: For observations, notes and an observation guide were developed in order to record observations during the 4day inspection period spanning 2 days per school.

Table 3.1: Table showing observation data collection method

Technical college	Checklist	Proposed number of checklists	Duration of observation
Gov't Technical Collage Eyagi Bida	Structured	52	2 days
Gov't Technical Collage Minna	Structured	52	2 days

Source: Fieldwork, 2022.

3.9 Method of Data Analysis

The study is of descriptive nature and it is carried out to determine the effectiveness of cognitive mind mapping in the achievement of electrical trade students in two technical colleges Niger state Nigeria. institutions. Observed data would be analyzed inferentially hence recorded observations would be reported and then interpreted either descriptively or pictorially. Statistical data would primarily be descriptive and qualitative using google analytics and Microsoft excel for analysis and data presented in tables and charts.

3.10 Decision rule for Relative Important Index Results

Decision rule on RII, results were ranked and analysed based on the cut-off points presented in

Table: Cut off point to RII

Cut off point	
RII	Impact
0.81 – 1.00	Very Effective
0.61 – 0.80	Effective
0.41 – 0.60	Less Effective
0.21 – 0.40	Least Effective
0.01 – 0.20	Not Effective

Source: Morenikeji, (2006); Agumba and Haupt, (2014); Shittu *et al*. (2016).

CHAPTER FOUR

4.0 RESULT AND DISCUSSION

This chapter presents the results and discussions of the data analyses for the study. The presentations were organized according to the research questions and null hypotheses that guided the study

Research question 1

What are the impacts of mind mapping on students' progress in basic electrical science fundamentals?

The Impact of Mind Mapping on Student Progress in Electrical Science Fundamentals

The Relative Importance Index (RII) was computed for each item in order to identify the impact of mind mapping and student progress in electrical science fundamentals. These items were ranked according to their Mean Item Score (MIS) and Relative Importance Index (RII). The result presented in Table 1 shows that the items had Mean Item Score (MIS) from 3.52 to 2.94 with an average mean of 3.33 and Relative Importance Index (RII) had values from 0.879 to 0.736. Provides a visual representation of the relationships between different concepts and helps students to better remember and comprehend them (MIS = 3.52; RII = 0.879) rank 1st, improves problem solving skills, as students are able to identify relationships and find creative solutions. (MIS = 3.46; RII = 0.865) rank 2nd, helps to break down complex topics into smaller, more manageable chunks. (MIS = 3.42; RII= 0.856) rank 3rd, promotes active learning, as students are encouraged to think critically and connect different concepts together. (MIS = 3.40; RII= 0.851) rank 4th, encourages students to think outside of the box and come up with novel solutions to complex problems (MIS = 3.37; RII= 0.841) rank 5th and help students to better manage their time, as they can easily see what tasks need to be completed and in what order (MIS = 3.23;

RII= 0.808) rank 6th. Therefore, these six (6) items were categorised as very effective using RII cut-off point. While Improve communication skills, as students are encouraged to discuss and explain their thoughts and ideas to others. (Mean = 2.94; RII= 0.736) rank 7th is the only item categorised as effective.

Table 4.1: Mean Impact of Mind Mapping on Student Progress in Basic Electrical Science Fundamentals

S/No	ITEMS	SCALE				MIS	RII	Ranking	Remark/ Decision
		Strongly Agree	Agree	Disagree	Strongly Disagree				
1	Helps to break down complex topics into smaller, more manageable chunks.	22	30	-	-	3.42	0.856	3	Very Effective
2	Promotes active learning, as students are encouraged to think critically and connect different concepts together.	21	31	-	-	3.40	0.851	4	Very Effective
3	Provides a visual representation of the relationships between different concepts and helps students to better remember and comprehend them.	27	25	-	-	3.52	0.879	1	Very Effective
4	Improves problem solving skills, as students are able to identify relationships and find creative solutions.	24	28	-	-	3.46	0.865	2	Very Effective
5	Encourages students to think outside of the box and come up with novel solutions to complex problems.	19	33	-	-	3.37	0.841	5	Very Effective
6	Help students to better manage their time, as they can easily see what tasks need to be completed and in what order.	20	24	8	-	3.23	0.808	6	Very Effective
7	Improve communication skills, as students are encouraged to discuss and explain their thoughts and ideas to others.	6	37	9	-	2.94	0.736	7	Effective
				Average		**3.33**			

Ho1: There is no significant difference between the mean achievement scores of electrical trade students taught the basic fundamentals of electrical science using mind mapping and those taught with conventional methods. At 0.05 level of significance.

The mean item score show in the above table 1 from 3.5 to 2.92 with average mean of 3.23 with relative importance index value of 0.87 to 0.736, the hypotheses rejected. With these result, there is a significant difference between the main effect of the treatment on the students achievement in basic fundamentals of electrical science.

Research Question 2

1. What are the impacts of mind mapping on students' electrical installation technology achievement?

The Impacts of Mind Mapping on Student's Electrical Installation Technology Achievement

The Relative Importance Index (RII) was computed for each item in order to identify the impact of the impacts of mind mapping of student's electrical installation technology achievement. These items were ranked according to their Mean Item Score (MIS) and Relative Importance Index (RII). The result presented in Table 2 shows that the items had Mean Item Score (MIS) from 3.44 to 2.98 with an average mean of 3.23 and Relative Importance Index (RII) had values from 0.861 to 0.754. Mind mapping helps students to identify and solve problems related to electrical installation technology (MIS = 3.44; RII = 0.861) rank 1st, Mind mapping helps students to visualize the concepts related to electrical installation technology (MIS = 3.40; RII = 0.851) rank 2nd, mind mapping helps students to comprehend the complex concepts of electrical installation technology quickly and easily (MIS = 3.39; RII= 0.846) rank 3rd, mind mapping helps students to have more confidence in their ability to understand and use the concepts related to electrical installation technology (MIS = 3.37; RII= 0.841) rank 4th mind mapping helps students to come up with creative

solutions for problems related to electrical installation technology (MIS = 3.35; RII= 0.837) rank 5th and mind mapping helps students to quickly recall the important information related to electrical installation technology (MIS = 3.31; RII= 0.827) rank 6th. These six (6) items were categorised as very effective using RII cut-off point. While just one (1) item is categorised as effective and this item is mind mapping helps students to come up with creative solutions for problems related to electrical installation technology (Mean = 2.98; RII= 0.745) rank 7th.

Table 4.2: Mean Impacts of mind mapping of student's electrical installation technology achievement

S/No	ITEMS	SCALE				MIS	RII	Ranking	Remark/ Decision
		Strongly Agree	Agree	Disagree	Strongly Disagree				
1	Mind mapping helps students to comprehend the complex concepts of electrical installation technology quickly and easily.	23	26	3	-	3.39	0.846	3	Very Effective
2	Mind mapping helps students to identify and solve problems related to electrical installation technology.	23	29	-	-	3.44	0.861	1	Very Effective
3	Mind mapping helps students to quickly recall the important information related to electrical installation technology.	21	26	5	-	3.31	0.827	6	Very Effective
4	Mind mapping helps students to store and retain the concepts related to electrical installation technology for a longer period of time.	21	28	3	-	3.35	0.837	5	Very Effective
5	Mind mapping helps students to come up with creative solutions for problems related to electrical installation technology.	9	33	10	-	2.98	0.745	7	Effective
6	Mind mapping helps students to visualize the concepts related to electrical installation technology.	21	31	-	-	3.40	0.851	2	Very Effective
7	Mind mapping helps students to have more confidence in their ability to understand and use the concepts related to electrical installation technology.	23	25	4	-	3.37	0.841	4	Very Effective
				Average		**3.32**			

Ho2: There is no significant difference between the mean achievement scores of electrical trade students taught the electrical installation technology using mind mapping and those taught with conventional methods. At 0.05 level of significance.

Mean items score shown in the above table 2 from 3.44 to 2.98, the average mean of 3.25 and relative importance index value of 0.861 to 0.754. The hypotheses is rejected with this result, there is a significance difference between main effect of treatment on students achievement in electrical installation technology.

Research Question 3

1. What are the impacts of mind mapping on student achievement in wiring system installation and closure?

The Impacts of Mind Mapping on Student's Achievement in Wiring Systems Installation and Closure

The Relative Importance Index (RII) was computed for each item in order to identify the impact of mind mapping on student's achievement in wiring systems installation and closure. These items were ranked according to their Mean Item Score (MIS) and Relative Importance Index (RII). The result presented in Table 3 shows that the items had Mean Item Score (MIS) from 3.59 to 3.27 with an average mean of 3.43 and Relative Importance Index (RII) had values from 0.899 to 0.817. Mind mapping can help better comprehend the various components of a wiring system and easily visualize their connections (MIS = 3.59; RII = 0.899) rank 1st, mind mapping can help students remember more information for longer periods of time and help them better recall wiring systems information for future projects (MIS = 3.52; RII = 0.879) rank 2nd, mind mapping can help better comprehend the various components of a wiring system and easily visualize their connections (MIS = 3.44; RII= 0.861) rank 3rd, mind mapping can help students better communicate their ideas to others (MIS = 3.42; RII= 0.856) rank 4th, mind mapping helps students stay organized and motivated and also help them stay focused on the task at hand and achieve their goals in a

timely manner (MIS = 3.40; RII= 0.851) rank 5th, mind mapping helps students think "outside the box" by allowing them to explore different ideas and connections (MIS = 3.37; RII= 0.841) rank 6th and Mind mapping encourages students to break complex problems into smaller, more manageable pieces helping them to identify the root cause of a particular issue and develop creative solutions to address it (Mean = 3.27; RII= 0.817) rank 7th. Therefore, all the seven (7) items were categorised as very effective using RII cut-off point.

Table 4.3: Mean impacts of mind mapping on student's achievement in wiring systems installation and closure

S/No	ITEMS	SCALE				MIS	RII	Ranking	Remark/Decision
		Strongly Agree	Agree	Disagree	Strongly Disagree				
1	Mind mapping can help better comprehend the various components of a wiring system and easily visualize their connections.	23	29	-	-	3.44	0.861	3	Very Effective
2	Mind mapping encourages students to break complex problems into smaller, more manageable pieces helping them to identify the root cause of a particular issue and develop creative solutions to address it.	19	28	5	-	3.27	0.817	7	Very Effective
3	Mind mapping helps students think "outside the box" by allowing them to explore different ideas and connections.	22	27	3	-	3.37	0.841	6	Very Effective
4	Mind mapping can help students better communicate their ideas to others.	22	30	-	-	3.42	0.856	4	Very Effective
5	Mind mapping helps students stay organized and motivated and also help them stay focused on the task at hand and achieve their goals in a timely manner.	21	31	-	-	3.40	0.851	5	Very Effective
6	Mind mapping can help students remember more information for longer periods of time and help them better recall wiring systems information for future projects.	27	25	-	-	3.52	0.879	2	Very Effective
7	Mind mapping can help better comprehend the various components of a wiring system and easily visualize their connections.	31	21	-	-	3.59	0.899	1	Very Effective
				Average		**3.43**			

Ho3: There is no significant difference between the mean achievement scores of electrical trade students taught wiring system and closure using mind mapping and those taught with conventional methods. At 0.05 level of significance.

The mean item shown in above table 3 from 3.59 to 3.27 an average mean of 3.43 and relative importance index value of 0.899 to 0.81, the hypotheses is rejected. With this result, there is a significance difference between the mean effect of the treatment on students achievement on electrical wiring system and closure.

Findings of the Study

1. The effect of mind mapping strategy on student achievement in wiring system and closure was higher than the effect of conventional method with an average mean of 3.43
2. The effect of mind mapping strategy on student achievement in basic fundamentals of electrical science was higher than the effect of conventional method with an average mean of 3.33.
3. The effect of mind mapping strategy on student achievement in electrical installation technology. was higher than the effect of conventional method with an average mean of 3.23.
4. Mind map instructional strategy has statistically significant effect on students‘ achievement in basic fundamentals of electrical science.
5. Mind map instructional strategy has statistically significant effect on students‘ achievement in wiring system and closure.
6. Mind map instructional strategy has statistically significant effect on students‘ achievement in electrical installation technology.

7. In all, mind map instructional strategy has statistically significant effect on students‘ achievement in all the selected abstract topics.

CHAPTER FIVE

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

5.1 Summary of the Study

This study is motivated by the evidence revealed in literature, together with researcher‘s experience that most Electrical trade graduates are neither gainfully employed nor self-reliant, and also on incessant students‘poor performance in NABTEB examinations. Most students and graduates find it difficult to practicalise what they have learnt. Some cannot fix a fan, or even troubleshoot minor electrical faults, let alone possessing the competencies that will drive the nation‘s quest for technological relevance.

Unsuccessful understanding of abstract contents in the trade has been indicted to be contributory to the non-performance of the students. The National Business and Technical Examination Board (NABTEB) recorded high failure rate among the graduates of technical colleges in the examination held in May/June 2012. This is a crown on the failure recorded in previous years, as exemplified in NABTEB‘s External examiner Reports.

Among others, the traditional teaching approach has been attributed to the problem encountered in the effective teaching and learning of abstract contents in Electrical trade. In order to facilitate students‘ understanding of abstract concepts, in the quest to improve student achievement, and also salvage the incessant production of ineffective Electrical trade graduates, it is now imperative to investigate innovative strategies like mind mapping, that can replace the ineffective conventional mode of teaching the abstract contents in Electrical trades.

5.2 Implications of the Study

The findings of this study have implications for Technical Teachers, Curriculum Planners-National Board for Technical Education (NBTE), Administrators of Technical Colleges and Ministry of Education (State and Federal). The study found that mind mapping instructional strategy is more effective in improving Electrical trade students‘ achievement in abstract content in technical colleges. The implication of this finding to curriculum planners is that they should develop appropriate curriculum that will make provision for adoption of mapping strategy for teaching abstract content in Electrical trades in technical colleges. Having found that mind mapping is more effective for improving student achievement; there is a need for technical teachers to adopt theuse of mind mapping in the teaching of abstract contents to Electrical trade student.

5.3 Contribution To Knowledge

The finding of this research will help the student to a long way and easier understanding on achievement of electrical trade technology towards using effect of cognitive mind mapping in technical collages in niger state .The research shows the need for diversify from conventional teaching method to mind mapping instructional method for best productive in state and country at large.

5.4 Conclusion

This study set out to determine effect of mind mapping strategy on achievement of Electrical trade students in Niger State technical colleges. It used the discovery that found that,- a good grasp of abstract contents in Electrical trade is germane to the understanding and application of other contents in the trade, as its base. The study found out that mind mapping is more effective

in improving students‘ achievement. These results therefore show that mapping strategy is a viable alternative to teaching of abstract contents in Electrical trades. Mind mapping give technical teachers opportunity to engage the students in activities that will unlock the potentials of their brain, helping them to brainstorm, organize thoughts and be able to recall information more easily in the future. It also gives students the opportunity to develop valuable thinking skills and acquire an understanding about the technology world.

5.5 Recommendations

Based on the finding of this study, the subsequent discussion, and their implications, the following recommendations are made:

1. The use of mind mapping strategy should be adopted by teachers and school administrators in order to promote meaningful learning in Electrical Trades.
2. Students should be carefully instructed in the use of the teaching strategy to enable them successfully integrate new concept into their existing cognitive structure. Electrical trade teachers should realize that when concepts are taught in isolation fromother concepts, the acquired knowledge is not likely to become functional.
3. Teacher training programmes should incorporate the teaching of pre-service teachers in the use of mind mapping. This will enable them to impact the use of the strategy in their students after graduation.
4. In service training, seminar, conferences and workshops should be organized by ministry of education and administrators of technical colleges for serving teachers in the technical colleges to improve their knowledge and skill on the use of mind mappingwhich have been found in this study to be very effective in promoting student achievement in abstract contents.

5. There is an urgent need for curriculum developers and planners to take a criticallook at the prevailing instructional strategies prevalent in the schools which have been found obsolete and then re-formulate new ones in line with the new strategy being in this study.

Authors of technical textbooks should write their texts to be learner centered and activity oriented as in mind map. This will help in facilitating understanding and meaningful learning in the trade.

5.6 Suggestions for Further Studies

From the findings of this study, the following further researches are suggested.

1. Replication of this study in other geo-political zones in Nigeria.
2. The effect of mind mapping strategy and interaction patterns on students' performance in other technical trade areas.
3. The effect of mind mapping on students' performance under different learning modes.
4. The effect of mind mapping on students' performance under different learning modes on other areas in technical education programme.
5. The use of mind map as evaluation tool to assess student understanding or misconception of content.
6. Influence of cognitive preference and preferred learning styles as effective use of mind maps to improve performance.

REFERENCES

Al-jarf, R. (2009, November). Enhancing freshman students' writing skills with a mind mapping software. Paper presented at the 5thInternational Scientific Conference, e- Learning and Software for Education. Bucharest.

Ashman, A. F. & Conway, R.N. (2003) Cognitive strategies for special education. Retrievedfromhttp://www.infibeam.com/Books/search?author=Adrian%20F %20Ashman.

ASO, (2019). Best electricians schools and programs. *Acredited schools online. https://www.accreditedschoolsonline.org/vocational-trade-school/electrician/*

Bakare, J.A. (2012). Skill improvement needs of electrical and electronic trade graduates in technical colleges. A paper presented at the biennial conference of the national Association of Teachers of technology (NAAT). Benue state university.

Cain, M. E. (2002). Using Mind Maps to raise standards in literacy, improve confidence and encourage positive attitudes towards learning. *Study conducted at Newchurch Community Primary School, Warrington.*

Fakorede, S.A. (2010). Effect of mapping strategies and learning modes on the psychomotor achievement of automobile technology students in Lagos state technical colleges (Unpublished doctoral thesis).Vocational Teacher Education Department, University of Nigeria, Nsukka.

Farrand, P., Hussain, F. & Hennessy E. (2002). The efficacy of the 'mind map' study technique'. Medical Education. *36 (5), pp 426-431.*

Holland, B., Holland, L. & Davies, J. (2004). An investigation into the concept of Mind Mapping and the use of Mind Mapping software to support and improve student academic performance. *Learning and Teaching Projects 2003/2004, pp 89-94.*

Martin D. (2018). Concept mapping, mind mapping and argument mapping: what are the differences and do they matter? *High Educ 10.1007/s10734-010-9387-6*

National Board for Technical Education (NBTE). (2000). National technical certificate and Advanced National Technical Certificate curriculum and module specifications for radio and TV works. Kaduna

National Board for Technical Education (NBTE). (2011). Directory of accredited programmes in polytechnics, similar tertiary institutions, technical colleges, and vocational enterprise institutions in Nigeria (16th edition). Kaduna

Okoye, N.N. (1987). Psychological facilitation of learning. Faculty lecture delivered at the faculty of education, University of Ibadan.

Olaitan, S.O. (1996). Vocational and technical education: Issues and Analysis. Onitsha: Noble graphic press.

Olaitan, S.O., & Nwoke, G.I. (1999). Practical Research Methods in Education. Onitsha: Summer Educational Publishers.

Sanni,J. (2002). An appraisal of problems encountered in teaching and learning of mathematics in secondary schools. ABACUS: Journal of the Mathematical Association of Nigeria

Toi, H (2009). Research on how Mind Map improves Memory. *Paper presented at the International Conference on Thinking, Kuala Lumpur, 22nd to 26th June 2009.*

Toi, H. (2009). Research on how mind map improves memory. Paper presented at the International Conference on Thinking, Kuala Lumpur, 22nd to 26thjune 2009.

Tony B. (2020). The complete guide to learning and using the most powerful thinking tools in the universe. *Foreword by Dominic O'Brien. 1(4)*

APPENDIX A

Suggested formulae for Determine the sample size

The base was too huge to be questioned first because of researchers' financial backing and purpose of research. Therefore, 10% of this population was selected to be used for this study. This constituted 60 persons. The Taro Yamane formula for the determination of sample size was applied to generate the required sample size.

$$n = \frac{\mathrm{N}}{1 + N\,(e)^2}$$

Where: n = sample size required
N = total number of people in the population
e = allowable error (usually 0.05) at 95% confidence interval by applying the formula, we have.

$$n = \frac{60}{1 + 60\,(0.05)^2}$$

$$n = \frac{60}{1 + 0.15}$$

$$n = \frac{60}{1.15}$$

$$n = 52.2$$

Therefore, the required sample size (n) is approximately 52 respondents.

APPENDIX B

FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGER STATE

SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION

DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION

QUESTIONNAIRE

EFFECT OF COGNITIVE MIND MAPPING ON THE ACHIEVEMENT OF ELECTRICAL TRADE STUDENT IN TECHNICAL COLLAGES IN NIGER STATE

INTRODUCTION: Please kindly complete this questionnaire by ticking the column that best present your perception about the topic. The questionnaire is for research purpose and your view will be confidentially and strictly treated in response to the purpose of the research work.

SECTION A

PERSONAL DATA

Teacher: ☐

Student: ☐

Note: A four (4) point scale is used to indicate your opinion, tick the options which best describe your agreement as shown below:

Strongly Agree	(SA)	=	4 points
Agree	(A)	=	3 points
Disagree	(D)	=	2 points
Strongly Disagree	(SD)	=	1 point.

Write 7 impact of cognitive mind mapping on student's progress in electrical science fundamentals

Section B: what are the impact of mind mapping and student progress in electrical science fundamentals?

S/N	Items	SA	A	D	SD
1	Helps to break down complex topics into smaller, more manageable chunks.				
2	Promotes active learning, as students are encouraged to think critically and connect different concepts together..				
3	Provides a visual representation of the relationships between different concepts and helps students to better remember and comprehend them.				
4	Improves problem solving skills, as students are able to identify relationships and find creative solutions.				
5	Encourages students to think outside of the box and come up with novel solutions to complex problems.				
6	Help students to better manage their time, as they can easily see what tasks need to be completed and in what order.				
7	Improve communication skills, as students are encouraged to discuss and explain their thoughts and ideas to others.				

Section C: what are the impacts of mind mapping of student's electrical installation technology achievement?

S/N	Skill Items				
		SA	A	D	SD
1	Mind mapping helps students to comprehend the complex concepts of electrical installation technology quickly and easily.				

2	Mind mapping helps students to identify and solve problems related to electrical installation technology.				
3	Mind mapping helps students to quickly recall the important information related to electrical installation technology.				
4	Mind mapping helps students to store and retain the concepts related to electrical installation technology for a longer period of time.				
5	Mind mapping helps students to come up with creative solutions for problems related to electrical installation technology.				
6	Mind mapping helps students to visualize the concepts related to electrical installation technology.				
7	Mind mapping helps students to have more confidence in their ability to understand and use the concepts related to electrical installation technology.				

Section D: what are the impacts of mind mapping on student's achievement in wiring systems installation and closure?

S/N	**Skill Items**	**Scale**			
		SA	**A**	**D**	**SD**
1	Can help better comprehend the various components of a wiring system and easily visualize their connections.				
2	Mind mapping encourages students to break complex problems into smaller, more manageable pieces helping them to identify the root cause of a particular issue and develop creative solutions to address it.				
3	Mind mapping helps students think "outside the box" by allowing them to explore different ideas and connections.				

4	Mind mapping can help students better communicate their ideas to others.				
5	Mind mapping helps students stay organized and motivated and also help them stay focused on the task at hand and achieve their goals in a timely manner.				
6	Mind mapping can help students remember more information for longer periods of time and help them better recall wiring systems information for future projects.				
7	Can help them better cope with the challenges of wiring system installation and closure.				