CONCEPTUAL MODEL FOR LEARNING AUTOMOBILE TRANSMISSION SYSTEMS IN NIGERIAN TERTIARY INSTITUTIONS OFFERING AUTOMOBILE ENGINEERING COURSE

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Specially dedicated to the families of Dagala Wazamda Medugu

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ABSTRACT

The experimental learning approach in Nigerian tertiary institutions offering Automobile Engineering (AE) faces criticism for various documented limitations and deficiencies in meeting with the desired expectations and in addressing the current challenges. The AE departments place less emphasis on Automobile Transmission Systems (ATS) due to apparent lack of conceptual model that can guide its implementation through Hausa medium of instruction. Hence, this research aims to develop a conceptual model for learning automobile transmission systems in Nigerian tertiary institutions offering AE course. Accordingly, the design of the research is applicable to determine ATS topics and their respective areas for the development of the model for successful learning of ATS in Nigeria. Quantitative research design, specifically non-equivalent controlled groups design, comprises the research basis. Three hundred and thirty one (331) participants, comprising 325 students and 6 AE experts underwent a selection process using a census sampling technique from three AE departments of three tertiary institutions in the Northeastern geopolitical zone of Nigeria. A researcher-made concept maps assessment test and structured questionnaire of four major topics of ATS that comprise the instruments used for data collection. The validation and reliability of the instruments proved satisfactory from the scrutiny of experts and pilot study assessments. Descriptive statistics, stepwise linear regression analysis and structural equation modelling proved suitable to analyze the research questions. The findings discovered a conceptual model for learning ATS in Nigerian tertiary institutions offering AE course that include gearbox, clutch propeller shaft and drive axle, which collectively comprise 19 areas of ATS. Therefore, the researcher recommends the implementation of the conceptual model in Nigerian tertiary institutions offering AE course for maximum understanding and successful application of the knowledge and skill learned in the subject.

ABSTRAK

Pendekatan pembelajaran eksperimen di institusi pengajian tinggi Nigeria yang menawarkan Kejuruteraan Automobil (AE) berhadapan dengan kritikan kerana pelbagai kekangan dan kelemahan dalam memenuhi jangkaan dan cabaran-cabaran semasa. Jabatan-jabatan AE kurang memberikan penekanan kepada sistem transmisi automobil kerana kurangnya model konseptual yang boleh dijadikan panduan untuk menggunapakai medium pengajaran berasaskan Hausa. Maka, kajian ini bertujuan untuk membangunkan model konseptual bagi pembelajaran sistem transmisi automobil (ATS) di institusi-institusi pengajian tertiari Nigeria yang menawarkan kursus Kejuruteraan Automobil . Oleh itu, reka bentuk kajian yang digunakan adalah bertepatan dengan topik-topik ATS dan bidang-bidang yang berkaitan dengannya bagi tujuan membangunkan model pembelajaran ATS di Nigeria. Reka bentuk kajian kuantitatif ini berasaskan kelompok terkawal kwasi tak setara. Tiga ratus tiga puluh satu (331) orang responden yang merangkumi tiga radus dua puluh lima (325) orang pelajar dan enam (6) orang pakar daripada tiga jabatan AE di tiga (3) institusi pengajian tinggi dalam zon geopolitik Timur Laut Nigeria dipilih secara kelas utuh (intact class). Peta konsep dan soal selidik bagi empat topik utama ATS merupakan instrumen yang digunakan dalam pengumpulan data. Kesahan dan kebolehpercayaan instrumen yang diperolehi melalui penilaian pakar dan kajian rintis adalah memuaskan. Statistik deskriptif, analisis regresi berperingkat (*Stepwise*) dan model persamaan struktur, terbukti berkesan untuk menilai persoalan kajian. Dapatan kajian menghasilkan model konseptual pembelajaran ATS di institusi-institusi pengajian tinggi Nigeria yang menawarkan kursus AE terdiri daripada kotak gear, cekam, aci perejang dan gandar pacu, yang secara keseluruhan mengandungi 19 bidang ATS. Justeru itu, penyelidik mencadangkan supaya model konseptual pembelajaran ini digunakan di institusi pengajian tinggi Nigeria yang menawarkan kursus AE supaya kefahaman dan pengaplikasian pengetahuan dan kemahiran mata pelajaran ini dapat dimaksimumkan.

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LE	-	Learning Environment
AE	-	Automobile Engineering
FRN	-	Federal Republic of Nigeria
NPE	-	National Policy on Education
ATS	-	Automobile Transmission System
FGN	-	Federal Government of Nigeria
UNESCO	-	United Nation Educational Scientific and Cultural Organization
ATI	-	Automobile Technical College
FCMA	-	Federal College of Mechanization Authority
DCI	-	Dagavent Construction Institution
TVE	-	Technical and Vocational Education
NLDA	-	National Language Development Agency
NL	-	National Language
IT	-	Industrial Training
NUC	-	National Universities Commission
CV	-	Constant Velocity
CGPA	-	Cumulative Grade point Average
RMSEA	-	Root Mean Square Error of Approximation
CMAT	-	Concept Maps Assessment Test
CFI	-	Comparative Fit Index
RMR	-	Root Means square Residual
CFI	-	Comparative Fit Index
IFI	-	Incremental Fit Index
TLI	-	Tucker-Lewis Index

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CHAPTER 1

INTRODUCTION

1.1 Problem background

Experimental learning practices have proven to be very important in Automobile Engineering (AE) from its emergence to date. Learning by doing is facilitated through a successful experimental learning practice, guided by a medium of instruction which is full of learner-centred activities that have direct association with the student's intellectual development which is the major focus of AE. Currently, students' intellectual development through medium of instruction constitutes the basic mechanism in the recent shift to knowledge acquisition. This may suggest why employers of labour are in dare needs of graduates from tertiary institutions who are well equipped to function effectively in contributing to the development of the society.

Therefore, medium of instruction in this context refers to the language of communication used for teaching and learning (Mirza *et al.*, 2013). As it relates to this study, it is the first language that is generally used for communication by all citizens in the areas of the study. Its use for learning especially, in AE in the North-Eastern zone of Nigerian is one of the most essential areas of concern among the Nigerian stakeholders of education. This is right from the level of the policy makers or administrators to the level of parents that are undergoing training in different academic fields of specialization. This has been described by Aguilar and Munoz (2014) in Spain; Costa and Coleman (2013) in Italy and Fafunwa (1990) in Nigeria. For this reason, Automobile Transmission Systems (ATS) topics - gearbox, clutch, propeller shaft and axle drive in AE needs to be studied in order to achieve the objectives of this research.

In view of the AE programme requirement for its graduates to compete favourably in the present labour market, and the role medium of instruction is playing in all aspects of educational system, its assessment remains of paramount importance. Therefore, this research is set out to assess the students' academic performance, identify the most important areas of ATS of AE in which the medium could be incorporated. After the assessment, the important areas identified under each topic are used in developing a conceptual model that could to serve as a guide for successful learning in Nigerian tertiary institutions offering AE course. Linguistically, in Nigeria there are three major indigenous languages for communication namely Hausa, Igbo and Yoruba. In the North-Eastern zone the area for this research, Hausa is the medium used for communication and is universally accepted by all. Learning environment refers to the locations, or settings and the climatic conditions of the settings where learners receive the required knowledge (Johnson, 2002; Turel and Johnson, 2012). It comprises of classrooms, laboratories workshops, library and lecture theatres.

Generally, it is understood that learners with the accepting attitudes in a favourable environment would at all time struggle for merit in their learning career (Bogler *et al.*, 2013). According to them, in acquisition of knowledge that involves a teacher and the learners, communication has a primary role in the acquisition process. The students employ the wisdom of developing conversation, reading, writing, studying and assessment, and then captivate the instruction. In addition, students need favourable learning environment, communicate very well with the instructor through the procedure that information is shared. This therefore, demands an exchange of acceptable languages. Nowadays, there are approximately over 5,000 languages in use, and that every country has its own medium as the means for communication that allows people conveying ideas, feelings, facts and their communication requirements (Mirza *et al*., 2013)

Today, the world has been transformed into economy nations. This is why employers of labour need graduates from institutions that are well equipped to function effectively for the development of the work force. This considerable shift has posed serious challenges to educational institutions. Well-informed based economy workforce implies and requires sound preparation of higher education students to work. In addition that the tertiary institutions must reinforce personal and social responsibility inside and outside of institutions, and simultaneously seek opportunity for students to participate in educational activities that is relevant in the changing world (Lungu *et al.*, 2012). It can therefore be agreed that it is the capacity and ability of the higher institutions to generate and transform new ideas, methods and products that can change these into monetary value or wealth.

Evidence with this development, AE at the forefront of economic, social and technological development must strive to provide viable opportunities to change the structural systems of teaching and learning. This will prepare the students to enter into a competitive global workforce. It is because students' academic and skill achievements have always been argued upon among educators and researchers in order to meet the learning conditions of this preparation (Nasri and El-Shaarawi, 2006).

However, for students to learn there are several external factors that should be considered and appraised continuously. These include: medium of instruction, learning environment, student-teacher relationship, socioeconomic factors, student aptitude, attitudes and administration must be considered (Weiner, 2005). According to the scholar, the internal factors like student's ability and effort are the most important factors that play great role in determining the students' academic achievement. In line with this observation, the scholar emphasized that, medium of instruction and learning environment which are flexible and dynamic in approach as experimental instructions and for encouraging learning can be redesigned and integrated into the teaching and learning of engineering disciplines. Therefore, in order to respond appropriately to the present challenges, the instruction structures where teaching and learning of the engineers takes place need to be considered and overhauled. Unfortunately, the demand for engineers have continued to increase following the collapse of the education systems in Nigeria, where flood disasters destroyed many buildings, the collapse of rail transport systems in the country, increase in technological advancement, and a very high cost of air transport plagued by high rates of casualties (Akintola *et al.*, 2002).

In education systems, training of all engineers for the engineering services of all types is the responsibilities of the tertiary institutions (UNESCO, 2013). However, the products of the present and past programmes especially engineering graduates lack the basic skills and efficiencies needed by the employers for effective productions in nowadays engineering industries (Backa and Wihersaari, 2014). According to them, the gaps created between the principles or methods of teaching and learning used, and the new technological innovations have made the needed skills for effective services for new technological industries, and to continue to avoid the products of the past.

Globally, the primary mission of tertiary institutions is to provide sequence functions of teaching and learning, research and development for public services (Trowler and Cooper, 2002). According to these researchers, the significance of graduate engineers is underscored by many. The manpower structure of every nation demands a large number of skilled labours like engineers, technicians, technologists and others who work together to provide the required services for the national development. It is the skilled personnel that provide working skills and the experiences for the development of a nation through the use of infrastructure, and also the needed services to achieve economic and technological development, and even the stability for the development.

Automobile engineering programme being at the forefront of professional development is supposed to respond positively towards the accomplishment of such a mission. For the programme to contribute towards this development, it requires proper training that can involve the graduate engineers in highly relevant experiences. This can make the program to contribute meaningfully and effectively to the development of the society. Supporting this assertion, UNESCO (2014) highlights that educational programmes must strive to meet the needs of the society through students' participatory activities that can enhance the achievement of the students for national development.

1.2 Problem statement

From time immemorial, tertiary institutions in Nigeria have acknowledged and developed policy documents that give a clear understanding of essential services. This include automobile engineering as a potential means for transforming tertiary institutions to provide the societal needs, and enable students acquire the necessary skills to cope with the demand and challenges of our contemporary world. However, no available researches within the reach of the researcher have discovered any existing model for learning automobile transmission systems in the literature with sufficient information about automobile transmission systems specifically, toward enhancing students' learning through Hausa medium of instruction in Nigerian tertiary institutions.

This therefore, has prompted the researcher to raise question that reveals the existing literature gap pertaining to this study as: what is the appropriate conceptual model for learning automobile transmission systems in Nigerian tertiary institutions offering automobile engineering course?

Despite research evidences that support and highlight on the importance of engineering services toward facilitating tertiary institutions to guarantee employment opportunities and students' commitment, yet there is a strong resistance to automobile engineering learning as a core function in the academic arena (Taks*et al.*, 2014). Researchers around the world in engineering education fields, for instance (Vogt, 2008); (Streveler *et al.*, 2008); (Borrego *et al.*, 2008) and (Huntzinger *et al.*, 2007) have a common view that, if the main purpose of tertiary institutions is to generate and spread intellectual knowledge through teaching and learning, students' commitment, research and development, then automobile engineering specifically has the potential to provide the necessary support for actualizing this great goal. In the aspect of students' commitment to learn, researchers (Kolmos and De Graaff, 2014); (Gomez Puente, 2015) and (Newstetter and Svinicki, 2014) described the rationale for tertiary institutions as a training environment to engage students in acquiring relevant knowledge, skills, and attitude that can empower them to sustain good living and contributes meaningfully to the development of society.

Unfortunately, researches as cited above have revealed that, one of the critical issues that contribute to the production of poor quality graduates is improper students' commitment in relevant academic activities that can facilitate students' effort to learn what is really required in the 21st century. According to Johri and Olds (2011), engineering prepares the mind of individuals to work through the acquisition of relevant knowledge and skills by giving paramount importance to successful experimental learning approach.

In recent years however, the current experimental learning approach in education system have been widely criticized for not yielding the desired result in teaching students the skills to meet the needs of the workplaces (Dhliwayo, 2008), yet this has been the regular practice in Nigeria. However, according to Gill (2004); Smit and Dafouz (20112); Puteh and Uum (2012), to enhance learning in any educational programme, medium of instruction is of paramount importance.

Although, the Nigerian language policy implementation in Southern part started as far back as 1977 after the Federal executive council approved the establishment of national language development agency (Akinnaso, 1991); Emenanjo, 1991). However, the policy only emphasized offering national language as a course of study meant for the training of industrial training of engineers and scientists partially adopted in the Southern part of the country. It does not emphasize the incorporation of the language as a tool for teaching and learning and other administrative activities in tertiary institutions in the country at large, but English language (Fafunwa, 1990). This justifies the reason why medium of instruction still remain the challenging factor in Nigerian tertiary institutions offering AE especially, in the North-Eastern part of the country for the 21st century as advocated by Bruton (2011a).

1.3 Objectives

The main objective of this research is to develop a conceptual model for learning automobile transmission systems in Nigerian tertiary institutions offering AE. The study therefore sought and specifically determine the effect of medium of instruction and learning environment on ATS students' academic performance, and developed a conceptual model of the established areas of the four ATS topics identified as important for consideration through the assessment of the medium and through the environment in North-Eastern Nigeria. The ATS topics are gearbox, clutch, propeller shaft and axle drive. In order to facilitate the conduct of this study, the following specific objectives are developed.

i. Determine the effect of Hausa medium of instruction on ATS students' academic performance in Nigerian tertiary institutions offering AE course.
ii. Determine the effect of learning environment using Hausa as medium of instruction on ATS students' academic performance in Nigerian tertiary institutions offering AE course.
iii. Determine the effect of English medium of instruction on ATS students' academic performance in Nigerian tertiary institutions offering AE course.
iv. Determine the areas of ATS topics considered important in Nigerian tertiary institutions offering AE course?
v. Determine the relationships between areas considered important in Nigerian tertiary institutions offering AE course.
vi. Develop a conceptual model of ATS areas considered important in Nigerian tertiary institutions offering AE course

1.4 Research questions

Based on the specific objectives in section 1.3, the following research questions are formulated to guide the conduct of the research:

i. Research Question 1:What is the effect of using Hausa as medium of instruction on students' academic performance in learning ATS topics in Nigerian tertiary institutions offering AE course?

ii. Research Question 2: What is the effect of learning environment using Hausa as medium of instruction on students' academic performance in learning ATS topics in Nigerian tertiary institutions offering AE course?

iii. Research Question 3: What is the effect of using English as medium of instruction on students' academic performance in learning ATS topics in Nigerian tertiary institutions offering AE course?

iv. Research Question 4: What areas are considered important of ATS topics on students' academic performance in Nigerian tertiary institutions offering AE course?

v. Research Question 5: What is the relationship between areas of each topic considered important on students' academic performance on ATS topics in Nigerian tertiary institutions offering AE course?

vi. Research Question 6: What is the appropriate conceptual model based on the areas considered important on the four topics for learning ATS in Nigerian tertiary institutions offering AE course?

1.5 Hypothesis

The following hypotheses are formulated based on the research questions in section 1.4 above and are tested at 0.05 confidence level. The significant results of research questions 1, 2 and 3 are guided by hypotheses 1, 2 and 3 respectively, while significant result of research question 5 is guided by hypothesis 4.

i. Hypothesis 1: There is no significant difference on the students' academic performance between controlled and treatment groups after introducing Hausa as medium of instruction in Nigerian tertiary institutions offering AE course.

ii. Hypothesis 2: There is no significant difference on the students' academic performance between controlled and treatment groups of learning environment after introducing Hausa as medium of instruction in Nigerian tertiary institutions offering AE course.

iii. Hypothesis 3: There is no significant difference on the students' academic performance between controlled and treatment groups after introducing English as medium of instruction in Nigerian tertiary institutions offering AE course.

iv. Hypothesis 4: There are no significant relationships between ATS areas considered important for learning ATS topics in Nigerian tertiary institutions offering AE course

1.6 Significances of the Study

The goal of automobile engineering in Nigerian tertiary institutions may not be achieved without a solid model and feasible strategies that may serve as a guide for the students, teachers, administrators, and stakeholders in Nigeria. In view of this, the outcome of the study can serve them in the following ways.

Students that are central to this study might find their studies timely. With the outcome of the study, important teaching and learning can be achieved. As a result, the students would be prepared to face the challenges in the changing world of work. Since the study has determine the students' academic performance in Hausa medium for instruction in conducive learning environment based on the ATS topics, and suggest principles and strategies in teaching and learning processes, engineering graduates could be prepared to perform better on their primary assignments if employed after successful completion of their training.

Furthermore, the findings of this research have also provided information to the automobile engineering teachers in tertiary institutions to be using Hausa medium for conducting their lessons. It could bring out the significant effect of the medium for instruction in favourable learning environment during teaching and learning process. It would in turn help the teachers to contribute in making students flexible in teaching and learning of automobile engineering course to face labour market challenges.

In addition, the findings of the study provide significant information of using Hausa as medium of instruction in Nigerian tertiary institutions. Using the medium can also provide relationships between the administrators of higher institutions for training their engineering graduates to be competent for employment. It has pointed out some topics and areas of automobile transmission systems in the curriculum to be given priority in the process of teaching and learning in their schools.

The stakeholders such as the directors of education, executive secretaries that serve as heads of engineering departments and agencies under the Federal ministries of education and the national universities commission could find the results and suggestions of this study very useful. This could be in organizing and implementing good instructions for the institutions to educate and produce competent and employable engineering graduates, especially automobile engineers

1.7 Conceptual Content Framework of the Study

The main concern of the researcher is to develop a conceptual model for learning automobile transmission systems to improve on the students' academic performance in Nigerian tertiary institutions offering automobile engineering.

The conceptual content framework of the research is developed based on the ATS topics in which Hausa medium of instruction was applied. As indicated in the literature review, the topics of ATS that requires the use of medium of instruction include but not limited to gearbox, clutch, propeller shaft and drive axle, which was taught using Hausa medium of instruction.

Nowadays, students use their medium of communication for instruction to explore scientific phenomena as a data gathering technique (Smith and Dafouz, 2012; Puteh and Uum, 2012). Likewise for theories of sciences in conducive learning workshops or laboratories, medium of instruction supports the connections between the materials and the learning objectives through simulation process (De Jong *et al.*, 2013). Same was done through Hausa medium of instruction during data collection for this study.

In addition, students' medium of communication for instruction can be used for improving academic performance in tertiary institutions (Mora *et al.*, 2001). Communication medium as a tool for collaboration and delivery is evidence on students' academic performance conducted in Pakistan (Mirza *et al.*, 2013). Therefore, the conceptual content framework of this research justifies the relationships between the ATS concepts that require the application of the medium and the conceptual model developed in this research. Figure 1.1 below shows that through successful medium of instruction implementation policy in conducive learning environment, students' academic performance and skill development would be enhanced in automobile engineering in Nigerian tertiary institutions. The model is therefore subject for Continuous Quality Improvement (CQI) based on the data driven approach for students' academic performance and skill development.

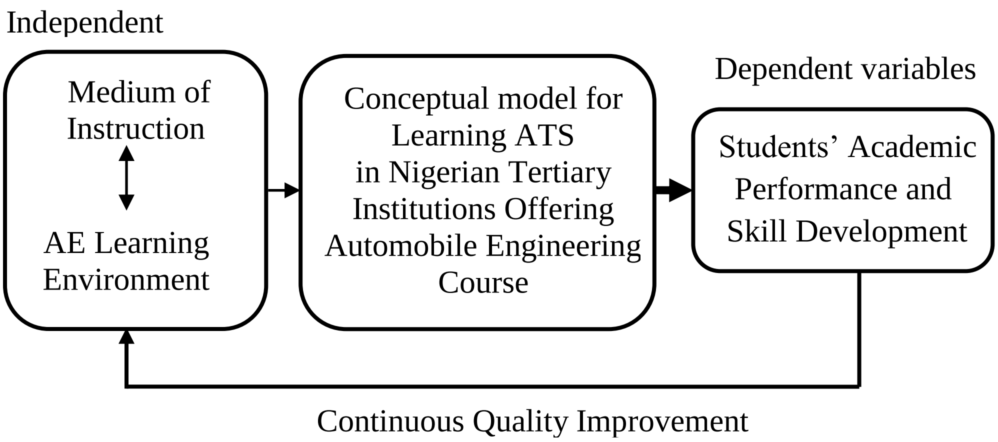

Figure 1.1 : Conceptual content framework of the study

1.8 Scope and Limitation of the Study

This research developed a conceptual model for learning automobile transmission systems in Nigerian tertiary institutions offering automobile engineering course. The model is developed based on the established ATS areas that are translated into Hausa medium of instruction that are considered important for learning ATS in the North-Eastern Nigeria. The research is carried out in tertiary institutions that awards Bachelor of Engineering (B. Eng.) and Bachelor of Technology in Engineering (B. Tech. Eng) degrees in North-Eastern geopolitical zone of Nigeria.

Although, the research intends to cover all tertiary institutions offering automobile engineering in Nigeria, but due to some social constraints such as the insecurity issues in the country, it is carried out in Federal institutions in the North-Eastern geo-political zone based on their characteristics in terms of curriculum, admission, teachers' conditions of service and graduation requirements are the same. The findings have some limitations due to the size of the sample used. However, the conceptual model might serve as a guiding document for students of AE during intervention through medium of instruction in other tertiary institutions that have similar characteristics with the institutions selected for this research, as well as to the lecturers and to the administrators of tertiary institution in Nigeria. Virtually, the propose model is validated by collecting data from students that are currently undergoing training in Nigerian tertiary institutions offering AE course

1.9 Outcome of the Study

The outcome of this research is essential, and the information regarding the field dependent variable, students' academic achievement and skills development base on the ATS topics is confirmed. A conceptual model for learning automobile transmission systems in Nigerian tertiary institutions is successfully developed base on the ATS areas that are considered important. In addition, through the conceptual model, the AE graduate engineers can be trained for skilful employment opportunities.

1.10 Conceptual Definitions of Terms

Terms used in this study are defined precisely in order to avoid confusing readers. It includes the following:

1.10.1 Medium of Instruction

Medium of instruction in this study refers to the language of communication for instruction for the experimental groups during teaching and learning. It is the general language of communication in the areas of the study that the students are use to, communicates with fluently and understands better.

1.10.2 Learning Environments (LE)

Learning environments are the improvised locations or places such as classrooms and workshops equipped with the required learning equipments or tools (Hannafin*et al*., 1999). It is where students receive the required knowledge and skills through Hausa medium of instruction.

1.10.3 Automobile Transmission System (ATS)

ATS is a pre-requisite course in which Hausa medium of instruction is use to teach. A student must have a good background in it before gaining an admission to read automobile engineering in Nigeria tertiary institutions. It is a course that comprises of the ATS topics such as gearbox, clutch, propeller shaft, and axles drive through which students are taught on how power is transmitted from an engine to the road wheels through which students' academic performance and skill development is assessed.

1.10.4 Gearbox

Gearbox is a sub-transmission system through which medium of instruction is use to teach. It is the power source responsible for transmission and reduction of the power. It consists of many gears arranged in a case and is use for instruction

1.10.5 Clutch

This is a device or mechanism of a vehicle for engaging and disengaging gears. It is one of the transmission systems use for teaching and learning for the students through Hausa medium of instruction.

1.10.6 Propeller Shaft

Propeller shaft is one of the motor vehicle transmission systems. It connects the gearbox and the rear axle. It is use for transmitting power from the engine to the axle drive for propulsion through the power torque. On the device, teaching and learning through Hausa language is done for assessing the students' academic performance on conceptual understanding.

1.10.7 Drive axle

Drive axle is also one of the transmission systems that connect the road wheels of a vehicle by the constant velocity (CV) joint. It enables the rotation of the road wheels freely on which Hausa language was used to teach and the students' conceptual understandings is assessed.

1.10.8 Independent Variables

These are non measured concepts of ATS to which Hausa medium of instruction is used to teach such as: gearbox, clutch, propeller shaft and drive axle. In this study, each independent variable is represented or enclosed with an ellipse.

1.10.9 Dependent Variables

Dependent variables are measured areas to which medium of instruction is incorporated in each of the four ATS topics mentioned in subsection 1.10.8 above. Each dependent variable is represented or enclosed with a rectangle.

1.11 Summary of the Chapter

The objective of the study is to develop a conceptual model for learning ATS in Nigerian tertiary institutions offering AE course. This became feasible after assessing students' academic performance and skill development in ATS topics through Hausa medium of instruction. Teaching and learning is to help students learn what they are expected to learn. Six research objectives with six corresponding research questions are stated that guided the conduct of the research. In addition, two hypotheses are stated and tested at 0.05 confidence levels.

Medium of instruction and learning environment have become the most discussed common educational tools in recent education history. Although some choose to criticize these determinants, this research is conducted under the assumption that the two, like other tools, are balanced. It is the perception of the researcher, guided by the various quality researches, which determine the end result these determinants had on the students in real learning situations.

The significance of the study could be vital for students and teachers in the area of automobile engineering. It has some implications on the administrators of higher institutions of automobile engineering to achieve considerable learning and for the stakeholders the required and qualified employable graduates.

The conceptual content framework of the study is conceptualize based on medium of instruction and concept maps learning theories specifically adapted from Navok and Cannas (2006); Smith and Dafouz (2012); Puteh and Uum (2012; Mora *et al*, 2001) as provided in the literature. The theories can be used in multidisciplinary areas that include automobile engineering for enhancing students' academic performances and skills development. This research is therefore limited collected from the students through the concept maps assessment test and the structured questionnaire after introducing Hausa as medium of instruction.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This study was conducted in response to the researcher's concern about the students' academic achievements using medium of instruction in favourable learning environment, and developed a conceptual model for learning automobile transmission systems in Nigerian tertiary institutions offering Automobile Engineering (AE) course. Literature related to the objectives of the research was reviewed under different headings. Literature review is a summary of findings from published journal articles, books, and other relevant documents and materials that provides information on the present and past events (Creswell and Garrett, 2008). Therefore, this chapter presents literature review based on the objectives of the research. Specifically, the following subtopics, for their significance to the objective were covered.

- Concepts of Engineering in Nigeria
- Students' Academic Achievement through medium of instruction
- Students' Academic Achievement through Favourable Learning
- Environment
- Concept Mapping Technique for Assessment of Students' Academic Achievements
- Theoretical framework of the Research

2.2 Concepts of Engineering in Nigeria

Generally, engineering is particularly broad, and encompasses a variety of more specialized fields of engineering, each with a more specific emphasis on particular areas of applied science, technologyand types of application (Einstein, 2015).

Engineering is about infrastructure. Engineers were known to create bridges and vehicles that get us from one point to the other. Now engineering is acknowledged as a discipline or training that opens up opportunities and creates technology and products that help make our lives easier. Through engineering training, skilled manpower is produced for social, economic, industrial improvement for technologically advanced and advancing nations in the world. It targets at the advancement of human talents in relations to the understanding of knowledge and skills in carrying out hand-on-activities in the chosen career (Jian, 2011).

In the Nigerian national policy on education, engineering was considered a discipline that enhance skills, abilities and appreciation for embracing the knowledge and information necessary desired by employees to enter and make positive changes in the workplace as explained by Johri and Olds (2011) and Alarape (2006). The course was essentially considered under the 6-3-3-4 system of education programme for self reliant (Aladekomo, 2004). It contributed greatly toward supporting and facilitating the national educational development, by improving the development of individuals (self-reliant) in the country at large. This was the reason why the Federal government of Nigeria in its national policy on education considered education as an instrument per excellent for national development (Aladekomo, 2004). As such it is not impartial to declare that engineering can be recognized as viable industry and a necessary for innovative technology, hence should have adequate training for the citizens. Based on the national policy on education, it provides training and imparts the basic abilities of a person for self- reliant and to be economically satisfactory (Umunadi, 2010).

Furthermore, engineering in Nigeria is about work and training for the job as explained in the Nigerian national policy on education (Aladekomo, 2004). Thus it provides sound preparation and to impart the essential skills to people so as to be self-reliant. When this goal is adequately realized, experts have made it clearer that, it would lead to available and vibrant workforce leading to the technological breakthrough for the developing nations (Dym *et al*., 2005).

Besides, engineering is an existing practice of fixing an individual systematically in order to make a graduate adequately for a worthy occupation in a practical knowledge occupation (Jahn *et al.*, 2009; Wulf *et al*., 2007). This embraced automobile occupational capacities, including other disciplines such as agriculture, chemical, electrical and civil Engineering to mention but a few, that are needed for gainful employment. All trainings are therefore, described as instructional practices that have been designed and equipped technically, strategically and steadily to give room for both the instructor and the learners in order to permit primarily the learners to obtain the basic and essential knowledge, skills talents, and attitudes required for individual proficient performance in the selected business carriers for building self-reliance and nation development.

Once more, experts (Taks *et al.,* 2014) clearly explained the philosophy of engineering studies in agreement to the Nigerian national policy on education. According to them, the instruction strategies together with the operations should be designed with the same tools and machines for the occupation being prepared for. Specific discipline is considered valuable to the degree that a person is trained directly and precisely in the intellectual and manipulative ways needed in the career. Based on that, the training environments and the instructional activities through which students are prepared, should be comparable to those they may ultimately become employed. For a particular career or trade in the training institutions, there is at least a high level of training preparation that has to be met in order to support and make the trainees acquire skills for employment in a specified occupation.

In an analysis on the idealistic implementation of engineering studies, the training received by the engineers during the 20th century years is marginal (Mega - Johari *et al.,* 2002). This being the factor that they are not recognized in the government leadership positions due to non-technical skills, having less ability in research and global development. According to them, it was as a result that engineers turned the programme into a literary kind of education where only the theoretical aspect of engineering skills are taught to the detriment of the practical aspects of the lessons. Certainly, many authors noted that, the training that the learners are prepared for does not look like the current training for them to be employed for national development (Fagerlind and Saha, 2014; Johari *et al.*, 2002).

In recent times, there were less dependence on the Nigerian graduate engineers especially automobile graduate engineers to be employed in private and public institutions, Federal Ministry of Education (FME, 2012) Nigeria, due to ill skilful. Some institutions according to its report - Automobile Technical College (ATC), Federal College of Mechanization Authority (FCMA) and Dagavent Construction Institute (DCI) are amongst the most highly rated engineering institutions located across the country. These institutions operate in teaching and learning for engineers in various engineering disciplines using French language as the medium for instruction. Based on the extracts reports obtained from these institutions, the greater percentage of the undergraduate students are from French speaking countries - Ghana, Cameroun, Niger and Benin Republic. This was due to the massive withdrawals of the students that could not resist the language deficiencies for instruction. Table 2.1 presents extracted statistics results of engineering graduates from the North-Eastern Nigeria tertiary institutions. The overall yearly percentage achievement results of the graduated students were below average, especially, in AE. Therefore, there is a need to assess and develop a model that could serve in order to enhance and produce qualified graduate engineers.

Consequently, on a holistic point of view, if engineering is the general training meant for academic delivery, civilization and improvement as asserted by Douglas *et al*. (2004), then, experimental learning is of paramount importance for individuals and for nations technological breakthrough, economic stability, social improvement, civic responsiveness and global competitiveness as accounted in the main objectives of the Nigerian national policy on education (Aladekimo, 2004)

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Table 2.1: Extracted results of engineering graduates from North-Eastern Nigeria (FME, 2012) in %

Year	Course	Institutions						
		A	B	C	D	E	F	G
2008	Automobile	25	12	32	25	-	-	-
	Agriculture	40	33	21	40	50	21	40
	Civil	50	36	21	50	35	21	50
	Computer	35	32	25	32	35	25	35
	Chemical	35	21	40	21	32	40	39
	Electrical	34	21	50	21	21	50	34
	Production	41	25	35	25	21	35	22
2009								
	Automobile	22	22	15	20	24	15	25
	Agriculture	30	50	34	50	40	21	40
	Civil	20	35	22	35	50	21	50
	Computer	25	32	25	32	31	25	35
	Chemical	35	22	40	21	32	40	39
	Electrical	32	25	50	21	21	50	34
	Production	21	20	15	19	21	30	19
2010	Automobile	21	32	25	32	32	25	32
	Agriculture	25	21	40	21	21	40	21
	Civil	40	25	40	32	21	50	21
	Computer	50	40	50	21	25	35	25
	Chemical	35	35	22	35	40	39	40
	Electrical	39	32	25	32	50	34	50
	Production	34	21	40	21	35	22	35
2011	Automobile	21	12	23	24	18	25	21
	Agriculture	35	25	35	35	22	40	21
	Civil	34	40	39	32	25	40	32
	Computer	41	50	34	21	40	50	21
	Chemical	22	22	22	25	40	35	21
	Electrical	30	30	40	40	50	35	40
	Mechanical	35	22	50	50	35	34	50
2012	Automobile	40	20	40	19	35	17	21
	Agriculture	21	40	35	35	34	22	35
	Civil	35	22	34	41	22	30	34
	Computer	39	30	41	22	30	20	41
	Chemical	34	20	22	30	20	25	22
	Electrical	41	25	30	20	25	31	30
	Production	50	31	32	25	32	25	20
2013	Automobile	18	32	21	40	21	40	25
	Agriculture	23	53	21	40	21	10	31
	Civil	34	21	35	22	25	35	32
	Computer	41	25	32	25	32	25	32
	Chemical	24	40	21	40	21	40	42
	Electrical	43	50	21	50	21	50	53
	Mechanical	54	35	25	35	45	35	65

Note:

A = Abubakar Tafawa Balewa University, Bauchi

B = Gombe State University, Gombe

C = Federal University of Technology, Yola

D = University of Maiduguri, Maiduguri

E = Adamawa State Polytechnic, Yola

F = Ramat Polytechnic, Maiduguri

G = Federal Polytechnic, Damaturu

2.3 Students' Academic Achievement through Medium of Instruction

Medium of instruction as a national language is the language that is generally used for communication in a particular environment for instruction purposes. As described in chapter one, Nigeria have three major national languages Hausa, Igbo, and Yoruba spoken across the country. Apart from the three major languages, there are other minor languages that are only spoken within their domains. Generally, the level of the students' academic achievements in Africa have been discouraging, Nigeria inclusive. This has been attributed partly due to the language related cases (Teferra*et al.,* 2004; Web, 2002).

As shown below, Tables 2.2 and 2.3 presents the changes in selecting a medium for instruction and percentage of the students' pass per course after the selection. This is a dual medium of instruction institution. One has to ask what a likely impact of a language is on academic development of students and assessment of their knowledge and skills, and whether there is any reason to suspect that, language factor is academically detrimental. From Table 2.2, it shows increase in number of percent of the university students opt in for English for instruction, but language problem was compounded by the fact that the majority of the teaching staff is Afrikaans-speakers.

From Table 2.3, it indicates that language may, indeed, be a factor contributing to academic development. The Table shows the results of the students in Afrikaans language (IsiZulu) as well as in English. The language factor in the table obviously did not vividly provide a sufficient explanation for the differences in academic performance. Scholars who discussed the role of language in academic success (Mirza *et al.,* 2013), and an academics who have worked on the same issue (Teferra*et al.,* 2004) agreed, in general, that it is extremely difficult to be specific about the contribution of the language factor to learning, emphasizing that there are many other factors of equal or greater importance involved in learning process. Nevertheless, language may be an important factor, and it deserves the full and proper consideration of any university (Web, 2002).

Table 2.2 : Change in ratio of students selecting for instruction in Africans as opposed to English, 1995-9, and 2001, in percentage points

	1995	1996	1997	1998	1999	2001
Afrikaans	70.8	65.	62.0	59.1	57.3	53.0
English	29.2	34.5	38.0	40.9	42.1	47.0

Table 2.3 : Percentage of students per course registration who passed selected first-year courses in 1999 at the university (numbers in the bracket) by language

	% pass First language use	Second language use
Statistic 110 (N=1939)	68	45
Public administration 110 (N=301)	73	45
Education 110 (N=302)	71	34
Psychology 110(N1000)	74	57
Information science 111 (N=583)	81	65
Sociology (N=327)	80	40
Traditional law 110 (N=679)	53	40
Commercial law 110 (N=1001)	79	53
Private law 110 (N634)	71	44
Physics 131 (N=575)	75	57

In addition, students' skills using IsiZulu as the language of learning and teaching to Post-Graduate Certificate in Education (PGCE) was determined. All students were specializing in the foundation phase in 2008 and 2009 at the University. During contact sessions, new experiences were recorded and were then analyzed under two categories. Under each category, themes were developed and experiences were distributed accordingly. The findings demonstrated the opportunities such as increase in performance and high students' involvement in class activities. The study indicated time constraints, shortage of expertise and negative attitudes as the threats of using IsiZulu as medium of instruction in higher education (Mashiya, 2010).

Baker (2001) stated that the interaction between teachers and students could flow more naturally with medium of instruction. Students can exchange opinions on meaning, conducting participatory teaching and learning as well as influencing the affective domain positively. Furthermore, when the language student's use at home, alongside the culture that is inseparable from it, enters the institution, identity, individual and group empowerment is facilitated (Cummins, 2000).

Mohanty (2009) reported that a bridge from the home language, the mother tongue, to the regional language and to the national language as well as world languages any other language; an empowering bridge that leads to meaningful participation in the wider democratic and global setup without homogenizing the beauty of diversity, a bridge that liberates but does not displace. Bilinguals perform better not only in metalinguistic tasks but also in tasks that require higher levels of control (Bialystok, 2003). Adesope *et al* .(2010) carried out a meta-analysis of 63 studies that examined the cognitive effects associated with bilingualism in students. The results suggested that speaking two languages contributes to one on a cognitive level, conducting better attention control, working memory, abstract and symbolic representation skills, and metalinguistic awareness.

According to Benson (2000), the positive side of using the mother tongue is not only cognitive, but through which participation and self-confidence are also affected positively. Smits, Huisman, and Kruijff (2008) found that mother-tongue instruction had a positive effect on educational attendance. As indicated above, medium of instruction has positive effects on students' academic performance. It influences students' academic success and life in various aspects.

Garcia (2009) stated that in the twenty-first century, however, mother tongue would seem to be more effective, though the linguistic complexity of the world monolingual education seems utterly appropriate. Language differences are seen as a resource, and bilingual education in all its complexity and forms, seems to be the only way to educate as the world moves forward (p.16). Based on the finding, it can be said here that insisting on national language would keep institutions from offering a more sophisticated and enhanced learning which is more likely to be achieved through national language.

Turkey has been home to different cultures for all of her history and has constituted a considerable importance owing to her geographical location. Even today, Turkey incorporates various cultures and languages. In this context, it is inevitable that Turkey responds to the needs of those various cultures and languages. According to Konda (2011), the ethnic infrastructure in Turkey is that the 78.1 percent of adult citizens are Turkish, 13.1 percent of adult citizens are Kurdish, and 1.5 percent of the adult citizens are Lazi and Turkmen. As for a comparative percent age analysis of the language spoken by these people, the 85 percent of the mother tongue widely spoken is the Turkish language and 13 percent of it is Kurdish and Zaza languages. Gursel, Kolasin and Altindag (2009) stated that 46% percent of people, whose native language is Kurdish, were not primary school graduates. This rate according to them has increased significantly in the eastern regions. There were disparities between eastern and western parts of Turkey due to language of instruction. Considering these percentage, it was mandated and became necessary for the people to keep to using their national language for instruction.

According to Aydin (2012), the need for developing language policies in order to meet the educational needs of people is a priority in eliminating the discrimination between different ethnic groups when it comes to the different ethnic groups for meeting their educational needs. Furthermore, according to the scholar, they have not been able to exercise their right to be educated due to this discrimination. However, the scholar emphasized, not having access to education in mother tongue caused many not to continue study. According to a study carried out by Nyika (2015), a noticeable performance result was the ratio of the students whose mother tongues other than those that faced difficulties in learning through English. Accordingly, those that could not speak their mother tongue language amount to the greater percent failure and could not continue with study at university levels. The ratio goes up to as high as 85 percent in developing countries. According to Coskun, Derince and Ucarlar (2010), the problems of students in learning in Turkey are due to lack of mother tongue for instruction. Their starting to study with no or little knowledge of Turkish and their failure to continue studying was lack of the medium for instruction. However, Kaya (2011) stated that Turkey has a social structure that incorporates multi-ethnicity and multilingualism. And that, constitutionally, medium of instruction guarantees the access for different ethnic groups to equal rights and freedom and relying on expert opinion for conflict resolution regarding any minority related problems that contributes to bringing the educational system to a higher level of standard. Based on this, the study discussed the solution of the instructional problems resulted from bilingual education in Turkey by asking the opinions of the academics, who prepare teachers and who are also the executers of education towards bilingual education.

A study conducted by Ilhan and Aydin (2015), to the solution of instructional problems of bilingual education in Turkey, through asking the opinions of the academics who prepare teachers and who are also the executers of education towards national language gathered data and analysed as follows; A total of 395 academics participated in bilingual education perception designed to serve the purpose of the study. 208 academics completed the survey for the study. Mean scores of items in bilingual education perception scales were computed to determine perceptions of academics towards bilingual education. Mean scores were interpreted in 0.80 ranges such as 1.00-1.80 very low,1.81-2.60 low,2.61-3.40 medium, 3.41-4.20 high, and 4.21- 5.00 very high. Data was analyzed via Statistical Package for the Social Sciences (SPSS, Version21). Each response by the participants to each item in the survey was scored to analyze the perceptions of the academics and, mean scores and standard deviation values were calculated.

Based on the results, data collected were analyzed on the perceptions of academics towards bilingual education through the mean scores in the scale. The result of the analyses indicated that academics have shown higher positive perception towards bilingual education. As presented in Table 2.4, the numbers of academics are presented in score ranges. In the table, 13 (6.25%) academics scored very low, 36 (17.30%) academics scored low, 33 indicates 15.86% of academics scored medium, 80 (38.46%) academics scored high and 46 (22.11%) academics scored very high. It can be inferred that the most accumulated part is the percentage of 38.46%, with 80 academics. It indicates that academics have shown higher positive perception towards bilingual education in Turkey.

As presented in Table 2.4, the mean score of the academics is 3. 45. This score is in the high category within 3.41- 4.20. The result also indicates that academics have shown higher positive perception towards bilingual education.

Table 2.4 : The number of academics in score ranges

Degrees and Scores	Very Low (1.00-1.80)	Low 1.81-2.60	Medium 2.61-3.40	High 3.41- 4.20	Very High 4.21-5.00	Total
Number of people	13	36	33	80	46	208
Percentage(%)						
6.26		17.30	15.86	38.46	22.11	
Mean						3.45

In addition, African scholars Bunyi (1999); Ouane and Glanz (2010) confirmed that the use of African languages at lower levels of education does not convey only strong academic advantages. Particularly, it does not enhance learning successfully for that level alone. The record suggests powerfully that, for educational benefits, learners' medium of communication for learning extends to tertiary institutions because of its paramount importance, though few books are available at that level.

Learners in Africa including, after synthesizing the findings of Heugh and others are often disadvantaged for having limited ability in English, thus, hindering effective teaching as reported by Alidou*et al.(*2006). For the learners to learn effectively according to them, the teachers too, due to deficiency in English had to use their academic strategies much more explicit as if they were taught with the languages. Evidence exists that, because of the teacher's deficiencies in English, most of them employed restricted strategies of teaching in English (Collier and Thomas, 2004).

After exploring the comfort ability of students learning between national and English languages, national language is more convenient and enhanced students' achievement (Aguilar and Muñoz, 2014). This was confirmed from the analysis of the data obtained from the participant's responses. In addition, according to the researchers, students' attitude becomes positive and motivated toward the medium of instruction.

From an impact of fine-tuning instruction policy on learning, a shift from national language to English language media did not favour the students being that national language has been their traditional instructional medium. The data analysis of the study involved 123 participants each from experimental and control group. The results obtained was mean of 7.32, standard deviation of 92.69 and mean of 0.70

and standard deviation of .67 from experimental and control groups respectively. Of the same finding, some students were depressed shifting from the Chinese medium of instruction to English medium of instruction. But in some cases, where mixed modes are practiced within the same system as an option for instruction, it was found to be more facilitative than the shift process. According to the scholar, students' responses while answering the research questions, Chinese medium makes them to understand both the media during the learning process, hence the shift was difficult to adopt since it's a policy of the country (Anita, 2013).

In teaching and learning process, learners need to talk in order to express themselves and to learn, especially in laboratory (Bunyi, 1999). Through learners' language, the learners talk to themselves more than in foreign language. This is because communicating in the medium makes them to understand the course concepts; hence they need to develop it. In Africa, students communicate frequently in groups or during lecture period and perform better when using their language for instruction (Teferra *et al.*, 2002); (Arthur and Martin, 2006).

On the effect of practical competency development to determine the effect of teaching practical skills to English speakers using explicit pre-instruction strategies in Spanish medium, the findings showed that some of the Spanish speakers performed significantly better than the English control groups (Dale and Lynn, 2005). The findings therefore, indicated positive achievement of the learners using their medium for instruction for practical skills than English medium.

2.4 Academic Achievements in Favourable Learning Environments

Learning Environment attracts learners in sense making or reasoning. This recommended places or spaces in an institutional setting, for example, a laboratory, workshop classrooms, lecture theatres and or a library (Hannifin *et al.,* 1999). Therefore, learning Environment implies the connector of the specific areas of learning that convey broad ideas about learners' academic achievements. The classroom and the workshops environments are assumed to be the major learning environments that consist of the teacher, teaching material and the materials, study habits and others. In a nutshell, learning Environment involves the conditions, processes and psychological that affects the educational achievement of the learners either positively or negatively.

In the present day, in a structured and technology driven, learning Environment could be cyber net-online, which must not be in a room. Perhaps a superior way to focus at it is the 21st century learning Environment. This unifies the condition in which individuals learn best (Hannifin *et al.*, 1999). It is the system that houses the unique learning needs of every learner and support the positive social relationships desired for active learning.

There are arguments between researchers and designers of learning environments that learners should get used to the learning environments or the learning environments adopt learners for learning. It is better to say how are the learners shaped by the learning environment and intern, how the learners are influenced by the learning environment. Evidently, in relation to the effect of the relationships between the learners and the learning, it involves considering the motivation of learners (Lave and Wenger, 1991). This comprises the learners, the teacher, the classroom facilities or workshop and including the building as shown in Figure 2.1.

In accordance and anticipation of the technological development, the 21st century academic environments are intended and designed for cooperative learning activities. These are where learners can be consistently re-organized to facilitate learning partnerships (Lave and Wenger, 1991).

Though, the 20th century planners and designers perceptions viewed the same century learners as dynamic. These are replaced with modern perceptions where repetition of concepts identified that, learners and learning environments are dynamic. With the improvement of the 21st century learning facilities compared with the 20th century type, the principles of learning remains the same. These are aimed at improving the learners by means of different learning tools. But the only difference is that, the 21st century tools are provided in order to motivate learners and extend their progress beyond their existing levels of awareness (Dent and Zukow, 1997).

On the other hand, the 21st century tools are made to foster critical thinking, social skills and self-directed principles than the 20th century. This is because environment acts as the “third teacher” that guides learning (Pithers and Rebeccah, 2000).

In the 20th century developed teaching tools were aimed to encourage learners to discover their environments during self-directed and cooperative learning. In early 1900s, new innovative technologies began with films, radios evolved into the learning environments (Oliver, 2004). Presently, the learning facilities for example computers, tablets and smart boards were introduced into instructional settings. However, none of these technologies are being fully incorporated into instruction programmes (Weiss, 2007). According to Oliver and Lippman (2007), among other reasons, the designs of the past learning environments are not suitable for integration of the modern technology.

Former technology tools were planned for particular trainings and viewed as essential tools for learning. Nevertheless, with the development of information technology, the tools are not planned for any specific training, but multipurpose training (Weiss, 2007). Figure 2.1 shows the accepted 21st century classrooms reflecting how learning is programmed and designed for the learning setting. Even though, the smart board has been introduced, this instrument has only replaced the blackboard at the central point of the room. Today’s equipments like white board encourage learning. Whereas, if learning equipments are fully implemented into learning environments, it can change the prevalent cultures in institutions and encourage learners to accept what can be done (Lippman, 2010).

Figure 2.1 : Model of 21st century classroom (Lippmann, 2010)

In a study titled “The paradox of reducing class size and improving learning outcome”, (Hattie, 2005) compared the achievements of the students in various class sizes and confirmed that the more the class size is, the lower students’ achievements is. This he emphasized, as the class size decreases, transparency and discipline problems reduces. Therefore, knowledge from peers increases easy grouping of student-centered motivation, hence students can be accessed to the recorded lectures, have good reactions to asking questions and answers at all times.

In Nigerian Universities, there are many challenges that affect students learning, these includes: funding problem, infrastructural globalization, relevance of curriculum to the national need, and brain drain (Olagbemiro, 2010). In the universities, there are few physical learning facilities, which have greatly affected students’ achievements (Robert, 2007). The researcher examined the students’ academic achievements on standard building versus substandard building using a comprehensive test score of basic skills.

The effects of building conditions on students’ academic achievements are significant (Blincoe*et al.*, 2009). Specifically, it was confirmed that air-conditions, materials in laboratories, lack of good conditions of classroom fittings, wall color, lighting systems, temperature, sound, air quality, physical space and layout, seating and table arrangements are connected with students attainment at a considerable level.

In a study, "Effect of physical learning environments on students based on aided and unaided" learning, positive effect was confirmed of the aided environments on students' achievements (Kazua and Demirkolb, 2014). They classified the environments into the following categories, modern learning, obsolete learning or half modern learning environment. Comparatively, students' achievements in modern learning environments are at all times better than in obsolete learning environments.

Evidently, from the inception of architectural departments in Nigerian universities, statistics showed increase in both students and staffing with no additional infrastructure, reading spaces and offices for students and staff respectively (Lekjep*et al,*. 2012). They emphasized that the existing buildings are completely dilapidated without maintenance or repair. This directly affects the level of students' academic achievements. The building conditions of the institutions accordingly, affected the level of students' academic achievements negatively. Students have no interest of working in the studios; rather they prefer to work in neither hostels nor homes. This very act accordingly deprived the students the opportunity for their mentors to properly mentor their studio works. Tables 2.5, Table 2.6 and Table 2.7 show the space utilization in square metres of physical infrastructure (studios), student's attitudes and their achievements effects of the studio on the students' academic achievements in their final year examinations in one of the institutions due to inadequate enabling environment (Lekjep*et al,*. 2012).

Table 2.5 : Facilities available in the studio

Space	No. of Students	NUC Rqd. Std. m^2	NIA Rqd. Std. m^2	Avail. Space m^2	Required Space m^2	Shortfall in Space m^2
Studio 100L	67	3	2.5	201.6	201	-
Studio 200L	65	3	2.5	129.9	195	65.1
Studio 300L	71	3	2.5	129.9	213	83.1
Studio 400L	46	3	2.5	256.0	18	-
Computer Lab	50	2	1.5	129.9	100	-
Data	40	2	1.5	43.2	-	36.8
Room/Lib.	-	-	-	85.5		-
Gallery						

Note: NUC = National University Commission, Rqd = required, STD = Standard, NIA = National Institute of Architecture, L = Level.

Table 2.6 : Record of Students' Attitudes to their Study

Level	Working in Studio	Not Working in Studio	Studio not Conducive	Conducive Studios	Other Reasons	Total no. of Students
100 L	7	57	57	7	3	67
200L	5	55	55	5	5	65
300L	13	51	51	13	7	71
400L	11	29	29	17	6	46

Table 2.7 : Students' Achievements in B.Sc. Architecture, 2003 - 2011

Class of Degree	03/04	04/05	05/06	06/07	07/08	08/09	10/11
1s class	-	-	-	-	-	-	-
2nd class Upper	6	6	5	6	5	3	2
2nd class Lower	43	49	31	42	25	25	15
Third class	7	2	5	1	2	-	1
Pass	-	-	-	-	-	-	-
Repeat courses	38	39	72	52	48	35	39
Withdrawn	1	2	1	-	-	-	-
Voluntary Withdrawal	1	-	2	-	-	1	1
Probation	-	-	-	-	1	-	-
Deferment	-	1	-	-	-	-	-
Total no. of students	96	99	115	102	81	64	58

In an analysis between traditional, blended and e-learning environment, blended learning was confirmed more facilitative than the other two (Al-Qahtani and Higgins, 2013). They emphasized that, blended learning, for example, face-to-face contact with an instructor involving required facilities; enhance greater achievement than traditional learning.

In addition, holding all learning materials including the learning spaces, it enhances students' academic achievement compared to those taught in the traditional classrooms (Brooks, 2010). In view of that, equipped academic learning environment autonomous of other negative influences has significant effect on students' academic achievements.

Similarly, a study for the purpose of evaluation of inconsistency of students past grades or results, it suggested that, Problem-Based Learning Laboratory (PBlab) is highly significant in both technical and generic skills of students' achievements compared to the grades obtained (Bahri*et al.*, 2012).

Of a Web-Based learning environment, blended learning environments and online learning environments for academic achievement and satisfaction, blended learning is more facilitative in academic achievement and retention of information than the online learning environments (Usta*et al.*, 2011). In addition, students' activity instruction is more facilitative in deepening the students' achievement than a lecture based strategy (Katrien*et al.,* 2006)

Particularly, in a Laboratory instruction in engineering education of experimentation using the lecture method and a classroom study, laboratory instruction showed highly significant difference in students' achievements compared to other methods. Therefore, a suggestion that hands-on laboratory using current technological instrument motivates students for engineering learning and in anticipation for the 21st century world of work (Krivickas and Krivickas, 2007).

Furthermore, on the effect of newly constructed classroom environment furnished with engineering training facilities, the effect showed the same significant achievements in mechanical and chemical engineering skills compared with other students in traditional classroom environment (Gurulke, 2001). The findings were of the same positive significance effect of physical learning environment with that of Laura and Jeremy (2011).

Finally, on a survey between face-to-face and online learning environments, it was indicated that, in online learning, students makes use of confirmation in arguments than during face-to-face learning. Whereas, face-to-face discussion is confirmed to be better than online learning (Roberta, 2008)

2.5 Technique for Assessment of Students' Academic Achievements: The Concept Mapping

In a research, concept maps assessment tests as a tool and a technique for assessing students' academic achievement could be applied through Hausa medium of instruction on some primary ATS systems. Concept map is defined as a graphical or pictorial organized tool used by many researchers to enhance meaningful learning (Novak and Gowin, 1984). Concept map comprises of interconnected propositions consisting of two or more concepts connected by labelling links. Concept maps allow interpretations of knowledge coherencies (Oliver, 2008). Concept maps can represent visually an individual structure of understanding or knowledge by showing a network of concepts, relationships and propositions (Nesbit and Adesope, 2006; Novak and Cannas, 2008; Tomlinson, 2014). Changes of knowledge structures over a given time by means of concept maps can signal the success of instructions (Bennedsen and Caspersen, 2006)

In addition, concept maps can be utilized to identify discipline knowledge and explore students in engineering concept areas for example; gearbox, clutch, propeller shafts and drive axles (Turns *et al.*, 2000). These researchers explained that concept map is the best assessment tool through which an instructor can visually assess students' understanding. Concept mapping technique is particularly appropriate for assessing interdisciplinary knowledge integration (Borrego *et al.*, 2009). These researchers also explained that the method can be useful to evaluate students' development in individual courses as well as across the curriculum. This is because of its ability to represent not simply content mastery, but connections across content and concept areas. Concept mapping technique has been integrated successfully to determine a visual pattern of structures of various identified concepts for a quality engineering education (Upadhyay*et al.*, 2008). They explained that, application of the technique helps decision-makers, planners and administrators to understand the necessary linkages in complex systems of engineering courses.

In visualizing the measure of the depth, breadth and organization of student's academic achievements, concept map is the best tools (Nicoll, 2001). The maps are built by placing terms, which represent the concepts to be mapped in structures called "nodes". Concept maps are valid, reliable and as a tool, a novel invention for assessing students' academic achievements (Jain *et al*., 2014). According to these scholars, in assessing the students' academic achievements, on the first day of intervention, students can be tested as pretest and after subsequent interventions; they can be re-tested as a posttest (to determine the effect of the treatment as a measurement). The measurement can be done using the same measuring tool. In line with this, two of the advantages of the concept map technique over many learning methods according to the researchers mentioned above are; 1) its open-endedness and, 2) its appropriateness for the nodes are then linked together into propositions to show how students connect or link the concepts. Based on the emphasis of open-endedness of the method, it allows students to respond freely and as such it can capture divergent issues related to students' understanding (Violante*et al*., 2015).

In assessing students' academic achievements in ATS course, there are numerous constructs needed to be considered. These are constructs through which the students are able to learn the ATS, for example, which, why and how the concepts are used by the students in understanding the course. These include the concepts of collaboration of how students collaborate in assembling of parts (Shimokawa*et al.*, 1997).

2.6 Theoretical Framework of the Research

Theoretical framework of any research is the philosophical basis upon which the researcher is based, and the researcher forms the link between the theoretical and the practical components of the research undertaken. In addition, a theoretical framework is a conceptual model of how one use theories to make realistic wisdom of the connection between numbers of factors acknowledged being very important to the research (Swabey*et al.,* 2014). In view of that, this research was based on the Concept Maps Learning Theories of Singh and Moono (2015);Novak and Cannas (2006); Borrego *et al*. (2009); Attribution Theory of Achievement and Motivation (Weiner, 2005); Diffusion Innovation Theory (Warford, 2005) and Acceptance Model Theory (Marsh *et al.,* 2002; Puteh and Uum, 2012).

2.6.1 Concept Maps Learning Theory

This theory centers on the most precise principles for assessing students' academic achievements and skill development. The knowledge representations are usually based on concepts enclosed in boxes or circle forms, and associations between concepts shown by connections between the concepts indicated by lines linking two or more concepts. The words linking the phrases specify the relationship between the concepts, and allow interpretation of knowledge coherences (Singh and Moono, 2015;Novak and Cannas, 2006).

Concept maps are utilized to identify discipline knowledge and explore students' engineering concept areas (Turns *et al.*, 2000). The maps represent valuable assessment tool because it provides the means to capture and represent student's understanding. Concept maps learning theory is particularly appropriate for assessing interdisciplinary knowledge integration (Borrego *et al.,* 2009). The theory explained that, the method can be useful to evaluate students' development in individual courses as well as across the curriculum because of the ability to represent not simply content mastery, but connections across content and concept areas.

Concept maps are integrated successfully to develop a visual pattern of structures of various identified concepts for quality engineering education (Upadhyay*et al*., 2008). During the pilot study concept maps learning theory was adapted for data collection. This was to ensure the functionality of the instruments used for the main study. It represented small implementation or report of the entire study. This lasted for a short period of time with 50 students each in experimental and control groups at the Federal University of Technology, Minna. This according to Thabane*et al.* (2010) and Araine*t al.* (2010) is simply to assess the practicability, time, cost, difficult procedures prior to full execution of the main study. Presented in Appendix I is the scoring rubric during the pilot study. The application of the theory help planners, administrators and students understand the necessary linkages in complex systems of engineering courses.

2.6.2 Attribution Theory of Achievement and Motivation

The theory explained how learning and its related cause outcomes are experienced by students in academic settings. The first dimensional factor of attrition reaction is "locus of control". This factor describes the cause of an outcome as either internal or external. An internal cause includes: the skill or ability of the learner toward learning. The external cause could be either from the environment, parents or teacher. The second dimension is "stability". This refers to the idea that there are many stable causes for success. Other causes such as effort and circumstances are considered unstable. The key thought with this dimension is that if a learner's success is linked to a stable cause, the teacher is much more likely to have repeated success than if it is a result of an unstable cause (Weiner, 2005).

Furthermore, according to Weiner, "controllability" is another dimensional attrition that some of the causes for success could be controlled. An excellent example of this is learning strategies that students and teacher can decide in advance what will help them succeed. It could vary, and is not dependent on the student. Based on causal belief, students are affected by learning environment and including personal factors such as prior knowledge. This according to Weiner (2005) with other variables forms the students' external and internal stabilities.

Attribution could be the expectation of a teacher on students' achievements (Wang, *et al*., 2008). This according to them, could be due to teachers' attribution for student's changes, and improves the students' behaviour and performance. Teachers' anticipation for students could be clarified by their attribution and explains to the students in perceiving their outcomes. In this case, students develop beliefs about their success or failure. Students considering their past achievement, attribute to their performances if they succeed in examination at times. Attribution could be due to the student past performance, characteristics or the influence of the teachers' effort and relationships with the students. Teachers usually judge students based on their past performances or grades.

A situation whereby teachers being actors, not observers in student-teacher relationships, makes themselves to attribute in enhancing students' performance or self-protective in the student' performance. This makes the teachers of crediting themselves and blaming students even if the teachers failed on their parts, but others accepts their faults and give students credit for their success. In addition, teachers must focus on both internal and external factors that facilitate learning starting from the simple to the complex (Krathwohl, 2002). This could normally be achieved through the teachers' ability to effectively communicate with the students (Ahmad *et al.,* 2011).

Above all, considering the students and the teachers, there are influences of instructional factors in teaching-learning equations that include other variables such as learning environments, organization of instruction, knowledge of repetition and skill development, and an instructor as explained subsequently:

2.6.2.1 Learning Environment

The setting in which the teaching and learning process occurs has great influence on learning. Some types of learning require a substantial amount of physical activities or practical work these cases, laboratories and workshops with appropriate equipment are essential (Arif and Sevilay, 2006).

2.6.2.2 Organization for Instruction

An organized instruction in one's language is more-effective in comprehension and application of science concepts than in a non-indigenous language (Ehindero, 1980). The activities being learnt should be meaningful to the learners and there should be a consistent system of evaluation.

2.6.2.3 Knowledge of Repetition and Skill Development

Repetition and guided practice are essential in skill development. Practicing engine overhauling for example, requires repeating certain repair experiences without conscious thought. When this occurs the learner has developed a skill, it is a thoroughly established habit of performing a task in an efficient manner.

2.6.2.4 Instructor

Finally, learners are influenced by the instructor. The ability of an instructor to communicate with the students enhances learning. Therefore, the communication medium with which the students among themselves exchange question and answers enhances learning (Arif and Sevilay, 2006).

2.6.3 Diffusion of Innovation Theory

This theory in a research centers on the situation which increase or decrease the likelihood that a new idea or practice is adopted by members of a given culture. The theory predicts that medium provide information and influence opinion and judgment. According to the scholar, diffusion of innovation consists of communication through the social system, time and consequences. The scholar further explained that diffusion is the process by which an innovation is communicated through certain channels over a period of time among the members of a certain society, and that innovation is an idea, practice, or object that is perceived to be new by an individual or society, while communication is a process in which participants share information with one another to reach a mutual understanding (Warford, 2005).

In addition, the theory has focused on five basics: the characteristics of an innovation which may influence its acceptance, the decision making process that occurs when individuals consider accepting a new idea or practice, the characteristics of individuals that make them likely to accept the idea or practice, the penalty for individuals and society of accepting the change, and communication channels used in the acceptance process (Warford, 2005).

2.6.4 Acceptance Model Theory

Acceptance model theory is information systems theory that shows the mode users accept changes based on its perceived usefulness and ease of usage. It advocates that when a new change is presented to users, some factors will have some influence on their decision on how and when they are to use it. Two factors are: the value of the change for example, the degree to which a person believes that using the change would enhance his or her achievement. Secondly, the extent to which a person believes that using a particular change would be free from fear (Marsh *et al.*, 2002).

As described earlier on the implication of each theory adapted, in a reflection to using Hausa medium of instruction, Figure 1.1 shows the diagrammatic representation of the theoretical framework that guided the conduct of this research. It shows the relationship between the key propositions of the theories with four key topics identified. These four topics are the main topics of ATS that require the use of Hausa as medium of instruction for learning in this research. The outcome according to the framework is a conceptual model for learning ATS systems in Nigerian tertiary institutions offering AE course. This resulted from the perception of the students on the role of Hausa for instruction. The framework further shows the relative advantage, compatibility, the usage, usefulness, awareness and a decision to adopt Hausa as medium of instruction. Adopting the medium for instruction on gearbox, clutch, propeller shaft and axle drive would enhance students' academic performance in Nigerian tertiary institutions offering AE course.

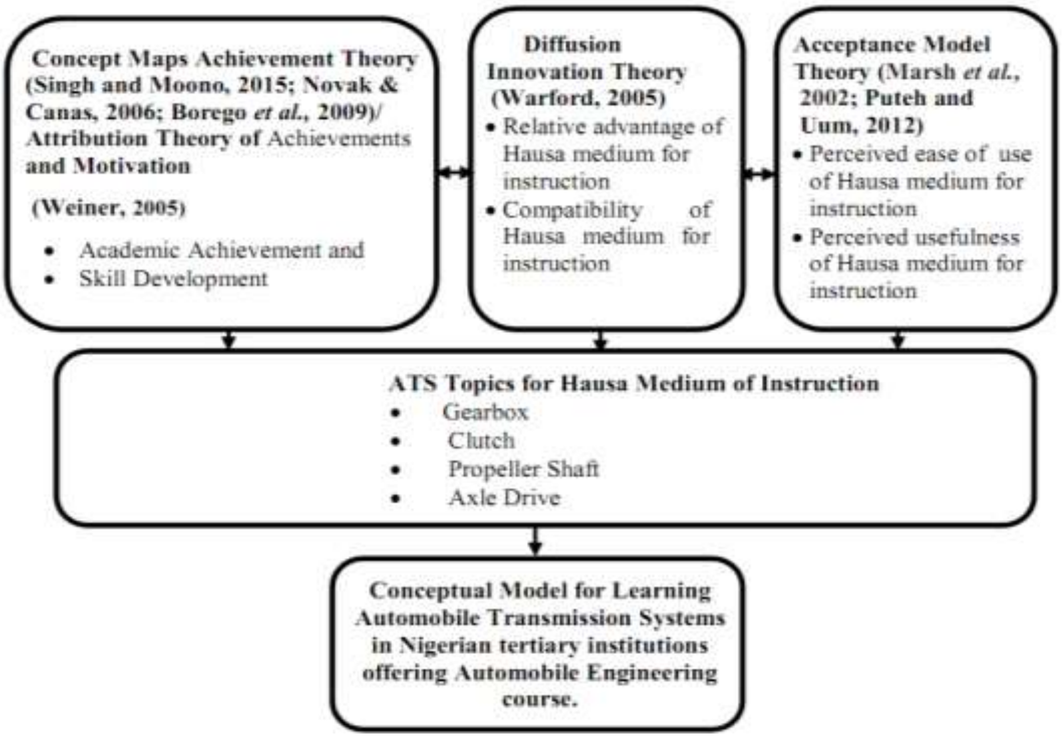


Figure 2.2 : Theoretical framework of the study

2.7 Summary

This study was conducted in response to the researchers' concern about the assessment of students' academic achievements using Hausa medium of instruction, there by developed a conceptual model for learning automobile transmission systems in Nigerian tertiary institutions offering AE course. It was conducted in government owned tertiary institutions. This was due to the fact that, all the government tertiary institutions offering AE have the same characteristics in terms of curriculum, admission criteria and staff administration. This study has six objectives: (1) to determine the effect of Hausa medium of instruction on ATS students' academic performance, (2) to determine the effect of learning environment for instruction on ATS students' academic performance, (3) to determine the effect of English medium of instruction on ATS students' academic performance, (4) to determine areas considered important of ATS topics on students' academic performance, (5) to determine the relationships of the areas considered important of ATS topics, and (6) to develop a conceptual model of areas considered important on ATS for learning automobile transmission systems in Nigerian tertiary institutions offering AE course.

Based on these objectives, this chapter was organized according to sub-themes in order to examine in greater detail the reality of these matters among the AE students in Nigeria. Judgments relating to the choice of appropriate information had to be applied, as most of the scientific literatures found in the field of medium of instruction are more likely to emphasize issues in the academics and automobile sectors. A model of learning according to some scholars is significant in national building.

The theoretical framework was theorized based on the theories of Singh and Moono (2015); Novak and Canas (2006); Weiner (2005); Warford (2005); Marsh *et al*. (2002). All theories dealt with the characteristics and principles of learning, diffusion innovation and acceptance which emphasized on the adaptability and ease of acceptability of a model for a particular society.

AE in Nigeria is generally for the training of skills for manpower production for social, economic, industrial improvement for technologically advancement of the nations. It's targeted at the advancement of human talents in relations to the understanding of knowledge and skills in carrying out hands-on activities in the chosen careers of the trainee as emphasised by Arid and Seville (2006).

As reviewed, several researchers such as Dafouz (2015; Bahri*et al*. (2012; Aguilar and Muñoz (2014) emphasized that medium of instruction enhanced student's academic achievements; likewise learning environments as examined by (Blincoe*et al.,* 2009) and Kazua and Demirkolb (2014) are pre-requisite factors for the academic achievements as well as for national developent.

According to Borrego *et al*. (2009); Upadhyay*et al.* (2008); Jain *et al*. (2014); Violante*et al*. (2015), one of the best techniques to assess students' academic achievement is through concept mapping. This according to them enhanced conceptual understanding in different disciplines.

CHAPTER 3

METHODOLOGY

3.1 Introduction

The purpose of this research was carried out to develop a conceptual model for learning Automobile Transmission Systems (ATS) in Nigerian tertiary institutions offering Automobile Engineering (AE). This was done through the data collected from the AE experts after evaluation of students' academic performance through Hausa as medium of instruction on ATS topics. This chapter first presents the research design, an overview of quantitative research design, location and population of the study, samples and sampling procedure, research instruments, Validity and the reliability of the research instruments followed by the pilot study. The chapter also presents detail explanation on the methodology used for data collection through Concept Maps Assessment Test (CMAT) using Hausa medium of instruction and analysis of the data. Also, mean, regression analysis, structural equation modeling and the model Fit evaluation indices used to develop the model were discussed.

Learning environment in this research was the improvised workshop equipped with automobile parts upon which teaching and learning was done on the equipments. This was done in order to explain the equipments with Hausa medium of instruction for better understanding. CMAT was the instrument used to assess the students' academic performance during intervention, while structured questionnaire was thereafter administered to AE experts that solicited for their opinions on the ATS areas for the model development through Hausa medium. According to Marsh and Laitinen (2005), medium of communication is acknowledged as a leading factor for academic achievements. Therefore, relevant topics of (ATS) with a code number ME 203 was chosen as a guide for this research. The rationale for the chosen course is based on the fact that it is a pre-requisite course provided in the Nigerian national policy on education that a candidate must have good background before proceeding to read AE discipline. For Bachelor of engineering and Bachelor of technology degree in automobile engineering the course contents are the same. Therefore, the researcher focused on four basic ATS topics - gearbox, clutch, propeller shaft and drive axles in order to assess the level of students' academic performance using Hausa as medium of instruction. Consequently, important ATS areas were considered for developing a model for successful learning of the ATS in Nigerian tertiary institutions.

In ATS, students were taught both the theoretical and the practical aspects of the systems. This was done during the assessment practices in order to evaluate students' procedural and declarative knowledge. In declarative knowledge, students were taught the cognitive aspect of the system parts, while in procedural the students were taught on particular command (skill), which were determined on particular system. In this process, students were required to dismantle and assemble the transmission systems upon which their academic performances and skills were assessed. In assessing the performances and skills, concept map technique as the best technique or tool as emphasized by (Acharya and Sinha, 2015; Gurupur *et al.*, 2015) was employed.

3.2 Research Design

This research was conducted using quantitative method design as shown in Figure 3.1. Quantitative research design alone was considered feasible for the study. This was because the types of population and methodology involved are similar in all characteristics as both are described in the later sections. Quantitative research method was the main method because according to Baron *et al*. (1996), it produce intended outcome faster than qualitative methods and it is simple and easy to administer.

3.2.1 Overview of Quantitative Research Design

According to Grabbe (2015), the main objective of quantitative research design is to collect numerical data for answering research questions and test hypothesis in a controlled environment. Therefore, quantitative research is the process of taking measurement on the dependent and independent variables for the purpose of assigning numerical values. In addition, according to Kothari (2009), quantitative research is used based on the understanding that the amount of an observable fact in a research can be described on the parameter of its quantity. In view of these, data were collected through quantitative data gathering instruments (see Appendix A1 for concept maps assessment test, see Appendix B for structured questionnaire) using numerical values. Numerical values used to compute the data collected on 5-point scale responses are calibrated as: A = 4; B = 3; C = 2; D =1; E= 0 for CMAT. It was computed based on the equivalent grading system of the Federal Ministry of Education (FME, 2012) Nigeria, as well as on a 5-point scale calibrated as: 1 = Not Important (NI); 2 = Less Important (LSI); 3 = Little Important (LI); 4 = Very Important (VI) and 5 = Highly Important (HI). Equivalent grading system of the instruments is presented in Appendix A2.

The design for this research as illustrated in figure 3.1 is a non-equivalent control group research design, which related to true experimental research designs. It is a strong design with respect to internal validity because of the same characteristics of the students for not having selection bias. It can enhance external validity or generalization. The design involved three groups of measurements; two experimental groups and one controlled group. The design is identical to randomized experimental group designs but lacks the random assignment to groups. That is why it is called non-equivalent controlled groups design. In addition, the groups may be different prior to study. The design is certainly superior like other quasi-empirical designs.

N	O	x	O: Experiment 1
N	O	x	O: Experiment 2
N	O		O: Controlled

Figure 3.1 : Non Equivalent group Controlled Design

3.3 Location of the study

This research was conducted in the North-East geopolitical zone of Nigeria. The zone comprised of 6 states namely: Adamawa, Bauchi, Borno, Gombe, Taraba and Yobe States. The study was conducted in only three states of the region, particularly in the institutions that are offering AE (see Table 3.2). Nigeria as the most heavily populated country in African continent; it lies between latitudes 4º16' and 13º53' to the North and of the longitudes 2º40' and 14º41' to the East of the Greenwich Meridian. The country is located in West African sub-region. It borders Chad in the Northeast, Niger in the north, Cameroon in the East, and the Republic of Benin in the West. It is bordered to the South by approximately 800 kilometres of the Atlantic Ocean and with a total land area of 923,768 square kilometres. The country is the fourth biggest in Africa as shown in Figure 3.2.

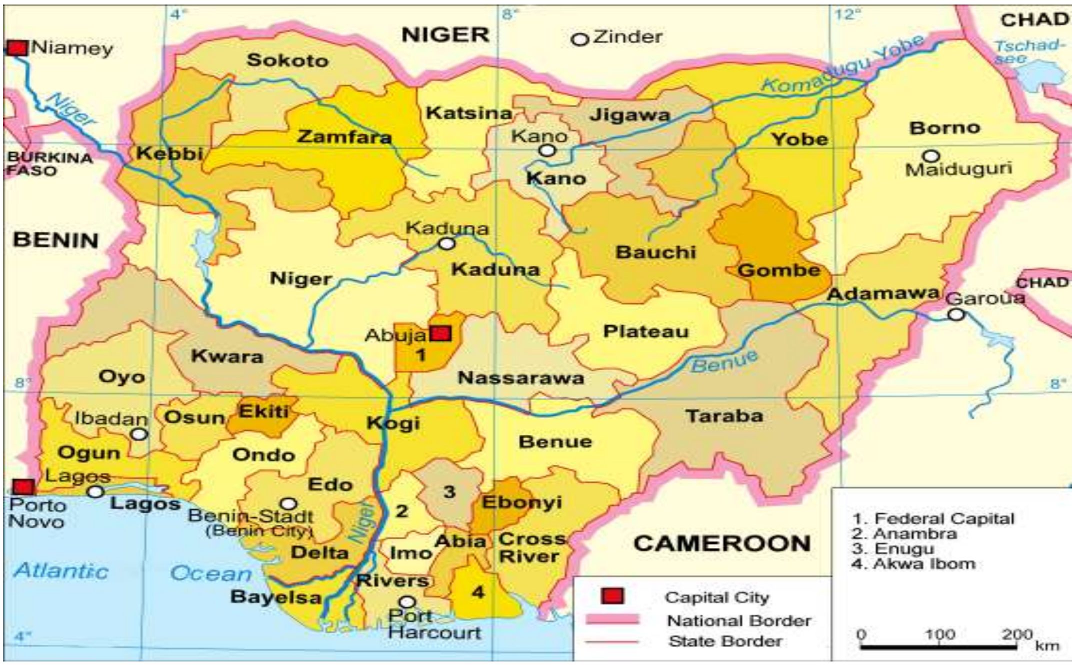


Figure 3.2 : Map of Nigeria showing 36 states

Educationally, Nigeria practices 6-3-3-4 system of education that is 6 years of primary school, 3 years of junior secondary school, 3 years of senior secondary school and 4 years of tertiary education in the university. Although, the 6-3-3-4 system has not changed, but 9 year basic education was launched in 1999 to emphasize free and compulsory basic education to all citizens of Nigeria.

Specifically, this research was conducted in tertiary institutions (Universities) offering AE in Nigeria. The institutions involved in this research, are those owned by the Federal government of Nigeria. The choice of the Federal government owned institutions was because all the institutions have related characteristic in terms of admission and graduation requirements. Principally, the institutions use the same guidelines to admit students from diverse political and cultural backgrounds all over Nigeria. Table 3.2 presents list of the tertiary institutions involved in the study. Three of the institutions were chosen because all are offering Bachelor degree in Engineering and Bachelor degree in Engineering Technology (B. Eng and B.Tech. Eng.) in the North-East geopolitical zone of Nigeria.

Table 3.1 : List of selected Federal Universities offering AE in the North-Eastern Nigeria

Abbreviation	Name of institution	Location
ATBU	Abubakar Tafawa Balewa University, Bauchi	Bauchi State
FUTY	Federal University of Technology, Yola	Adamawa State
UNIMAID	University of Maiduguri, Maiduguri	Borno State

3.4 Population of the Study

Population of a research is the totality of all individuals or objects about which the research is concerned (Sambo, 2005). Detailed explanation about the nature of the population is of vital importance to all research as it will give the information about the subject that may belong to the population.

Population was also described by Ugwu (2014) as the group of people inhabiting a specified geographical location. The scholar explained that it defines the limit within which the research findings are applicable and generalized. A population can also be classified into target and accessible. The target population according to the scholar is the particular group to which the research relates, while accessible population refers to those essentials in the group within the contact of the researcher. Therefore, the population of this research study consist of all AE students of the selected tertiary institutions offering AE at Bachelor Degree (B. Eng and B.Tech. Eng) levels in the North-Eastern Nigeria.

3.5 Research Sample Sizes and Sampling Techniques

In most research studies, it is not possible or even necessary to collect data on the entire elements of the population. What is normally done is to collect data on a small subset of the population from which inferences on the condition obtained on the population are made. The small subset is called a sample (Sambo, 2005). Different types of sampling techniques apply to different situations of sample selections depending on the situation and the type of data to be drawn.

Nigeria is divided into six strata (geopolitical zones); North-East, North-West, North-Central, South-East, South-South, and South-West. One strata (North-East) was chosen for this study, and the North-Eastern zone also comprised of six states (Adamawa, Bauchi, Borno, Gombe, Taraba and Yobe). As such, three federal tertiary institutions from North- Eastern zone were selected for the study.

As presented in Table 3.2, intact classes for sampling technique was applied for both concept map assessment and structured and questionnaire. ATBU and FUTY served as the experimental groups with 108 participants each, while UNIMAD served as the control group with 109 participants in addition of 2 experts each from every institution. Therefore, the total samples of the research were 325 participants from three of the tertiary institutions involved in the study.

Table 3.2 : Samples of Data Collection

No	Name of Institution	Groups	No. of Participants	
			Students	Experts
1	Abubakar Tafawa Balewa University (ATBU) Bauchi	Hausa	108	2
2	Federal University of Technology, (FUTY), Adamawa	Learning Environment	108	2
3	University of Maiduguri, (UNIMAID), Maiduguri	Controlled	109	2
Total			**325**	**6**

3.6 Research Instruments

Data collection for this research was done using two sets of instruments, the 35 item concept maps assessment test (see Appendix A1) and 40 item structured questionnaire (see Appendix B). The instruments were developed based on the specific objectives of the study. The items of the instruments were translated from English to Hausa, using Hausa Dictionary published by John (2004) and goggle translate and were validated by the experts according to how the medium is used in the areas of the study.

Both the concept maps assessment test in Appendix A1 and the structured questionnaire in Appendix B were developed based on the four ATS topics in line with the specific objective of the research through Hausa as medium of instruction. The concept maps assessment test was fully constrained, designed within the scope of the research objectives as well as the course curriculum as presented in Appendix F. It was constrained that students were allowed to construct the concept maps using only the items provided for them in Table 3.5 which were translated to Hausa. Likewise, the structured questionnaire that was developed to obtain information on the areas considered important for learning on the four topics of ATS was also translated in Hausa medium. The academic performance and skills of the students were assessed based on the students' ability to construct a complete ATS concept maps presented as Figure A1X as presented in Appendix A2.

In taking into consideration of the nature of this research and the type of population under investigation, as said in the former paragraph, fully constrained concept mapping procedure according to Johnson and O'Connor (2008) was adopted. Fully constrained procedure allows testees to use the specified items supplied to them for constructing the maps. Students were asked to construct only the concept maps based on the randomly arranged nodes and concepts. At the same time, the nodes and the concepts were used to develop the structured questionnaire. Regression analysis was then used to determine the important areas of the construct variables after which structural equation modelling was applied on the most important areas. Thereafter, the results of the analysis were used to develop a conceptual model for learning automobile transmission systems in Nigerian tertiary institutions offering automobile course.

3.6.1 Validity and Reliability of Research Instruments

Both the concept maps assessment test and the structured questionnaire were presented to experts for face and content validation procedure (Schmidt *et al.*, 2009). Face validation was done to check the organization of the instruments and language flow, while content validation was done to check if the contents of the instruments are in conformity with the objectives and research questions, and as well as with objective of the AE curriculum as presented in Appendix F. It was validated by two experts; one of the Medium of instruction see Appendix C1, and the other one of AE see Appendix C2. Observations and corrections from the experts were reflected in the updated version of the instruments produced after the validation process. Output of the reliability coefficients of the instruments is presented in Appendix H. The instruments were pilot tested with 50 students each in the experimental and control groups from the Federal University of Technology, Minna, Nigeria. Pilot tested instruments consisted of the four subheadings of the ATS topics - gearbox, clutch, propeller shaft and drive axle as outlined in the course curriculum. The instruments consist of 35 items for concept maps assessment test and 40 items for the structured questionnaire.

The reliability of the instruments was established after a pilot test result was analyzed and was used for the main study see Table 3.4 and Table 3.5. The reliabilities of the instruments were above the accepted Cronbach, 1951 alpha coefficient cut-off value of 0.70. However, the rule of thumb is that 0.80 or more is regarded to fit well, while according to Tavakol (2011), Alpha value ranges between 0.70 and 0.95 which was adapted in this study. The output of the SPSS results is presented in Appendix H.

Table 3.3 : Reliability of Concept Maps Assessment Test

Constructs	Total No. Items	Piloted Alpha	Alpha Final	Alpha Total
Gearbox	12	0.93	0.89	
Clutch	8	0.88	0.91	0.88
Propeller Shaft	8	0.96	0.92	
Axle Drive	7	0.92	0.90	
Total Number of areas	35			

Table 3.4 : Reliability of Concept Maps Assessment Test

Construct Variable	Total No. Items	Piloted Alpha	Alpha Final	Alpha Total
Gearbox	10	0.81	0.82	
Clutch	10	0.86	0.86	0.87
Propeller Shaft	10	0.92	0.92	
Axle Drive	10	0.91	0.92	
Total Number of Items	40			

3.6.1.1 Content Validity

Content validity was established through expert's reviews and review of the relevant literature. Having expert's reviews of the items/areas included in the instruments confirmed to the students' academic performance that was measured. It was presented to the experts for determining the clarity, relevancy, conciseness of the areas for the related constructs and recommended wording for such areas (DeVellis, 2003). The Validation was done in collaboration with, and was closely monitored by Dr. Ahmad Aliyu Deba, Department of Hausa language, University of Maiduguri (Appendix C1) and Dr. Mohammed Benjamin Umar of the Department of Mechanical Engineering, University of Maiduguri (Appendix C2).

3.6.1.2 Convergent Validity

Another form of validity considered very important in this study was convergent and discriminate validity. Convergent validity was the relatedness of construct variables items to measure the construct. It was determined from the initial measurement model by examining each indicator estimate loading of the underlying factor as large or good, and the p-value was considered statistically significant.

Items together with p-values that were not statistically significant indicated that the items were not good measures of the factor and were omitted from further calculation during structural equation modelling analyses. This was to obtain modified measurement model.

3.6.1.3 Discriminate Validity

Discriminate validity was the extent to which the measurements of the construct variables were different to each other. This was the uniqueness of the items of each construct variables measuring each construct independently. As the two sets of instruments in the study was used to measure different phenomenon, concept maps assessment test was used to measure students' academic performance, while the structured questionnaire was used to solicit for the opinion of the students on using Hausa as medium of instruction. Therefore, discriminate validity of the questionnaire was determined for four construct variables - gearbox, clutch, propeller shaft and drive axle. This was by constraining the estimated correlation parameters between them and then performed different pair wise tests of the values obtained during the initial and modified measurement models.

3.7 Pilot Study

During the pilot study, students were trained on how to create concept maps. The concept map assessment test is a graphical tool that enhances meaningful learning and at the same time, for assessing students' academic achievement (Stoica*et al.*, 2011; Ruiz-Primo *et al.*, 2001; Ingec, 2009). Therefore, during the training, students were taught on the basic structure, how to construct and classify the concept maps based on the research objectives. After the training, students were asked to develop their own simple concept map as illustrated by the researcher as an exercise for them to be familiar with the mapping methods. Table 3.5 presents randomly arranged concepts (nodes) translated in Hausa language used for construction of the concept maps. Students were scored and assessed as indicated in the assessment scoring rubric in Appendix I. This was in conformity to the grading system of the Federal government of Nigeria see Appendix A2.

Table 3.5 : Randomly Arranged Concepts (nodes) Translated in Hausa

Gearbox (gearbox)	Clutch (klochi)	Propeller Shaft (farfelashaf)	Axle Drive (dravaxul)
Driven gears (kore giya) Driving gears (tukigiya) Spur gears (spur giya) Helical gears (helical giya) Connect (haduwa, nadaya) Parallel shafts (shaft layidaya) Non-intersection shafts (shafts bamahada) Examples (misali, nadaya) Example (missal, nabiyu) Connect (hadi, nabiyu) Consist of (kunchi, na da) Consist of (kunchi, nabiyu)	Fixed on (dauraakan) Pressure plate (fayi-fayiclochi) Clutch disc (klochi dis) Engine (engin) Input shaft (imputshaf) Consist of (kunshi, nadaya) Consist of (kunshi, nabiyu) Splinned to (daurakan, nabiyu) Splinned to (daurakan, nabiyu)	Connect (hada, nadaya) Spider (gizo-giz) Spider bearing (gizo-gizohali) Spider ring (gizogizozobe) Connect (hada, nabiyu) Consist of (kunshi, nadaya) Consist of (kunshi, nabiyu) Connect (hada, nauku) Sleeve yoke (hannunriga karkiya)	Connect (hada) Inboard joint talip (hadingwiwatalip) Axle hub (dairy cibiya) Tripod spider (tazigizo-gizo) Attached to (a hade) Has(yana da)

Note: Words in parentheses translations in Hausa

As presented in Appendix I, the concept maps scoring procedures, for Classification (CL) of one correct item under the transmission system, 0.5 point was given. For correct interconnection of item 1 and item 2 and indicate the formation of correct Valid Statement (VS), 1 point was allocated for the measure. 1.5 points was given to a respondent that related the formation of Valid Structure (VST) in order and that formed a logical structure, and 1 point each for any example (EX) given.

During the pilot study, time for the assessment test and the students' reactions for the task were observed in order to improve for the main study. Interpretation of the data collected from the concept maps assessment test for the main study was analyzed using descriptive statistics approach. Therefore, means, standard deviations and grand mean were computed for the descriptive statistics during the pilot study, and was also used to analyze the research question 1 of the main study.

The concept maps scoring rubrics used in the pilot study presented in Appendix I and the method of scoring presented in Figure 3.3 was used according to the need of this study. The criteria of CL were based on the acceptable items classified under each concept in the study. The criteria for VS represent acceptable items relevant to the intended concept created within the items to be connected. The formation of VST represents acceptable structure of the system relevance to the intended concept. The procedures employed for scoring system with no linking nodes or statements is as shown in Figure 3.3.

3.8 Data Collection Procedures

Data collection for this study was done in two phases after obtaining the approval letters see Appendices D1, D2 and D3 from the respective institutions involved in the study. This was basically done to assess the students' academic performances through the concept maps development, and to determine the areas of the ATS topics that were considered important for learning automobile transmission systems through the structured questionnaire.

3.8.1 First Phase: Students' Academic Performance Procedure

This phase of data collection for the students' academic achievements was done through the concept maps assessment test (see Appendix A1.) The concept maps assessment test is a graphical tool that enhances meaningful learning and at the same time, for assessing the students' academic achievement according to Ruiz-Primo *et al*. (2001). Students were trained on how to create the concept maps. During the training, students' were taught the basic structure, how to construct, and classify the concept maps based on the study objectives, followed by simple exercise. At the end of every lesson of each concept, students were provided with a sheet of A4 paper with a question printed on top edge of the paper written "what do you understand about gearbox, clutch, propeller shaft and drive axle"? respectively. This was to ensure that they are familiar with the construction of concept maps of the entire ATS concepts chosen for the study.

At the end of the training session, students were provided with the sheet of A4 paper for final assessment with the question printed on it. The items as areas of the concepts in Table 3.6 translated in Hausa medium was attached to the question in order to assist the students in assembling their internal understandings of the topics treated. It was done during semester I of 2014/2015 session for the duration of 45 minutes each. Therefore, Table 3.6 presents the combined overall proposed concept maps scores of the generated concept maps for all concepts graded independently. Students were scored in accordance to four levels of the concept maps. Details of the scoring procedure are presented in Appendix A2. Overall scores for each concept = (b + c + d +e)/ (total score) x 100% = X1 to X4 for the grades A to E obtained.

Table 3.6 : Proposed concept maps scores in %

Concepts	Total No. of Items (a)	CL	VS	VST 4 levels	EX 2	Overall Score for each Concept = (b+c+d+e)/total score X 100	Grades
		Total Score = (a) x 0.5 (b)	Total Score = (a) x 1 (c)	Total Score = 4 x 1.5 (d)	Total Score = 2 (e)		A B C D E 4 3 2 1 0
Gearbox	13	6.5	13	6	2	X1	
Clutch	10	5	10	6	2	X2	
Propeller	10	5	10	6	2	X3	
Shaft Axle drive	7	3.5	7	6	2	X4	

3.8.2 Treatment (Intervention)

Treatment or intervention refers to using the independent variables (medium of instruction and learning environment) on the dependent variable (students' academic performance). This was done to determine the significance of the independent variables on the dependent variables. During the treatment, the experimental groups were given treatment on the ATS topics using medium of instruction and learning environment. The control group was treated conventionally using English language. The instruments were translated to Hausa medium of instruction for the experimental group as was done during the pilot study. Same was administered to the learning environment group. This was to determine the effect of the medium of instruction on the equipments improvised by the researcher. But the control group was taught using English language. All groups were taught different topic at different times but chosen from the selected topics for the study.

The design for this research is related to true experimental research design but varies in some aspects. There was no randomization; intact class selection technique was employed for data collection. Diagrammatically, the design is as illustrated in Table 3.7. As shown in the table, Ge1 and Ge2 are the experimental groups of medium of instruction and learning environment. Gc is the control group. X1, Y1 and Z1 are the pre-test scores of Ge1, Ge2 and Gc groups respectively. X and Y indicate treatments given to G1 and G2 using medium of instruction and learning environment, while Gc was treated using English language. X2, Y2 and Z2 are the post-tests scores of G1, G2 and Gc respectively. Subjects were assigned through intact class technique for all treatments. Independent variable effects were measured on the dependent variables.

Table 3.7 : Treatment procedure

Groups	Pre-Test	Treatment	Post-Test
Ge1= Experiment 1	X1	X (Medium of instruction)	X2
Ge2 = Experiment 2	Y1	Y(Learning environment)	Y2
Gc = Control	Z1		Z2

3.8.3 Second Phase: To Determine Important Areas of ATS topics to Develop the Model

The second phase of the data was collected from automobile engineering experts through 40 items structured questionnaire see Appendix B. This was done for determining the ATS areas considered important to develop a conceptual model to enhance students' learning in AE course. Data were collected and analyzed based on the experts' opinion on the important areas of ATS after introducing Hausa as medium of instruction for learning the ATS in Nigerian tertiary institutions offering AE course.

3.9 Method of Data Analysis

Data were analyzed with the use of suitable methods and statistical tools as presented in Table 3.8. The data obtained from the study was analyzed based on descriptive statistics, stepwise linear regression analysis and structural equation modelling with Statistical Package for Social Science (SPSS) version 21 and AMOS version 18 respectively. The results of the analyses are statistically discussed for answering specific research questions and response to the corresponding hypotheses. The grand mean results were used to answer research questions 1, 2 and 3. That is, the students' academic performance in each group as well as comparing the performances in each topic through t-test analyses followed by pair wise t-test analyses. stepwise linear regression analyses results presented the results of the ATS areas considered important by the experts for learning which answered research question 4, while structural equation modelling technique through the use of AMOS presented the results of the relationships between the areas considered important on the automobile transmission systems topics. AMOS results were used to answered research question 5. Finally, the general findings of the analyses answered research question 6. Therefore, Table 3.8 presents the methods of the analysis for each research question with the corresponding research objectives.

Table 3.8 : Methods and purpose of data analysis

Objective	Instruments		Method of Analysis
	Concept Maps Assessment Test		
	RQs	**Information on:**	
Determine the effect of Hausa medium for instruction on ATS students' academic performance in Nigerian tertiary institutions offering AE course.	RQ1.	Students' Academic performance in ATS topics using Hausa medium of instruction in Nigerian tertiary institutions offering AE course.	Descriptive Statistics, Mean , Grand Mean and Standard Deviation
Determine the effect of learning environment using Hausa as medium of instruction on ATS students 'academic performance in Nigerian tertiary institutions offering AE course.	RQ2	Students' Academic performance in ATS topics using Hausa medium of instruction in Nigerian tertiary institutions offering AE course.	
Determine the effect of English medium for instruction on ATS students' academic performance in Nigerian tertiary institutions offering AE course.	RQ3	Students' academic performance in ATS topics using Hausa medium of instruction in Nigerian tertiary institutions offering AE course.	
Determine the areas considered important of ATS topic in Nigerian tertiary institutions offering AE course.	Structured Questionnaire		Stepwise Linear Regression (SLR) Analysis
	RQ4	Areas considered important of ATS topics in Nigerian tertiary institutions offering AE course.	
Determine the relationships of established areas considered important of ATS in Nigerian tertiary institutions offering AE course.	RQ5	Relationships between areas considere important on ATS topics using controlled and experimental groups in Nigerian tertiary institutions offering AE course.	Structural Equation Modeling (SEM)
Develop a conceptual model of areas considered important of ATS topics in Nigerian tertiary institutions offering AE course	RQ6	Topics considered important for learning ATS topics in Nigerian tertiary institution offering AE course.	

3.9.1 Grand Mean

The grandmean in this study is the mean of the means (Field, 2009; Everitt and Skrondal, 2002) on which the students' academic performance in ATS topics using Hausa as the medium of instruction was based. The scores of the students on each topic were computed for a measure of the dependent variables and the means of the measurements from every topic were computed. The mean of the measures from each topic constitutes the topic mean. The mean of the topics mean is then the grand mean that determined the respondent's academic performance in the ATS topics.

3.9.2 Regression Analysis

Regression analyses, specifically stepwise linear regression analysis was employed to answer research question 4. This technique was chosen because of its appropriateness in evaluating the level of relevance of each independent variable in relation to the dependent variable. The analyses presented four topics of ATS with the areas considered important in this research according to their level of importance.

3.9.3 Requirements for Using Analysis of Moment of Structure (AMOS)

For answering research question 5, AMOS was used. In order to get satisfactory results in AMOS, a minimum of 100 students are recommended according to Rahman*et al*. (2015); Arbuckle (2007) and Bacon and Bacon (1997). With the use of 331 students, maximum estimate was achieved, although according to these researchers, at least 100 sample sizes is more appropriate. Thus, the sample of 331 respondents used in this study is sufficient enough to achieve satisfactory results. Consequently, in this research sample sizes, more than 100 subjects per construct variable were used

3.9.4 Sstructural Equation Modeling (SEM) as a Technique

Structural Equation Modelling (SEM) as a technique via Analysis of Moment of structure (AMOS) was specifically used to analyze the initial and modified measurement models of medium of instruction on ATS topics. During the analyses, jointly the number of factors and their indicators were explicitly specified as described by Kline (2005). The purpose of AMOS was also to determine the factor structure within a measurement model and to confirm how well the model fits the data according to Bollen (1989). Established procedure on the proposed sequence of steps for SEM has been provided by several researchers. The model evaluation started with an evaluation of parameter estimates, such as square multiple correlations (R^2), followed by the examination of model fit as described by Joreskog and Sorbom (1996). When the model fit was poor, various diagnostic indicators such as standardized residuals, regression weights, and the modification indices according to Koufteros (1998) were properly considered. According to him, most standardized residuals should be less than 2.0 in absolute value for correlation models. Besides, other indicators also affected the fit performance of the proposed model. This included multivariate normal distribution and covariances. Multivariate normality of all observed variables was standard distribution assumptions in the structural equation modeling. A sample was considered to be multivariate when normality distributed at 0.05 level of significance and the critical ratio was smaller than 1.96, indicating that the coefficient of multivariate kurtosis was not significantly different from zero according to Mardia (1970). However, the multivariate Kurtosis can be large and multivariate non-normality can be extreme (critical ratio >1.96) even if univariate skewness and/or Kurtosis range between (-1.00 to +1.00) recommended by Muthen and Kalpan (1985) was obtained from most of variables in data. Based on the value of critical ratio of 1.96, some multivariate might be included in the sample, and therefore, should not be used as the standard value (Gao *et al.*, 2007; and Kline, 2005). Therefore, modified measurement model which complied and fit well to the data based on the default indices were considered as an appropriate answer for specific research question.

3.9.5 Model Construction and Development

There are several parameters indices used in assessing the goodness of fit of every model developed through structural equation modeling. The default model indices are clearly summarised in table 3.9 according to several researchers. According to Browne and Cudeck (1993) and Kocalevent*et al.* (2007), the root mean square error of approximation (RMSEA) is a measure of the discrepancy per degree of freedom for a model. Value of about 0.05 or less indicate a close fit of a model to a data, and values of about 0.08 or less indicates a reasonable error of approximation.

According to Kline (1998) and Hoe (2008), Comparative Fit Index (CFI) is an incremental fit index with value greater than 0.90, but should not exceed 1.0. This indicates a good data fit. Likewise, according to Hu and Bentler (1999); Bryne (2001), Root Mean square Residual (RMR) values less than 0.05 indicate an acceptable fit value. The advantage of Comparative Fit Index (CFI) is that, it is less sensitive to sample sizes (Kline, 1998). Therefore, in developing the model for learning ATS, the Incremental Fit Index (IFI) and Tucker-Lewis Index (TLI) were observed. The closer the fit values to one, the better the goodness of fit of the model to the data collected. This was advocated by Arbuckle (2007) and Cunningham (2006). The normed χ^2 was also observed. It is the ratio of the χ^2 to its degree of freedom. Commonly it is subjective or practical index of fit, typically used as addition to the χ^2 statistics (Bryne, 2010). Values below 1.0 indicate an “over-fitted” model according to Schumacker and Lomax (1996), and values greater than 2.0 or more liberal limit of 5.0; indicate that the model does not fit the observed data and needs improvement. For a good model fit, the ratio x^2/df should be as small as possible. Since there is no absolute standard according to a Schermelleh-Engel *et a.* *(*2003), the ratio between 2 and 3 is indicative of a good or acceptable data. Model fit commonly used is χ^2 statistics (χ^2/df ratio of 3 or less) according to Hoe (2008).

Therefore, during the analyses, the following parameters as discussed above were observed. The Root Mean Square Error of Approximation RMSEA) also called population-based index, measured the discrepancy per degree of freedom for the model. A rule of thumb is that RMSEA ≤ .05 (Kline, 2005; Cunningham, 2006) which indicated close or approximate fit, values between 0.05 and 0.08 suggest reasonable error of approximation (Cunningham, 2006) and RMSEA ≥0.10 suggests poor fit (Browne and Cudeck, 1993). Therefore, Table 3.9 summarises the model fit evaluation indices for valid good model (Kenny *et al.*, 2014).

3.9.6 Model Fit Evaluation Indices

During the ATS model construction and development, the indices values described above by various researchers in section 3.9.5 for good model fit were adapted. The model was evaluated as good for learning automobile transmission systems based on the summary of the default model indices parameter values in Table 3.9. The ratio of the chi-square and degree of freedom (x^2/df) at significance level $p < 0.05$ statistical value was observed. Other parameters such as Goodness of Fit Index (GFI), Tuker Lewis Index (TLI) and Comparative Fit Index (CFI) in Table 3.9 are presented to explain the range of model fit values. Root Mean Square Residual (RMSR) and Root Mean Square Error of Approximation (RMSEA) were used to explain the mean covariance residuals and Fit index precisions.

Table 3.9 : Default model fit evaluation indices adapted from Kenny, *et al*. (2014)

Model Fit Indices	Range Values	p
Chi Square (x^2/df)	< 0.30	
Goodness of Fit Index (GFI)	≥ 0.90	
Incremental Fit Index (IFI)	≥ 0.90	
Tucker-Lewis Index (TLI)	≥ 0.90	.000
Comparative Fit Index (CFI)	≥ 0.90	
Root Mean Square Residual (RMSR)	≤ 0.05	
Root Mean Square Error of Approximation (RMSEA)	≥ 0.05	

3.10 Research Operational Framework

Research operational framework adapted from Driessen*et al.* (2014) refers to the procedures or steps followed for the feasible outcome of the study. Below shows step by step procedures followed during the conduct of this study.

i) The purpose and objectives was defined
ii) Thorough literature review was conducted for other researches with the same population or topic
iii) The design of the research was determined, specifically, quantitative design method
iv) Relevant variables were justified
v) Research instruments (concept maps assessment test and structured questionnaire were developed and translated to Hausa medium.
vi) Instruments were validated by experts and final changes were made
vii) Instruments were pilot tested
viii) Reliabilities of the instruments was determined
ix) Data was collected through concept maps assessment test and analyzed to determine the students' academic performance
x) Questionnaire was later administered for model development based on the respondent' opinions for using Hausa as medium of instruction
xi) Discussion of the results
xii) Finally, after recommendations and suggestions for further studies were proffered, conclusion of the research was drawn.

These procedure enumerated above were transformed into graphical operational framework as presented in Figure 3.4. The figure served as an overall guideline throughout the entire study effort. Some modifications on particular procedures were made in order to make sure they are suitable for the research purpose. These essential procedures were combined with other approaches of stepwise linear regression analysis and structural equation modelling as suggested by other researchers across various field of studies. This detailed framework was followed for the entire study for developing a conceptual model for learning automobile transmission systems in Nigerian tertiary institutions offering AE course. This involved assessing the students' academic performance in ATS topic using Hausa as medium of instruction across three tertiary institutions: Abubakar Tafawa Balewa University Bauchi, Federal University of Technology, Yola, and University of Maiduguri, Nigeria.

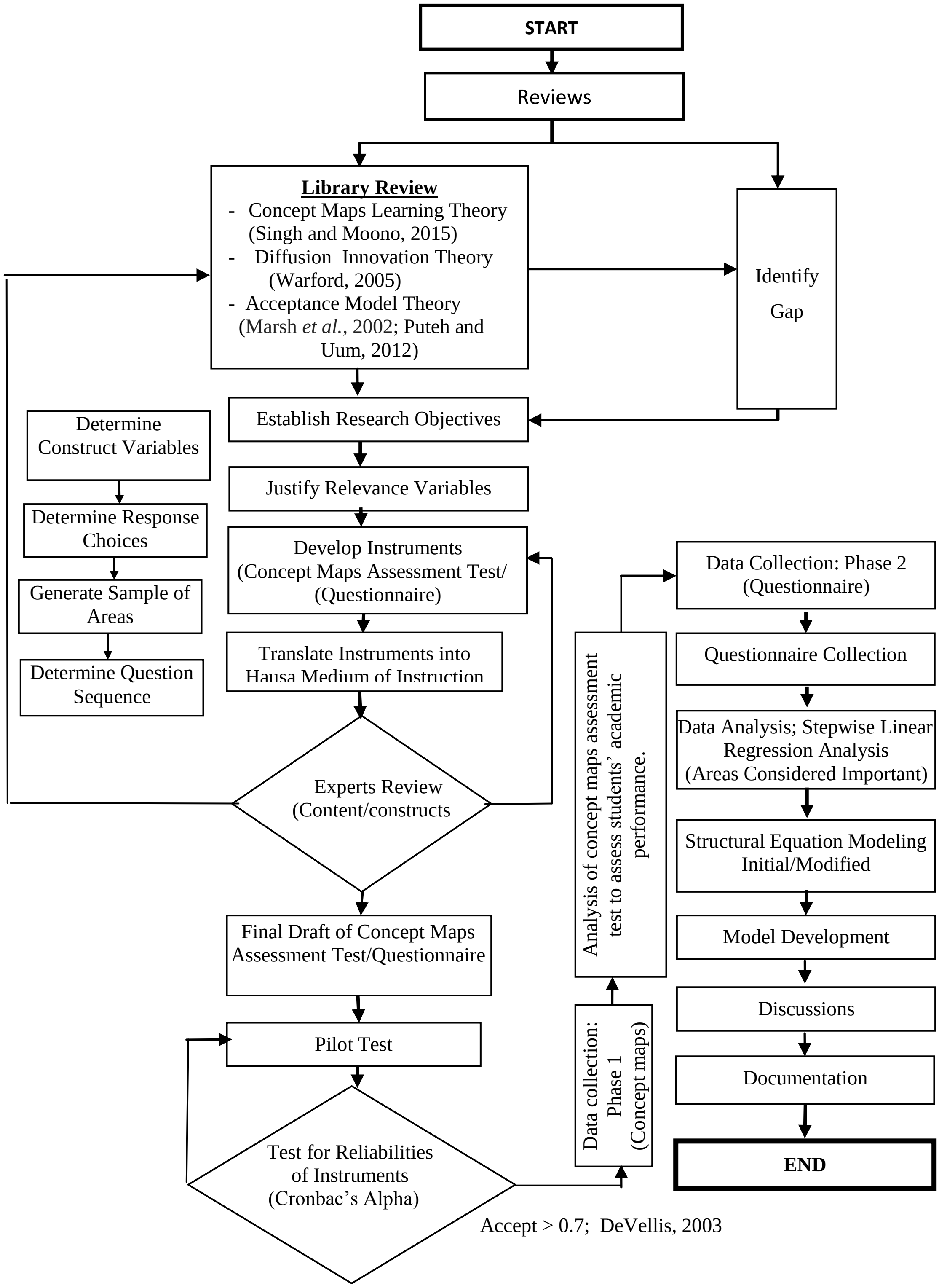


Figure 3.4 : Research operational frameworks

CHAPTER 4

RESULTS

4.1 Introduction

The purpose of this research was to develop a conceptual model for learning Automobile Transmission Systems (ATS) in Nigerian tertiary institutions offering automobile engineering (AE) course. This was done after the assessment of the students' academic performance through Hausa medium of instruction. In achieving this particular objective, related topics - gearbox, clutch, propellers shaft and axle drive were considered. Concept maps performance test data was used to assess students' academic performance, while data obtained from the experts through structured questionnaire was used to determine the important areas of the topics treated as well as for developing the conceptual learning model. The data were compiled into Statistical Package for Social Science (SPSS) Version 21 for assessing the students' academic performance based on the mean, grand mean, and the standard deviations of the students 'scores. While the questionnaire was used to solicit for the experts opinion on the areas considered important through Hausa as medium of instruction and was analyzed through Stepwise Linear Regression Analysis (SLR) via Structural Equation Modeling (SEM) respectively.

Descriptive statistics analyses were used to determine the students' academic performance in research questions 1, 2 and 3; while SLR analyses were used to determine the areas considered important based on their predictions in a regression model in research question 4. SEM through Analyses of Moment of Structure (AMOS) was used to establish the relationships between the areas considered important of the ATS topics in research question 5. Through SEM analyses, the initial and modified measurement models were tested for the interrelations between the identified areas. This was based on the model fit indices parameters. As a result, data analyses were divided into; (1) analyses of students' academic performance, (2) SLR analyses to identify important ATS areas, and (3) SEM analyses of structural equation modelling. Therefore, this chapter presents Tables of results of the analyses based on the research questions followed by the corresponding hypothesis as set out in Chapter 1.

4.2 Analyses of Students' Academic Performance

This section presents the analyses of the students' academic performance results using descriptive statistics based on the means, grand mean and standard deviation. The analyses of the data obtained through concept maps assessment tests were used to answer research question 1, 2 and 3 subsequently followed by responses to the corresponding hypothesis. To assess the students' academic performances, the assessment grading system equivalent to the grading system provided in the Nigerian national policy on education by the Federal Ministry of Education (FME, 2012) was adapted as presented in Appendix A2. Figure 4.1 shows a concept maps assessment test diagram drawn by a student on an A4 sheet of paper. The candidate did not include propeller shaft, therefore no score obtained for that part. Similar scoring rubric as presented in Appendix I was used to determine the academic performance of the students for research questions 1, 2 and 3.

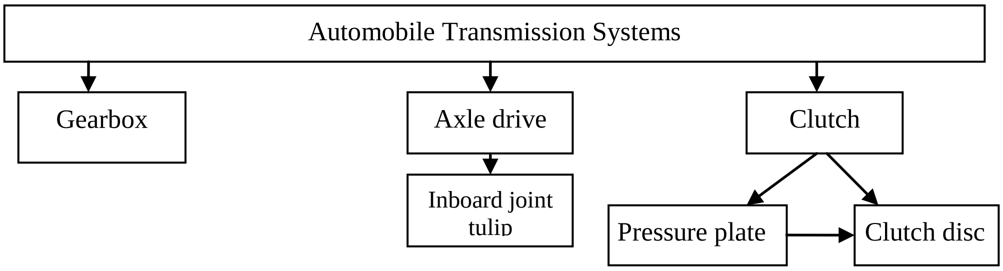


Figure 4.1 :A4 Sheet of paper used by a respondent

4.2.1 Research Question 1:

What is the effect of using Hausa as medium of instruction on students' academic performance in learning ATS topics in Nigerian tertiary institutions offering AE course?

4.2.2 Hypothesis 1:

There is no significant difference on the students' academic performance between controlled and treatment groups after introducing Hausa as medium of instruction in Nigerian tertiary institutions offering AE course.

Students' academic performances and significant differences between controlled and treatment groups are presented based on the ATS topics treated. These are done after every analysis and are followed by the pair wise t-test analysis in each topic. The topics are - gearbox, clutch, propeller shaft and drive axle presented as follows:

Table 4.1 presents analyses of the pretest scores of students in Hausa group. The mean, grand mean and standard deviation scores of students in gearbox are 13.59, 12.91 and 2.46, with the corresponding minimum and maximum scores of 8.00 and 19.00. In clutch, the entire students obtained the mean and standard deviation of 13.44 and 2.35 with the minimum and maximum scores of 7.00 and 17.00. In propeller shaft, the students obtained the mean and standard deviation of 11.56 and 1.98 with the corresponding minimum and maximum scores of 7.00 and 16.00, while in axle drive, students obtained mean and standard deviation of 13.06 and 3.31 with the corresponding minimum and maximum scores of 6.00 and 20.00 respectively. The general remark of the students in pretest scores is fail (see Appendix A2.)

Table 4.1 : Analyses of pretest scores of students in Hausa group.

ATS Topics	N	Minimum Score	Maximum Score	Mean	Grand Mean	Standard. Deviation.	Remark
Gearbox.	108	8.00	19.00	13.59		2.46	
Clutch	108	7.00	17.00	13.44	12.91	2.35	Fail
Prop. Shaft	108	7.00	16.00	11.56		1.98	
Axle Drive	108	6.00	20.00	13.06		3.31	

Table 4.2 presents the posttest scores of students in Hausa group with an overall grand mean of 35.99 which indicates moderate result (see Appendix A2.) The students obtained the mean and standard deviation of 36.63 and 4.61 in gearbox with the corresponding minimum and maximum scores of 22.00 and 47.00. In clutch, students obtained mean and standard deviation of 33.53 and 4.91 with the corresponding minimum and maximum scores of 20.00 and 48.00. In a propeller shaft, the students obtained mean and standard deviation of 36.80 and 7.06 with minimum and maximum scores of 26.00 and 50.00. In axle drive, the students obtained mean and standard deviation of 36.98 and 6.46 with the corresponding minimum and maximum scores of 28.00 and 49.00 respectively. The overall remark of students in posttest scores indicated pass as presented in Appendix A2.

Table 4.2 : Analyses of posttest scores of students in Hausa

ATS Topics	N	Minimum score	Maximum score	Mean	Grand Mean	Standard Deviation	Remark
Gearbox	108	22.00	47.00	36.63		4.61	
Clutch	108	20.00	48.00	33.53	35.99	4.91	Moderate
Prop. Shaft	108	26.00	50.00	36.80		7.06	
Axle Drive	108	28.00	49.00	36.98		6.46	

Table 4.3 shows the pair t-test comparison between pretest and posttest scores of students in Hausa group for all ATS topics. From the Table, the pair1 t-test comparison analyses on gearbox shows the mean difference of 23.04, standard deviation of 5.28, standard error of .51, lower and upper bounds of 22.03 and 24.04, calculated t-value of 45.38, degree of freedom (df) of 107 and significant value (Sig.) of .000. Based on the general significance of alpha value decision, it states that, if t-calculated is greater than the t-critical at the significance level of .05, statistically significant difference between the performances exists. Likewise, if t-calculated is less than critical t-value at .05 levels, no statistically significant difference exists. Therefore, since t-cal (45.38) is greater than t-critical (1.66) in Appendix G (A) at .05 level of significance, this implies that there is significant differences between the academic performance scores in pre-test and post-test of the students in Hausa group. Therefore, sub hypothesis 1(a) which states: there is no significant difference of the students' academic performance between pretest and posttest scores of Hausa group after introducing Hausa as medium of instruction in Nigerian tertiary institutions offering AE course is rejected for gearbox.

On the other hand, from the Table, pair 2 t-test comparison analyses of the students in clutch shows the mean score of 20.08, standard deviation of 5.51, standard error of .53, lower and upper bounds of 9.03 and 1.13, calculated t-value (t-cal) of 37.88, degree of freedom (df) of 107 and significance (sig.) of value .000. The t-cal (37.88) is also greater than 1.66 as shown in Appendix G (A) at the significance level of 0.05. This indicates that the result is significantly different between the performance scores in pre-test and post-test of the students in Hausa group. Sub hypothesis 1(a) which states that: there is no significant difference on the students' academic performance between pretest and posttest scores of Hausa group after introducing Hausa as medium of instruction in Nigerian tertiary institutions offering AE course is also rejected for clutch.

Furthermore, in pair 3 t-test comparison analyses of students in propeller shaft, it shows a mean difference of 25.24, standard deviation of 7.45, standard error of .72, lower and upper bounds of 3.82 and 6.66, calculated t-value (t-cal) of 35.19, degree of freedom (df) of 107 and significance (sig.) value of .000. The t-cal (35.19) obtained is greater than 1.66 see Appendix G (A) at 0.05 significance level. This also implies that there is significant difference between the academic performance scores in pre-test and post-test of the students in Hausa group. Therefore, sub hypothesis 1(a) which states that: There is no significant difference on the students' academic performance between pretest and posttest scores of Hausa group after introducing Hausa as medium of instruction in Nigerian tertiary institutions offering AE course is again rejected for propeller shaft.

Finally, in pair 4 t-test comparison analyses of the drive axle, it shows a mean difference of 23.93, standard deviation of 6.96, standard error of .67, lower and upper bounds of 2.60 and 5.25, calculated t-value (t-cal) of 35.73, degree of freedom (df) of 107 and significance (sig.) value of .000. The t-calculated (35.73) is greater than 1.66 at .05 significance level as shown Appendix G (A). The results also indicate that there is significant difference between the academic performance scores in pre-test and post-test of the students in Hausa group. Therefore, sub hypothesis 1(a) was also rejected for axle drive.

Table 4.3 : Pair t-test analyses on the differences between pre-test and post-test scores of students in Hausa group

ATS Topics		Paired Differences					t-cal.	df.	Sig.
		Mean	Standard. Deviation	Standard Error	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair1	Gearbox Post-test Gearbox Pre-test	23.04	5.28	.51	22.03	24.04	45.38	107	.000
Pair 2	Clutch Post-test Clutch Pre-test	20.08	5.51	.53	9.03	21.13	37.88	107	.000
Pair 3	Pro. Shaft Post-test Pro. Shaft Pre-test	25.24	77.45	.72	3.82	26.66	35.19	107	.000
Pair 4	Axle Dr Post-test Axle Drive Pre-test	23.93	66.96	.67	2.60	25.25	35.73	107	.000

4.2.3 Research Question 2

What is the effect of learning environment using Hausa as medium of instruction on students' academic performance in learning ATS topics in Nigerian tertiary institutions offering AE course?

4.2.4 Hypothesis 2

There is no significant difference on the students' academic performance between pretest and posttest scores in learning environment group after introducing Hausa as medium of instruction in Nigerian tertiary institutions offering AE course

Table 4.4 shows the analyses of pretest scores of students in ATS topics. The overall grand mean of the pre-test scores of the students in the group is 11.53. The mean and standard deviation scores of the students in gearbox are 11.87 and 2.39 with the corresponding minimum and maximum scores of 8.00 and 18.00. In clutch, the students obtained mean and standard deviation of 11.73 and 1.68 with the minimum and maximum scores of 8.00 and 19.00. In propeller shaft, they obtained mean and standard deviation of 12.16 and 1.52 with minimum and maximum scores of 10.00 and 15.00. In drive axle, students obtained mean and standard deviation of 10.34 and1.73 with minimum and maximum scores of 6.00 and 13.00. The general remark of the students in pretest scores is fail as presented in Appendix A2.

Table 4.4 : Analyses of the pretest scores of students in learning environment group

ATS Topics	N	Minimum Score	Maximum Score	Mean	Grand Mean	Standard Deviation	Remark
Gearbox	108	8.00	18.00	11.87		2.39	
Clutch	108	8.00	19.00	11.73	11.53	1.68	Fail
Prop. Shaft	108	10.00	15.00	12.16		1.52	
Axle Drive	108	6.00	13.00	10.34		1.73	

Table 4.5 presents the posttests analyses of students in learning environment group. The Table shows the overall grand mean score of the students in the group as 38.06 indicating highly moderate as presented in Appendix A2. The mean and the standard deviation of the students in gearbox is 39.61 and 6.28 with the minimum and the maximum scores of 22.00 and 48.00. In clutch, students obtained mean and standard deviation of 38.74 and 6.56, with the corresponding minimum and maximum scores of 28.00 and 49.00. In propeller shaft, students obtained mean and standard deviation of 36.78 and 7.03, with the minimum and maximum scores of 27.00 and 51.00. Finally, in drive axle, students obtained mean and standard deviation of 37.12 and 6.85 with the corresponding minimum and maximum scores of 16.00 and 49.00 respectively.

Table 4.5 : Analyses of posttest scores of students in learning environment group

ATS Topics	N	Minimum Score	Maximum Score	Mean	Grand Mean	Standard Deviation	Remark
Gearbox	108	22.00	48.00	39.61		6.28	
Clutch	108	28.00	49.00	38.74	38.06	6.56	Highly Moderate
Prop. Shaft	108	27.00	51.00	36.78		7.03	
Axle Drive	108	16.00	49.00	37.12		6.85	

Table 4.6 shows the pair t-test analyses comparison between the pretest and post-test scores of students in learning environment group for all the ATS topics. In pair1 t-test comparison analyses, it shows the mean difference of 27.74, standard deviation of 6.72, standard error of .65, lower and upper bounds of 26.46 and 29.02, calculated t-value (t-cal) of 42.90, degree of freedom (df) of 107 and significance (sig.) value of .000. Based on the decision criteria, the calculated t-value (42.90) obtained from the SPSS was greater than 1.66 at .05 significance level see Appendix G (A). This indicates that there is significant difference between the mean scores of the pre-test and the post-test scores in gearbox. Therefore, sub hypothesis 1(b) which states: There is no significant difference on the students' academic performance between pretest and posttest scores in learning environment after introducing Hausa as medium of instruction in Nigerian tertiary institutions offering AE course was rejected for gearbox.

Furthermore, pair 2 t-test comparison analyses of clutch shows that the mean difference of the students is 27.01, standard deviation of 6.89, standard error of .66, lower and upper bounds of 5.70 and 28.32, t-calculated (t-cal) of 40.75, degree of freedom (df) of 107 and significance (sig.) value of .000. Since t-cal (40.75) is greater than 1.66 at significance level of .05 as seen in Appendix G (A), it implies that there is significant difference between the academic achievement in pretest and the post-test scores of the students in clutch. Therefore, sub hypothesis 1(b) which states: There is no significant difference on the students' academic performance between pretest and posttest scores in learning environment group after introducing Hausa as medium of instruction in Nigerian tertiary institutions offering AE course is also rejected for clutch.

In addition, in pair 3 of propeller shaft, the t-test comparison shows the mean difference of 24.63, standard deviation of 7.19, standard error of .69, lower and upper bounds of 23.26 and 26.00, calculated t-value (t-cal) of 35.59, degree of freedom (df) of 107 and significance value of .000. The t-cal value (35.59) is greater than 1.66 as shown in Appendix G (A) at .05 significance level. This implies that there is significant difference between the students' academic performance in pre-test and post-test mean scores in propeller shaft. Hence, sub hypothesis 1(b) which states: There is no significant difference on the students' academic performance between pretest and posttest scores in learning environment group after introducing Hausa as medium of instruction in Nigerian tertiary institutions offering AE course is again rejected for propeller shaft.

Finally, in pair 4 t-test comparison analyses, it shows a mean difference of 26.78, standard deviation of 7.06, standard error of .68, lower and upper bounds of 5.43 and 28.12, calculated t-value (t-cal) of 39.43, degree of freedom (df) of 107 and significance (sig.) value of .000 for axle drive. Since t-cal (39.43) is greater than 1.66 at .05 significance level shown in Appendix G (A), significant difference between the academic performance in pretest and posttest scores of the students in axle drive exist. Sub hypothesis 1(b) which states: There is no significant difference on the students' academic performance between pretest and posttest scores in learning environment group after introducing Hausa as medium of instruction in Nigerian tertiary institutions offering AE course is again rejected for axle drive.

Table 4.6 : Pair t-test analyses on the differences between the pretest and posttest scores of students in learning environment group.

ATS Topics		Paired Differences					t_{Cal}	f	Sig.
		Mean	Standard Deviation	Standard Error	95%Conf. Interval of the Difference				
					Lower	Upper			
Pair 1	Gearbox Post-test Gearbox Pre-test	27.74	6.72	.65	26.46	29.02	42.90	107	.000
Pair 2	Clutch Post-test Clutch Pre-test	7.01	6.89	.66	5.70	28.32	40.75	107	.000
Pair 3	Prop. Shaft Post-test	4.63	7.19	.69	23.26	26.00	35.59	107	.000
	Prop. Shaft Pre-test	6.78	7.06	68	5.43	28.12	39.43	107	.000
Pair 4	Axle Drive Post-test Axle Drive Pre-test								

4.2.5 Research Question 3

What is the effect of using English as medium of instruction on students' academic performance in learning ATS topics in Nigerian tertiary institutions offering AE course?

4.2.6 Hypothesis 3

There is no significant difference on the students' academic performance between controlled and treatment groups after introducing English as medium of instruction in Nigerian tertiary institutions offering AE course.

Table 4.7 shows that students in English group have an overall grand mean of score of 14.42 with a general remark of fail as presented in Appendix A2. The group has the mean and standard deviation of 15.90 and 2.25 in gearbox with the corresponding minimum and maximum scores of 11.00 and 19.00. In clutch, the students obtained mean and standard deviation of 14.69 and 2.22 with the corresponding minimum and maximum scores of 10.00 and 19.00 respectively. In Propeller shaft, the students obtained mean and standard deviation of 14.73 and 3.60 with minimum and maximum scores of 3.00 and 22.00. Finally, the group obtained the mean and standard deviation of 12.36 and 4.50 with the corresponding minimum and maximum scores of 2.00 and 19.00 in axle drive respectively.

Table 4.7 : Analyses of pretest scores of students in English group

ATS Topic	N	Minimum Score	Maximum Score	Mean	Grand Mean	Standard Deviation	Remark
Gearbox	325	11.00	19.00	15.90		2.25	
Clutch	325	10.00	19.00	14.69	14.42	2.22	
Prop. Shaft	325	3.00	22.00	14.73		3.60	Fail
Drive Axle	325	2.00	19.00	12.36		4.50	

Table 4.8 below presents the analysis of posttest scores of students for English group. The Table shows overall grand mean scores of students to be 14.11 with a general remark of fail as presented in Appendix A2. The mean and standard deviation scores of the students in gearbox are 15.14 and 2.35, with minimum and maximum scores of 8.00 and 19.00. In clutch, students have mean and standard deviation of 15.00 and 2.13, minimum and maximum scores of 8.00 and 21.00. In propeller shaft, the mean and standard deviation of the students are 12.33 and 2.71, minimum and maximum scores of 5.00 and 16.00. Finally, the students obtained a mean and standard deviation of 13.95 and 2.80 with the corresponding minimum and maximum scores of 6.00 and 19.00 in axle drive respectively.

Table 4.8 : Analyses of post-test scores of students in control group.

ATS Topic	N	Minimum Score	Maximum Score	Mean	Grand Mean	Standard Deviation	Remark
Gearbox.	109	8.00	19.00	15.14		2.35	
Clutch.	109	8.00	21.00	15.00	14.11	2.13	
Prop. Shaft,	109	5.00	16.00	12.33		2.71	Fail
Axle Drive	109	6.00	19.00	13.95		2.80	

Table 4.9 presents the pair t-test comparison between pretest and prosttest scores of the students in controlled group for all the ATS topics. From the Table, pair1 t-test comparison analyses shows the mean difference of .96, standard deviation of 2.88, standard error of .28, lower bound and upper bounds of .38 and 1.47, calculated t-value (t-cal) of 3.35, degree of freedom (df) of 108 and significance (sig.) value of .001. T-calculated value (3.35) obtained is greater than 1.66 at .05 significance level see Appendix G (A). This indicates that there is significant difference between the academic performance in protest and posttest mean scores of the students in gearbox. Therefore, sub hypothesis 1(c) which states: There is no significant difference on the students' academic performance between pretest and posttest scores of English group after introducing Hausa as medium of instruction in Nigerian tertiary institutions offering AE course in gearbox is rejected.

Furthermore, the pair 2 t-test comparison analysis on clutch shows the mean difference of .94, standard deviation of 3.43, standard error of .33, lower and upper bounds of .28 and .59, calculated t-value (t-cal) of 2.83, degree of freedom (df) of 108 and significance (sig.) value of .006. The t-cal value (2.83) obtained is greater than 1.66 at .05 significance level see Appendix G (A). This indicates that significant difference between the academic achievement in pre-test and post-test scores of students in clutch exist. Therefore, sub hypothesis 1(c) which states: There is no significant difference on the students' academic performance between pretest and posttest scores of English group after introducing Hausa as medium of instruction in Nigerian tertiary institutions offering AE course rejected for clutch.

In addition, in pair3 t-test for propeller shaft, the comparison between pretest and posttest of students shows a mean difference of 1.05, standard deviation of 4.44, standard error of .43, lower and upper bounds of .20 and .89, calculated t-value (t-cal) of 2.45, degree of freedom (df) of 108 and significance (sig.) value of .016. T-calculated (2.45) is greater than 1.66 at .05 significance level see Appendix G (A). This also indicates that there is significant difference between the academic performance scores in pretest and post- test of the students in propeller shaft. Sub hypothesis 1(c) which states: There is no significant difference on the students' academic performance between pretest and posttest scores of English group after introducing Hausa as medium of instruction in Nigerian tertiary institutions offering AE course for propeller shaft is also rejected.

Likewise in the axle drive, pair 4 t-test comparison between pre-test and posttest of the students shows a mean difference of 1.51, the standard deviation of 4.69, standard error of .45, lower and upper bounds of .62 and .40, calculated (t-cal) of 3.35, degree of freedom (df) of 108 and significance (sig.) value of .001. T-calculated (3.35) is greater than t-critical (1.66) at .05 level of significance shown in Appendix G (A). This indicates that there is significant difference between the academic performance scores in protest and posttest of the students in axle drive of the English group. Sub hypothesis 1(c) which states: There is no significant difference on the students' academic performance between pretest and posttest scores of English group after introducing Hausa as medium of instruction in Nigerian tertiary institutions offering AE course is again rejected for axle drive.

Table 4.9 : Pair t-test analyses of the differences between pretest and posttest scores of the students in controlled group

ATS Topics		Paired Differences					t_{Cal}	df	Sig.
		Mean	Standard Deviation	Standard Error	95% Conf. Interval of the Difference				
					Lower	Upper			
Pair 1	Gearbox Post-test Gearbox Pre-test	.96	2.88	.28	.38	1.47	3.35	108	.001
Pair 2	Clutch Post-test Clutch Pre-test	.94	3.43	.33	.28	.59	2.83	108	.006
Pair 3	Prop. Shaft Post-test Prop. Shaft Pre-test	1.05	4.44	.43	.20	.89	2.45	108	.016
Pair 4	Axle rive Post-test Axle Drive Pre-test	1.51	4.69	.45	.62	.40	3.35	108	.001

Research Question 1 states: What is the effect of using Hausa medium of instruction on students' academic performance in learning ATS topics in Nigerian tertiary institutions offering AE? This was done based on the respective groups and topics in the previous sections as indicate during treatment for data collection procedures. The corresponding hypotheses 1(a) to 1(c) discussed in the previous sections which stated that: there is no significant difference between the mean pretest and posttest scores of the students in Hausa group, learning environment and English groups respectively are further examined to determine in which group the significant differences exists.

Table 4.10 summarizes the result of the intervention effects of the independent variables (Hausa and learning environment) using Hausa as medium of instruction on the dependent variables (students' academic performance). The Table presents the analyses of the posttest mean scores of the students' academic performance in 3 groups. It indicates that English group has posttest mean and standard deviation scores of 59.204 and 5.815, standard error of .559, minimum and maximum scores of 43.00 and 72.00 with the corresponding lower and upper bounds of 58.095 and 60.313 respectively. On the other hand, Hausa group has mean and standard deviation scores of 153.648 and 15.670, standard error of 1.507, minimum and maximum scores of 116.00 and 190.00 with the corresponding lower and upper bounds of 150.659 and 156.637, while learning environment group has mean and standard deviation of 152.472 and 12.372, standard error of 1.190, minimum and maximum scores of 122.00 and 184.00 respectively. Based on these analyses, there is statistically significant difference between the mean scores of the students' academic performances within and between the groups.

Table 4.10 : Analyses of posttest scores of students in Hausa, Learning environment and controlled groups.

Groups	N	Mean	Standard Deviation	Standard Error	95% Conf. Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Controlled	108	59.204	5.815	.559	58.095	60.313	43.00	72.00
Hausa	108	153.648	15.670	1.507	150.659	156.637	116.00	190.00
Learning Environment	109	152.472	12.372	1.190	150.112	154.832	122.00	184.00
Total	325							

Analysis of Variance (ANOVA) summary results in Table 4.11 shows that between and within English, Hausa and learning environment groups, the sum of squares are 634325.488 and 46269.065 with degree of freedoms (df) of 2 and 322, mean squares of 317162.744 and 144.140 respectively. The computed F-value is 2200.374 at significance level of .000. In this case, significant difference of the students' academic performances after attending the ATS course between the groups exists. This is because the decision rule for statistically significance was used to justify the significant differences. According to the rule, if F-calculated value is greater than F-critical value at .05 level of significance, it indicates that the result is statistically significant. However, if F-calculated value is less than F-critical at .05 level of significance, it implies that there is no significant difference between the results.

Based on the decision rule, the result of the analyses in Table 4.11 indicates that in ATS course, significant differences of the academic performance of students in all groups exists. This is because the calculated F (2200.374) is greater than 4.71 as shown in Appendix G (B) at .05 level of significance. Therefore, hypothesis 1 which states: There is no significant difference on the students' academic performance between controlled and treatment groups after introducing Hausa as medium of instruction in Nigerian tertiary institutions offering AE course is rejected. That is; $F(2, 322) = 2200.374$ at $p < .05$ is rejected. Therefore, since there is statistically significant difference between and within the students' academic performances in the groups, there is need for Scheffe's Post Hoc analysis (above two groups) to determine where the significant differences of the students' academic performances exists (Ruxton and Beauchamp, 2008).

Table 4.11 : Post-test ANOVA of students' mean scores in Hausa, learning environment and controlled groups

Source of variation	Sum of Squares	df	Mean Square	F-value	Sig.
Between Groups	634325.488	2	317162.744		
Within Groups	46269.065	322	144.140	2200.374	.000
Total	680594.553	324			

Table 4.12 presents Scheffe's Post Hoc comparison between the mean scores of the students' academic performances in Control, Hausa and learning environment groups. The Table presents students' academic performance mean scores in Hausa group as statistically significantly different when compared to control group at p < .05=.000 (two tailed). Although, the two sets of statistical mean differences are -94.444 and 94.444 respectively. Therefore, sub hypothesis 1(a) which states: there is no significant difference between the academic performances in posttest mean scores of the students in Hausa group when compared with Control group was rejected.

In addition, students' academic performance mean scores in learning environment group was significantly different at p < .05 = .000 when compared to Control group at P < .05= .000. Though, the two sets of statistical mean differences are -93.268 and 93.268 respectively. Therefore, sub hypothesis 1(b) which states: there is no significant difference between the academic performances in posttest mean scores of the students in learning environment group when compared with Control group was rejected.

Besides, the students' academic performance mean scores in learning environment group was not statistically significantly different at p >.05 (.752) when compared to Hausa group at P > .05 = .752. Though, the disparities of the two sets of statistical mean differences of score are 1.176 and -1.176. Therefore, sub hypothesis 1(c) which states: there is no significant difference between the mean academic performances in posttest mean scores of the students in learning environment group when compared to students academic performances in Hausa group was accepted. This means that Hausa as medium of instruction in the class as well as in the workshop on the ATS topics had similar effect on student' academic performances. Therefore, no significant difference between the posttest means scores of students' performances in both cases. Based on the finding, Scheffe's Post Hoc pair comparison analyses showed that in both Hausa and learning environment groups, Hausa enhanced learning equally. Therefore, the mean differences between the two groups were not significant.

Table 4.12 : Scheffe's pos hoc analyses of pair comparisons of students' scores in Hausa, learning environment and controlled groups

Treatments (I)	Treatments (J)	Mean Difference (I -J)	S. E	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Controlled	Hausa	-94.44444*	1.63379	.000	-98.2914	-90.5975
	Learning Environment	-93.26852*	1.63379	.000	-97.1155	-89.4215
Hausa	Controlled	94.44444*	1.63379	.000	90.5975	98.2914
	Learning Environment	1.17593	1.63379	**.752**	-2.6711	5.0229
Learning Environment	Controlled	93.26852*	1.63379	.000	89.4215	97.1155
	Hausa	-1.17593	1.63379	**.752**	-5.0229	2.6711

* mean difference is significant at 0.05 levels

Finally, Figure 4.2 presents the posttest means score plot analyses results of the Hausa, Learning environment and Control groups. The Figure shows that the mean scores of students' academic performance in Control, Hausa and Learning environment groups are approximately 59.209, 152.472, and 153.472 respectively. This indicates the significant effects of the independent variables (Hausa and Learning environment) on the dependent variable (students' academic performance) with the posttest mean score values of 152.472 and 153.472, while for Controlled group is 59.209 respectively.

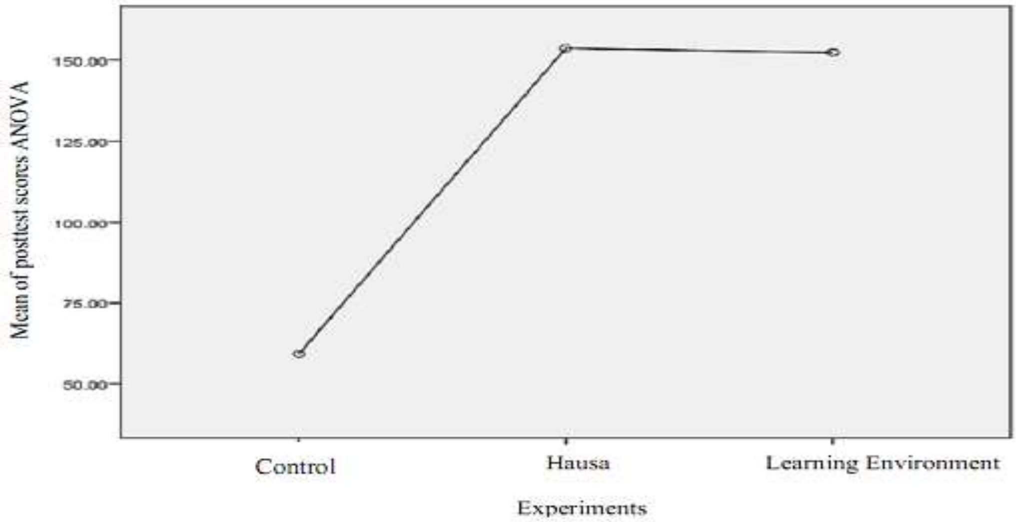


Figure 4.2 : Posttest means plots analyses results of the experiment

4.3 Regression Analysis of Areas Considered Important for Learning ATS in Nigerian Tertiary Institutions Offering AE course

This Section presents Stepwise Linear Regression (SLR) analyses of each of the four topics ATS areas considered important for learning automobile transmission systems in Nigerian tertiary institutions offering AE course. The results of the analyses answers research question 4 as follows.

4.3.1 Research Question 4

What areas are considered important on ATS topics on students' academic performances in Nigerian tertiary institutions offering AE course?

In determining the areas considered important for learning, ATS systems, research question 4 was further subdivided and is restated into research questions 4(a) to 4(d) based on each topic. In this section, analyses are done using the data obtained through the structured questionnaire through SLR. Results are presented based on the experts' opinions on the areas considered important for using Hausa as medium of instruction on the ATS topics to develop the model for learning.

During SLR analyses, appropriate areas of ATS topics for model development were regressed. This was because of the inconsistency in the data accounted for the regression model in line with each of the four topics. Analyses of the data were critically examined with the translated areas in Hausa medium and are presented in Tables of model summary as follows:

4.3.1.1 Research question 4 (a)

What areas are considered important on gearbox topic on students' academic performance in Nigerian tertiary institutions offering AE course?

Table 4.13 presents analyses of the areas of gearbox. Specifically, SLR analysis method in SPSS software version 21 is used to analyze the data collected on the gearbox. Eight out of ten areas were observed and considered important on gearbox for learning automobile transmission systems in Nigerian tertiary institutions offering AE.

The areas observed as having influence and considered important with their respective absolute standardized Beta values are: working principles of gears = .224, gear system arrangement = .132, servicing of gears system = .128, parallel and non-intersection shafts = .095, main and counter shafts functions = .127, driven/driving gears =.111, alignment of meshing gears = .110 and auxiliary gears systems = .079 at $p < .05$. From the summary of the SLR analysis (Table 4.14), eight areas were observed and considered important on gearbox for successful learning of automobile transmission system after introducing Hausa medium of instruction.

Table 4.13 : Stepwise linear regression analysis on areas of gearbox

Areas Considered Important on Gearbox		Std. Coef. Beta	T-Value	Sig. Value
1	Working principles of gears	.987	88.851	.000
2	Working principles of gears	.566	12.496	.000
	Gear system arrangement	. 430	9.505	.000
3	Working principles of gears	.370	7.214	.000
	Gear system arrangement	.319	7.097	.000
	Servicing of the system	.310	6.470	.000
4	Working principles of gears	.317	6.247	.000
	Gear system arrangement	.264	5.882	.000
	Servicing of gears system	.252	5.240	.000
	Parallel and non-intersection shafts	.169	4.363	.000
5	Working principles of gears	.302	6.073	.000
	Gear system arrangement	.209	4.465	.000
	Servicing of gears system	.212	4.388	.000
	Parallel and non-intersection shafts	.140	3.601	.000
	Main and counter shafts functions	.139	3.317	.001
6	Working principles of gears	.267	5.329	.000
	Gear system arrangement	.190	4.110	.000
	Servicing of gears system	.156	3.086	.002
	Parallel and non-intersection shafts	.129	3.360	.001
	Main and counter shafts functions	.131	3.174	.002
	Driven and driving gears systems	.132	3.174	002
7	Working principles of gears	.224	4.403	.000
	Gear system arrangement	.132	2.708	.007
	Servicing of gears system	.128	2.533	.012
	Parallel and non-intersection shafts	.095	2.453	.015
	Main and counter shafts functions	.127	3.160	.002
	Driven and driving gears systems	.111	2.686	.008
	Alignment of meshing gears	.110	2.759	.006
		.079	2.124	.035
8	Working principles of gears	.224	4.403	.000
	Gear system arrangement	.132	2.708	.007
	Servicing of gears system	.128	2.533	.012
	Parallel and non-intersection shafts	.095	2.453	.015
	Main and counter shafts functions	.127	3.160	.002
	Driven / driving gears systems	.111	2.686	.008
	Alignment of meshing gears	.110	2.759	.006
	Auxiliary gears systems	.079	2.124	.035

Table 4.14 below shows the summary of the eight areas considered important for using Hausa medium of instruction on gearbox. The model presents eight observed areas such working principles of gears, gear system arrangement, servicing of gears system, parallel and non-intersection shafts, main and counter shafts functions, driven/driving gears functions, alignment of meshing gears, and auxiliary gear systems with the corresponding R-square (regression index) of 973, 981, 984, 986, 986, 987, 987 and .988 respectively. All areas are considered important on gearbox for using Hausa as medium of instruction in Nigerian tertiary institutions offering AE course.

The correlation coefficients (R) are presented in descending order starting from the observed areas that were considerably most important. The observed areas are presented in Table 4.14 following the order of the significant coefficients. The correlation coefficients indicated linear relationships between the eight observed areas. The highest value of Adjusted R^2 of .987 in Table 4.14 indicates that, the model account for 98.7% variance in the areas considered most important for developing gearbox model using Hausa medium of instruction in Nigeria tertiary institutions offering AE course.

Table 4.14 : Model summary of important areas of gearbox

Areas Considered on Gearbox	R	R^2	Adjusted R^2	Std. Error
1 Gear system arrangement (Tsarin giyoyi)	.987[a]	.973	.973	.625
2 Working principles of gears (Ayukan giyoyi)	.991[c]	.981	.981	.525
3 Servicing of gears system (Sabis na tsarin giyoyi)	.992[d]	.984	.984	.481
4 Parallel and non-intersection shafts (Shaf da layi daya da kuma wadanda ba mahada)	.993[e]	.986	.985	.462
5 The main and counter shafts functions (Ayyukan main da counter shaf)	.993[f]	.986	.986	.451
6 Driven and driving gears systems (Bambance tsakanin driven da driving giyoyi)	.993[g]	.987	.987	.442
7 Alignment of meshing gears (Jerin meshing giyoyi)	.994[h]	.987	.987	.436
8 Auxiliary gears systems (Karin kaya tsarin giyoyi)	.994[i]	.988	.987	.432

Note: words in parentheses indicate translations in Hausa medium

4.3.1.2 Research question 4(b)

What areas are considered important on clutch topic on students' academic performance in Nigerian tertiary institutions offering AE course?

Table 4.15 shows stepwise regression analyses of the areas of clutch. In particular, using stepwise were eight out of ten areas observed as important for learning automobile transmission system in Nigerian tertiary institutions offering AE course.

Consequently, the areas observed as important with their respective absolute standardize Beta values are: mounting of clutch plate and disc on main shaft = .140, hydraulic pipelines fault diagnose = .209, function of the clutch release = .120, functions of pilot bush bearings= .110, adjustment of the release bearing = .121, function of the clutch linkages = .089, disc and pressure plate alignment = .121 and working principle of the clutch = .098 at $p < .05$. From the summary of the stepwise linear regression analysis method, eight areas were observed and considered important on cloth for learning automobile transmission systems in Nigerian tertiary institutions offering AE course.

Table 4.15 : Stepwise linear regression analysis on areas of clutch

	Areas Considered Important on Clutch	Std. Coeff. Beta	T-Value	Sig. Value
1	Mounting of clutch plate and disc on main shaft	.990	103.712	.000
2	Mounting of clutch plate and disc on main shaft	.594	14.432	.000
	Hydraulic pipelines fault diagnose	.403	9.798	.000
3	Mounting of clutch plate and disc on main shaft	.456	10.992	.000
	Hydraulic pipelines fault diagnose	.324	8.434	.000
	Function of the clutch release	.223	7.338	.000
4	Mounting of clutch plate and disc on main shaft	.374	8.878	.000
	Hydraulic pipelines fault diagnose	.296	8.088	.000
	Function of the clutch release	.168	5.474	.000
	Functions of Pilot bush bearings	.167	5.217	.000
5	Mounting of clutch plate and disc on main shaft	.260	5.322	.000
	Hydraulic pipelines fault diagnose	.234	6.126	.000
	Function of the clutch release	.163	5.525	.000
	Functions of Pilot bush bearings	.146	4.661	.000
	Adjustment of the release bearing	.203	4.205	.000
6	Mounting of clutch plate and disc on main shaft	.218	4.568	000
	Hydraulic pipelines fault diagnose	.137	5.810	.000
	Function of the clutch release	.131	4.635	.000
	Functions of Pilot bush bearings	.173	4.243	.000
	Adjustment of the release bearing	.125	3.624	.000
	Functions of clutch linkage	.132	3.535	.001
7	Mounting of clutch plate and disc on main shaft	.224	4.403	.000
	Hydraulic pipelines fault diagnose	.132	2.708	.007
	Function of the clutch release	.128	2.533	.012
	Functions of Pilot bush bearings	.095	2.453	.015
	Adjustment of the release bearing	.127	3.160	.002
	Functions of clutch linkage	.111	2.686	.008
	Disc and pressure plate alignment	.110	2.759	.006
		.079	2.124	.035

8	Mounting of clutch plate and disc on main shaft	.140	2.646	.009
	Hydraulic pipelines fault diagnose	.209	5.709	.000
	Function of the clutch release	.120	4.087	.000
	Functions of Pilot bush bearings	.110	3.599	.000
	Adjustment of the release bearing	.121	2.499	.013
	Functions of clutch linkage	.089	2.485	.014
	Disc and pressure plate alignment	.121	2.968	.003
	Working principles of the clutch	.098	2.561	.011

Table 4.16 shows the summary of the eight areas on clutch. The model presents eight observed areas such as: mounting of clutch on the flywheel, hydraulic pipelines faults diagnose, function of the clutch release, functions of pilot bush bearings, adjustment of the release bearing, function of clutch linkages, disc and pressure plate alignment, and working principle of the clutch with the corresponding R-square (regression index) of .980, 986, 989, 990, 991, 992, 992 and .992 respectively. This means that, eight of the observed areas are considered important on clutch for learning automobile transmission system in Nigerian tertiary institutions offering AE course

The correlation coefficients (R) are presented in descending order starting from the observed item that was significantly important. The correlation coefficients indicate linear relationship between the eight observed areas. The highest value of adjusted R^2 of .992 in Table 4.16 indicated that, the model account for 99.2% variance with the areas considered important in developing important clutch model for learning in Nigeria tertiary institutions offering AE course.

Table 4.16 : Model summary of important areas of clutch

Areas Considered Important on Clutch	R	R^2	Adjusted R^2	Std. Error
1 Mounting of clutch plate and disc on main shaft(Hawa da klochi plat da dis akan shaf)	.990[a]	.980	.980	.549
2 Hydraulic pipelines fault diagnose (gane rashin aikin layukan man klochi)	.993[c]	.986	.986	.457
3 Function of the clutch release (Ayukan klochi disc)	.995[d]	.989	.989	.420
4 Functions of Pilot bush bearings (Ayyukan pilot bush bearing)	.995[e]	.990	.990	.386
5 Adjustment of the release bearing (Daidaiton biari)	.996[f]	.991	.991	.372
6 Functions clutch linkages (Ayyukan klochi linkage)	.996[g]	.992	.991	.362
7 Disc and pressure plate alignment (Jerin dis a cikin matsa lamba farantin)	.996[h]	.992	.992	.357
8 Working principle of the clutch (Ka'idodin klochi)	.996[i]	.992	.992	.353

Note: words in parentheses indicate translations in Hausa medium

4.3.1.3 Research question 4 (c)

What areas are considered important on propeller shaft topic on students' academic performance in Nigerian tertiary institutions offering AE course?

Table 4.17 shows stepwise regression analyses of areas of propeller shaft. Explicitly, stepwise linear regression analysis method was employed to analyze the data collected on propeller shaft areas. There are six out of ten areas indicated and considered as important on propeller shaft.

From the analysis of the data, the areas with their respective absolute standardize Beta values were: the outer shaft connector to the gearbox = .233, yoke shaft = .171, flange assembly = .238, transmission of torque by the propeller shaft = .167, the inner and outer shaft housing assembly =. 095, function of yoke shaft = .100, at $p < .05$ (.000). Therefore, the summary of stepwise linear regression analyses shows that six areas were observed as important on propeller shaft for learning in Nigeria tertiary institutions offering AE course.

Table 4.17 : Stepwise linear regression analyses on areas of propeller shaft

	Areas Considered Important on Propeller Shaft	Std. Coeff. Beta	t-value	Sig.Value
1	Outer shaft connection to the gearbox	.991	107.278	.000
2	Outer shaft connection to the gearbox	.697	16.743	.000
	Yoke shaft	.299	7.190	.000
3	Outer shaft connection to the gearbox	.459	8.321	.000
	Yoke shaft	.255	6.483	.000
	Flange assembly	.286	6.027	.000
4	Outer shaft connection to the gearbox	.313	5.199	.000
	yoke shaft	.196	5.014	.000
	Flange assembly	.257	5.676	.000
	Transmission of torque by the propeller shaft	.236	4.971	.000
5	Outer shaft connection to the gearbox	.277	4.584	.000
	yoke shaft	.166	4.166	.000
	Flange assembly	.256	5.736	.000
	Transmission of torque by the propeller shaft	.197	4.069	.000
	Inner and outer shaft housing assembly	.106	2.836	.005
6	Outer shaft connection to the gearbox	.233	3.751	.000
	yoke shaft	.171	4.341	.000
	Outer shaft connection to the gearbox	.238	5.339	.000
	Transmission of torque by the propeller shaft	.167	3.374	.001
	Inner and outer shaft housing assembly	.095	2.542	.012
	Functions of yoke shaft	.100	2.532	.012

Table 4.18 shows model summary of six important areas of propeller shaft. The model presents six observed areas such as outer shaft housing assembly, yoke shaft, flange assembly, transmission of torque by the propeller shaft, inner and outer shaft housing assembly and functions of yoke shaft with the corresponding R-square (regression index) of .982, 985, 987, 989, 989, and 989, respectively. This means that the six observed areas on propeller shaft are considered important in developing propeller shaft model using Hausa for learning in Nigeria tertiary institutions offering AE course.

The correlation coefficients (R) are presented in descending order starting from the most important observed areas. The observed areas are presented in table 4.18 following the order of the significance. The correlation coefficients indicate linear relationships between six observed areas. The highest value of the Adjusted R^2 of .989 indicated that the model account for 98.9% variance in the areas considered important in developing propeller shaft model for using Hausa as medium of instruction in Nigeria tertiary institutions offering AE course.

Table 4.18 : Model summary of important areas of propeller shaft.

Areas Considered Important on Propeller Shaft	R	R^2	Adjusted R^2	Std. Error
1 Outer shaft connection to the gearbox haduwan shaf na waje da gearbox)	.991[a]	.982	.982	.522
2 Yoke shaft (yoke shaf)	.993[c]	.985	.985	.469
3 Flange assembly (Ayyukan flangi)	.994[d]	.987	.987	.435
4 Transmission of torque by the propeller shaft (Watsa daga karfin juyi da farfela shaf)	.994[e]	.989	.988	.412
5 Inner and outer shaft housing assembly (Hadawan shaf na ciki da waje)	.995[f]	.989	.989	.406
6 Functions of yoke shaft (Ayyukan yoke shaf)	.995[g]	.989	.989	.401

Note: words in parentheses indicate translations in Hausa medium

4.3.1.4 Research Question 4 (d)

What areas are considered important on drive axle topic on students' academic performance in Nigerian tertiary institutions offering AE course?

Table 4.19 shows the stepwise regression analyses of the areas of drive axle. Specifically, stepwise linear regression analysis method in SPSS software Version 21 was used to analyze the data collected on drive axle. There are six out of ten areas observed and considered important.

The areas observed as having influence with their respective absolute standardize Beta values were: functions of bearing types = .166, CV joint assembly = .194, lubrication of bearings in the hub = .215, functions of ball joints = .190, inner and outer races diagnose = .108, splines of axle shaft = .131, at $p < .05$. From the summary of the stepwise linear regression analyses method, six areas are observed as important on axle drive after introducing medium of instruction for learning automobile transmission systems in Nigerian tertiary institutions offering AE course.

Table 4.19 : Stepwise linear regression analyses on areas of drive axle.

	Areas Considered Important on Drive Axle	Std. Coeff. Beta	t-value	Sig. Value
1	Functions of bearing types	Beta		
2	Functions of bearing types	.527	12.600	.000
	CV joint assembly	.470	11.243	.000
3	Functions of bearing types	.347	7.717	.000
	CV joint assembly	.337	8.062	.000
	Lubrication of bearings in the hub	.317	7.256	.000
4	Functions of bearing types	.281	6.327	.000
	CV joint assembly	.246	5.677	.000
	Lubrication of bearings in the hub	.247	5.667	.000
	Functions of ball joints	.228	5.083	.000
5	Functions of bearing types	.270	6.156	.000
	CV joint assembly	.191	4.077	.000
	Lubrication of bearings in the hub	.211	4.694	.000
	Functions of ball joints	.214	4.811	.000
	Inner and outer races diagnose	.117	2.799	.006
6	Functions of bearing types	.166	2.686	.008
	CV joint assembly	.194	4.175	.000
	Lubrication of bearings in the hub	.215	4.842	.000
	Functions of ball joints	.190	4.216	.000
	Inner and outer races diagnose	.108	2.594	.010
	Splines of axle shaft	.131	2.382	.018

Table 4.20 shows the summary of six areas considered important for using Hausa on drive axle topic. The model presents six observed areas (functions bearing types, CV joint assembly, lubrication of bearings in the hub, functions of ball joint , inner and outer races diagnose, splines of axle shaft,) with the corresponding R-square (regression index) of .969, 981, 984, 986, 987, and 987, respectively. This means that the six observed areas are considered important for using Hausa as medium of instruction in Nigerian tertiary institutions offering AE course.

The correlation coefficients (R) are presented in descending order starting from the observed areas that is considered most important. The observed areas are presented in Table 4.20 following the order of the significance. The correlation coefficients indicate linear relationship between the six observed areas. The highest value of Adjusted R^2 of .987 indicates that, the model account for 98.7% variance of the areas considered important in developing important drive axle model through Hausa as medium of instruction in Nigerian tertiary institutions offering AE course.

Table 4.20 : Model summary of important areas of drive axle.

Areas Considered Important on Drive Axle	R	R^2	Adjusted R^2	Std. Error
1 Functions of ball joint(Ayyukan ball joints)	.995[a]	.986	.986	.678
2 Lubrication of bearings in the hub(Lubrication daga bearings a cikin cibiya)				
3 CV joint assembly(hadin gwiwan CV joints)	.993[c]	.986	.986	.539
4 Functions of bearing types(aikin bearings iri)	.993[d]	.985	.985	.484
	.994[e]	.986	.986	.458
5 Inner and outer races diagnose(Ganewan shudin tredi na asali)	.994[f]	.987	.987	.450
6 Splines of axle shaft (Splain na aksali shaf)	.994[g]	.987	.987	.445

Note: words in parentheses indicate translations in Hausa medium

4.4 Structural Equation Modeling (SEM) Using Analysis of Moment of Structures (AMOS)

Structural Equation Modeling (SEM) technique was performed on the data collected through questionnaire. This was to further analyse the areas suggested earlier through stepwise linear regression analyses in the previous sections to develop the model. It comprised of four independent tests: 1) SEM of gearbox; 2) SEM of clutch; 3) SEM of propeller shaft; and 4) SEM of drive axle using AMOS version 18. This was to determine the modified measurement models of various tests mentioned above to comply and fit well to the data. This is considered appropriate answer for research question 5.

As described in chapter three, AMOS is one of the most powerful and reliable software for SEM. According to Arbuckle and Wothke (1999), it facilitates users in supporting their research and theories by extending normal multivariate analysis methods, factor analysis, regression analysis, correlation analysis, as well as analysis of variance. It is therefore, very essential to use AMOS to identify the most important areas of ATS topics based on their level of importance, and to drop the areas that are not fit to develop a model for learning automobile transmission systems.

Furthermore, AMOS was specifically used in this research to show structurally the relationships between the four ATS topics and the areas considered important for learning AE course in Nigeria. AMOS Model fit indices are used to determine the inclusion or other wise of an area as it relates to the topics of ATS. This is based on the hypothesized model which states that; there is significant relationships between areas considered important for learning ATS topics in Nigerian tertiary institutions offering AE course.

4.5 Results of Analysis of Moment of Structure (AMOS)

Internal consistencies of areas considered important were determined using Cronbach's Alpha statistics after SLR analyses as follows: gearbox (0.82), clutch (0.80), propeller shaft (0.76), and axle drive (0.84). In that no values below 0.50 and all the variables are above adequate of 0.70 which is classified as conventional (Cronbach, 1951). Table 4.21 presents the Cronbach's Alpha reliability coefficient results of the four ATS. See SPS output in Appendix H.

Table 4.21 : Cronbach's Alpha reliability of ATS topics

Major Topics in the Model	No. of Items	Cronbach's α
Gearbox	8	0.82
Clutch	8	0.80
Propeller Shaft	6	0.76
Axle Drive	6	0.84

After the internal consistencies between the ATS areas were established, the initial measurement models were developed. Thereafter, modified measurement model was developed and evaluated based on the default model fit evaluation indices as described in chapter three section 3.8.5 and represented in Table 4.22. Chi-square/df (χ^2/df), GFI, CFI, RMSEA, TFI, RMSR, RMSEA, and P-values as shown in the table are used to determine the fitness of modified measurement models from the initial measurement models of all ATS topic areas. AMOS output model fit summaries of all modified models are presented in Appendix E.

Table 4.22 : Default model fit evaluation indices

Model Fit Indices	Range Values
Chi Square (χ^2)/df	< 0.30
Goodness of Fit (GFI)	≥ 0.90
Incremental Fit Index (IFI)	≥ 0.90
Tucker-Lewis Index (TLI)	≥ 0.90
Comparative Fit Index (CFI)	≥ 0.90
Root Mean Square Residual (RMSR)	≤ 0.05
Root Mean Square Error of Approximation (RMSEA)	≥ 0.05

4.5.1 Research Question 5

What are the relationships between areas considered important on ATS topics on students' academic performance after introducing Hausa as medium of instruction in Nigeria tertiary institutions offering AE course?

4.5.2 Hypothesis 4

There is no significant relationship between areas considered important on ATS topics on students' academic performance after introducing Hausa as medium of instruction in Nigeria tertiary institutions offering AE course?

To answer research question 5 and response to the corresponding hypothesis 4, Analysis and Moment of Structures (AMOS) was used. This was to establish the relationships between areas considered important on ATS topics for using Hausa as medium of instruction in Nigerian tertiary institutions offering AE course.

Research question 5 with the corresponding hypothesis 4, were sub divided into research questions 5(a) to 5(d) based on the ATS topics followed by hypotheses 4(a) to 4(d) respectively. Though, SLR analyses were used to compute the areas considered important for each topic, the extent of the level to which the areas relates to each other have not been shown. Therefore, in order to establish the level of relationships between each topic and the areas considered important for learning ATS using Hausa as medium of instruction, AMOS was further run on the data. Therefore, each research question followed by the corresponding hypotheses were restated and described as follows:

4.5.3 Research Question 5(a)

What is the relationship between areas considered important on gearbox topic after introducing Hausa as medium of instruction on students' academic performance in Nigeria tertiary institutions offering AE course.

4.5.4 Hypothesis 4 (a)

There is no significant relationship between areas considered important on gearbox topic after introducing Hausa as medium of instruction on students' academic performance in Nigeria tertiary institutions offering AE course**.**

Table 4.23 presents the computed values for model fit indices of the initial measurement model of gearbox after introducing Hausa as medium instruction. Based on the result, the measurement model does not satisfy the goodness of fit indices with the following results: 7.52 for (χ^2)/df, GFI (0.83), TLI (0.65), CFI (0.75), IFI (0.75), RMR (0.05), RMSEA (0.17) at P < 0.05. The computed values indicated are not correct to the range values for a good model. Therefore, further analyses of the data to obtain correct computed values to the range values were run. This has resulted in the modification of the initial measurement model in Figure 4.2.

Table 4.23 : Initial measurement model fit indices of gearbox.

Model Fit Indices	Computed values	Range Values	P
Chi-square (χ^2)/df	7.52	< 3.00	
Goodness of Fit (GFI)	0.83	≥ 0.90	
Tucker-Lewis Index (TLI)	0.65	≥ 0.90	
Comparative Fit Index (CFI)	0.75	≥ 0.90	.000
Incremental Fit Index (IFI)	0.75	≥ 0.90	
Root Mean Square Residual (RMR)	0.05	≤ 0.05	
Root Mean Square Error of Approximation (RMSEA)	0.17	≤ 0.05	

Figure 4.3 shows the structure of the initial measurement model of gearbox (GBX) with a total of eight important areas (GBX1 - GBX8) that are considered important to determine their relationship after introducing Hausa as medium of instruction in AE. The items as areas in the questionnaire refers to GBX1 (working principles of gears), GBX2 (gear system arrangement), GBX3 (servicing of gear systems), GBX4 (parallel and non-intersection shafts), GBX5 (main and counter shafts functions), GBX6 (driven/driving gears systems), GBX7 (alignment of

meshing gears), and GBX8 (auxiliary gear systems). The SPSS output estimates revealed that the regression weight have significant p-values (.000)

The model exposed that two items GBX6 (driven/driving gear systems) and GBX8 (auxiliary gear systems) out of the eight important areas had low factor loadings of .16 and .31 with low correlation .40 and .56 coefficients respectively. Due to the low factor loadings and the correlation coefficient with the criteria of default model fit indices, the model became unfit. Therefore, to further run the model, the two areas were considered to be removed in to obtain good model fit parameter indices.

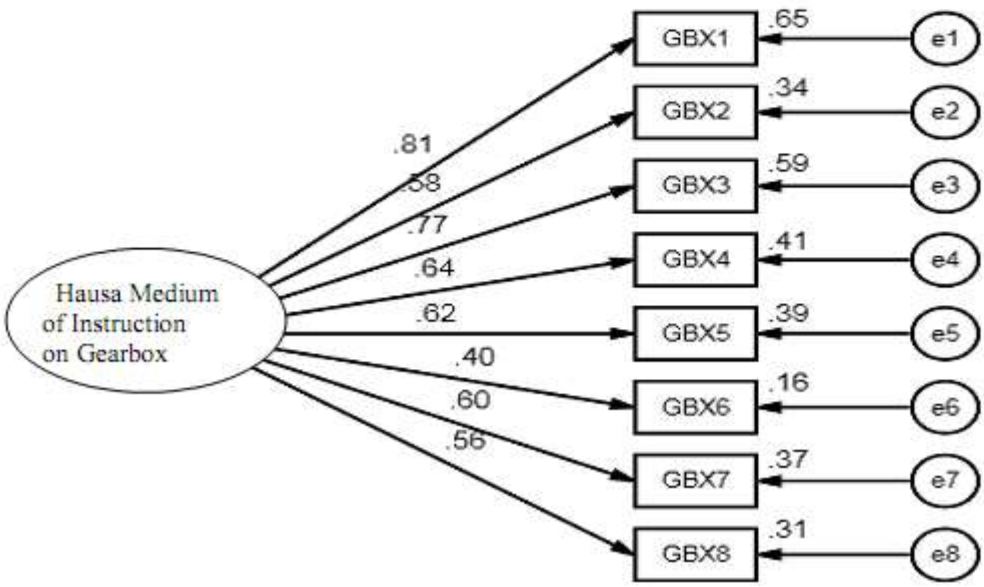


Figure 4.3 : Initial measurement model of gearbox.

As estimates of regression weight shown in Table 4.24, it indicates that all measured variables are statistically significant at values of p = .000. Significant values are vital before pursuing any measurement model testing.

Table 4.24 : Regression weights of initial measurement model of gearbox.

			Estimate	S.E.	C.R.	P
GBX1	<---	GBX	1.000	.165	5.567	.000
GBX2	<---	GBX	1.099	.185	5.950	.000
GBX3	<---	GBX	1.376	.221	6.240	.000
GBX4	<---	GBX	1.236	.198	6.242	.000
GBX5	<---	GBX	1.548	.267	5.803	.000
GBX6	<---	GBX	1.245	.221	5.630	.000
GBX7	<---	GBX	1.038	.211	4.924	.000
GBX8	<---	GBX	1.131	.232	4.871	.000

Normality of univariates in terms of critical ratio and kurtosis values of gearbox are shown in Table 4.25. Ideally, each variable should be approximately normal in univariate distribution with skewness and kurtosis ranges between -1 and +1. The univariate normality of individual variables for initial measurement model can be greater than -1 or +1. As observed in the table, GBX3 and GBX6 are outside boundary of recommended values. Therefore, further analyses were run for modification of the initial measurement model of gearbox to obtain the recommended values.

Table 4.25 : Normality of initial measurement model of gearbox

Variable	min	max	skew	c.r.	kurtosis	c.r.
GBX8	1.000	5.000	.676	2.056	.427	-280
GBX7	1.000	5.000	.647	1.879	.751	-2252
GBX6	1.000	5.000	.210	2.263	-1.410	- 2.229
GBX5	1.000	5.000	.851	5.105	.783	-4.349
GBX4	1.000	5.000	.395	2.369	.507	-1.522
GBX3	1.000	5.000	.835	1.011	-1.879	-.638
GBX2	1.000	5.000	.555	1.328	.711	-2.134
GBX1	1.000	5.000	.538	3.230	.592	1.776
Multivariate					7.779	6.328

Table 4.26 shows the standardized residual covariance of tested measurement model of gearbox. Absolute values were greater than 2.0 especially GBX6 which indicate that the initial measurement model was not well fit to the experimental data and was further run for appropriate modification indices.

Table 4.26 : Standardized residual covariances of initial measurement model of gearbox.

Variable	GBX8	GBX7	GBX6	GBX5	GBX4	GBX3	GBX2	GBX1
GBX8	.000							
GBX7	-.080	.000						
GBX6	2.986	2.129	.000					
GBX5	-.474	-.664	.431	.000				
GBX4	-.725	-.435	-1.646	1.334	.000			
GBX3	.888	.168	-.673	.451	-.871	.000		
GBX2	-.161	.666	.262	-.486	.099	-.640	.000	
GBX1	-.678	-.281	-.855	-.452	.827	.195	.420	.000

Table 4.27 presents the covariance estimates that were considered for trimming of GBX6 and GBX8. This was due to their insignificant statistical relationships and to improve the chi-square statistical value to the acceptable model fit indices values. The error terms e6 correlated and affected measurement error terms e5 and e8. Error term e8 correlated and affected measurement error terms e6 and e7 with higher M.I of 20.139. Therefore, deletion of the observed factor with the error terms e6 and e8 including the main observed construct variable is necessary. This might decrease the chi-square statistics value to the barest minimum, and to obtain good modification indices values for a good model.

Table 4.27 : Covariances estimates of initial measurement model of gearbox.

			M.I.	Par Change
E8	<-->	E7	16.213	.0227
E8	<-->	E6	18.815	-.999
E6	<-->	E8	7.814	.083
E6	<-->	E5	20.139	.116
E4	<-->	E8	14.667	-.122
E3	<-->	E5	7.263	-.074
E2	<-->	E8	6.730	-.069

Table 4.28 shows the computed values for model fit indices of the modified model for gearbox after introducing Hausa medium of instruction. Based on the result, the modified model satisfied Goodness of Fit (GOF) indices with 2.65 for (χ^2)/df, GFI (0.95), TLI (0.91), CFI (0.93), IFI (0.94), RMR (0.02) and RMSEA (0.04) at $P < .05$. Therefore, the hypothesis of the significant relationship between important areas of gearbox is rejected and Figure 4.3 was generated.

Table 4.28 : Modified measurement model fit indices of gearbox.

Model Fit Indices	Computed values	Range Values	P
Chi-square (χ^2)/df	2.65	< 3.00	
Goodness of Fit (GFI)	0.95	≥ 0.90	
Tucker-Lewis Index (TLI)	0.91	≥ 0.90	
Comparative Fit Index (CFI)	0.93	≥ 0.90	.000
Incremental Fit Index (IFI)	0.94	≥ 0.90	
Root Mean Square Residual (RMR)	0.02	≤ 0.05	
Root Mean Square Error of Approximation (RMSEA)	0.04	≤ 0.05	

Figure 4.4 shows a structural model of the significant relationship between six areas considered important on the topic of gearbox after introducing Hausa medium of instruction on gearbox for learning ATS in Nigeria. Therefore, from the modified model, it can be concluded that for learning ATS in AE, the most important areas such as: GBX1 (working principles of gears), GBX2 (gear system arrangement) GBX3 (servicing of gears system), GBX4 (parallel and non-intersection shafts), GBX5 (main and counter shafts functions), and GBX7 (alignment of meshing gears) can be considered. AMOS output summary of the modified model is presented in Appendix E

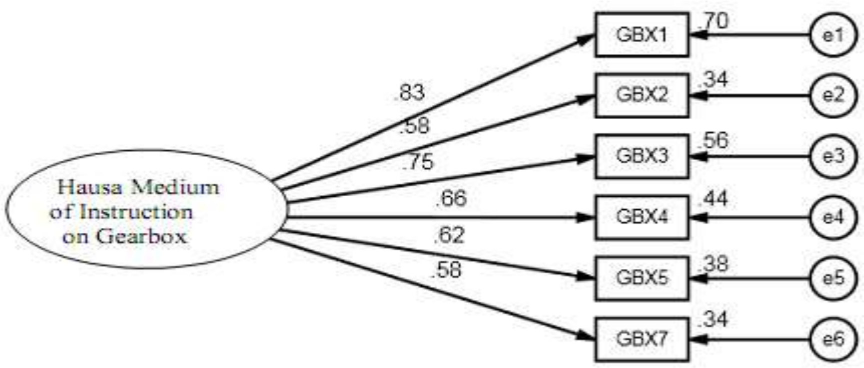


Figure 4.4 : Modified measurement model of gearbox.

Estimate of regression weight of modified measurement model of gearbox are shown in Table 4.29. All measured variables were statistically significant at values of p = 0.05. Thus, these measured variables were converged appropriately after introducing Hausa as medium of instruction on gearbox.

Table 4.29 : Regression weight of modified measurement model of gearbox.

			Estimate	S.E.	C.R.	P
GBX1	<---	Hausa on Gearbox	1.000			
GBX2	<---	Hausa on Gearbox	.929	.127	7.331	.000
GBX3	<---	Hausa on Gearbox	1.279	.160	7.996	.000
GBX4	<---	Hausa on Gearbox	.831	.108	7.721	.000
GBX5	<---	Hausa on Gearbox	.971	.138	7.049	.000
GBX7	<---	Hausa on Gearbox	.634	.128	4.938	.000

Table 4.30 shows the assessment of univariate normality distribution of the modified measurement model of Gearbox in AE. The skewness and kurtosis of the six observed factors variables are between the ranges of -1 and +1. This has supported the application of the observed factors for developing gearbox model after introducing Hausa as medium of instruction in ATS in AE.

Table 4.30 : Normality of modified measurement model of gearbox.

Variable	min	max	skew	c.r.	kurtosis	c.r.
GBX7	1.000	5.000	-.647	-3.879	-.751	-.252
GBX5	1.000	5.000	-.851	-5.105	-.183	-.349
GBX4	1.000	5.000	-.395	-8.369	-.507	-.522
GBX3	1.000	5.000	-.835	-5.011	-.879	-.638
GBX2	1.000	5.000	-.555	-3.328	-.711	-.134
GBX1	1.000	5.000	-.538	-3.230	-.592	-.776
Multivariate					4.728	6.046

Table 4.31 shows the standardized residual covariances of modified measurement model of gearbox after introducing Hausa as medium of instruction. It exposed that all the covariance values are less than 2.0 in absolute value. This indicates that the developed model of the six observed factors have confirmed well to the model of gearbox for learning ATS in AE.

Table 4.31 : Standardized residual covariances of modified measurement model of gearbox

	GBX7	GBX5	GBX4	GBX3	GBX2	GBX1
GBX7	.000					
GBX5	.725	.000				
GBX4	1.027	.705	.000			
GBX3	-.919	-.273	-.556	.000		
GBX2	-.249	.192	-.674	-.490	.000	
GBX1	-1.830	-.428	-1.196	.282	.213	.000

The Cronbach's Alpha of the modified measurement model for gearbox is shown in Table 4.32 as .831. These six areas have high level of consistency and are capable of measuring the degree of Hausa medium of instruction on gearbox in AE.

Table 4.23 : Content validity of modified measurement model of gearbox.

	Areas Considered important for Effective Integration of L1 in Gearbox	Mean	Std. Dev.	Cronbach's Alpha
GBX1	Working principles of gears (Ayukan giyoyi)	3.824	.686	.831
GBX2	Gear system arrangement (Tsarin giyoyi)	4.088	.679	
GBX3	Servicing of gears systems (Sabis na tsarin)	4.078	.829	
GBX4	Parallel and non-intersection shafts (Shafts da layi daya da kuma wadanda ba mahada)	4.000	.830	
GBX5	The main and counter shafts functions (Ayyukan main da counter shaft)	4.028	.824	
GBX7	Alignment of meshing gears (Jerin meshing giyoyi)	4.139	.759	

Note*:* words in parentheses indicate translations in Hausa

4.5.5 Research Question 5 (b)

What is the relationship between areas considered important on clutch topic after introducing Hausa as medium of instruction on students' academic performance in Nigeria tertiary institutions offering AE course.

4.5.6 Hypothesis 4 (b)

There is no significant relationship between areas considered important on clutch topic after introducing Hausa as medium of instruction on students' academic performance in Nigeria tertiary institutions offering AE course**.**

Research question 5 (b) is to determine the structural relationships of the areas considered important in gearbox through SEM to develop the model for learning ATS in Nigeria. This was done in consideration to the model fit indices parameters as advocated by various researchers. Therefore, Table 4.33 shows the computed values for model fit indices of the initial measurement model of clutch after introducing Hausa medium of instruction. Based on the result, the measurement model does not satisfy the goodness of fit indices with; 3.38 for (χ^2)/df, GFI (0.93), TLI (0.84), CFI (0.89), IFI (0.89), RMR (0.05) and RMSEA (0.11) at $P < .05$ below and above the normal range of values for a model fit. This has resulted to the modification of the model by removing the observed variables that contributed less to the model goodness of fit. Figure 4.4 below shows the structure of the measurement model.

Table 4.33 : Initial measurement model fit indices of clutch.

Model Fit Indices	Computed values	Range Values	P
Chi-square (χ^2)/df	3.38	< 3.00	
Goodness of Fit (GFI)	0.93	≥ 0.90	
Tuker-Lewis Index (TLI)	0.84	≥ 0.90	
Comparative Fit Index (CFI)	0.89	≥ 0.90	.000
Incremental Fit Index (IFI)	0.89	≥ 0.90	
Root Mean Square Residual (RMR)	0.05	≤ 0.05	
Root Mean Square Error of Approximation (RMSEA)	0.11	≤ 0.05	

Figure 4.5 shows the initial measurement model of clutch. The model shows a structure of areas considered important on the clutch topic for learning ATS in AE in Nigeria. The important areas in the questionnaire refer to CLH1 (Mounting of clutch plate and disc on main shaft), CLH2 (Hydraulic pipelines faults diagnose),

CLH3 (Function of clutch release), CLH4 (Function of Pilot bush bearing), CLH5 (Adjustment of release bearing), CLH6 (Functions of clutch linkages), CLH7 (Disc and pressure plate alignment), and CLH8 (Working principle of clutch). The output estimates revealed that the regression weight have significant p-values =.000.

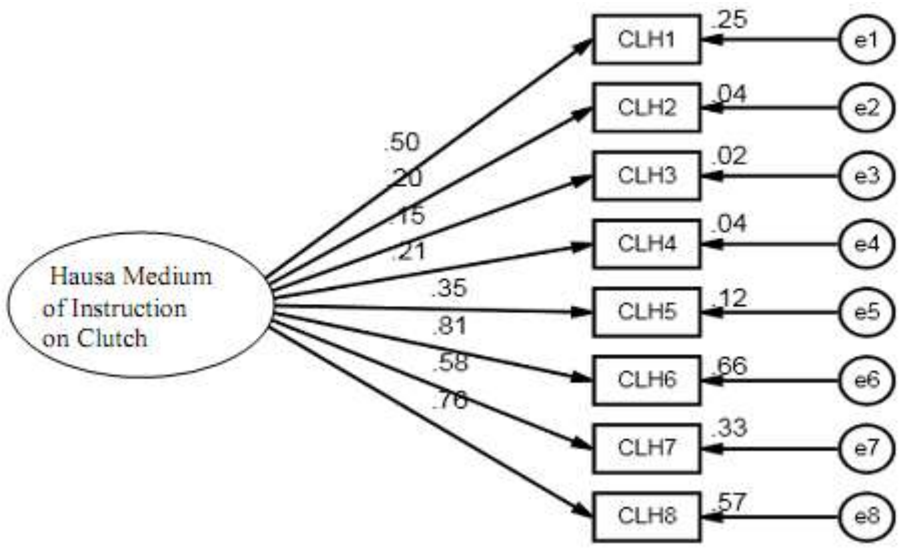


Figure 4.5 : Initial measurement model of clutch.

Several evidences were investigated in order to identify most problematic factors in this model. Regression weight of the clutch areas especially CLH2, CLH3, CLH8 are not significant at value of p = 0.05 as presented in Table 4.33. This would be the reason for lower goodness of fit. Therefore, the measured variables mentioned above were recommended for deletion in order to improve the model.

Table 4.34 : Regression weight of initial measurement model of clutch.

			Estimate	S.E.	C.R.	P
CLH1	<---	Hausa on Clutch	1.000			
CLH2	<---	Hausa on Clutch	.499	.194	2.579	.010
CLH3	<---	Hausa on Clutch	.313	.163	1.918	.055
CLH4	<---	Hausa on Clutch	.322	.123	2.616	.009
CLH5	<---	Hausa on Clutch	.756	.185	4.080	.000
CLH6	<---	Hausa on Clutch	1.252	.189	6.622	.000
CLH7	<---	Hausa on Clutch	.878	.152	5.767	.000
CLH8	<---	Hausa on Clutch	1.407	.215	6.542	.000

Assessment of normality is very important in Structural Equation Modeling. This is because the value of skewness and kurtosis serves as a guide to the statistical elimination of particular areas or predictor. Majority of researchers use values ranging from -1 to +1 to identify the most problematic variable(s) in the whole model. The univariate normality of individual variables in this sub construct was achieved because no single value was found to be greater than one in Table 4.35.

Table 4.35 : Normality of initial measurement model of clutch.

Variable	min	max	skew	c.r.	kurtosis	c.r.
CLH8	1.000	5.000	.835	5.011	.879	-.638
CLH7	1.000	5.000	.555	3.328	-.711	-.134
CLH6	1.000	5.000	.538	3.230	-.592	-.776
CLH5	1.000	5.000	.749	4.496	-.178	-.533
CLH4	1.000	5.000	.592	3.552	-.660	-1.979
CLH3	1.000	5.000	.043	.259	.886	-2.659
CLH2	1.000	5.000	.375	2.248	-.506	-1.519
CLH1	1.000	5.000	.473	2.837	-.362	-1.087
Multivariate					9.116	5.296

Standardized residual covariance matrix shown in Table 4.36 indicates that all residual covariance are less than 2.0 in absolute value. Thus, this indicates that the measurement model could be well fit to the experimental data and could be correctly developed.

Table 4.36 : Standardized residual covariance for initial measurement model of clutch.

	CLH8	CLH7	CLH6	CLH5	CLH4	CLH3	CLH2	CLH1
CLH8	.000							
CLH7	-.464	.000						
CLH6	.292	.455	.000					
CLH5	-1.182	.393	.020	.000				
CLH4	-.509	-1.542	-.692	.665	.000			
CLH3	-1.141	.273	-.352	.467	.450	.000		
CLH2	.835	-1.859	-1.021	-.067	.761	-.172	.000	
CLH1	.289	.328	-.866	.448	.220	-.410	.727	.000

Although, regression weight estimates were considered for trimming of CLH2, CLH3, and CLH4 in developing a model of clutch. This was due to their insignificant statistical relationships. Error term e2 affected error terms e6, and e7. Furthermore, error term e3 affected error terms e4, e5 and e8 and error term e4 affected error terms e5 and e7. Therefore, deletion of the observed factors with error terms, e2, e3, and e4 deemed critical. Deletion of the error terms might decrease the chi-square value to the barest minimum in order to obtain the required modification indices see Table 4.37.

Table 4.37 : Covariance of initial measurement model of clutch.

			M.I.	Par Change
e5	<-->	e8	5.375	-.090
e4	<-->	e7	4.181	-.055
e4	<-->	e5	16.598	.173
e3	<-->	e8	4.201	-.081
e3	<-->	e5	23.978	.285
e3	<-->	e4	32.171	.244
e2	<-->	e7	6.069	-.105
e2	<-->	e6	5.183	-.083

In conclusion of the initial measurement model of clutch, based on the results in Table 4.38, three areas CLH 2(hydraulic pipelines fault diagnose, CLH3 (function of clutch release and CLH4 (function of pilot bush bearings out of the eight important areas have low factor loadings of .20, .15 and .21 respectively. Based on the default model fit indices, the model became unfit. Therefore, to further run the data, the areas were removed. Results in Table 4.38 were obtained from the modified model.

Table 4.38 shows computed values of model fit indices of modified model of areas considered important on the clutch for learning in AE. The modified model satisfied the conditions for goodness of fit with the values of 2.45 for (χ^2)/df, GFI (0.95), TLI (0.93), CFI (0.95), IFI (0.95), RMR (0.02) and RMSEA (0.03) at $P < .05$. The corresponding hypothesis which states that: There in no significant relationship between areas considered important on clutch topic after introducing Hausa as medium of instruction on students' academic performance in Nigeria tertiary institutions offering AE course isrejected, a structure of the modified measurement model in Figure 4.5 was generated.

Table 4.38 : Modified measurement model fit indices of clutch.

Model Fit Indices	Computed values	Range Values	P
Chi-square (χ^2)/df	2.45	< 3.00	
Goodness of Fit (GFI)	0.95	≥ 0.90	
Tucker-Lewis Index (TLI)	0.93	≥ 0.90	
Comparative Fit Index (CFI)	0.95	≥ 0.90	.000
Incremental Fit Index (IFI)	0.95	≥ 0.90	
Root Mean Square Residual (RMR)	0.02	≤ 0.05	
Root Mean Square Error of Approximation (RMSEA)	0.03	≤ 0.05	

Figure 4.6 shows the structural model of the significant relationship between five areas considered important on the clutch for learning ATS in Nigeria. From the modified model, it can be concluded that, for learning of clutch, areas such as CLH1 (mounting of clutch plate and disc on main shaft), CLH5 (adjustment of release bearing), CLH6 (function of clutch linkages) and CLH7 (disc and pressure plate alignment) and CLH8 (working principles of clutch) could be considered important. Analysis of moment of structure output summary of the modified model fit indices of clutch is presented in Appendix E.

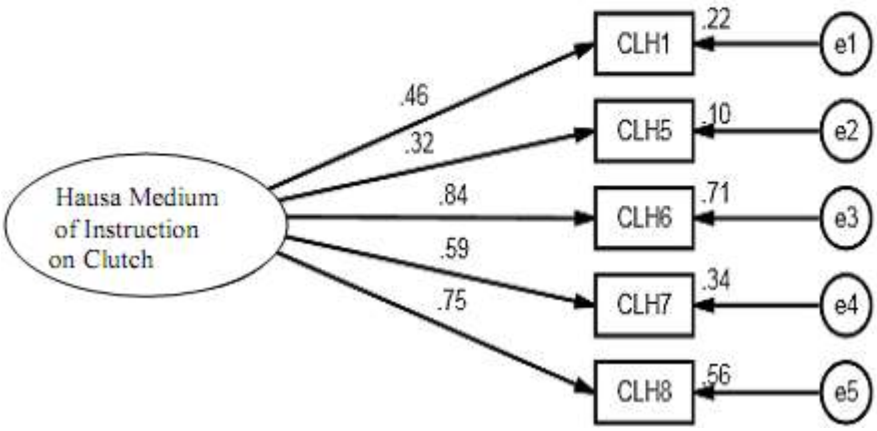


Figure 4.6 : Modified measurement model of clutch.

Estimate of regression weights of initial measurement model of clutch are shown in Table 4.39. All measured variables were statistically significant at values of p = 0.05. Thus, the measured variables were converged to Hausa medium of instruction on clutch appropriately.

Table 4.39 : Regression weight of modified measurement model of clutch

			Estimate	S.E.	C.R.	P
CLH1	<---	Hausa on Clutch	1.000			
CLH4	<---	Hausa on Clutch	.752	.200	3.764	.000
CLH5	<---	Hausa on Clutch	1.390	.224	6.196	.000
CLH6	<---	Hausa on Clutch	.960	.173	5.544	.000
CLH7	<---	Hausa on Clutch	1.494	.244	6.132	.000

Table 4.40 shows the assessment of univariate normality distribution of the modified measurement model of clutch. The skewness and kurtosis parameters of the five observed factors variables are found to be between the ranges of -1 and +1. The skewness and kurtosis of the entire sub-observed construct are all less than a unit value. This has supported the application of the observed factors for developing a model of clutch using Hausa for learning in AE course.

Table 4.40 : Normality of modified measurement model of clutch.

Variable	min	max	skew	c.r.	kurtosis	c.r.
CLH8	1.000	5.000	.835	5.011	.879	-.638
CLH7	2.000	5.000	.555	3.328	.711	-.134
CLH6	2.000	5.000	.538	3.230	.592	1.776
CLH5	1.000	5.000	.749	4.496	.178	.533
CLH1	1.000	5.000	.473	2.837	-.362	-1.087
Multivariate					4.570	6.014

Table 4.41 presents the standardized residual covariance of a modified model of clutch. All standardized residual covariance values are less than 2 in absolute value, which mean that the five measured observed factors have conformed well to the model of clutch in AE. This also indicates that the model is properly developed.

Table 4.41 : Standardized residual covariance of modified model of clutch

	CLH8	CLH7	CLH6	CLH5	CLH1
CLH8	.000				
CLH7	-.507	.000			
CLH6	.113	.128	.000		
CLH5	-.878	.557	.188	.000	
CLH1	.698	.539	-.667	.793	.000

The Cronbach's Alpha coefficient of modified measurement model of clutch is .831 presented in Table 4.42. This indicates that the five areas had good internal consistency (Cronbach Alpha, 1951) and is capable of confidently measuring the degree of Hausa medium of instruction on clutch in AE accurately.

Table 4.42 : Content validity of modified measurement model of.clutch

Items	Areas Considered important for Effective L1 Integration in Clutch	Mean	Std. Dev.	Cronbach's Alpha
CLH1	Mounting of clutch plate and disc on main shaft (Hawa da disk an shaf)	3.724	.786	
CLH5	Adjustment of the release bearing (Daidaiton biari)	4.098	.679	
CLH6	Functions of clutch linkages (Ayyukan klochi linkage)	4.078	.829	.831
CLH7	Disc and pressure plate alignment (Jerin disc a cikin matsa lamba farantin)	4.001	.840	
CLH8	Working principle of clutch (Ka'idodin klochi)	4.011	.822	

Note: words in parentheses indicate translation in Hausa.

4.5.7 Research Question 5 (c)

What is the relationship between areas considered important on propeller shaft topic after introducing Hausa as medium of instruction on students' academic performance in Nigeria tertiary institutions offering AE course

4.5.8 Hypothesis 4 (c)

There is no significant relationship between areas considered important on propeller shaft topic after introducing Hausa as medium of instruction on students' academic performance in Nigeria tertiary institutions offering AE course**.**

Table 4.43 shows the computed values of model fit indices of the initial measurement model of propeller shaft. Based on the result, the model did not satisfy the goodness of fit indices, with 2.33 (χ^2)/df, GFI (0. 97), TLI (0.93), CFI (0.96), IFI (0.96), RMR (0.02) and RMSEA (0.08) at $P < .05$. To improve the structure of the model, some observed variables were considered to be removed.

Table 4.43 : Initial measurement model fit indices of propeller shaft.

Model Fit Indices	Computed values	Range Values	P
Chi-square (χ^2)/df	2.33	< 3.00	
Goodness of Fit (GFI)	0.97	≥ 0.90	
Tucker-Lewis Index (TLI)	0.93	≥ 0.90	
Comparative Fit Index (CFI)	0.96	≥ 0.90	.000
Incremental Fit Index (IFI)	0.96	≥ 0.90	
Root Mean Square Residual (RMR)	0.02	≤ 0.05	
Root Mean Square Error of Approximation (RMSEA)	0.08	≤ 0.05	

Figure 4.7 shows the initial measurement model of areas considered important for using Hausa as medium of instruction on propeller shaft for learning ATS in AE. The areas in the questionnaire refer to; PLS1 (outer shaft connection to the gearbox), PLS2 (hub assembly), PLS3 (flange assembly), PLS4 (transmission of torque by the propeller shaft), PLS5 (inner and outer shaft assembly), PLS6 (functions of flange) and PLS7 (Function of Slip joints.

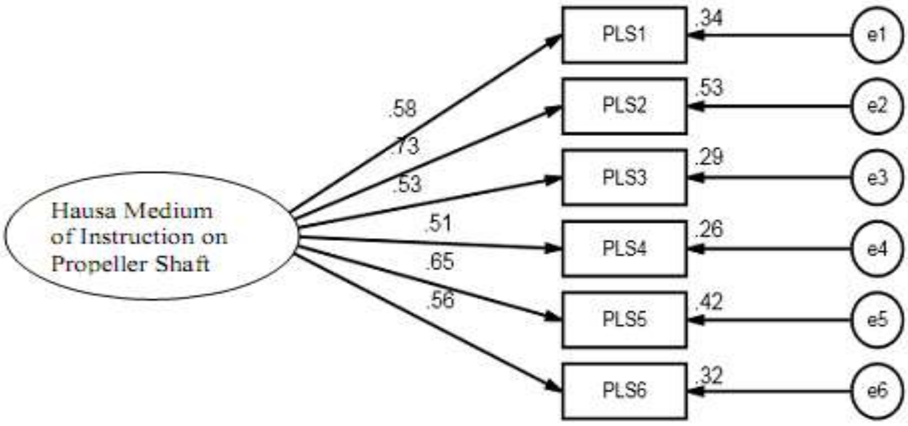


Figure 4.7 : Initial measurement model of propeller.

Estimate of regression weight of clutch are shown in Table 4.44. All measured variables were statistically significant at values of p = 0.05. Thus, these measured variables were converged to Hausa as medium of instruction on propeller shaft appropriately.

Table 4.44 : Regression weight of initial measurement model of propeller.

			Estimate	S.E.	C.R.	P
PLS1	<---	Hausa on propeller shaft	1.000	.214	8.612	.000
PLS2	<---	Hausa on propeller shaft	1.601	.224	8.251	.000
PLS3	<---	Hausa on propeller shaft	1.139	.192	6.837	.000
PLS4	<---	Hausa on propeller shaft	1.059	.184	6.859	.000
PLS5	<---	Hausa on propeller shaft	1.441	.214	7.840	.000
PLS6	<---	Hausa on propeller shaft	1.009	.164	7.164	.000
PLS7	<---	Hausa on propeller shaft	1.323	.263	6.231	.000

Table 4.45 shows the computed univariate normality of the initial measurement model of propeller shaft. The calculated skewness and kurtosis of the variables measured under propeller shaft especially PLS2 was not within the acceptable values of -1 and +1. Hence, the normality of the construct variable was not reasonable. Therefore, the model was recommended for modification.

Table 4.45 : Normality of initial measurement model of propeller shaft.

Variable	min	max	skew	c.r.	kurtosis	c.r.
PLS6	1.000	5.000	-.501	-3.007	.725	-.174
PLS5	1.000	5.000	-.925	-5.547	.554	-.662
PLS4	1.000	5.000	-.724	-4.343	.295	-.884
PLS3	1.000	5.000	-.770	-4.621	.055	-.166
PLS2	1.000	5.000	-1.132	-6.794	.811	-.434
PLS1	2.000	5.000	-.772	-4.630	.936	-.808
Multivariate					11.342	8.507

Analyses of the standardized residual covariance of the initial measurement model of propeller shaft are presented in Table 4.46. It shows that the maximum residual covariance between paired values was 1.712 in absolute value. Ideal standardized residual covariance value need to be less than 2 in absolute estimate value. Therefore, further modification of the model was recommended.

Table 4.46 : Standardized residual covariance of initial measurement model of propeller shaft.

	PLS6	PLS5	PLS4	PLS3	PLS2	PLS1
PLS6	.000					
PLS5	.073	.000				
PLS4	-.884	.004	.000			
PLS3	.609	-.306	-.577	.000		
PLS2	.317	.573	.081	-.795	.000	
PLS1	-.493	-.862	1.162	1.712	-.431	.000

Table 4.47 presents the covariance estimates of the initial measurement model of propeller shaft. It shows one instance of little error estimate that caused the goodness of fit fairly not fit. Therefore, the measurement error term e4 with the observed factor was removed for a good model fit.

Table 4.47 : Covariance of initial measurement model of propeller shaft.

	M.I.	Par Change
e4 <--> e5	8.301	.065

Based on the results in Table 4.48, in accordance to the default model fit indices the model satisfies goodness of fit. The Table shows the computed values for model fit indices of the modified model of propeller shaft. The model satisfied the goodness of fit indices with 2.86 for (χ^2)/df, GFI (0. 97), TLI (0.91), CFI (0.96), IFI (0.96), RMR (0.02), and RMSEA (0.04) at $P < .05$. Therefore, the hypothesis which states that there is no significant relationship between areas considered important on the topic of propeller shaft for learning ATS in Nigeria is hereby rejected, and the structural model in Figure 4.7 was generated.

Table 4.48 : Modified measurement model fit indices of propeller shaft

Model Fit Indices	Computed values	Range Values	P
Chi-square (χ^2)/df	2.86	< 3.00	
Goodness of Fit (GFI)	0.97	≥ 0.90	
Tucker-Lewis Index (TLI)	0.91	≥ 0.90	
Comparative Fit Index (CFI)	0.96	≥ 0.90	.000
Incremental Fit Index (IFI)	0.96	≥ 0.90	
Root Mean Square Residual (RMR)	0.02	≤ 0.05	
Root Mean Square Error of Approximation (RMSEA)	0.04	≤ 0.05	

Figure 4.8 shows a structure of the significant relationship between four areas considered important on the topic of propeller shaft for learning ATS in Nigeria. From the modified model in Figure 4.7 and the fit indices in Table 4.48 above, it can be concluded that four important areas such as PLS1 (outer shaft connection to the gearbox), PLS3 (Flange assembly), PLS5 (Inner and outer shaft housing assembly), and PLS6 (functions of yoke shaft) should be given due consideration. AMOS output summary of the modified model Fit indices of propeller shaft is presented in Appendix E.

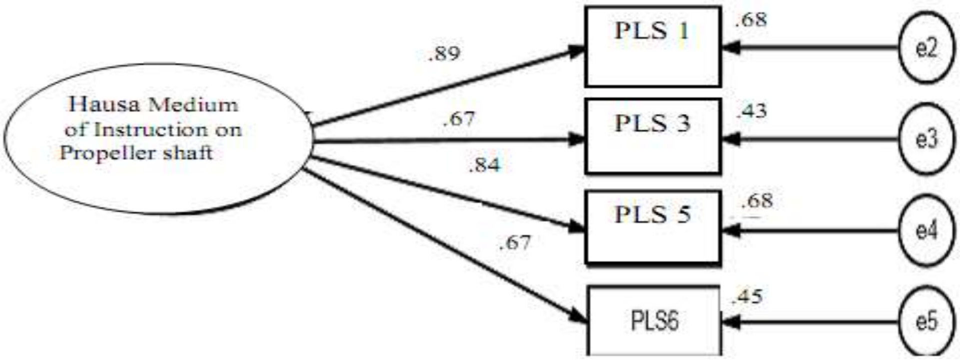


Figure 4.8 : Modified measurement model of propellershaft.

Table 4.49 shows the estimate of regression weight of modified measurement model of propeller shaft. All measured variables were statistically significant at values of $p < 0.05$. Thus, these measured variables were converged to Hausa as medium of instruction on propeller shaft appropriately.

Table 4.49 : Regression weight of modified model of propeller shaft.

			Estimate	S.E.	C.R.	P
PLS1	<---	Hausa on propeller shaft	1.000			
PLS3	<---	Hausa on propeller shaft	1.310	.322	6.979	.000
PLS5	<---	Hausa on propeller shaft	1.318	.377	8.308	.000
PLS6	<---	Hausa on propeller shaft	1.233	.366	6.995	.000

Inspection of the multivariate normality distribution of experimental data in Table 4.50 indicated that there was no observable factor that had serious univariate distribution problems. Skewness and kurtosis of all factors were recorded less than one in absolute value**.** Thus, the improved model was correctly developed.

Table 4.50 : Normality of modified measurement model of propeller shaft.

Variable	min	max	skew	c.r.	kurtosis	c.r.
PLS6	1.000	5.000	-.421	-4.007	.615	6.234
PLS5	1.000	5.000	-.915	-6.547	.454	5.212
PLS3	1.000	5.000	-.770	-4.621	.055	3.277
PLS1	1.000	5.000	-.972	-5.630	.836	5.138
Multivariate					9.673	7.179

Assessment of standardized residual covariance matrix in Table 4.51 indicated that all residual covariances are less than 2.0 in absolute value. Therefore, this measurement model was developed correctly and no misspecification was detected.

Table 4.51 : Standardized residual covariance of modified measurement model for propeller shaft.

	PLS6	PLS5	PLS3	PLS2	PLS1
PLS6	.000				
PLS5	-.320	.000			
PLS3	.247	-.417	.000		
PLS1	-.418	-.543	.830	-.394	.000

Cronbach's alpha coefficient of modified measurement model of propeller shaft is shown in Table 4.52 as .823. This indicated that these four variables had good internal consistency (Cronbach, 1951) and that the model is capable of precisely measuring the degree of Hausa medium of instruction on Propeller shaft.

Table 4.52 : Content validity of modified measurement model of propeller shaft.

Variable	Areas	Mean	Std. Dev.	Cronbach's Alpha
PLS1	Outer shaft connector to gearbox (Hadawan shaft na ciki da waje)	4.6981	.59361	
PLS3	Inner and outer shaft housing assembly(Hadawan shaft na ciki da waje)	4.1613	.73662	.823
PLS5	Flange assembly (Ayyukan flangi)	4.1759	.76952	
PLS6	Function of yoke shaft (Ayyukan yoke shaft)	4.7704	.61897	

Note: Words in parentheses indicate translations in Hausa

4.5.9 Research Question 5 (d)

What is the relationship between areas considered important on drive axle topic after introducing Hausa as medium of instruction on students' academic performance in Nigeria tertiary institutions offering AE course

4.5.10 Hypothesis 4 (d)

There is no significant relationships between areas considered important on drive axle topic after introducing Hausa as medium of instruction on students' academic performance in Nigeria tertiary institutions offering AE course**.**

Table 4.53 shows the computed values of model fit indices on the initial measurement model for drive axle topic in AE. Based on the result, the model did not satisfy the conditions of goodness of fit indices, with 2.83 for (χ^2)/df, GFI (0.96), TLI (0.91), CFI (0.95), IFI (0.95), RMR (0.02) and RMSEA (0.92) at P < .05. Some observed variables were considered to be removed in other to modify the model fit parameters.

Table 4.53 : Initial measurement model fit indices of axle drive.

Model Fit Indices	Computed values	Range Values	P
Chi-square (χ^2)/df	2.83	< 3.00	
Goodness of Fit (GFI)	0.96	≥ 0.90	
Tucker-Lewis Index (TLI)	0.91	≥ 0.90	
Comparative Fit Index (CFI)	0.95	≥ 0.90	0.000
Incremental Fit Index (IFI)	0.95	≥ 0.90	
Root Mean Square Residual (RMR)	0.02	≤ 0.05	
Root Mean Square Error of Approximation (RMSEA)	0.92	≤ 0.05	

Figure 4.9 shows the initial measurement model of all areas considered important on drive axle after introducing Hausa medium of instruction. The areas in the questionnaire refer to: AXD1 (functions of bearing types, ADX2 (CV joint assembly), AXD3 (lubrication of bearings in the hub), AXD4 (functions of ball join), AXD5 (inner and outer races diagnose) and AXD6 (splines of axle shaft).

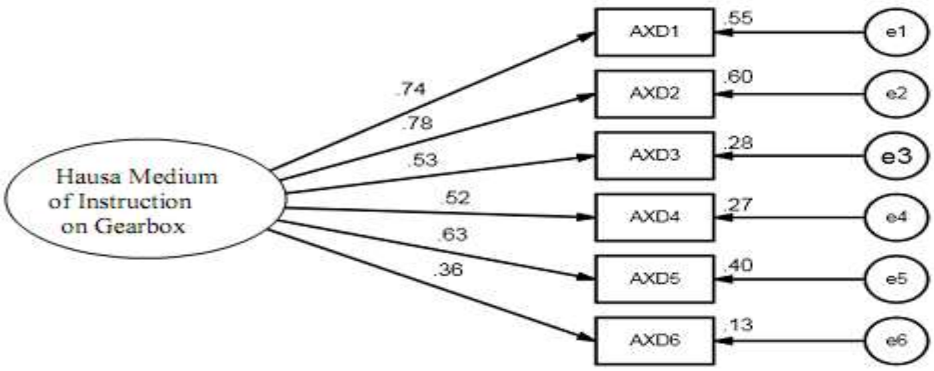


Figure 4.9 : Initial measurement model of drive axle.

Estimate of regression weight are shown in Table 4.54. All measured variables were statistically significant at values of p = 0.05. Thus, these measured variables were converged to Hausa as medium of instruction on propeller shaft appropriately.

Table 4.54 : Regression weight of initial measurement model of drive axle.

			Estimate	S.E.	C.R.	P
AXD1	<---	Hausa on axle Drive	1.000			
AXD2	<---	Hausa on axle Drive	1.347	.141	.575	.000
AXD3	<---	Hausa on axle Drive	.940	.138	.792	.000
AXD4	<---	Hausa on axle Drive	.931	.132	.075	.000
AXD5	<---	Hausa on axle Drive	1.112	.136	.171	.000
AXD6	<---	Hausa on axle Drive	.788	.126	.252	.000

Table 4.55 shows the multivariate normality distribution of drive axle after introducing Hausa as medium of instruction. One area - AXD1 and AXD3 have normality problems because the skewness and kurtosis absolute values exceeded +1. Therefore, this particular area was suggested to be deleted in order to obtain acceptable goodness of fit parameter values.

Table 4.55 : Normality of initial measurement model of drive axle.

Variable	min	max	skew	c.r.	kurtosis	c.r.
AXD8	2.000	5.000	-.564	-3.385	.618	1.855
AXD5	2.000	5.000	-.676	-4.056	.427	1.280
AXD4	1.000	5.000	-.647	-3.879	.751	2.252
AXD3	1.000	5.000	-1.210	-7.263	.410	7.229
AXD2	1.000	5.000	-.851	-5.105	.783	5.349
AXD1	1.000	5.000	1.395	-8.369	2.507	9.522
Multivariate					9.354	7.015

Assessment on standardized residual covariances matrix in Table 4.56 indicated that all residual covariances were less than 2.0 absolute value. Therefore, this measurement model was well fit to the experimental data and might correctly be developed.

Table 4.56 : Standardized residual covariance of initial measurement model for drive axle

	AXD6	AXD5	AXD4	AXD3	AXD2
AXD6	.000				
AXD5	-.526	.000			
AXD4	.474	-.195	.000		
AXD3	1.507	-.475	.429	.000	
AXD2	-.444	.448	-.159	-.341	.000

In modification indices, poor performance of model fits is detected through covariance matrix indices. Table 4.57 indicated that the measurement error of e1, if correlated to e4 and e6 might enhance the properties of the tested model to a certain degree. This solution seems to be inappropriate. Therefore, the factor AXD1 (Functions of bearing types) was recommended for removal for correct modification indices.

Table 4.57 : Covariance of initial measurement model of drive axle

			M.I.	Par Change
e2	<-->	e6	6.391	-.061
e1	<-->	e6	4.850	.041
e1	<-->	e4	4.617	-.040

Based on the results in Table 4.58 and Figure 4.9, the model satisfied the goodness of fit indices with 1.52 for (χ^2)/df, GFI (0.99), TLI (0.97), CFI (0.99), IFI (0.97), RMR (0.02) and RMSEA (0.04) at P < .05. The hypothesis which states that: There in no significant relationship between areas considered important on drive axle topic after introducing Hausa as medium of instruction on students' academic performance in Nigeria tertiary institutions offering AE course is accepted.

Table 4.58 : Modified measurement model fit indices of drive axle.

Model Fit Indices	Computed values	Range Values	P
Chi-square (χ^2)/df	1.52	< 3.00	
Goodness of Fit (GFI)	0.99	≥ 0.90	
Tucker-Lewis Index (TLI)	0.97	≥ 0.90	
Comparative Fit Index (CFI)	0.99	≥ 0.90	
Incremental Fit Index (IFI)	0.97	≥ 0.90	000
Root Mean Square Residual (RMR)	0.02	≤ 0.05	
Root Mean Square Error of Approximation (RMSEA)	0.04	≤ 0.05	

Figure 4.10 shows a structure of the significant relationship between four areas considered important on axle drive topic for learning ATS in AE in Nigeria. Therefore, from the modified measurement model fit indices in Table 4.58, it can be concluded that for successful learning of ATS in AE, four important areas such as: AXD3 (lubrication of bearings in the hub), AXD4 (functions of ball joints), AXD5 (inner and outer races diagnose), and AXD6 (splines of axle shaft) need to be given due consideration. AMOS output summary of the modified model Fit indices of drive axle is therefore presented in Appendix E.

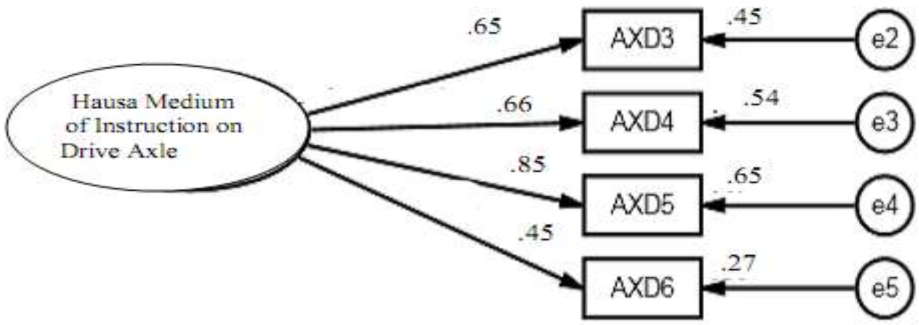


Figure 4.10 : Modified measurement model of drive axle.

Practically, multivariate normality depends on the univariate normality of individual variables. It is believed that if most univariate skewness and kurtosis are less than one in absolute value, the impact of multivariate normality on statistical estimates would be minimized. Table 4.59 indicates that there was no skewness and kurtosis greater than +1 absolute value after deletion of AXD2 with abnormality kurtosis of 1.783.

Table 4.59 : Normality of modified measurement model of drive axle.

Variable	min	max	skew	c.r.	kurtosis	c.r.
AXD8	2.000	5.000	-.875	-6.375	.512	1.745
AXD5	2.000	5.000	-.986	-2.022	.443	1.278
AXD4	1.000	5.000	-.457	-2.8675	.451	1.312
AXD3	1.000	5.000	-.320	-5.321	.721	1.021
Multivariate					2.279	1.225

Assessment on standardized residual covariances matrix in Table 4.60 shows that all residual covariances were less than 2.0 absolute value. Thus, the measurement model was correctly developed and represents the data accurately.

Table 4.60 : Standardized residual covariances of modified measurement model of drive axle.

	AXD8	AXD5	AXD4	AXD3	AXD2
AXD8	.000				
AXD5	-.661	.000			
AXD4	.653	-.285	.000		
AXD3	.611	-.515	.627	.000	

The Cronbach's alpha coefficient of modified measurement model of drive axle areas is presented in Table 4.61. The areas considered important have internal consistency of .810. Therefore, the model is considered as capable of measuring the degree of students' academic performance through Hausa as medium of instruction on drive axle in Nigerian tertiary institutions offering AE course.

Table 4.61 : Content validity of modified measurement model of drive axle.

Code	Areas Considered Important	Mean	Std. Dev.	Cronbach's Alpha
AXD3	Lubrication of bearings in hub (Lubrication daga bearings a cikin cibiya)	4.231	.772	
AXD4	Functions of ball joint (Ayyukan ball join)	4.138	.734	.810
AXD5	Inner and outer races diagnose (Ganewan shudin tredi na asali)	5.124	.753	
AXD6	Splines of axle shaft (Splain na aksali shaft)	4.103	.7055	

Note: Words in parentheses indicate translations in Hausa

4.6 Discriminate Validity of ATS Topics

Figure 4.11 presents the discriminate validity of all the ATS systems presented as topics in this study to each other. It is the distinct measure of every topic from each other. The discrimination between the topics was achieved through series of tests of the pairs of individual unobserved areas before modification to be correlated and uncorrelated after modification. Therefore, Figure 4.11 represents six related pairs of the analyses of the four ATS models with the chi-square values of the initial measurement models greater than the modified measurement models. Further detailed description of the modification indices of the models is in Table 4.63.

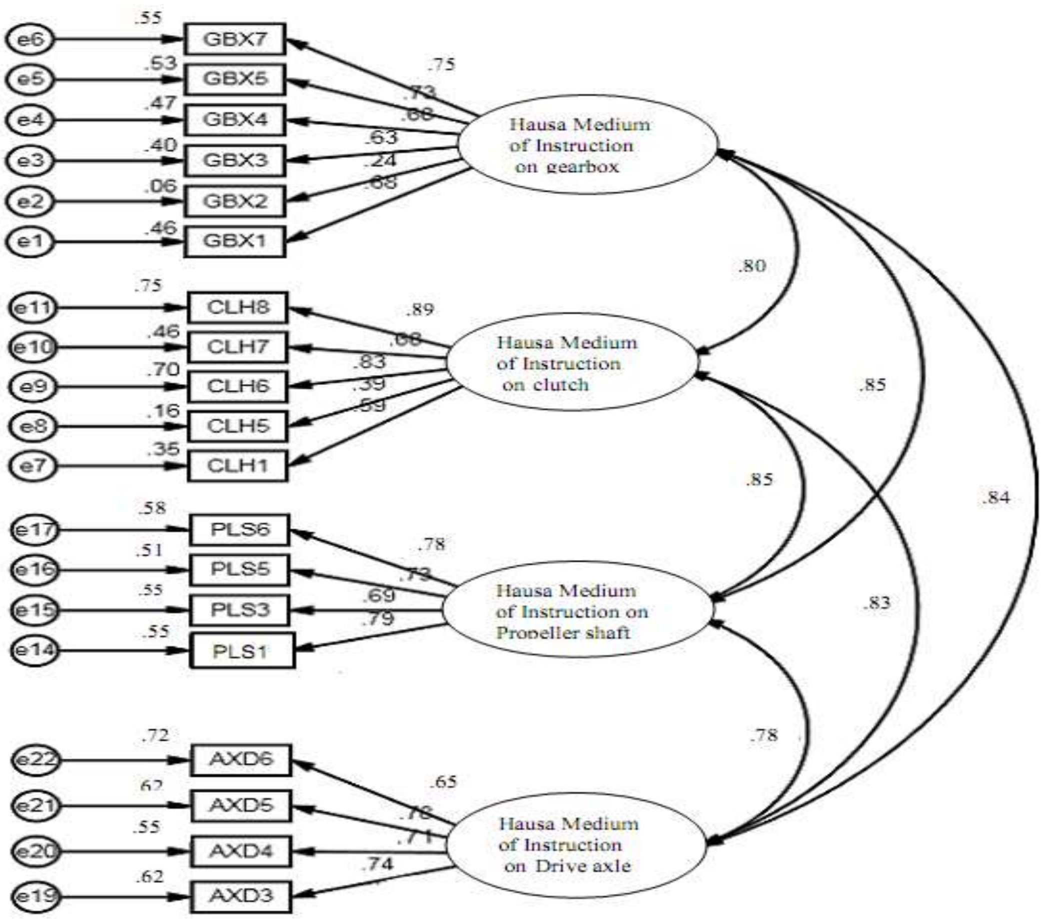


Figure 4.11 : Discriminate analysis of modified ATS models.

Table 4.62 present six analyses results of the related pairs of the ATS topics at 0.00 level of significance with the chi-square values of the initial measurement models greater than the modified measurement models. It was proven that the areas which represented gearbox (GBX), clutch (CLH), propeller shaft (PLS) and axle drive (AXD) were discriminate to each other.

Table 4.62 : Discriminate validity of modified ATS topics.

Pair wises	Unconstraint (Initial)			Constraint (Modified)		
	Chi-square	df	p	Chi-square	df	p
GBX – CLH	220.548	103	.000	121.111	53	.000
GBX – PLS	197.213	76	.000	122.780	43	.000
GBX – AXD	123.613	76	.001	112.930	43	.000
CLH – PLS	160.833	76	.000	94.023	43	.001
CLH – AXD	185.232	76	.000	111.235	43	.000
PSH – AXD	138.364	53	.000	87.000	34	.003

Finally, as presented in Figure 4.11 above, the modification model fit indices in Table 4.63 of all the four ATS systems presented as topics have complied with the default model fit indices in Chapter 3. The model satisfied the goodness of fit indices with 1.68 for (χ^2)/df, GFI (0.91), TLI (0.92), CFI (0.92), IFI (0.92), RMR (0.02) and RMSEA (0.05) at P < .05 as found in the literature. Therefore, through Hausa medium of instruction, the sub models were correctly developed and capable of measuring the students' academic performance in Nigerian tertiary institutions offering automobile engineering course. SPSS output summary of the modification fit indices is presented in Appendix E.

Table 4.63 : Model fit indices of modified ATS areas.

Model Fit Indices	Computed Values	Range Values	Sig.
Chi-square (x^2/df	1.68	< 3.00	
Goodness of Fit (GFI)	.91	≥ 0.90	
Tucker- Lewis Index (TLI)	.92	≥ 0.90	
Comparative Fit Index (CFI)	.92	≥ 0.90	.000
Incremental Fit Index (IFI)	.92	≤ 0.05	
Root Mean Square Residual (RMR)	.02	≥ 0.90	
Root mean Square Error of Approximation (RMSEA)	.05	≤ 0.05	

4.7 Research Question 6

What is the appropriate conceptual model based on the areas considered important on the four topics for learning ATS in Nigerian tertiary institutions offering AE course?

The appropriate conceptual model that answered research question (6) above was realized from the research question 4 and the corresponding hypotheses that was tested at 0.05 level of significant.. However, the developed conceptual model specifically presented in Figure 5.5 that comprises of the results of introducing Hausa as medium of instruction on gearbox, clutch, propeller shaft and drive axle. The model consists of 6 areas of gearbox, 5 areas of clutch, 4 areas each of propeller shaft and drive axle respectively, making an overall model of 19 areas of ATS.

4.8 Summary of the Chapter in Response to Research Questions

Based on the analyses and interpretation of the data, the results are presented in Table 4.64. The Table shows the research questions and the corresponding significant answers obtained from (1), students' academic performance in Hausa group and learning environment groups after introducing Hausa medium of instruction on both groups. Likewise, students academic performance in a controlled group, (2) the areas considered important of the ATS topics on students' academic performances after introducing Hausa as medium of instruction, and 3) the significant relationships of the areas considered important for learning ATS in Nigerian tertiary institutions offering AE course.

Table 4.64 : Research questions and the significant answers.

Research Questions	Statements	Groups/ Construct Variables	Significant Answers Based on GRD Mean and Important Areas	Remarks
RQ1	What is the effect of using Hausa on students' academic performance in learning ATS topics in Nigerian tertiary institutions offering AE course?	Hausa	Pre- test: 12.91 Post-test: 35.99	Fail Moderate
RQ2	What is the effect of learning environment using Hausa on students' academic performance in learning ATS topics in Nigerian tertiary institutions offering AE courses?	Learning Environme-nt	Pre- test : 11.53 Post-test : 38.96	Fail Moderate
RQ3	What is the effect of using English on students' academic performance in learning ATS topics in Nigerian tertiary institutions offering AE course?	Controlled	Pre- test : 14.11 Post-test : 14.42	Fail Fail
		(a) Gearbox	GBX1 - Working principles of meshing gears GBX2 - Gear system arrangement, GBX3 - Servicing of gears system, GBX4 - Parallel and non-intersection shaft, GBX5 - Main and counter Shaft functions	

RQ 4	What areas are considered important of the ATS topics on students' academic performance in Nigerian tertiary institutions offering AE course?		GBX7- Alignment of meshing gears
		(b) Clutch	CLH1- Mounting of clutch on the flywheel, CLH5 - Adjustment of the release bearing, CLH6 - Function of the clutch linkages, CLH7- Disc and pressure plate alignment, and CLH8 - Working principle of the clutch
		(c) Propeller Shaft	PLS1 - Outer shaft connector to to gearbox, PLS3 - Flange assembly, PLS5 - Inner and outer shaft housing assembly, and PLS6 - Functions of York shaft
		(d) Drive Axle	AXD3- lubrication of bearings in hub, AXD4 -Functions of ball joint AXD5 -Inner and outer races diagnose, AX D6 -Splines of axle Shaft
RQ5	What are the relationships between areas considered important on ATS topics considered important in Nigerian tertiary Institutions offering AE course.	(d) Drive Axle	Relationships between areas were considered importance for introducing Hausa medium of instruction in Nigerian tertiary institutions offering AE course. Six areas were considered related in gearbox model, while five areas in clutch and four areas each in propeller shaft and axle drive topics respectively were considered important in developing each of the models.
RQ6	What is the appropriate conceptual model based on the four topics for learning ATS in Nigerian tertiary institutions offering AE course?		The model in Figure 5.5 in chapter 5 presents the pictorial diagram of a conceptual model that consists of four conceptual models of 19 areas considered important on ATS topics for learning automobile transmission systems in Nigerian tertiary institutions offering AE course.

CHAPTER 5

DISCUSSION, RECOMMENDATIONS AND CONCLUSION

5.1 Introduction

This study developed a conceptual model for learning Automobile Transmission Systems (ATS) in Nigerian tertiary institutions offering AE course. The model was developed based on the areas considered important on ATS topics. The study relied exclusively on the concept maps assessment test and structured questionnaire instruments translated from English to Hausa language developed by the researcher that were believed suitable for AE achievements. Six objectives and six related research questions with two corresponding hypotheses guided the conduct of the study. Four ATS topics that were considered in the study are: gearbox, clutch, propeller shaft and drive axle. This chapter was outlined and discussed under five subheadings as: discussion of findings, implication of findings, recommendations, suggestion for further studies and conclusion. These were done in relation to the findings obtained in the study. First of all, the discussions of the findings were based on the six research questions following the four main topics of ATS considered important in the research. The results of students' academic performance after introducing Hausa as medium of instruction were first discussed followed by the areas that were considered important on each of the four topics that were further illustrated clearly in a graphical form. This is titled as the conceptual model for learning ATS in Nigerian tertiary institutions offering AE course.

5.2 Discussion of Research Findings

The discussion of the findings discovered in each of the four topics after Stepwise Linear Regression (SLR) analyses were redressed through Structural Equation Modelling (SEM) for the model development. This was because all the findings focused on the same research questions that targets specified research objectives. Also findings obtained from the research questions were all on automobile transmission systems; these are gearbox, clutch, propeller shaft and drive axle topics. The collective discussion of the findings for each of the four topics of automobile transmission systems were considered and presented. However, the discussion on each of the four topics submerged in every research question was to develop a conceptual model for learning automobile transmission systems in AE as outlined in the last objective of this study in chapter 1 as follows:

5.2.1 Research Question 1

What is the effect of using Hausa as medium of instruction on students' academic performance in learning ATS topics in Nigerian tertiary institutions offering AE course?

Based on research question 1 above as presented in Table 4.1 and Table 4.2 in the former chapter, descriptive statistics analyses were used. The Tables presents the results of students' academic performance in Hausa group as 12.91 and 35.99 before and after introducing Hausa as medium of instruction. Based on the post-test results, 35.99 of the students' academic performance indicate moderate score in accordance with the Federal ministry of education grading system presented in Appendix A2. The result indicates significant improvement on the students' academic performance after introducing Hausa medium of instruction as advocated by Shin *et al.* (2015), Hassanzedah and Hoseini (2011) as well as Aquilar and Munoz (2015).

5.2.2 Research Question 2

What is the effect of learning environment using Hausa as medium of instruction on students' academic performance in learning ATS topics in Nigerian tertiary institutions offering AE course?

In learning environment group, the performance of the students as presented in Table 4.4 and 4.5 are 11.53 and 38.96 in pretest and posttest scores respectively. The results indicate highly moderate performance. This was after favourable learning environment was improvised but using Hausa as the medium of instruction on the equipment improvised for teaching and learning. In accordance to the Federal ministry of education grading system presented in Appendix A2, the result shows is significant improvement on the students' academic performance after introducing Hausa as medium of instruction as emphasized by Lipmann (2010), Lipmann (2010), Pamel et al. (2007) and Oliver and Lipmann (2007).

5.2.3 Research Question 3

What is the effect of using English as medium of instruction on students' academic performance in learning ATS topics in Nigerian tertiary institutions offering AE course?

In controlled group, Table 4.6 and Table 4.7 presented the results as 14.11 and 14.42 in pretest and posttest scores respectively. The results indicates no significant improvement on the students' academic performance as indicated in the Federal ministry of education grading system see Appendix A2. Therefore, English as a medium used for instruction in the controlled did not improve students' academic performance compared to Hausa medium of instruction in the North-Eastern geo-political zone of Nigeria.

5.2.4 Research Question 4

What are the areas considered important of ATS topics on students' academic performance in Nigerian tertiary institutions offering AE course?

Research question 4 above was to determine the important areas of ATS topics by introducing Hausa as medium of instruction, through which the conceptual model was developed for learning ATS in Nigerian tertiary institutions offering AE course. Based on the four topics considered important in the research, important areas for each of the topics of gearbox, clutch, propeller shaft and drive axle were further searched and found. A total of nineteen (19) areas that comprises of six areas on gearbox, five areas on clutch and four areas each on propeller shaft and drive axle respectively were found as important for learning ATS. The relevant areas in each of the four topics were found independently in relation to the main construct variables. Therefore, the discussions are presented based on each topic as follows:

i. Hausa Medium of Instruction on Gearbox in AE course

Areas that were considered on gearbox after introducing Hausa as medium of instruction were identified from this study. Based on the findings, Hausa as medium of instruction on gearbox could be focused toward enhancing learning in teaching of these areas confirmed as follows:.

Through Hausa as medium of instruction, learning of working principles of gears, gears system arrangement and servicing of gears systems could be encouraged. To get acquainted with the principles or procedures of the gear systems in the class and or workshops, and the gear system arrangement for the concepts simplicity of understanding through medium of instruction as confirmed by Bruton (2011); Bylum and Diaz (2012) as well as Dafouz (2015) would easily be delivered.

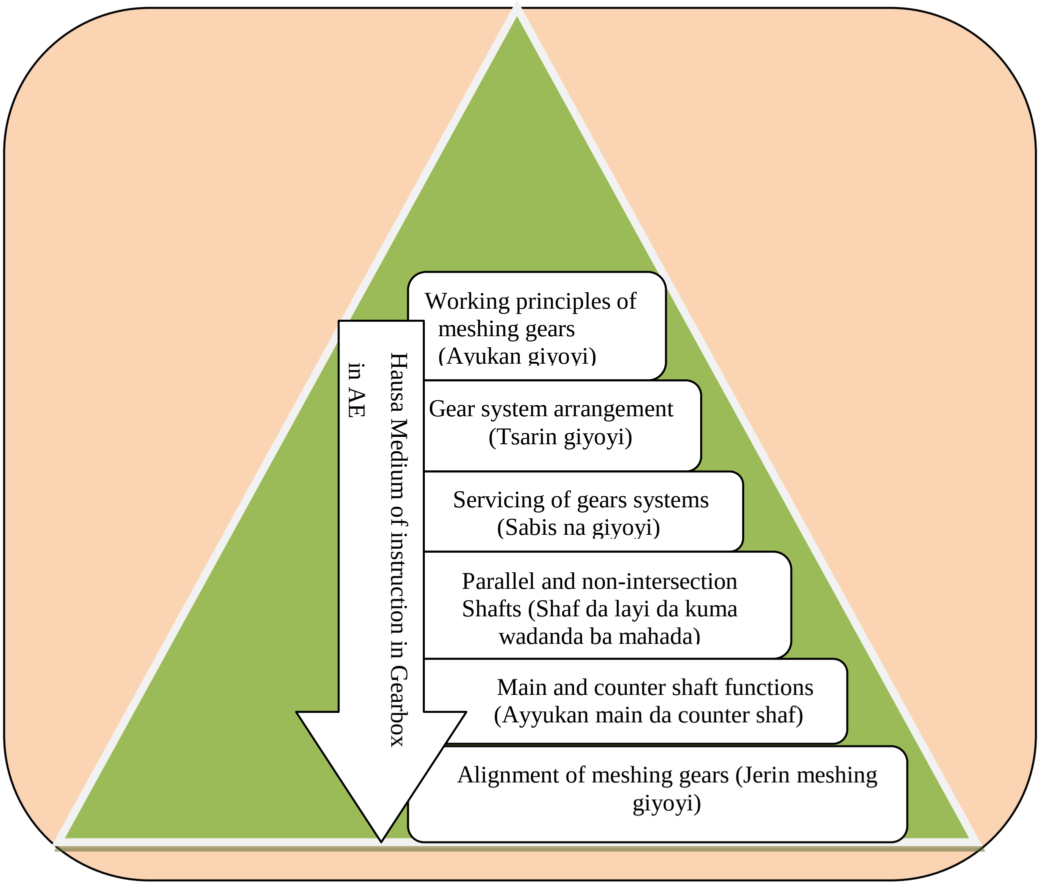
Consequently, in some tertiary institutions in Nigeria, the use of Hausa medium for conducting experiments in the workshops especially in engineering related areas is not official as compared to what is obtainable in other countries.

Nevertheless, with the findings of this study, using Hausa for instruction in Nigerian tertiary institutions, specifically, in the North- Eastern part of the country, it would provide the opportunity of knowing exactly the areas that require special priority during its incorporation in teaching of gearbox. In that, the use of Hausa as medium for teaching and learning, it can help simplify the concepts of the learning levels of students as emphasized by Coyle (2013), that learners can be flexible and can successfully express their learning difficulties through effective communication through their medium with the instructor. Apart from the flexibility, medium of instruction as the students' medium for communication as used in this study offered both the researcher and the student's easy process of learning the ATS concepts. It offered the learners and the instructor easy means of simplifying difficult teaching experiences as confirmed by Reljić *et al.* (2014) of the meta-analyses of national language studies in Europe. The researcher confirmed the positive effects of several bilingual studies on students' academic achievements.

Through Hausa medium of instruction, Working Principles of meshing gears, gear system arrangement, servicing of gear systems, parallel and non-intersectionshafts, main and counter shaft functions and alignment of meshing gears were considered most important by the experts in the areas of priority in learning about gearbox. The finding is timely considering the fact that most unexpected automobile problems on highways are no unconnected to the shaft. This could easily be handled by the car owner instantly provided the owner has an idea. However, due to the numerous advantages of medium of instruction, the learners can find its applications in various technical and engineering courses to be simpler as according to Lo Bianco (2007). Despite the advantages and benefits of using learners communication medium for instruction in workshops which gave it recognition, most of the African institutions have not started adopting the tool into the workshop situation. This is evidenced in the finding of a study conducted in South Africa, that poor performance of indigenous students at universities in developing countries are caused due to predominant use of English according to Nyika (2015). The scholar emphasized that it is because students that are English deficient could not used the medium for understanding during instruction. The scholar further stressed that lecturers were also found to prefer the use of their national language instead of the

English language because it enhances academic performance, civic and intercultural awareness.

Based on the finding of this research, after incorporation of Hausa as medium of instruction in gearbox, Figure 5.1 was developed. The figure shows a conceptual model of the areas considered important on the gearbox for learning using Hausa as medium in AE course. Shown in the figure, the areas of the findings are presented based on their level of importance. The areas were translated in Hausa medium during intervention. The triangular shape indicated by the arrow represents top-down hierarchy of the areas through Hausa medium of instruction in gearbox in AE course.



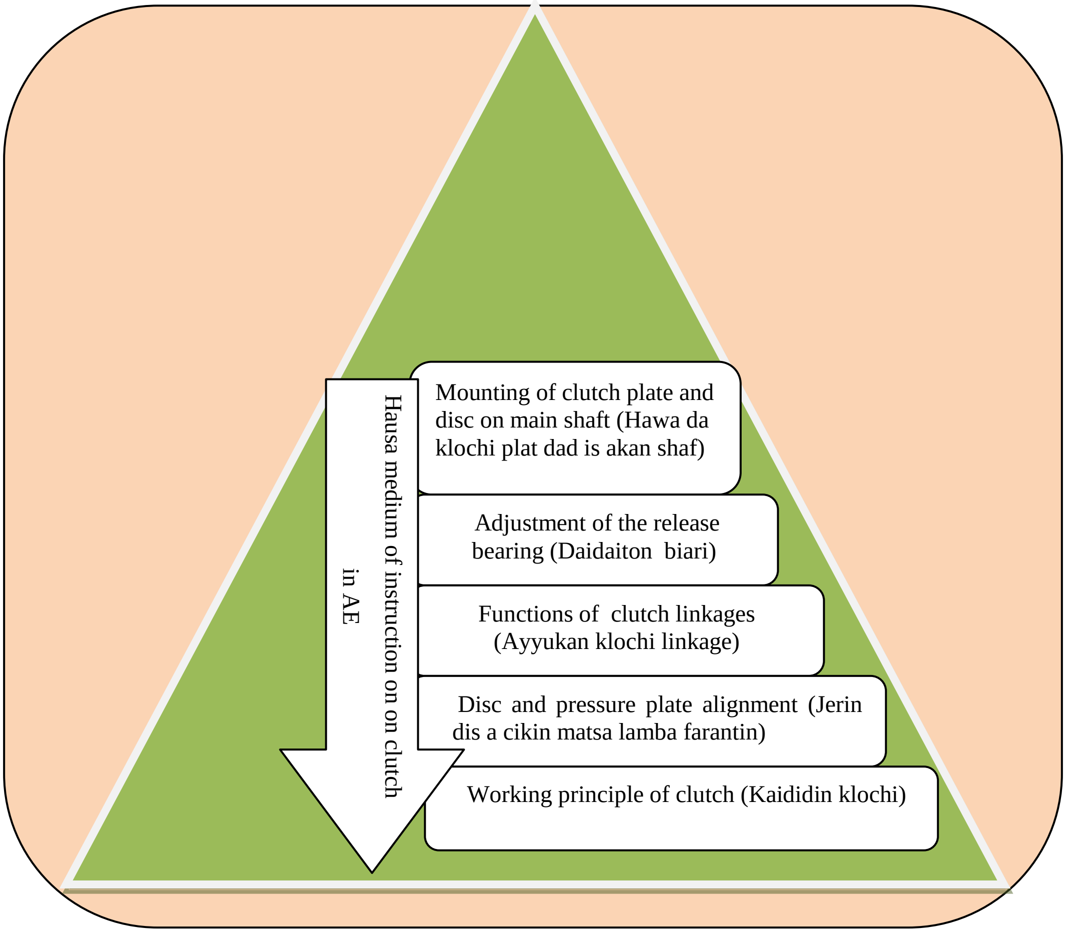
Note: words in parentheses indicate translation in Hausa

Figure 5.1 : Conceptual model for gearbox.

ii. Hausa Medium of Instruction on Clutch in AE

The finding identified six areas that are to be considered important on clutch for introducing Hausa as medium of instruction on clutch. Specifically, mounting of clutch plate and disc on main shaft, adjustment of release bearing, functions of clutch linkages, disc and pressure plate alignment and working principle of clutch were the fundamental areas recommended by the expert after translating the areas in Hausa medium for instruction. This finding become crucial at this time when most of the tertiary institutions agitates for the shift in the process of teaching and learning through the national medium for instruction according to Dalton-Puffer (2008). It was confirmed that, the use of national medium for instruction and for assessment has been recognized as a means of enhancing student learning and feedback that enable peer assessment of students as it was done through concept map assessment test in this study. Therefore, the finding of this research might improve assessment process in AE especially in the areas mentioned above because all involves learning through psychomotor, affective and cognitive domains.

Figure 5.2 shows a conceptual model of the areas that were considered important by the experts on clutch for using Hausa as medium of instruction in AE course in Nigeria. Based on the findings, using Hausa as medium of instruction, the conceptual model indicates that mounting of clutch plate and disc on the main shaft, followed by adjustment of release bearings down to working principles of the clutchcan be considered for implementation. The implication of this model to the practices of AE is that, depending on the availability of conducive learning environment for skill learning of mounting of clutch plate and disc on the main shaft. Based on the experts views it was rated as very important and first to be considered during teaching and learning on clutch in tertiary institutions offering AE course in Nigeria. Through learning of skill practices, automobile engineering skill via workshop could be obtained leading to self-reliant since it requires skill knowledge according to Zimmerman (2002), Jian (2011) and Umunadi (2010).



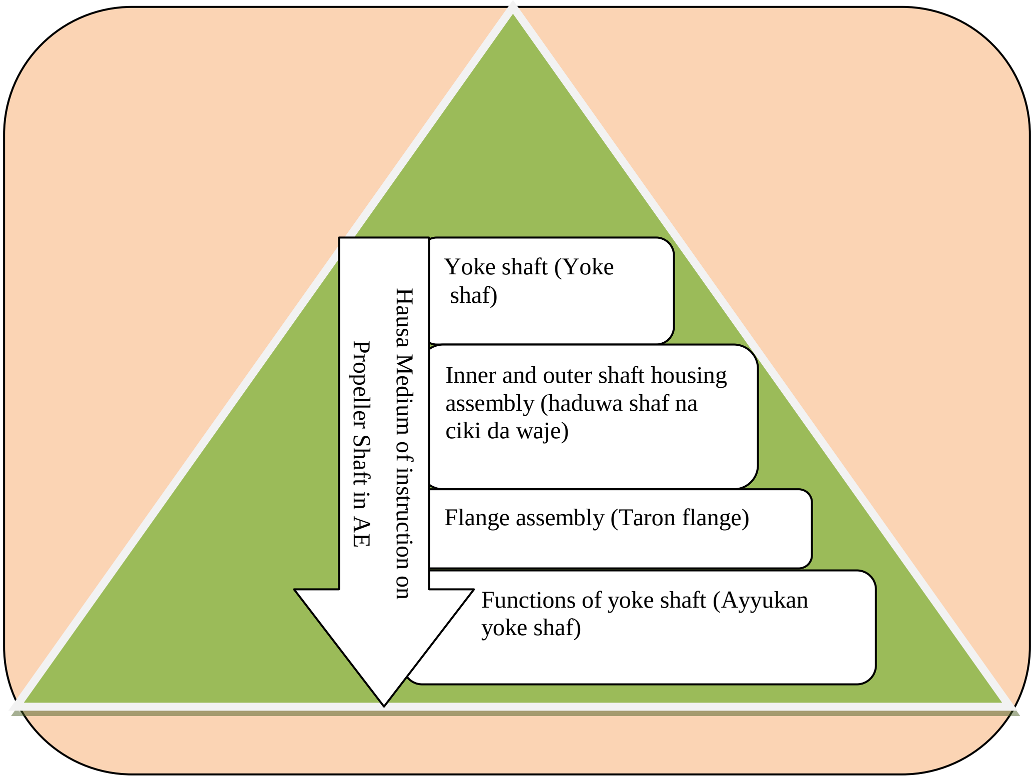
Note*:* words in parentheses indicate translation in Hausa

Figure 5.2 : Conceptual model for clutch.

iii. Hausa Medium of Instruction on Propeller Shaft in AE

Analyses of data collected on propeller shaft from the experts exposed that through Hausa as medium of instruction, areas considered important on propeller shaft for learning in AE course are: yoke shaft, inner and outer shaft housing assembly, flange assembly and function of yoke shaft. In a related finding, some researchers have identified that indigenous medium for instruction does not only improve the academic achievement of students, but influence the training experiences of entire participants for instruction (Arthur and Martin, 2006). Therefore, based on the opinions of the experts, the finding of this research indicated that Hausa as medium of instruction could be introduced on the propeller shaft for student' comprehensive understanding involving affective, cognitive and psychomotor experiences. Successful learning of skills could be achieved through disassembly and assembling the entire propeller shaft system.

Based on the expert's opinions, Figure 5.3 was developed. The figure shows a conceptual model of propeller shaft. Areas considered important from the findings are presented following the triangular shape based on their level of importance. That is yoke shaft was the first area considered important for using Hausa medium on propeller shaft in the tertiary institutions offering AE in Nigeria. This was followed by inner and outer shaft housing down to functions of the yoke shaft being the forth. In the figure, the arrow on the triangle point the direction to represents top-down hierarchy of the areas considered important for introducing Hausa as medium of instruction on propeller shaft.

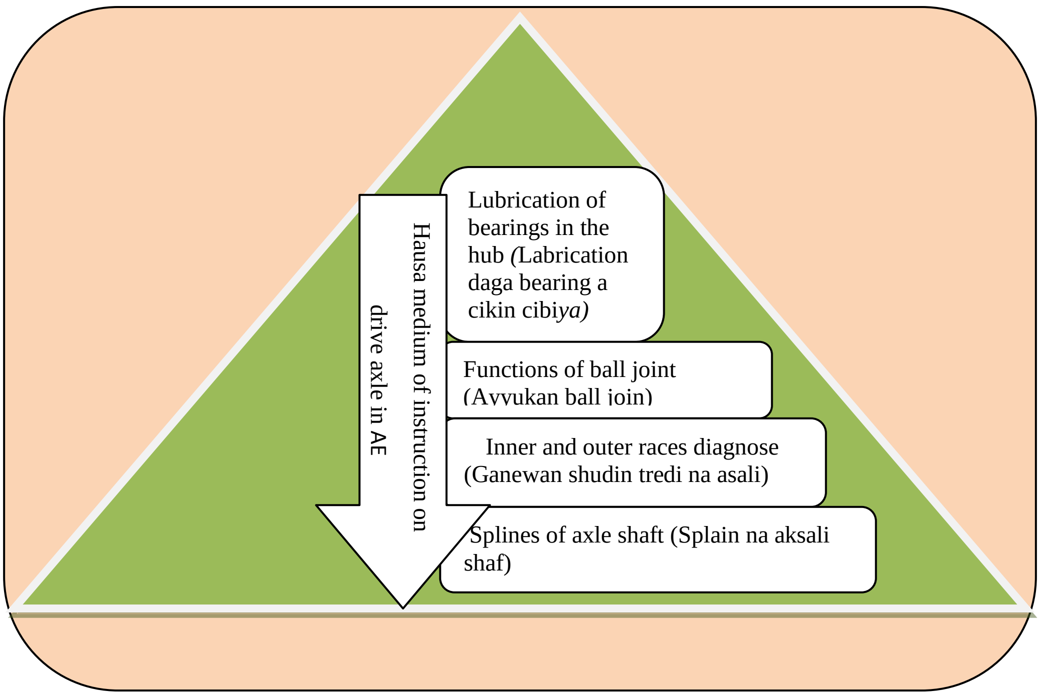


Note: words in parentheses indicate translation in Hausa

Figure 5.3 : Conceptual model of propeller shaft.

iv. Hausa Medium of Instruction on Drive Axle in AE

Figure 5.4 shows four important areas for introducing Hausa as medium of instruction on drive axle. Based on the findings, introducing the medium on drive axle can be focused toward teaching of lubrication of bearings in the hub, functions of ball joint, inner and outer races diagnose, and splines of axle shaft. The use of Hausa in learning of these areas, aid learners to get acquainted with the automobile skills, and both theoretical and experimental concepts of the areas can be delivered through the medium as advocated by Krirkpatrick (2013). Therefore, the figure shows a conceptual model of the areas considered important on drive axle. Shown in the figure, are the areas from the findings presented based on their level of importance. The triangular shape and the arrow direction shows top-down hierarchy of the important areas as generated from the analyses.



Note: words in parentheses indicate translation in Hausa

Figure 5.4 : Conceptual model for drive axle

5.2.5 Research Question 5

What is the relationship between areas of each topic considered important on students' academic performance in Nigerian tertiary institutions offering AE course?

Analyses on ATS topics through the structural equation modeling (SEM) in research question 4 have shown the relationships between areas and their topics of ATS. Based on the SEM results, all the areas to have relationships on their respective topics were redressed for whether there are significant relationships between the areas or not. All the four sets of areas in the four ATS topics were found with appreciable relationships within themselves and equally between the areas and their main ATS topics independently. The analyses started from the initial measurement model to the modified measurement model in line to SEM guideline. However, the relationships of the findings obtained from research question 4 are discussed as follows:

Research Question 5 is therefore based on the analyses presented in research question 4 which shows that all areas previously discovered to have relationships on each topic were further confirmed in the SEM analyses. First and famous, the finding on gearbox topic analyses initially exposed eight areas considered important through stepwise linear regression analyses. In SEM analyses via AMOS, six areas (Working Principles of meshing gears, gear system arrangement, servicing of gear systems, parallel and non-intersectionshafts, main and counter shaft functions and alignment of meshing gears) out of eight were recommended as the most important and have significant relationships. Hence Figure 5.1 was developed from figure 4.4. This became feasible because of the significant relationships between the areas considered important after introducing Hausa medium of instruction. Thus, learning on gearbox through medium of instruction can aimed to stimulate students' interest and attitude toward AE. Several studies showed that medium of instruction on students academic performance has significant effects on stimulating students' interest and attitude; for example, a similar research focus that examines the potential influence of medium of instruction on technologists attitudes and behaviors suggests a positive conclusion that it influences their socioeconomic attitudes and beliefs (Stepp-Greany, 2002); (Salili and Lai, 2003). Research conducted by Sylvén and Thompson (2015) exhibits a positive result on motivation to students' interest and attitude toward their conventional medium of instruction.

Similar research supported the above finding which discloses that medium of instruction can stimulate students' orientation and interest in several disciplines toward future academic course choices (Jensen and Thogersen, 2011). Another quantitative finding also supported this finding which reveals that medium of instruction can improve student attitude and interest to learn beyond the limits of the conventional medium of instruction (Tatzl, 2011).

Secondly, the finding on the clutch topic initially exposed eight areas considered as important in regression analyses. Further analyses via SEM revealed five areas (mounting of clutch plate and disc on main shaft, adjustment of release bearings, functions of clutch linkages, disc and pressure plate alignment and working principles of clutch) out of eight as most important with significance relationships. Thus, from Figures 4.3 presented in Chapter 4, Figure 5.2 in Chapter 5 was generated. This also became feasible due to cohesive relationships between the areas considered most important for learning ATS after introducing Hausa as medium of instruction on clutch. According to Feldon*et al.* (2015); Segal *et al.* (2014), learning about skills development are obtained through experntial learning, which involves learning of such areas.

Furthermore, seven areas were considered as important after introducing Hausa medium of instruction on propeller shaft during regression analyses. After SEM analyses for modification of the propeller shaft model, four areas (yoke shaft, inner and outer shaft housing assembly, flange assembly and functions of the yoke shaft) out of seven were considered most important through which Figure 5.3 was developed. These are skills developed through experimental learning. Specifically, automobile engineering have been integrated into learning acquisition for human skill development through experimental learning (Nelso, 2013); (Schuster *et al.*, 2015).

Finally, introducing Hausa medium of instruction on drive axle, four areas (lubrication of bearings in hubs, functions of ball joints, inner and outer races diagnose and splines of axle shaft) out of eight areas initially considered as important in regression analyses were finally considered as most important in SEM. These areas were hierarchically and significantly arranged based on their relationships in SEM analyses. Based on the relationships between the areas, Figure 5.4 was developed for learning ATS in Nigerian tertiary institutions offering AE. This finding was not surprising, due to the fact that the areas are industrial skill areas that are essentially acquired through occupational competencies that are gain through hand-on experience in a typical experimental learning setting such as the AE.

The issue of skills is deems appropriate, particularly in this contemporary time. Skill involved in AE includes but not limited to machine operational proficiency, handling of sophisticated equipments/machines, use of measurement instruments, work spaces management, breaking of task into specific activities, use of basic first aids, interpretation of work sheet and expertise of cleaning and storing tools outfit. This finding has been supported in many part of the literature. Few to mention comprise the proclamation that reveals that the emphasis for AE in an occupational therapy course was to give opportunity for students to gain professional skills development that comprise opportunity to develop work activity analysis, moving and handling techniques for job creation (Kreiner*et al.* 2015; Lee *et al.* 2015).

5.2.6 Research Question 6

What is the appropriate conceptual model based on the areas considered important of the four topics for learning ATS in Nigerian tertiary institutions offering AE course?

Based on the research findings on the four major topics of ATS discussed above, the research came up with a general conceptual model for learning in Nigerian tertiary institutions offering AE course. This became feasible after introducing Hausa as medium of instruction on the various ATS topics. Figure 5.5 shows the illustration of the conceptual model. The four major topics were represented by their respective areas established from the findings. At the centre of the depicted model indicates the conceptual model for learning automobile transmission systems in Nigerian tertiary institutions offering AE course that is surrounded by the four respective systems (gearbox, clutch, propeller shaft and drive axle) that were deemed important for learning in the Nigerian tertiary institutions offering AE course. The description of each of the four topics was according to the sub model discussed previously.

The fact that the developed conceptual model was built in cognizance with the 4 established systems, they were considered important as topics for the research. Areas considered important on each of these systems were quantitatively established to form four conceptual models in relation to the systems.

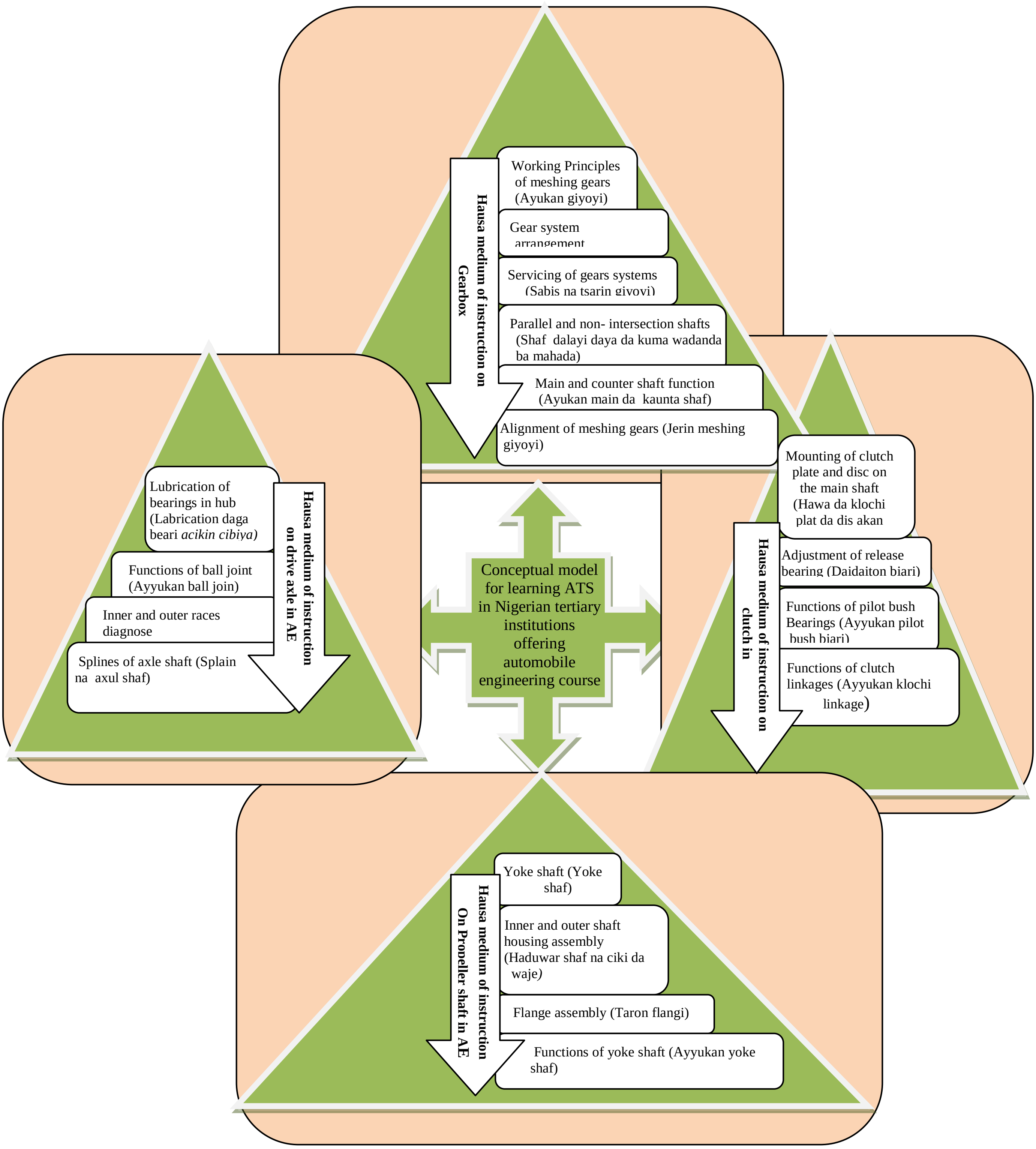
For instance, six (6) areas on the gearbox were identified and considered important and shown in the overall conceptual model. The Six areas (working principles of meshing gears, gear system arrangements, servicing of gears systems, parallel and non-intersection shafts, main and counter shafts functions, and alignment of meshing gears) in the research were presented based on their level of importance.

Furthermore, five (5) areas on clutch were considered important as presented in the general conceptual model. Five areas (mounting of clutch plate and disc on main shaft, adjustment of the release bearing, functions of clutch linkages, disc and pressure plate alignment, and working principles of clutch) were presented accordingly based on the level of importance.

In addition, four (4) areas on the topic of propeller shaft were considered important in the general conceptual model. The areas were presented accordingly based on the level of importance. This is to say ‘yoke shaft’ has higher level of importance and ‘functions of yoke shaft’ has least level of importance.

Besides, four (4) areas on the drive axle considered importance in the research were presented accordingly based on the level of importance. This is to say ‘lubrication of bearings in hub’ has higher level of importance and ‘splines of axle shaft’ has least level of importance.

In conclusion, the conceptual model for learning ATS in Nigerian tertiary institutions offering AE course was achieved and is presented in Figure 5.5. The model constitutes the main focus of the research that summarized 19 areas of ATS under four topics for successful learning in Nigerian tertiary institutions offering AE course.



Note: words in parentheses indicate translation in Hausa

Figure 5.5 : Conceptual model for learning automotive transmission systems in Nigerian tertiary institutions offering automobile engineering course.

5.3 Implications of the Research Findings

The principal motive of the research is the conceptual model developed for learning automobile transmission systems in Nigerian tertiary institutions offering AE course. This was conducted in response to using Hausa as medium of instruction on ATS topics. The research has some implication on students, automobile engineering lecturers, the National Universities Commission (NUC), Federal government of Nigeria, policy makers, stakeholders and the entire community of North-Eastern Nigeria where the tertiary institutions are located. The finding has further implication on the theories of learning, diffusion innovation and acceptance model theories. However, the implication of the study was further explained in relation to the listed subheadings as follows:

5.3.1 Implications of the Research for Students

Students that are involved from Nigerian tertiary institutions offering AE course are the direct beneficiaries to this research. They are central in that, Hausa as medium of instruction in AE course in totality is to the betterment of the students' knowledge and skills toward gaining employable skills that can help them to fit into the self-motivated labour market. This research was carried out and determined the effect of Hausa as medium of instruction, identified important areas of ATS for consideration and developed a conceptual model for learning automobile transmission in Nigeria tertiary institutions offering AE course. Therefore, all specific areas identified have direct impact on students for learning.

Implication of this research to all students that are involved is right from the implementation of the medium of instruction policy. By having Hausa medium of instruction policy in the Northern Nigeria, specifically, AE students would be free for using the medium. Incorporation of the medium for instruction would help students relate with their teachers for clear and easy communication. In teaching and learning through student's medium of communication, students can perform better in addition with the provision of favourable learning environments more than the conventional environment (Yin, 2009). Students doing their assignments through collaboration can be improved using Hausa medium for communication since they are used to the medium at all times.

5.3.2 Implications of the Research for the Lecturers

As the instructors, the lecturers could attribute and motivate the students during learning process using Hausa as medium of instruction. Teaching and learning process under the heads of departments can be reflected in the teaching documents of using Hausa medium of instruction. As developed in this research that medium of instruction be incorporated for learning engineering skills through workshop, lecturers might find it useful as it spells out to them specific areas of ATS for using the medium.

5.3.3 Implications of the Research for NUC

As a commission that have direct link to the tertiary institutions offering AE course in Nigeria, National Universities Commission (NUC) is directly responsible for the findings of this research. The implication on the agency is on its roles in controlling, supervising and monitoring of tertiary institutions involved in this research. In this regard, this agency is responsible for all that are needed especially training of staff in the medium for instruction as at when due. By so doing, tertiary institutions would be conducive for teaching/learning and research with Hausa medium. To the agency, this research has implications in challenging their roles by highlighting the areas that require urgent intervention. Furthermore, this research has outlined important areas to be given due considerations for using Hausa medium of instruction in ATS which could simplify planning the staff for such mission.

5.3.4 Implications of the Research for Federal Government of Nigeria

Federal Government of Nigeria being the owner of the tertiary institutions involved in this research, in totality has the implications on the finding. The funding of such institutions is solely the responsibility of the Federal government and as such, this research highlighted the need to increase funding toward developing lively AE in order for the programme to measure up to benchmark. This can only be done if the entire programme is restructured to accept and be using Hausa as medium of instruction, more especially training of the teachers in the medium. The finding might not be realized without effort from the Federal Government to procure all that is required for the proper implementation of the model in AE in Nigeria. The findings of this research has far reaching implications on the Federal government of Nigeria toward getting AE staff of the tertiary institutions become Hausa literates so that implementation process could be successful through them.

5.3.5 Implications of the Research for Policy Makers

The implication of this research on policy makers of AE in Nigerian tertiary institutions is on the areas considered important for inclusion into the policy. The policy makers are responsible to drawing policies for the betterment of respective institutions. Although, policy makers in this research are identified as deans of faculties offering AE programmes that serves as representative to the management board, they are responsible for policy implementation. Since policy making is the first step for implementation of the programme, medium of instruction in this case, even if areas of policy provision have not been included in the research, it is their responsibilities to provide resources to cater for the realization of the medium for instruction implementation in their administration. This research further implied that policy makers could find it relevant to develop successful monitoring mechanism to oversee the progress of medium of instruction implementation. The issue of training for successful implementation of the medium for instruction by the staff for the students is one of the areas that would fasten the implementation of this research.

5.3.6 Implications of the Research for the stakeholders

Stakeholders in this research are the administrators, they are key officers that are directly affected by this research, in that, and they are the central integrators of the medium for the instruction together with policy makers, lecturers and students. By implication, administrators of AE programme would find this research helpful since the model would simplify learning by identifying by using the medium for instruction in AE course. Lecturers who will be the frequent users of the model and students at the receiving end are all under the direct supervision of the administrators in this research. As such, it is the responsibility of the heads of departments to ensure smooth implementation of the medium for instruction.

5.4 Theoretical Implications of the Research

The conceptual model for learning automobile transmission systems in AE course developed from this research has some implications for learners and the entire communities concerned. This could be based on training of the students through attribution and motivation learning theory and concept maps learning theory. These theories according to Singh and Moono (2015) and Novak and Gowin (2006) both centers on the most precise principles for assessing students' academic achievements and skill development, which need to be adopted by the lecturers of this course. The theories also emphasized on how students can be motivated through new idea like through using Hausa as medium of instruction. Using indigenous language for instruction makes students free to asking a teacher (Mirza *et al.*, 2013). This is because students that are English deficient find it difficult expressing themselves asking questions in English. Using Hausa medium being the fluent medium of communication, students become cordial with their teachers, hence successful learning can take place. Concept maps learning theory is a tool for measuring students' conceptual knowledge of understanding pictorially (Novak and Gowin, 2006). Therefore, through the use of Hausa medium, visual knowledge and skill of students can be known.

In addition, the findings of this research have an implication of diffusion of innovation theory (Marsh *et al.,* 2002). The theory emphasizes on new ideas or practices. Therefore, using Hausa for instructional strategy becomes an innovation that is, if the users, the entire society have recognized its relative advantage. Diffusion of research centers on the conditions which increases or decreases the likelihood that a new idea or practice would be adopted by members of a given society. Based on the theory according to Warford (2005), it predicts that the idea of using Hausa as medium of instruction could provide information that can persuade the opinions of recipients. Studying how innovation occurs, Borego*et al.* (2010) emphasized that it has some stages namely: invention, communication through the public system, time and consequences.

Therefore, this research was based on the idea of the translated ATS content areas through Hausa as medium of instruction and developed conceptual model for learning ATS in Nigeria. It has improved on the students' academic performance as discussed in research question 1 and 2 results. Therefore, the use of this became viable based on its perceived relative advantages and its compatibility toward improving teaching and learning in automobile engineering course. The consequence of incorporating Hausa medium for instruction would be realized through diffusion of innovation theory as emphasized by Warford (2005), the impact Hausa medium would make in teaching and learning of ATS in Nigeria. This implies that because of the advantages of Hausa as an idea for instruction, improvement may be expected in the field of AE in Nigeria.

The findings have some implications on the North-Eastern Nigerian community based on the theory of acceptance. The advocates of the theory (Marsh *et al.*, 2002) emphasized on how innovation can be accepted in an organization or community because of its perceived usefulness and perceived ease of use. Therefore, this research found out important areas for consideration using Hausa medium for instruction. Its incorporation for learning is considered an important aspect toward improving the current condition of unemployed AE graduates in Nigeria. The findings have thus showed the relevance of the theory of acceptance into this research.

5.5 Recommendations

Based on the findings of this research, a conceptual model for learning automobile transmission systems in Nigerian tertiary institutions offering automobile engineering course was developed. The model comprised of automobile transmission areas considered important for learning in automobile engineering through Hausa medium of instruction in Nigeria. Based on the developed model, recommendations that could lead to its successful implementation are hereby proffered to stakeholders of AE in Nigeria as follows:

i. Federal government through NUC can adopt and implement the model for tertiary institutions offering AE in Nigeria.

ii. The model is also recommended to policy makers and administrators in planning and implementation of Hausa medium for instruction in AE programmes in Nigeria.

iii. Lecturers of AE programmes would also find the model worthy for adoption, in that it would serve as a document that will permit using Hausa as medium of instruction in AE course.

iv. The model is recommended for engineering students for collaboration within themselves and with the lecturers. There may be easy communication between them and the teachers, hence academic achievements may be improved.

v. The model is also recommended for researchers as a reference in order to build further research to explore more on additional areas of AE using Hausa medium as well as in other engineering disciplines.

5.6 Suggestion for Further Studies

After the completion of this research, gap still exist in the literature waiting for more exploration. The conceptual model developed shows areas considered important on the various ATS topics through Hausa medium of instruction on the students performances in Nigerian tertiary institutions offering AE course. Based on the model, more research is needed in the following areas.

i. Research on the conceptual model implementation strategies should be conducted
ii. Additional important areas of AE using Hausa as medium of instruction in various topics need to be explored.
iii. Conceptual model of for learning using Hausa as medium of instruction should equally be developed for Polytechnics and Monotechnics offering AE course
i. Further research could be conducted on students to explore how they response to Hausa medium of instruction in other disciplines.
v. A research involving parents of the perceived impact of Hausa medium of instruction on their children's need to be conducted.

5.7 Conclusion

Quality education is enormously an essential element for economic and social security of any nation (Babalola*et al.,* 2007), Nigeria is not an exception. If the motives of provision of excellence teaching and learning and research are to be actualized in the 21st century, education in tertiary institutions, important transformation must be considered in such a way that education attend to real world practices through experimental learning using medium of instruction. Concept mapping in engineering education has proved to be a successful instructional approach for developing students' knowledge of understanding according to Acharya and Sinha (2015); Gurupur*et al.* (2015), through which data was collected using

Hausa as medium of instruction for this study. However, through Hausa medium of instruction, this research study developed a conceptual model for learning automobile transmission systems in Nigerian tertiary education offering AE course. Four major topics of ATS that comprised of gearbox, clutch, propeller shaft and drive axle were duly considered important for automobile transmission system to be successfully integrated in AE. The conceptual model further elicits important areas of ATS in the outlined topics of AE that are important.

Based on the identified areas of the four ATS topics of the conceptual model, it implied that AE has direct benefits to its stakeholders (Faculty, students, community members, automobile engineering service agencies as well as tertiary institutions). These qualities of AE services were conceivably enunciated in many of the AE research studies. In this regard, the researcher concluded that the developed conceptual model for learning ATS established in this study could serve as a legitimate instrument for steering the implementation of the model in Nigerian tertiary institutions. The implementation of the conceptual model could serve in founding a strong and reliable AE practices in the Nigerian tertiary institutions for developing a holistic and skilled-minded AE graduates that are needed in the 21stcentury.

In conclusion, the developed conceptual model has some implications on the Federal government of Nigeria towards increase in funding for training of AE lecturers. The implication of the findings on supervisory agencies are towards ensuring that Hausa medium of instruction be implemented for learning. Policy makers and administrators are also challenged by the finding to provide necessary arrangements towards implementing Hausa medium of instruction policy, budgetary allocation and ensuring successful arrangement for making Hausa medium of instruction based on the areas identified on each topic. The model could be used to help undergraduates become more skilful for employment opportunities and subject for Continuous Quality Improvement (CQI) based on the data driven approach. It can also help automobile engineering teachers to teach successfully and help upgrade the standard of automobile engineering departments in Nigeria.

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APPENDIX A1

Concept maps assessment test

CENTER FOR ENGINEERING EDUCATION, SCHOOL OF GRADUATE STUDIES, UNIVERSITI TEKNOLOGI MALAYSIA, 81300, SKUDAI JOHOR BAHRU, MALAYSIA

TOPIC: CONCEPTUAL MODEL FOR LEARNING AUTOMOBILE TRANSMISSION SYSTEMS IN NIGERIAN TERTIARY INSTITUTIONS OFFERING AUTOMOBILE ENGINEERING COURSES

Number: ________________________ Institution: _________________

INSTRUCTION:

This test is designed to assess the students' academic achievement at B. Eng and B. Tech. Eng levels offering Automobile Engineering(AE) in automobile transmission systems (ATS) on the concepts of gearbox, clutch, propeller shaft and axle drive. Students are expected to construct concept maps of ATS using randomly arranged items in parentheses that are translations in Hausa.

Question 1: What do you understand about automobile transmission systems?
(Me ka fahinta game mota watsa tsarin)?

S/No	ATS Concepts (fassar mota)	Items/Areas (abubuwan yankunan)
1		Driven gears (kore giya)
2		Driving gears (tuki giya)
3		Spur gears (spur giya)
4		Helical gears (helical giya)
5	Gearbox (gearbox)	Connect (haduwa, na daya)
6		Parallel shafts (shaf layi daya)
7		Non-intersection shafts (shaf ba mahada)
8		Example (misali, na daya)
9		Examples (misali, na biyu)
10		Connect (hadi, na biyu)

11		Consist of (Kunchi, na daya)
12		Consist of (Kunchi, na biyu)
1		Fixed on (daura akan)
2		Pressure plate (fayi fayi klochi)
3		Clutch disc (klochi dis)
4		Engine (engine)
5	Clutch (klochi)	Input shaft (imput shaf)
6		Consist of (kunshi, na daya)
7		Consist of (kunshi, na biyu)
8		Splinned to (daura kan, na daya)
9		Splinned to (daura kan, na biyu)
1		Connect (hada, na daya)
2		Spider (gizo-gizo)
3		Spider bearing (gizo-gizo hali)
4		Spider ring (gizo-gizo zobe)
5	Propeller Shaft	Connect (hada, na biyu)
6	(Farfela Shaft)	Consist of (kunshi, na daya)
7		Consist of (kunshi, na biyu)
8		Connect (hada, na uku)
9		Sleeve Yoke (hannun riga karkiya)
1		Connect (hada)
2		Inboard joint talip (hadin gwiwa talip)
3		Axle hub (Dairy cibiya)
4	Drive Axle (Axul)	Tripod spider (tazi gizo-gizo)
5		Attached to (a hade)
6		Has (yana da)

APPENDIX A2

CMAT structure of automobile transmission systems

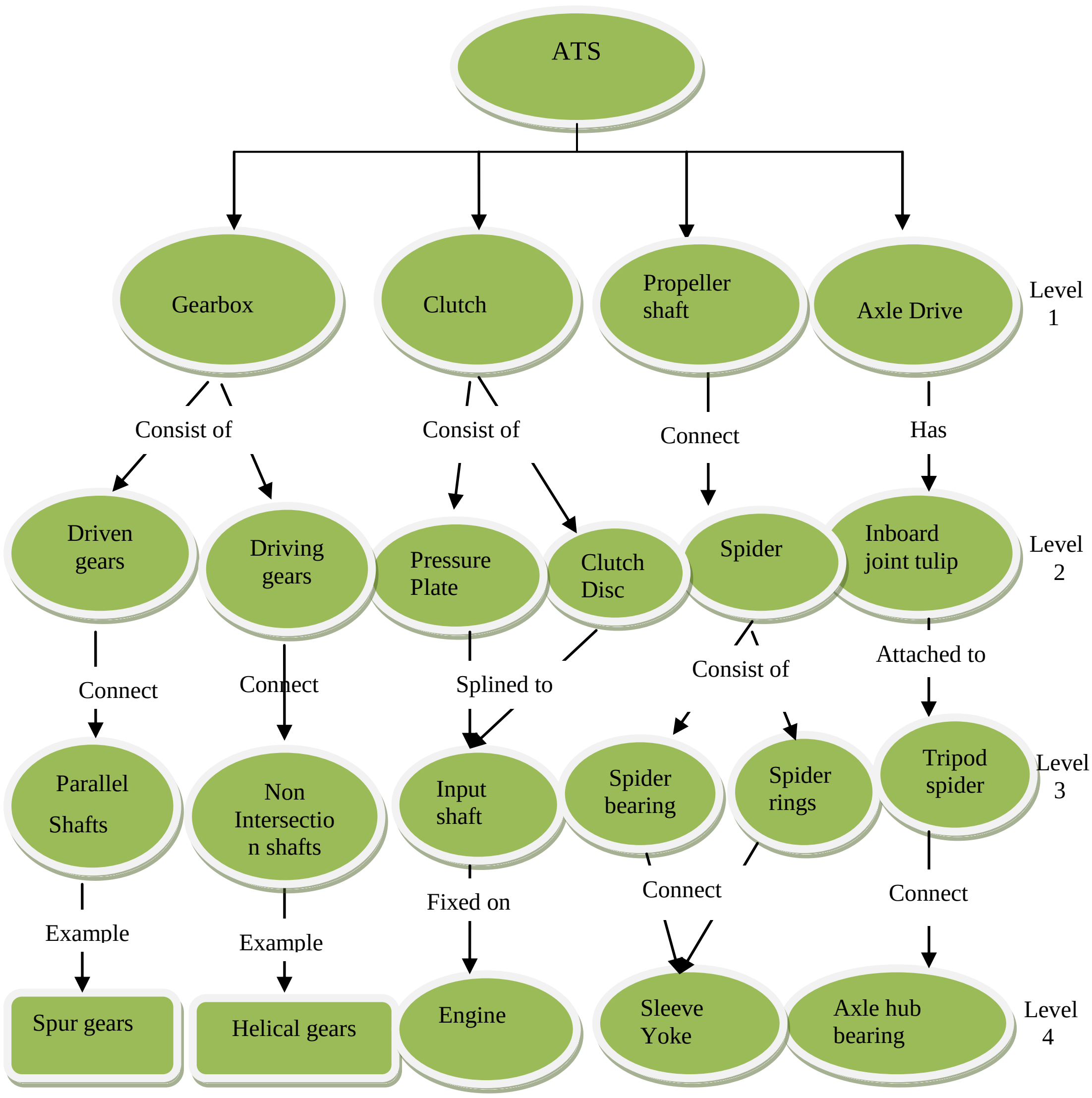

Figure A1X

APPENDIX A2 CONTINUE

Concept maps assessment scoring scheme in %

Gearbox	70 - 100 A (4)	60 - 69 B (3)	50 - 59 C (2)	40 - 49 D (1)	00 - 39 E (0)
Gearbox Classification (CL), Relationships =13 x 0.5 = 6.5 Valid Statement (VS), Links = 13 x 1 = 13 Valid Structure (VST), Hierarchy = 4 x1.5 = 6 Examples (EX) 2, 1, or 0 Total = 27.5/27.5 x 100					
Clutch Classification (CL), Relationships = 10 x 0.5 = 5 Valid Statement (VS), Links = 10 x 1 = 10 Valid Structure (VST), Hierarchy = 4 x1.5 = 6 Examples (EX) 2, 1, or 0 Total = 23/23 x 100					
Propeller Shaft Classification (CL), Relationships = 10 x 0.5 = 5 Valid Statement (VS), Links = 10 x 1 = 10 Valid Structure (VST), Hierarchy = 4 x1.5 = 6 Examples (EX) 2, 1, or 0 Total = 23/23 x 100					
Axle Drive Classification (CL), Relationships = 7 x 0.5 = 3.5 Valid Statement (VS), Links = 7 x 1 = 7 Valid Structure (VST), Hierarchy = 4 x1.5 = 6 Examples (EX) 2, 1, or 0 Total = 18.5/18.5 x 100					

Grading Systems

Concept Maps (Besterfield-Sacre *et al*,. 2004) in mean	Federal Ministry of Education (FME, 2012) Nigeria in %
00.00 - 24. 99 = (E) Fail	00.00 – 39. 99 = (E) Fail
25.00 - 30. 99 = (D) Low	40.00 – 49. 99= (D) Low
31.00 - 35. 99 = (C) Moderate	50.00 – 59. 99 = (C) Moderate
36.00 - 42. 99 = (B) Highly Moderate	60.00 – 69. 99= (B) Highly Moderate
43.00 - above = (A) Excellent	70.00 – Above = (A) Excellent

APPENDIX B

Structured questionnaire

CENTRE FOR ENGINEERING EDUCATION, SCHOOL OF GRADUATE STUDIES, UNIVERSITI TEKNOLOGI MALAYSIA, 81300, SKUDAI JOHOR BAHRU

TOPIC: CONCEPTUAL MODEL FOR LEARNING AUTOMOBILE TRANSMISSION SYSTEMS (ATS) IN NIGERIAN TERTIARY INSTITUTIONS OFFERING AUTOMOBILE ENGINEERING (AE) COURSES

Number: ________________________ Institution: __________________

INTRODUCTION:

This research questionnaire is proposed to seek the opinions of ATS Lecturers in high academic institutions in Nigeria offering Bachelor Degree of B. Eng. and B. Tech. Eng. levels in Nigeria levels through Hausa medium of instruction. However, information on the areas considered important on the components of gearbox, clutch, propeller shaft and drive axle for learning of ATS in AE in Nigeria will be gathered to develop an ATS model. Therefore, the following five point Likert scale type will be used for rating the responses as follows:

Tick √ in the appropriate box to show your opinion.

Note: Words in parentheses indicate translation in Hausa used them as appropriate.

1. HI (5) = Highly important
2. VI (4) = Very important
3. LI (3) = Little Important
4. LSI (2) = Less important
5. NI (1) = Not important

Research Question 1 (a): What areas are considered important on gearbox system for introducing Hausa as medium of instruction in Nigerian tertiary institutions?

i. To introduce Hausa as medium of instruction on gearbox system, the following areas are considered as:

(Don gabatar Hausa as matsakaici na wa'azi a kan giyabox tsarin, da wadannan yankunan suna dauke kamar)

S/N	Areas	NI (1)	LSI (2)	LI (3)	VI (4)	HI (5)
1	Gear system arrangement (Tsarin giyoyi)					
2	Service of gears system (Sabis na giyoyi)					
3	Alignment of meshing gears (Jerin meshing giyoyi)					
4	Differences between driven and driving gears (Bambance tsakanin driven da driving giyoyi)					
5	Working principles of gears (Ayukan giyoyi)					
6	Parallel and non-intersection shafts (Shaf da layi daya da kuma wadanda ba mahada)					
7	Driven/driving gears functions (Ayyukan driven da driving giyoyi)					
8	Gear lever position (Wajen zaman giya liver)					
9	The main and counter shafts functions (Ayyukan main da counter shaf)					
10	Gearbox mountain (Gearbox mauntin)					

Research Questions 1 (b): What is the perception of Lecturers on the areas considered important on the clutch in AE courses in Nigeria?

i. To introduce Hausa as medium of instruction on clutch, the following areas are considered as: (Don gabatar Hausa as matsakaici na wa'azi a kan klochi, da wadannan yankunan suna dauke kamar:)

S/N	Items/areas	NI (1)	LSI (2)	LI (3)	VI (4)	HI (5)
1	Mounting of plate and disc on the main shaft (Hawa da klochi plat da dis kan shaf)					
2	Adjustment of the release bearing (Daidaiton biari)					
3	Alignment of plate and disc with flywheel (Jeri plat dis daflawheel)					
4	Working principle of the clutch (Ka’idodin klochi)					
5	Disc alignment in the pressure plate (Jerin disc a cikin matsa lamba farantin)					
6	Function of the clutch release (Ayukan klochi dis)					
7	Hydraulic pipelines fault diagnose (Gane rashin aikin layukan man klochi)					
8	Torsion coil rings functions (Ayyukan torsio bearing)					
9	Pilot bush bearings functions (Ayyukan pilo bush bearing)					
10	Functions of clutch linkages (Ayyukan klochi linkage)					

Research Questions 1 (c): What is the perception of Lecturers on the areas considered important on the propeller shaft in AE courses in Nigeria?

ii. To introduce Hausa as medium of instruction on propeller shaft, the following areas are considered: (Don gabatar Hausa as matsakaici na wa'azi a kan farfela shaft, wadannan yankunan suna dauke:)

S/N	Areas	NI (1)	LSI (2)	LI (3)	VI (4)	HI (5)
1	Transmission of torque by the propeller shaft (Watsa daga karfin juyi da farfela shaf)					
2	Hub assembly (hada hub)					
3	Principles of propeller shaft rotation (Juiyewan ferfela)					
4	Propeller shaft connection to the universal joints (Haduwan farfela shaft da gadonbaya)					
5	The inner and outer shaft housing assembly (Hadawan shaf na ciki da waje)					
6	The outer shaft connection to the gearbox (Haduwan shaf na waje da gearbox)					
7	Rear/front axle connections (haduwan askali na baya da gaba)					
8	Spider bearing arrangement (Arrangemen na gizo-gizo hali)					
9	Flange Functions (Ayyukan flangi)					
10	Function of Slip joints (Ayyukan slip join)					

Research Questions 1 (d): What areas are considered important on the clutch system for introducing Hausa as medium of instruction in Nigerian tertiary institutions?

(iv) To introduce Hausa as medium of instruction on drive axle, the following areas are considered as: (Don gabatar Hausa as matsakaici na wa'azi a kan drive gindin mota, da wadannan yankunan suna dauke da)

S/N	Areas	NI (1)	LI (2)	LI 3)	VI (4)	HI (5)
1	CV joint assembly (hadin gwiwa CV)					
2	Axle shaft rotation principle (Kai'idodin juyawan axul shaf)					
3	Lubrication of bearings in the hub (Lubrication daga bearings a cikin cibiya)					
4	Ball join functions (Ayyukan ball join)					
5	Connection of axle to the hub (Dangane gindin mota zuwa cibiya)					

6	Functions of bearing types (Ayyukan bearings)					
7	linkages systems (Hadin kai da tsarin)					
8	Splines of axle shaft (Splain na asul shaf)					
9	Inner and outer races diagnose (Ganewan shudin tredi na asali)					
10	Tulip assembly (Hada tulip)					

APPENDIX C1

Validation letter from University of Maiduguri: Language unit

UNIVERSITY OF MAIDUGURI
Faculty of Education
(Office of the Dean)
Internal Memo

Languages Unit

Dr. A. A. Deba (MNSL) Rgd.
B.Ed. Hausa (UNIMAID); M. Ed. Linguistics (WSU), London
Ph. D Linguistics (WSU), London

P.M.B. 1069, Maiduguri,
Borno State, Nigeria,
Tel: +2348039590549.
E-mail: ahmadaliyu34@yahoo.com

Ref: PL: 123011- Mr. Victor DAGALA

Date: 14th June, 2015

VALIDATION LETTER

Dear Sir,

This is to certify that: the translations of the items of the instrument for the research topic "Conceptual Model for Integrating Medium of Instruction for Nigerian Tertiary Institutions Offering Automobile Engineering" in respect of **Mr Victor Dagala Medugu**, having gone through and to the best I am acquainted with, is true and accurate.

Thank.

Dr. A. A. Deba
H.O.D (Hausa)

APPENDIX C2

Validation letter from University of Maiduguri (UNIMAI): Automobile Unit

UNIVERSITY OF MAIDUGURI

Faculty of engineering

Automobile Engineering Unit

Dr (Engr.) M.B.UMAR COREN Rgd.
B.Eng. Mechanical (FUTY).
M. Eng. Thermodynamics (Kano)

P.M.B. 1069, Maiduguri
Borno State, Nigeria
Tel: 08030641408
E-mail: mbumar44@gmail.com

Ref: Dagala Victor Medugu

Date: 10/06/2015

TO WHOM IT MAY CONCERN

Dear Sir,

Referenced to the concept map questionnaire items for the research topic "*Conceptual Model for Integrating Medium of Instruction for Nigerian Tertiary Institutions Offering Automobile Engineering*" of **Mr. Dagala Victor Medugu**. I have personally examined and reviewed the contents in the document. I hereby certify that the information contained in the questionnaire is familiar to me and to the best of my knowledge and belief is in conformity to the curriculum of the course.

Thank.

Faithfully

HOD (AUTO)

APPENDIX D1

Abubakar Tafawa Balewa University (ATBU), Bauchi

Approval letter for data collection

Center for Engineering Education (CEE),
School of Graduate Studies,
University Teknologi Malaysia (UTM),
Skudai 81310, Johor Bharu, Malaysia.
6th February, 2014

The Dean,
Faculty of Engineering,
Abubakar Tafawa Balewa University, Bauchi

Through: H.O.D
Department of Automobile
University of Maiduguri,
Borno State

PERMISSION LETTER FOR DATA COLLECTION

Dear Sir,

I am a PhD graduate student at Universiti Technologi Malaysia undertaking a research titled "**Conceptual Model for Integrating Medium of Instruction (L1) in Nigerian Tertiary Institutions Offering Automobile Engineering**". Your institution is one of the Nigerian tertiary institutions offering automobile engineering at (B.Tech. Eng.) Levels in North-Eastern part of the country where I intends to collect data for the study.

The data collection period will be for Semester 1 2014/2015 session. There will be no compensation for students that will participate in the data collection, nor there be any known risk involve. In order to ensure that all information will remain confidential, students' names will not be included. The data to be collected will provide useful information regarding my analysis in the model proposal process

If you are not satisfied with the manner in which this study is being conducted, you may (if you so wish) report any complaint to the Dean School of Graduate Studies, Universiti Technologi Malaysia (UTM) Skudai, 81310, Johor Bharu, Malaysia at a link - graduate@utm.my. Or if you require additional information or have questions, please contact me or my supervisors at any of the numbers or emails below.

Thank you for accepting and assisting me in my educational endeavours.

Faithfully,

Victor Dagala Medugu
+2348030641408
+60146730795

Dr. A. Bin Udin (Supervisor 1)
+60137705717
p-amir@utm.my

Prof. Dr. Z. M. Bin Mat Saman (Supervisor 2)
+60197796872
zameri@utm.my

APPENDIX D2

Federal University of Technology (FUTY), Yola

Approval letter for data collection

Center for Engineering Education (CEE),
School of Graduate Studies,
University Teknologi Malaysia (UTM),
Skudai 81310, Johor Bharu, Malaysia.
6th February, 2014

The Dean,
Faculty of Engineering,
Federal University of Technology, Yola

Through: H.O.D,
Department of Automobile Engineering,
Federal University of Technology, Yola,
Adamawa State, Nigeria

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Victor Dagala Medugu
+2348030641408
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Dr. A. Bin Udin (Supervisor 1)
+60137705717
p-amir@utm.my

Prof. Dr. Z. M. Bin Mat Saman (Supervisor 2)
+60197796872
zameri@utm.my

APPENDIX D3

University of Maiduguri, Maiduguri (UNIMAID)

Approval letter for data collection

Center for Engineering Education (CEE),
School of Graduate Studies,
University Teknologi Malaysia (UTM),
Skudai 81310, Johor Bharu, Malaysia.
6th February, 2014

The Dean,
Faculty of Engineering,
University of Maiduguri, Maiduguri

Through: H.O.D,
Department of Automobile Engineering
University of Maiduguri, Maiduguri
Borno State, Nigeria.

PERMISSION LETTER FOR DATA COLLECTION

Dear Sir,

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Thank you for accepting and assisting me in my educational endeavours.

Faithfully,

Victor Dagala Medugu
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Dr. A. Bin Udin (Supervisor 1)
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Prof. Dr. Z. M. Bin Mat Saman (Supervisor 2)
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zameri@utm.my

APPENDIX E

Output summary of modified model fit indices.

Model fit summary of gearbox

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	14	37.156	14	.001	2.8054
Saturated model	28	.000	0		
Independence model	7	372.383	21	.000	17.733

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.031	.977	.906	.477
Saturated model	.000	1.000		
Independence model	.186	.553	.404	.415

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.900	.850	.956	.966	.968
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.039	.054	.123	.035
Independence model	.279	.255	.304	.000

Model Fit Summary of clutch

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	14	34.344	14	.002	1.351
Saturated model	28	.000	0		
Independence model	7	447.712	21	.000	21.320

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.030	.951	.917	.479
Saturated model	.000	1.000		
Independence model	.211	.523	.364	.392

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.923	.885	.933	.968	.967
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.032	.048	.117	.061
Independence model	.307	.283	.333	.000

Model Fit Summary of propeller shaft

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	10	14.327	5	.014	2.732
Saturated model	15	.000	0		
Independence model	5	227.976	10	.000	22.798

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.020	.924	.922	.325
Saturated model	.000	1.000		
Independence model	.153	.632	.449	.422

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.937	.874	.978	.978	.977
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.023	.038	.151	.087
Independence model	.318	.283	.355	.000

Model Fit Summary of drive axle

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	10	7.626	5	.178	2.922
Saturated model	15	.000	0		
Independence model	5	198.934	10	.000	19.893

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.030	.914	.955	.328
Saturated model	.000	1.000		
Independence model	.159	.668	.502	.445

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.962	.923	.976	.921	.941
Saturated model	1.000		1.000		1.000

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Independence model	.000	.000	.000	.000	.000

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.024	.000	.115	.431
Independence model	.296	.261	.333	.000

Model Fit Summary of discriminate analyses of ATS topics

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	19	8.636	42	.198	1.676
Saturated model	12	.000	0		
Independence model	4	198.934	10	.000	18.993

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.018	.910	.955	.328
Saturated model	.000	1.000		
Independence model	.169	.878	.722	.775

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.962	.923	.916	.918	.918
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.048	.000	.115	.431
Independence model	.386	.361	.343	.000

APPENDIX F

ME 203: Course outline objectives

(Automobile transmissio systems)

B. Gearbox

1. Prepare gearbox for removal. 2. Remove gearbox from the engine. 3. Separate the gearbox into its basic components. 4. Name the three basic cleaning processes.

C. Clutch

1. Describe the various clutch components and their functions. 2. Name and explain the advantages of the different types of pressure plate assemblies. 3. Name the different types of clutch linkages. 4. List the safety precautions that should be followed during clutch servicing. 5. Explain how to perform basic clutch maintenance. 6. Name the six most common problems that occur with clutches. 7. Explain the basics of servicing a clutch assembly.

D. Propeller Shaft

1. Prepare propeller shaft for removal. 2. Remove propeller shaft from rear axle drive vehicle. 3. Separate the propeller shaft into its basic components. 4. Name the three propeller shaft housings

E. Axle Drive

1. Diagnose problems in CV joints. 2. Perform preventive maintenance on CV joints. 3. Explain the difference between CV joints and universal joints. 4. Name and describe the components of a rear-wheel-drive axle. 5. Describe the operation of a rear-wheel-drive axle. 6. Explain the function and operation of a differential and drive axles. 7. Describe the various differential designs, including complete, integral carrier, removable carrier. 8. Explain the function of the main driving gears, drive pinion gear, and ring gear. 9. Describe the different types of axle shafts and axle shaft bearings.

APPENDIX G

Critical values of T

(A)

	Levels of Significance for a One-Tailed test						
	.10	.05	.025	.01	.005	.001	.0005
	Levels of Significance for Two-Tailed test						
df	.20	.10	.05	.02	.01	.002	.001
26	1.3150	1.7056	2.0555	2.4786	2.7787	3.4350	3.7066
27	1.3137	1.7033	2.0518	2.4727	2.7707	3.4210	3.6896
28	1.3125	1.7011	2.0484	2.4671	2.7633	3.4082	3.6739
29	1.3114	1.6991	2.0452	2.4620	2.7564	3.3963	3.6594
30	1.3104	1.6973	2.0423	2.4573	2.7500	3.3852	3.6459
35	1.3062	1.6896	2.0301	2.4377	2.7238	3.3400	3.5911
40	1.3031	1.6839	2.0211	2.4233	2.7045	3.3069	3.5510
50	1.2987	1.6759	2.0086	2.4033	2.6778	3.2614	3.4960
60	1.2958	1.6707	2.0003	2.3902	2.6604	3.2319	3.4604
70	1.2938	1.6669	1.9945	2.3808	2.6480	3.2109	3.4351
80	1.2922	1.6641	1.9901	2.3739	2.6387	3.1953	3.4164
90	1.2910	1.6620	1.9867	2.3685	2.6316	3.1833	3.4020
100	1.2901	1.6602	1.9840	2.3642	2.6259	3.1738	3.3905
120	1.2887	1.6577	1.9799	2.3578	2.6174	3.1596	3.3735
200	1.2858	1.6525	1.9719	2.3451	2.6006	3.1315	3.3398
300	1.2844	1.6500	1.9679	2.3389	2.5923	3.1176	3.3232
400	1.2837	1.6487	1.9659	2.3357	2.5882	3.1107	3.3150
500	1.2833	1.6479	1.9647	2.3338	2.5857	3.1066	3.3101
1000	1.2824	1.6464	1.9623	2.3301	2.5808	3.0984	3.3003
∞	1.2816	1.6449	1.9600	2.3264	2.5758	3.0902	3.2905

Critical Values of F

(B)

df Denominator	α	df Numerator 1	2	3	4	5	6	7	8	9	10	11	12	14
200	0.05	3.89	3.04	2.65	2.42	2.26	2.14	2.06	1.98	1.93	1.88	1.84	1.80	1.74
	0.01	6.76	4.71	3.88	3.41	3.11	2.89	2.73	2.60	2.50	2.41	2.34	2.27	2.17
500	0.05	3.86	3.01	2.62	2.39	2.23	2.12	2.03	1.96	1.90	1.85	1.81	1.77	1.71
	0.01	6.69	4.65	3.82	3.36	3.05	2.84	2.68	2.55	2.44	2.36	2.28	2.22	2.12
1000	0.05	3.85	3.00	2.61	2.38	2.22	2.11	2.02	1.95	1.89	1.84	1.80	1.76	1.70
	0.01	6.66	4.63	3.80	3.34	3.04	2.82	2.66	2.53	2.43	2.34	2.27	2.20	2.10
∞	0.05	3.84	3.00	2.61	2.37	2.21	2.10	2.01	1.94	1.88	1.83	1.79	1.75	1.69
	0.01	6.64	4.61	3.78	3.32	3.02	2.80	2.64	2.51	2.41	2.32	2.25	2.19	2.08

APPENDIX H

(A) SPSS output of reliability of concept maps assessment test.

Item Statistics of gearbox

	Mean	Std. Deviation.	N
GBX1	4.5032	.94512	325
GBX2	4.5012	.91524	325
GBX3	4.5188	.92033	325
GBX4	4.5023	.94532	325
GBX5	4.5254	.90453	325
GBX6	4.5012	.92031	325
GBX7	4.4965	.92552	325
GBX8	4.6432	.86123	325
GBX9	4.5021	.93043	325
GBX10	3.8321	.80714	325
GBX11	3.9013	.81525	325
GBX12	3.9643	.83463	325

Item Statistics of clutch

	Mean	Std. Deviation	N
CLH1	4.6759	.76912	325
CLH2	3.6204	.68642	325
CLH3	3.5630	.63137	325
CLH4	3.5972	.68185	325
CLH5	3.4491	.79856	325
CLH6	3.4028	.70861	325
CLH7	3.8241	.78164	325
CLH8	3.6389	.69100	325

Item Statistics of propeller shaft

	Mean	Std. Deviation.	N
PLS1	3.6296	.78403	325
PLS2	3.5880	.60359	325
PLS3	3.5065	.61588	325
PLS4	3.4583	.79942	325
PLS5	3.5231	.73203	325
PLS6	3.8380	.76934	325
PLS7	3.5417	.79942	325
PLS8	3.5093	.73239	325

Item Statistics of drive axle

	Mean	Std. Deviation	N
AXD1	3.5787	.79713	325
AXD2	4.5370	.85281	325
AXD3	4.5602	87554	325
AXD4	3.6019	.77772	325
AXD5	4.5093	.87862	325
AXD6	4.5556	.86787	325
AXD7	4.5046	.87867	325

Reliability Statistics summary

Variables	N of items	Piloted alpha	Alpha Fina	Cronbach's Alpha
Gearbox	12	.9302	.8910	
Clutch	8	.8816	.9100	.8791
Propeller Shft	8	9622	.9234	
Drive Axle	7	9201	.9021	

(B) SPSS output: Reliability of questionnaire

Item Statistics of gearbox

	Mean	Std. Deviation.	N
GBX1	4.5232	.94523	6
GBX2	5.5023	.91523	6
GBX3	5.5043	.92032	6
GBX4	5.5032	.94586	6
GBX5	4.5232	.90445	6
GBX6	5.5023	.92054	6
GBX7	4.5043	.92515	6
GBX8	4.5145	.86173	6
GBX9	5.5032	.93031	6
GBX10	5.5551	.80753	6

Item Statistics of clutch

	Mean	Std. Deviation	N
CLH1	4.6759	.76912	6
CLH2	3.6204	.68642	6
CLH3	3.5630	.63137	6
CLH4	3.5972	.68185	6
CLH5	3.4491	.79856	6
CLH6	3.4028	.70861	6
CLH7	3.8241	.78164	6
CLH8	3.6389	.69100	6
CLH9	4.7651	.7877	6
CLH10	4.881	.6871	6

Item Statistics of propeller shaft

	Mean	Std. Deviation.	N
PLS1	4.6296	.88403	6
PLS2	4.5880	.70359	6
PLS3	4.6065	.71588	6
PLS4	4.4583	.79942	6
PLS5	3.5231	.63203	6
PLS6	3.8380	.86934	6
PLS7	4.5417	.89942	6
PLS8	3.5093	.73239	6
PLS9	4.5001	.77771	6
PLS10	4.2312	.73211	6

Item Statistics drive axle

	Mean	Std. Deviation	N
AXD1	4.6296	.71588	6
AXD2	4.5880	.79942	6
AXD3	4.6065	.63203	6
AXD4	4.4583	.71588	6
AXD5	3.5231	.79942	6
AXD6	4.6296	.79942	6
AXD7	4.5880	.63203	6
AXD8	4.2222	7.3421	6
AXD9	4.5321	7.6643	6
AXD10	4.2312	7.3456	6

Reliability Statistics summary

Variables	N of items	Piloted alpha	Alpha Fina	Cronbach's Alpha
Gearbox	10	.8102	.8210	
Clutch	10	.8616	.8600	.8711
Propeller Shft	10	9222	.9234	
Drive Axle	10	9101	.9221	

APPENDIX I

Concept map assessment test scoring rubric

Scoring Components	Points	Score Descriptions
Classification (CL)	0.5	Familiar labels and nodes
Valid Statement (VS)	1.0	2 connected items (valid connection)
Valid Structure (VST)	1.5	3 connected items (valid structure)
Examples (EX)	1.0	1 point each for an example given

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