# CHAPTER ONE

# INTRODUCTION

## Background to the Study

In a rapid developing country like Nigeria, the need for educational institutions to produce craftsmen and master craftsmen with job-related skills and competence required in the work place has been a major concern to employers of labour. These cadres of human capital Adelakun (2011) pointed out are mostly trained at the technical colleges.

Technical college is the post basic school level of Nigeria vocational education system, which was established to produce craftsmen and master craftsmen. Technical college programme is intended to prepare students for entry into various occupations. In technical colleges, students are trained to acquire relevant knowledge and skills in different occupations for employment in the world of work. According to Federal Republic of Nigeria, (FRN) (2013), the students of technical colleges upon graduation are expected to either be employable in the industry or be self employed. In order to achieve this goal, technical college curriculum was split into different trades with corresponding modules so as to enable learners choose and accomplish trade of their interest successfully. One among the various trades offered at the technical colleges is the automobile trade whose components include auto electric works, motor vehicle mechanics, vehicle body building and agricultural implement mechanics.

Auto mechanics, according to FRN (2013), is one of the vocational trades offered at the technical college level as motor vehicle mechanics. The philosophy of auto mechanics programme according to the National Board for Technical Education, (NBTE) (2013) is to produce competent craftsmen and technicians in auto mechanics trade for Nigeria's technological and industrial development. Auto mechanics craftsmen are expected to test, diagnose, service and completely repair any fault relating to the conventional vehicles and also assemble main units and systems by following the manufacturers' specifications**.** It is important therefore, that auto mechanics technicians are equipped with current skills and knowledge to be able to efficiently carry out maintenance work and repair modern highly automated and computerized electronics gadgets in modern vehicles. To achieve these objectives auto mechanic teachers need to adopt instructional methods that have strong links to the needs of the workplace. The appropriate teaching and learning of auto mechanic will qualify students for the world of work. It will enhance their academic achievement and as well qualify them for higher educational level that would enable them become knowledgeable in the field of technology. It is against this backdrop that researchers, such as Daluba (2013), Vincent and Akpan (2014), Amaechi and Thompson (2016) as well as Osuyi and Ainetor (2018), recommend that demonstration teaching method be used for teaching within vocational education community.

Demonstration teaching method refers to the type of teaching method in which the teacher is the principal actor while the learners watch with the intention to act later. Here the teacher does whatever the learners are expected to do at the end of the lesson by showing them how to do it and explaining the step-by-step process to them (Adekoya & Olatoye, 2011). Daluba (2013) described it as a display or an exhibition usually done by the teacher while the students watch with keen interest. Daluba further added that, it involves showing how something works or the steps involved in the process. It is a method of teaching concepts, principles of real things by combining explanation with handling or manipulation of real things, materials or equipment (Akinbobola & Ikitde, 2011). Demonstrations provide a multi-sensory means to describe a concept, idea, or product that may otherwise be difficult to grasp by verbal description alone (Cabibihan, 2013). The act of demonstrating readily helps to kindle more natural interactions between the students and the teacher.

In demonstration teaching method, according to Dorgu (2015), the role of the teacher is to illustrate how to do something or illustrate a principle first by explaining the nature of the act verbally, followed by demonstrating the act in a systematic manner and later the students repeat the act. Demonstration is useful mostly in imparting psychomotor skills and lessons that require practical knowledge. The gains of using demonstration method in teaching lies in the fact that it bridges the gap between theory and practice, enables learners to become good observers and generate their interest; students see immediate progress as a result of a correct effort and it enables the teacher to teach manipulative and operational skills.

The demonstration teaching method according to McCabe (2014), is an attention inducer and a powerful motivator in lesson delivery. It gives a real-life situation of course of study as students acquire skills in real-life situations using tools and materials; it helps to motivate students when carried out by skilled teachers and it is good in showing the appropriate ways of doing things. The demonstration strategy is effective for long-term memory retention and appropriate for practical skills acquisition.

Although the demonstration method is a wonderful way to explain things to students, it however seems not to be yielding the desired result in auto mechanic trade in technical colleges. This is because there is still persistent high failure rate among technical college students especially in auto mechanic trade as shown in Appendix B on page 128. This is a challenge which necessitates the investigation of the use of another instructional method like the cognitive apprenticeship instructional method (CAIM).

Cognitive apprenticeship instructional method is a teaching method in which experts teach a skill to a novice through guided experience on cognitive and meta cognition. It is a learning relationship in which an expert (teacher or more knowledgeable peer) stretches and supports a novice's understanding of the use of the culture's skills. It is a process that enables the teachers move from focusing on what students know to focusing on what students can do with what they know. It attempts to bring tacit processes out in the open. The term underscores the importance of activity in learning and highlights the situated nature of learning. In cognitive apprenticeship instructional method, the teacher often model strategies for students. Then, the teacher or more skilled peer support students' effort at doing the task. Finally, students are encouraged to continue their work independently. The focus of this learning through guided experience is the combination of cognitive, meta-cognitive and physical skills rather than only the physical skills as in the case of traditional apprenticeship in auto mechanics.

In cognitive apprenticeship instructional method, learners are invited into the actual practices of a knowledge domain and are asked to perform these practices as an apprentice or intern (Garner, 2012). Learning in CAIM is embedded in a setting that is more like work with an authentic connection to students' lives. Students interact with experts, who model and explain their actions and decisions. When the students participate in the processes by which an expert practice skills, it can help the learners learn on their own more skillfully (Garner, 2012).

In CAIM the teacher presents a range of tasks varying from specific to diverse. The teacher also encourages students to reflect and articulate the elements which are common across tasks (Vanessa & Kerry, 2014). As the teacher presents the targeted skill to students, the students can increasingly vary the context in which those skills are used. The goal according to Gerard and Eric (2011) is to help students generalize the skill or knowledge so that it could be transferred and applied independently to different settings. Teo, Cooper and Eric (2015) observed that modeling, coaching, scaffolding, articulation, reflection and exploration are the primary components of cognitive apprenticeship instructional method.

In modeling the instructor sets the example. In coaching the instructor guides the students. In scaffolding the instructor offers feedbacks and hints to students. In articulation, students articulate their knowledge and problem-solving process. In reflection, students compare their own problem-solving process with that of the teachers, while the students try to solve their own problems in exploration. No matter which aspect of the CAIM component that is used, students will ultimately have to practice the task on their own after practicing with the teacher, using materials clearly provided by the teacher and imitating the teacher's actions to complete the task themselves. What seems to be unique in this method according to Vanessa and Kerry (2014) is that it sufficiently enables the learner to concretize phenomena through personal interpretation of experience which could enhance their academic achievement.

Academic achievement represents the outcome that indicates the extent to which a person has accomplished specific goals that were the focus of activities in instructional environments, specifically in schools. Tella (2010) posited that academic achievement is used to measure student's success in educational institutions or how well students meet standard set out by examining bodies or the institution. Eze, Ezenwafor and Molokwu (2015) contended that a student's academic achievement is dependent on several factors such as, learning environment, instructional methods and teaching strategy, teachers' attitude and enthusiasm, as well as students' attitude and background. Among these factors, the instructional method used by teachers, challenge students to work at higher intellectual level that would improve their academic achievement and retention of learning**.**

The implication of this is that teachers especially in technical colleges should develop and employ instructional methods which should encourage learners to participate actively in the learning process. Teachers should promote instructional methods which could bring about improved relationship and interaction among students and their teachers. It is therefore hoped that when these are achieved by teachers in technical colleges, it would challenge students to work at higher intellectual level that would improve their academic achievement and retention of learning**.**

Retention of learning is simply the ability to remember what has been learnt. Joda and Mohamed (2017), stated that retention is the ability to retain the knowledge of what is learnt and to be able to recall it when it is required. Maigida (2013) defined retention as the preservative factor of the mind. Maigida posited that whatever touches consciousness leaves trace or impression and is retained in the mind in form of images. This implies that for one to talk about retention, one must have been exposed to certain experiences or activities such as teaching. Retention is usually measured in collaboration with academic achievement. It is therefore seen as the achievement on a subject after a certain period of time. Retention helps in knowledge development. Knowledge development can be guaranteed when effective teaching methods are used in the teaching and learning process. Baker and Robinson (2017) contented that the use of appropriate instructional method could enhance students' retention which could in turn improve academic achievement of students. The assumption is that when effective method is employed for instruction, it aids students to internalize what they have been taught in order to correctly and successfully remember and apply it on a later date. Since it is presumed by the researcher that cognitive apprenticeship instructional method could enhance students' academic achievement, it is equally important to determine whether students' retention ability can be achieved.

Apart from the use of appropriate teaching strategy in the classroom, another important role of the teacher is to ensure the use of motivational techniques to secure and sustain the attention and interest of the learner. If the teaching strategy is fascinating, students' interest would be aroused. Therefore, in order to facilitate teaching and learning in auto mechanics trade, the interest of the students is also a relevant factor.

Interest is a tendency to become absorbed in an experience and to continue it. It is the zeal or willingness of participating in activity from which one derives some pleasure (Omeje, 2011). The interest in a particular thing is a feeling manifested in an activity. According to George (2016) interest plays a major role in any undertaking as it influences devotion to duties, fairness, firmness, honesty, endurance, and discipline. This fact according to George, indicated that interest is a factor that correlate positively and significantly with competence, because students achieve significantly in those areas they had interest, and achieve poorly in the areas they lack interest.

Learner's interest is very important in the study of any subject because the interest of a learner is in many ways the reflections of the deeds (Nwachukwu, 2016). Therefore, it is pertinent to say that the interest of a student in a particular trade or career plays a long role in the academic achievement of such student. Nworgu (2015) indicated that there is a very close relationship between a student's interest and academic achievement. Nworgu further explained that individual interest have personal significance and are usually associated with high levels of knowledge and value, positive emotions and increased reference value. Oyenuga (2010) submitted that it is up to a teacher to make a subject interesting. Oyenuga further stressed that the teacher can help in setting up certain conditions that will enable the students to create interest in the subject. From the above, interest is seen to play a mediator role in academic achievement, especially between instructional process and academic outcomes. However, interest of a student in any subject is borne out of motivation and attitude exhibited by the teacher in the course of teaching. Also, students' morale and interest irrespective of gender can be dampened if a teacher uses ineffective instructional method.

However, Chukwu (2012) laid emphasis on the need for teachers to stimulate students' interest in learning without which students' achievement will be minimal. Therefore it is pertinent that auto mechanic teachers use teaching strategy which could motivate students' curiosity and interest. The researcher therefore believes that the use of appropriate instructional strategy such as CAIM for teaching in auto mechanic can provoke significant interest among students irrespective of gender.

Gender refers to the biological and physiological reality of being male or female (Igbo, Onu & Obiyo 2015). Igbo et al, described gender as a behaviour pattern and attitude perceived as a masculine and feminine within a culture. Furthermore, Olaoye and Adu (2015) described gender as a psychological term, which describes behaviours and attributes expected of individual on the basis of being a male or female. It is a social and cultural construct which distinguishes difference in the attributes of men and women, boys and girls and accordingly refers to the roles of men and women (Santrock, 2010). Over the years, education has focused on closing the enrolment gap between male and female students, while insufficient attention has been paid to the differences in their achievement. According to Odagboyi (2015), adopting an approach that takes into account the relationship between male and female students will not only lead to improving equality of students' enrolment, but will also address equality of educational outcomes among male and female students. It will also ensure that both male and female students are fully able to realize the benefit of education. In general, students irrespective of gender could do well in all subjects if the appropriate instructional method is used in teaching the students.

However, it has been observed that the few students that offer auto mechanics in technical colleges perform poorly in external examination such as National Business and Technical Examinations Board (NABTEB) as shown in Appendix B on page 128. The implication is that the demonstration method mostly used in teaching auto mechanic students in technical colleges seems not to be yielding the desired result. Therefore, it is pertinent that auto-mechanics teachers use teaching strategy which ensures active involvement of students in learning irrespective of gender and also stimulates their interest to improve academic achievement, retention and interest in technical colleges.

On the other hand, various scholars (Abubakar 2012; Maigida 2013; Vanessa & Kerry 2014; Farzaneh , Rohani, Ahmad & Kamariah, 2015) have revealed that cognitive apprenticeship instructional method has significant effects on students' academic achievement and retention in many other subjects in arts, social and physical sciences. However, no consideration has been made to ascertain the effects of CAIM on students' academic achievement, retention and interest in auto mechanic technology in Delta State. Therefore, there is need for the study to investigate the effect of CAIM on students' academic achievement, retention and interest in auto mechanics technology in technical colleges.

**Statement of the Problem**

Technical college graduates upon graduation are supposed to have three options. These options, according to FRN (2013) are to secure employment in industries, pursue further education in advanced craft in a higher technical institution or set up their own business and become self employed. To achieve this, Government at various levels have doubled efforts to ensure quality education in technical colleges. Despite all the efforts by Government to ensure qualitative education at the technical colleges and bring about high quality products both in academic and employability, there seems to be persistent reports of high failure rate among graduates of technical colleges as reported by NABTEB (2002; 2006; 2013, 2017) This has become worrisome to educationists who attributed the high failure rate of students to a number of factors such as inadequate instructional materials, dearth of committed teachers, nonchalant attitude of students to their study and the use inappropriate instructional techniques. However, studies have also revealed that among the numerous factors, the instructional method used by the teacher plays a predominant role on academic achievement of students in technical colleges.

The demonstration method mostly used in technical colleges among other methods is socially acceptable method of teaching which has been used by teachers to present skills, knowledge, and appreciations to the learners in the class room or laboratory. This method being predominantly used for teaching in technical colleges according to Osuyi and Ainetor (2018), though has its own advantages, but seems not to be yielding the desired result in auto mechanics trade in technical colleges. This is because there is still persistent high failure rate among technical college students especially in auto mechanic trade as shown in Appendix B on page 128**.** Could this problem of persistent poor academic achievement among auto mechanics students in technical colleges be enhanced by the use of Cognitive Apprenticeship Instructional Method? This is a challenge which necessitates the need for the study to determine if the new instructional method rooted on Cognitive Apprenticeship Instructional Method could improve the academic achievement, retention and interest of auto mechanics students in technical colleges.

**Purpose of the Study**

The purpose of the study was to determine the effect of cognitive apprenticeship instructional method on students' academic achievement, retention and interest in auto mechanics technology. Specifically, the study determined:

1. The academic achievement mean scores of auto mechanic students in technical colleges taught using cognitive apprenticeship instructional method and those taught using demonstration teaching method.
2. The retention mean scores of auto mechanic students in technical colleges taught using cognitive apprenticeship instructional method and those taught using demonstration teaching method.
3. The interest mean scores of auto mechanic students in technical colleges taught using cognitive apprenticeship instructional method and those taught using demonstration teaching method.
4. The academic achievement mean scores of male and female auto mechanic students in technical colleges taught using cognitive apprenticeship instructional method.

5. The retention mean scores of male and female auto mechanic students in technical colleges taught using cognitive apprenticeship instructional method.
6. The interest mean scores of male and female auto mechanic students in technical colleges taught using cognitive apprenticeship instructional method

**Significance of the Study**

The findings of this study will reveal the effects of demonstration and cognitive apprenticeship instructional method in the teaching of auto mechanics students. Therefore, the findings of this study would be of immense benefit to auto mechanics teachers, auto mechanics students, curriculum planners, automobile industries and educational researchers.

The findings of this study would guide the auto mechanics teachers in employing effective teaching method in order to enhance students' interest and stimulate teaching and learning in auto mechanics. The findings of this study would enable the auto mechanics teachers to increase the complexity and diversity in lesson sequence and provide a learning environment that would transform the class room into rich student centred interactive knowledge environment**.**

The findings of this study would be beneficial to auto mechanics students because it would enable them have an in-depth understanding of their role in the learning process by actively participating in the learning process. Also when effective teaching method identified in the study is used in the learning of auto mechanics; it would enhance the students' academic achievement and help them to retain more knowledge of auto mechanic concepts for further advancement. The findings would help the students to become active thinkers when faced with novice problems in automobile industry. In effect, this would enable them to obtain and retain jobs upon graduation in the modern automobile industry that is in constant state of flux.

Automobile industries would equally benefit from the findings of this study, because it would provide them with graduates who must have acquired and retained relevant knowledge and workplace skills required for the advancement of automobile industries.

Curriculum planners would benefit from the findings of this study because it would enable them to develop and integrate more effective teaching methods that could enhance students' academic achievement. With the adoption of CAIM if found effective more insight would be exposed to curriculum planners in technical colleges on the learner's learning process. When more knowledge is acquired about learning process, the knowledge would directly influence future trend in designing the curriculum in-line with the required workplace skills. Therefore, the findings of this study would provide curriculum planners with the needed information that would enrich auto mechanics curriculum which would provide a learning environment that uses real-world contexts and immerses the learner in the culture of a particular practice for the acquisition of relevant work place skills. More so, knowledge of the finding of this study will not only enable the curriculum planner to recommend effective teaching methods, but also plan and conduct an in-service training in respect of such methods.

Finally, educational researchers would benefit from the findings of this study when carrying out similar research and reviewing related literature. It would provide empirical data which could serve as a reference point for further researches on cognitive apprenticeship instructional method.

**Scope of the Study**

The study focused on the effect of cognitive apprenticeship instructional method on students' academic achievement, retention and interest in auto mechanics. The study was delimited to vocational II auto mechanics students in technical colleges in Delta State, Nigeria. The independent variables of the study were delimited to two groups (demonstration and cognitive instructional methods). The following areas of auto mechanics instruction was covered: identification of engine parts, dismantling of engine unit, coupling of engine unit, identification of vehicle transmission parts, dismantling and coupling of vehicle transmission system.

**Research Questions**

The following research questions guided the study:

1. What is the difference between the academic achievement mean scores of students taught auto mechanics using cognitive apprenticeship instructional method and those taught using demonstration teaching method?
2. What is the difference between the retention mean scores of students taught auto mechanics using cognitive apprenticeship instructional method and those taught using demonstration teaching method?
3. What is the difference between the interest mean scores of students taught auto mechanics using cognitive apprenticeship instructional method and those taught using demonstration teaching method?
4. What is the difference between the academic achievement mean scores of male and female students taught auto mechanics using cognitive apprenticeship instructional method?
5. What is the difference between the retention mean scores of male and female students taught auto mechanics using cognitive apprenticeship instructional method?

6. What is the difference between the interest mean scores of male and female students taught auto mechanics using cognitive apprenticeship instructional method?

**Hypotheses**

The following null hypotheses were tested at 0.05 level of significance.

1. There is no significant difference between the academic achievement mean scores of students taught auto mechanics using cognitive apprenticeship instructional method and those taught using demonstration teaching method.
2. There is no significant difference between the retention mean scores of students taught auto mechanics using cognitive apprenticeship instructional method and those taught using demonstration teaching method.
3. There is no significant difference between the interest mean scores of students taught auto mechanics using cognitive apprenticeship instructional method and those taught using demonstration teaching method.
4. There is no significant difference between the academic achievement mean scores of male and female students taught auto mechanics using cognitive apprenticeship instructional method.

5. There is no significant difference between the retention mean scores of male and female students taught auto mechanics using cognitive apprenticeship instructional method.
6. There is no significant difference between the interest mean scores of male and female students taught auto mechanics using cognitive apprenticeship instructional method.

# CHAPTER TWO

## REVIEW OF RELATED LITERATURE

The review of related literature on this study is organized under the following headings:

**Conceptual Framework**

Cognitive Apprenticeship Instructional Method

Academic Achievement

Retention

Interest

Auto Mechanics Technology

**Theoretical Framework**

Situated Cognition Learning Theory

Constructivist Theory of Learning

**Theoretical Studies**

Conventional Teaching Method

Demonstration Teaching Method

Cognitive Apprenticeship Instructional Method

Technological Advancement in Auto Mechanics Technology

Auto Mechanics Trade in Technical Colleges

Technical College Programme in Nigeria

**Empirical Studies**

Effect of CAIM on Students' Achievement

Effect of CAIM on Students' Retention

Studies on Students' Interest and Achievement

Gender Issues in Achievement

**Summary of the Review of Related Literature**

**Conceptual Framework**

Relevant concepts in the title of this study are reviewed in this section as follows:

**Cognitive Apprenticeship Instructional Method**

Cognitive apprenticeship instructional method according to Teo, Cooper and Eric (2015), is an instructional method that originates from the traditional apprenticeship but incorporates elements of structured learning. Cognitive apprenticeship instructional method is a lot like the traditional apprenticeships, but focuses on learning through guided experience on cognitive and meta cognitive skills and processes rather than only the physically skills as in the case of traditional apprenticeships.

Cognitive apprenticeship instructional method combines the age-long apprenticeship learning principles of on-the-job training with the modern pedagogical practice of engaging students with problems in the context of real world experiences (Darabi 2005). This approach is based on the underlying principle of apprenticeship learning and focuses on the use of such strategies as modeling of behavior and coaching students to imitate an exert skills until they are competent in the performance of those skills.

Cognitive apprenticeship instructional method according to Gerard and Eric (2011) is an instructional tool that is aimed at acquiring both thinking and physical skills resulting in sustained students' participation within a community and application of such knowledge to solving future problems. Cognitive apprenticeship according to Gerard and Eric originated from the tri-phasic structure of traditional apprenticeship (modelling, coaching and scaffolding/fading), but includes three more components or elements (articulation, reflection and exploration). This instructional method is important not only to solving problems in a learning environment that uses real-world contexts and immerses the learner in the culture of a particular practice, but also to allow learners to witness the practitioners of that culture solve problems and carry out tasks.

Cognitive apprenticeship instructional method according to Cawthon, Alycia and Robin (2010) is an instructional approach which is based on the underlying principle of apprenticeship learning and focuses on the use of such strategies as modeling of behavior and coaching students to imitate an exert skills until they are competent in their performance. In cognitive apprenticeship instructional approach, the teacher, expert or more knowledgeable peer need to deliberately bring the thinking to the surface to make it visible. The teachers' thinking must be made visible to the students and students' thinking must be made visible to the teacher. The aim is to get thinking process out into the space between teachers (experts) and students (novice) where they can both literarily see it.

With regard to this study cognitive apprenticeship instructional method can be viewed as an instructional method where the teacher or a more knowledgeable person having guided the learner through the acquisition of required skills, gradually withdraw his assistance or support in the learning process to enable the learner achieve perfection in the acquisition of new skills. The aim is to ensure internalization of the learnt concept which in turn enhances academic achievement and retention.

**Academic Achievement**

Academic achievement according to Eze and Osuyi (2018) refers to some methods of expressing a student's scholastic standing. This can be regarded as course or subject grade. Jimoh (2010) observed that students' academic achievement connotes performance in school subjects as symbolized by a score on an achievement test. Furthermore, Fatokun and Eniayeju (2014) explained that academic achievement is quantified by a measure of the student's academic standing in relation to those of other students of same age and standard.

A number of motivational processes (intrinsic and extrinsic) are involved in achievement (Tella, 2010). Intrinsic motivation is based on internal factors such as self-determination, curiosity, challenge, and effort. On the other hand, extrinsic motivation involves external incentives such as rewards and punishments. The humanistic and cognitive approaches stress the importance of intrinsic motivation in achievement. According to Santrock (2010), some adolescents study hard because they are internally motivated to perform high in their work (intrinsic motivation) while other adolescents study hard because they want to avoid parental disapproval (extrinsic motivation). However, teachers' instructional approach to teaching could go a long way in promoting improved relationship and interaction among students and their teachers. This could challenge students to work at higher intellectual level that would improve their academic achievement and retention of learning**.** There are two dimensions to academic achievement: good academic achievement that leads to success and poor academic achievement that result to failure. Each of the achievement has been experienced by students in one form or another.

Owing to the fact that academic achievement covers a wide range of educational outcomes, its definition therefore depends on the indicators being used to measure it. Hence academic achievement in the context of this study can be viewed as the outcome of students' effort of achievement in an examination. In this study, any student that score between 20 and 40 out of the obtainable 40 marks will be considered to have good academic achievement while those who score between 0-19 will be considered to have poor academic achievement.

**Retention**

Retention can be defined as the ability to keep or retain something in memory for a substantial period of time (Joda, 2019) According to Oyenuga (2010), retention is the ability to recall or remember what has been taught after a given period of time with view of measuring students' progress. Maigida (2013) defined retention as the process of maintaining a replica of the acquired new meaning or part of them. Ogunkunle and Onwunedo (2014) defined retention as the ability to retain the knowledge of what is learnt and be able to recall it when it is required.

With regard to this study retention is defined as the ability to assimilate and retain information or learning for a considerable span of time with the aim of determining the level of success or progress attained. Hence when teacher embrace teaching method that encourages retention, the students would likely remember what they learnt and eventually achieve excellently in examination. More so, if students must develop positive attitudes towards auto mechanics trade, the teacher has to use instructional method that will get them interested in such auto mechanics trade.

**Interest**

Interest is that attraction which forces or compels a student to respond to a particular stimulus (Fadairo 2009). According to Fatokun and Eniayeju (2014), interest can be viewed as emotionally oriented behavioral trait which determines a student’s vim and vigour in tackling educational programmes or other activities. Chukwu (2012) defined interest as a zeal or willingness of participating in activity from which one derives some pleasure. Musa further observed that interest is a tendency to become absorbed in an experience and continue in it. Interest is therefore a persisting tendency to pay attention and enjoy some activities. According to Omeje (2011), interest plays a major role in any undertaking as it influences devotion to duties, fairness, firmness, honesty, endurance, and discipline. The interest in a particular thing is a feeling manifested in an activity. Interest is a tendency to become absorbed in an experience and to continue it. It is a zeal or willingness of participating in activity from which one derives some pleasure (George 2016). Nworgu (2015) also saw interest as a particular class of attitudes which are always positive, satisfying and pleasure giving. According to Nworgu, interest can be seen as the cause of certain actions. In Nworgu's views, interest act as a drive or motivation that propels people to act in certain ways. Nworgu also saw interest as a type of attitude which share in same characteristics namely: the cognitive (knowledge) component, affective (feeling) component, and action (behaviour) component.

With regard to this study interest is defined as affective behaviour that could be aroused and sustained in teaching and learning of auto mechanics students through appropriate teaching strategy.

**Auto Mechanic Technology**

Auto-mechanics involves the application of specific knowledge in the design, selection of materials, construction, operation and maintenance of automobiles. Auto mechanics technology is one of the automobile trades offered as motor vehicle mechanics' work in the technical colleges of Nigeria (FRN, 2013). Auto mechanics technology is connected with scientific principles/knowledge applied in the design and construction of a motor vehicle (Van der Wall, 2007). According to Osho (2017), auto mechanic technology is defined as the practical application of knowledge about self propelled vehicles. It is the term that describes the diverse field of integrating technology into self propelled vehicles. Limbourg (2014) defined auto mechanics technology as a course of study that prepares the recipients for occupation in repairing and maintaining of auto mobiles. Limbourg futher stated that it is the subject that equips the recipient with relevant skills required to function in a variety of auto mobile or specific area of auto mobile. Auto mechanics technology according to Ogundola, Popoola and Oke (2010) is a programme in vocational institutions that enable students to acquire specialised knowledge and skills required for the construction, repair and maintenance of motorized vehicles consisting of four wheels and powered by internal engine.

With regard to this study auto mechanic technology can be viewed as a subject that prepares the students for the acquisition of relevant skills required to service, repair and maintain auto mobiles. Students in auto mechanics technology programme develop skills for servicing, repair and maintenance of all automobiles.

**Theoretical Framework**

This study is anchored on situated cognition learning theory and constructivist theory.

## Situated Cognition Learning Theory

Situated cognition is a learning theory propounded by Brown, Collins and Duguid in 1989. The theory refers to the idea that thinking is located (situated) in social and physical contexts, not within an individual's mind. Situated cognition stipulates that knowledge is embedded in and connected to the context in which the knowledge developed. It further stated that learning environment should be created to be as close to real-world circumstances as possible so that knowledge and skills could be taught in contexts that reflect the way the knowledge will be useful in real life. The theory posits that knowledge should not be separated from activities, and argued that traditional school system treats knowledge and activity separately. Situated cognition learning theory emphasized that learning activities should be carry out in an environment that reflects the nature of such activities in the world of work. In situated cognition, learners learn by active engagement; by actually doing rather than preparing to do.

The situated cognition learning theory is relevant to this study because, cognitive apprenticeship instructional method is carried out in an environment where the training jobs are carried out the same way, with the same operations, the same tools and the same machines as in the occupation itself. However, the researcher assumes that learner's understanding of new concept is constantly reconstructed as new evidence is presented with the current understanding. Therefore, the need for the study to also anchored on constructivist learning theory.

**Constructivist Theory of Learning**

The constructivist learning theory propounded by Vygotsky and Bruner in 1978 is based on the assumption that knowledge is constructed by learners as they attempt to make sense of their experiences. The theory states that learners' understanding of something is constantly reconstructed as new evidence is presented with conflicts with the current understanding. Constructivists do not believe that there is one reality "out there" that individuals should learn, but that each individual creates its own reality. Learners therefore are not empty vessels waiting to be filled, rather active organisms seeking meaning.

In constructivists' approach, the goals of instruction are to help learners develop learning and thinking strategies; focus on individuals' active construction of knowledge and facilitate learning by encouraging active inquiry. This approach is exemplified by Bruner's concept of Discovery Learning, wherein learners are encouraged to find regularities and relationships in the environment, which serve as models to guide discovery. A constructivist instructor guide learners to question tacit assumptions and help students to uncover meanings, taking on the role of a coach or guide and engaging students in active dialogue. A teacher using a constructivist approach would also provide student-centred instruction in complex learning environments with formats appropriate to the learner's current state of understanding that incorporate authentic activities, provide for social negotiation, and include access to multiple modes of representation. These techniques employed in constructivists instruction according to Vygotsky and Bruner include, scaffolding, fading, cognitive apprenticeship, and collaborative learning.

Thus an instructional designer using constructivist principles would leave identification of relevant information and correct solution open. It would be assumed that each learner is an individual and comes with his/her own prior knowledge. The development of learning environment should be presented from multiple perspectives and the designer should assess thinking and problem-solving skills through use of authentic domain

As proposed by Bruner's theory on spiral organization, curriculum should be organised in a spiral manner so that the student continually builds upon what is already learnt and the new knowledge can more readily be grasped, creating a condition of student readiness. Instructors presenting materials in effective sequencing and spiral organization would then result in the student being able to simplify, generate new propositions and increase the manipulation of information. Instruction should also be designed to facilitate the learner's ability to fill in the gaps and generalize to go beyond the information given. Then instruction, if properly contextualised, sequenced and organised would result in the student having a better predisposition toward learning through intrinsic motivation and more success in the learner's cognitive information processing, this new understanding would also be reflected in the learner's changed cognitive structure or schema/mind.

The theory is relevant to the study because the constructivist approaches hold that learning is constructed and co-constructed within the community of learners in which the learner is involved. This entails that learning occurs when learners are actively involved in a process of knowledge construction which leads to the development of a theory of cognitive apprenticeship technique.

**Theoretical Studies**

The theoretical studies that relate to the present study are reviewed under suitable heading as follows:

**Conventional Teaching Method**

Conventional teaching method such as the lecture and demonstration methods are instructional methods executed by the teacher while the learner observes and listen. Literature on conventional instructional methods is seen to dwell largely on the area of teacher-centered approach. In a traditional talk-chalk method of teaching in the classroom, the teacher does the talking as the students listen and this type of method is referred to as lecture method. Studies from various scholars such as (Eze & Osuyi 2018; Eze, Ezenwafor & Obidile 2016; Ndinechi & Obidile 2013; Tella 2010) revealed that the lecture method is the most commonly used method of teaching in most schools. In lecture method, the teacher lectures while the students only take notes and the blackboard is used for illustration (Osuyi & Ainetor 2018). According to Asogwa (2011) when using lecture method, teachers launch into monologues when giving examples, explaining concepts, pointing out relationships and as such, the method has been severally criticized by educators. Asogwa stated that the intellectual passivity and weariness of listeners and lack of discussion are said to be a contradiction of the process of the free flow of information and exchange of ideas which learning demands. Tella (2010) sees lecture method as a type of teaching skill involving sole performance and one-way communication.

Corroborating the views of Asogwa (2011), Tella (2010), Eze et. al. (2018) describe lecture method as the “sage on the stage method” because the teacher (the sage) only read the notes in the class, make few explanations, if the need arises, and may not even entertain suggestions or questions from the students as it is only one-way communication. Thus the lecture method contributes the transfer of knowledge by didactic exchange or rote learning which leads to the acquisition of low level fact and knowledge. This is far below what is required in this current complex technological dispensation. Eze and Osuyi (2018) described the lecture method as a teacher-centered method; the technique is instruction centered and does not challenge the teacher's ability. For example the teachers could be ill prepared, presentation could be dull and less challenging, teacher may not create the opportunity for creativity and self discovery for learners to rationalize and explore knowledge. Furthermore the method may not promote excellence and hard work, it could lead to failure. They highlighted some of the characteristics of lecture method by pointing out that the lecture method is also the telling method. The method pre-supposes that the teacher is an embodiment of knowledge and that the learner is blank. With this assumption, the teacher proceeds to dish out what he knows to the pupils. This method makes students to be passive listeners and does not demand an active involvement of students physically, psychologically, and intellectually.

The literature reviewed on lecture method from various scholars such as (Eze & Osuyi  2018; Eze, Ezenwafor & Obidile 2016; Ndinechi & Obidile

2013; and Tella 2010) revealed that the lecture method has advantages and disadvantages. According to them, the advantages are: a. A teacher can take a large number of students at a time. b. A lot of grounds can be covered by the teacher. c. The method makes it possible to disseminate large quantity of information to the students in a short period of time. d. The lecture method is economical in terms of time and staff needs. e. Lecture well prepared can be repeated, thus saving the lecturer's time and energy.

The disadvantages include: a. The lecture method is teacher centred and teacher oriented. b. The method shows no regard for individual differences among learners. c. It does not provide opportunity for adequate class participation. d. The students learn comparatively little of what has been taught as they only hear and see the teacher. e. The class is most cases, passive. f. Boredom is easily associated with the method. g. The lecture method has been to the detriment of the students in terms of appropriateness of the use in relation to the students' learning outcomes.

The lecture method as aptly analyzed and criticized by researchers reviewed above, sees the teachers as an end and not the means to an end. Secondly, it tends to restrict the learning process of most students. What seems to be common in the various views is that it does not sufficiently enable the learner to concretize phenomena. The consequence of this is that the students are unable to retain their learning and to apply it to new situations. This is a challenge which necessitates a shift from the instructional approaches based on the behavioral learning theories to those rooted in constructivism learning theories.

## Demonstration Teaching Method

According to Dorgu (2015), demonstration involves showing, doing or displaying to students the point of emphasis. It is mostly used as a technique within a method of teaching and sometimes as a method of teaching itself. Here the role of the teacher is to illustrate how to do something or illustrate a principle first by explaining the nature of the act verbally, followed by demonstrating the act in a systematic manner and later the students repeat the act. Here students are involved in dong things that will influence their behaviour patterns. Through demonstrations, students are exposed to physical materials that will illustrate some meaning to their cognitive framework. Direct experiences like this go a long way to enrich learning. Demonstration is useful mostly in imparting psychomotor skills and lessons that require practical knowledge. The gains of using demonstration method in teaching lies in the fact that it bridges the gap between theory and practice, enables learners to become good observers and thus arouse their interest. Students see immediate progress as a result of a correct effort and it enables the teacher to teach manipulative and operational skills.

Ibritam, Udofia and Onweh (2015) explained that demonstration method is most effective in teaching skill acquisition in sciences, arts, vocational and technical education. Demonstration strategy has emerged to become an instructional approach that is gaining rising interest within the vocational education community (Daluba 2013). Research has found that diverse students benefit vastly when they have the opportunity to participate in activities, interact with materials and manipulate objects and equipment (Adekoya & Olatoye 2011). Osuyi and Ainetor (2018) affirm that demonstration strategy is the most widely used teaching strategy for acquisition of practical skills as it includes the verbal and practical illustration of a given procedure. The authors have further added that the strategy is highly effective because it contains active participation of the students. Though these methods have been adopted by both novice and veteran teachers, they seem to have failed in addressing the effect of globalization and the rapid rate of technological changes (Dorgu 2015).

The demonstration teaching method relies on one key element in order to provide instruction: modeling. In this style of education, the teacher demonstrates a given task or procedure; this can be anything from a math problem to a dance routine to a cooking style. There are two ways demonstration can be done. First, the instructor can demonstrate the task with no narration, annotation, or questioning on behalf of students; this would strictly allow them to watch the task carried out from start to finish. This strategy can be most effective when dealing with clear, concise, process-based tasks, such as a cooking style or physical action. Secondly, the instructor can provide a demonstration while students observe and listen to an explanation; if it is relevant, they can even take notes to supplement what is being displayed. Questions could be encouraged throughout this process, allowing students to fully understand what is taking place before their eyes. This can be most effective in more abstract demonstrations, such as the completion of a math problem. Both methods have their benefits and drawbacks.

In the first, students have the potential for becoming confused more easily, particularly if this method is applied to an inappropriate task or demonstration. In the second, the very nature of questions from other students can cause confusion for others. The first, however, allows students to see the entire process from start to finish, holding their questions and concerns until after it is completed; this delay, though, can cause some to forget questions or become distracted easily.

Ronald (2009) also observed that the convectional approach of knowledge delivery and skill acquisition through demonstration methods must be improved or even replaced with methodologies which allow students to acquire needed skills in the context within which the skills are used in the real world. Hence Audu, Abdulkadir and Abdul (2013) opined that for any modern effective teaching and learning to take place in vocational technical institution, teacher must adopt an instructional technique that enhances the acquisition of the cognitive, meta-cognitive and physical skills of the students. Ability of the students to adapt their skills to new situation is very important in determining the level of their progress (Uduafemhe, 2015). Learners should be presented the challenges of experimenting and creating new form of the learned skills to provide an opportunity for self fulfillment and positive self concept. Therefore, Okorie (2012) opined that the most appropriate instructional techniques is one that incorporates both realistic presentation of knowledge, procedure, skill and opportunities for students to apply knowledge and practice the procedures and skills in a realistic context.

**Cognitive Apprenticeship Instructional Method**

Cognitive apprenticeship instructional method is a teaching method that requires people to learn from one another, through observation, imitation and modeling. According to Liu (2005), one cannot engage in cognitive apprenticeship alone, but rather depends on expert demonstration (modeling) and guidance (coaching) in the initial phases of learning. Learners are challenged with tasks slightly more difficult than they can accomplish on their own and must rely on assistance from and collaboration with others to achieve these tasks. In other words, learners must work with more experienced expert and later move from a position of observation to one of active practice. The learning tasks in cognitive apprenticeship are holistic in nature and increase in complexity and diversity over time as the learner becomes more experienced. A major advantage of learning by cognitive apprenticeship as opposed to traditional classroom-based methods is the opportunity to see the subtle, tacit elements of expert practice that may not be explicated in demonstration teaching method.

Cognitive apprenticeship according to Garner (2012) improves and supports students' achievement. As students are coached to acquire useable skills, they improve achievement, and their achievement alters both their public and self-image. A sense of pride in achievement replaces the experience of failure and negative self-image. When students actively develop and apply new skills and knowledge, they become actively involved and engaged in learning. The use of CAIM models has been noted to reduce class distraction to learning and virtually eliminates behaviour problems in the classroom (Cawthon, Alycia & Robin 2010). The methods used in CAIM (modeling, coaching, and scaffolding) support the teachers' role as an ally in the learning process rather than as an adversary. This approach serves to gradually inculcate a value for the educational process and school as developmental stage useful to their lives rather than a required abstract activity with teacher, school and pedagogically-defined and prescribed goals.

Another aspect of CAIM is the option of working collaboratively in groups (Tompkins 2016). Students' community practice (working in groups of insiders) resembles the natural "work environment" of students outside the classroom, rather than the individually focused academic (outsiders) environment of traditional classroom. If the educational process is designed to support student exploration of their own community; making use of that community challenge students to move past the intimidation and pressure of individual performance and meet new challenges.

The CAIM teaching method advocated by Collins, Brown and Holum (2004) fall into three groups: the first three groups (modeling, coaching and scaffolding) are the core of cognitive apprenticeship, designed to help students acquire an integrated set of skills through processes of observation and guided practice. The next two (articulation and reflection) are methods designed to help students to focus both on their observations of expert problem-solving strategies and to gain conscious access to (and control of) their own problem-solving strategies. The final method (exploration) is aimed at encouraging learner autonomy, not only in carrying out expert problem-solving processes but also to define or formulate problems to be solved. These stages of learning processes are not clearly involved in the demonstration teaching method.

The cognitive apprenticeship techniques as formulated by Aziz (2003) consist of six teaching methods: modeling, coaching, scaffolding/fading, articulation, reflection and exploration. The instructional activities involved in each stage/step of the method are illustrated in the figure 1.

| S/N | METHODS | Ways to promote the development of expertise |
|---|---|---|
| 1 | Modeling | Master performs a task so that students can observe |
| 2 | Coaching | Master and students perform the task |
| 3 | Scaffolding | Master provide supports to help students to perform the task |
| 4 | Articulation | Master encourages students to perform the task independently |
| 5 | Reflection | Master enable students to compare their performance with that of others students. |
| 6 | Exploration | Master invites students to pose and solve their own problems |

**Figure 1. Instructional Activities Involved in each Stage of the Method.**

**Sources: Aziz (2003).**

These methods illustrated in figure 1 are the components of cognitive apprenticeship instructional techniques which are inter-related in the instructional process of CAIM. Therefore, detail explanation of the relationship of these components is shown in figure 2.

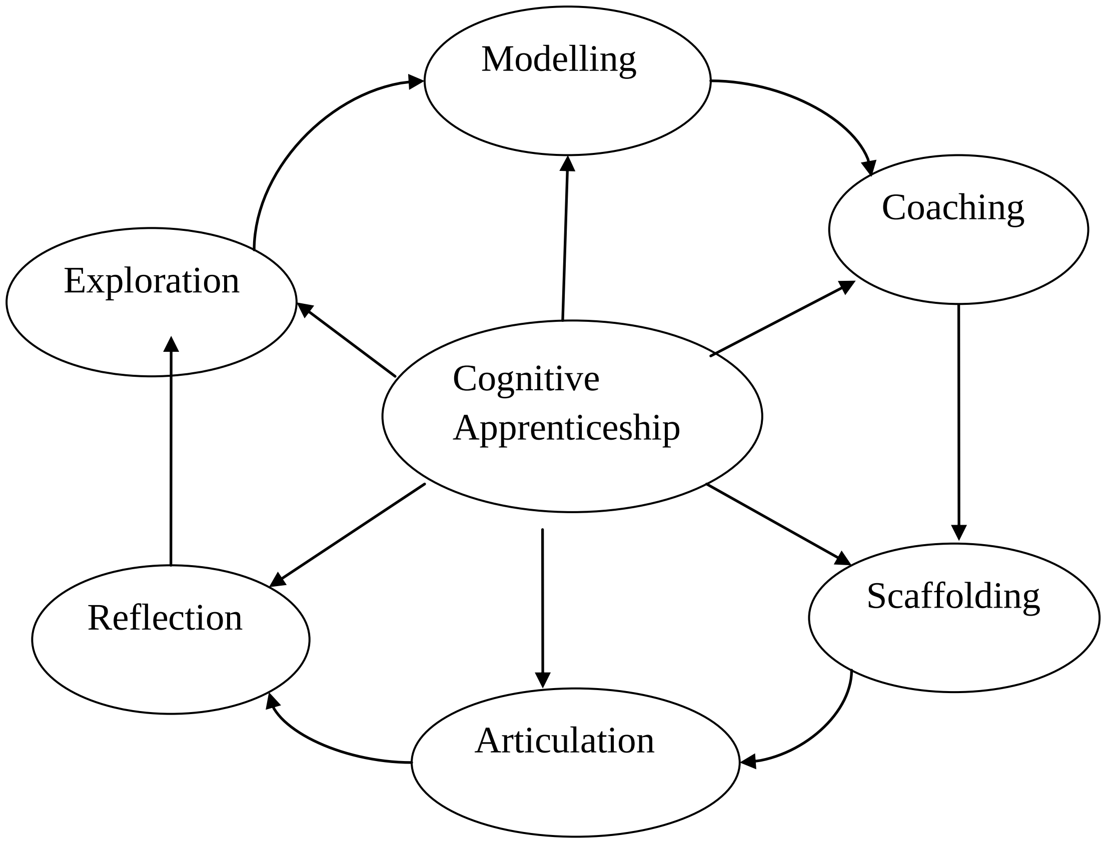



**Figure 2: Components of Cognitive Apprenticeship**

**Source: Aziz (2003).**

In **modelling,** the cognitive master models processes to show how the process unfolds or how the mentors/peers function in certain situations. In other words, an expert performs a task so that students can observe the actions and build a conceptual model of the processes required for task accomplishment. For instance, the process of training students to dismantle and couple the vehicle engine will require the cognitive master to clearly dismantle and couple the vehicle engine and state the various components of the vehicle engine. This method according to Casem (2013) necessitates the externalization of internal cognitive process. It enables the learner see the problem solving process and discovers different ways of solving problems.

In **coaching,** the cognitive master must always provide assistance as needed by learners. Attention must be paid on difficulties the learners are having, providing help at “critical times” or when the learners need them most. He must also provide requested assistance as needed and withdrawing unneeded help, as well as asking relevant questions to stimulate learners’ thought and provide a different view point of learning situations. Here students are engaged in problem-solving activities that require them to appropriately apply and actively integrate sub-skills and conceptual knowledge (Akani, 2015). In this way, conceptual and factual knowledge are exemplified and situated in their contexts of use, thereby grounding the knowledge in experience and making learning meaningful. Consequently, this approach helps to avoid learning outcomes where knowledge remains bound to surface features of problems as they appear in textbooks. The expert coaches students by providing hints, feedback, and reminders to assist students to perform closer to the level of accomplishment. As the cognitive master coaches, sometimes, he or she offers additional modeling or explanation.

In **scaffolding,** students perform guided tasks that are closely supervised. The cognitive master assists students to manage a more complex task performance. If necessary, the cognitive master completes those parts of the task that students have not yet mastered. This method may entail students engaging in legitimate peripheral participation (Uduafemhe, 2015). That is, students participate in the practice of an expert, but only to the extent that they can handle and with the amount of responsibility that they are capable of assuming. The cognitive master also intervenes whenever the student is getting confused or not very clear on what is happening or what to do next. Scaffolding is coupled with fading- the gradual removal of the cognitive master's support as students learn to manage more of the tasks on their own. The interplay between observation, scaffolding, and increasingly independent practice aids students in developing the meta-cognitive skills of self-monitoring and self-correction and in achieving integrated skills and knowledge characteristic of expertise. Thus, modeling and coaching support students' efforts to "grow into" domain competence while scaffolding and fading support students' efforts to "grow out of" dependence on the expert.

In **articulation,** students are enabled to see other applications of their knowledge. Here, learners are required to explain and think about what they are doing by making their knowledge explicit. Therefore, they can see other applications of their knowledge, and test their understanding of the knowledge. The role of the cognitive master here is to encourage students to explicate their knowledge, reasoning, and problem solving strategies (Olatubosun, 2015). Such activities provide the impetus for students to engage in the refinement and reorganization of knowledge. Such tasks require students to participate in generating knowledge and evaluating the outcomes of the knowledge-building activities as part of collaborative learning activities.

In **reflection,** learners reflect on work they have already performed and analyze or deconstruct it. Accuracy or quality of work is an essential aspect of an automobile mechanics performance, time taken to complete a task is also an important factor. The learners are conscious of this fact as they observe and compare their performance with each other. According to Nonye, and Nwosu, (2011), when the students compare their performance with that of the teacher and their mates, they would then tend to reflect on the difficulties and improve on their performance by perhaps imitating other students, try different procedures or seek teachers' assistance. Through this process, they can increase the awareness of their own knowledge (or meta-cognition) and be able to compare what they know with what others know. Reflection therefore aids students in diagnosing their difficulties and adjust their performance until they achieve competence. The role of the cognitive master is to provoke students to compare their problem solving processes with the cognitive master's work and with that of other students. Such comparisons aid students in diagnosing their difficulties and in incrementally adjusting their performance until they achieve full competence.

In **exploration,** learners try out different hypotheses, methods and strategies by exploring their project and work environment. Through exploration they can learn how to set achievable goals, form and test hypotheses, and make independent discoveries. Here, the cognitive master's role is to encourage students to be independent learners; identify personal interests; and pursue personal goals. In fact, forcing students to engage in exploration teaches them how to frame interesting questions and to identify difficult problems on their own. Exploration can also help students gain confidence in their ability to learn on their own thereby extending their understanding of the subject. The cognitive master can encourage exploration through thought provoking assignments or stimulated faults.

Teaching methods should generally be designed to give students the opportunities to observe, engage in and invent or discover expert strategies in context (Aziz, 2003). Such an approach will enable students to see how these strategies combine with their factual and conceptual knowledge and how they use a variety of resources in social and physical environment. Therefore Cognitive apprenticeship instructional method addresses the acquisition of skills and knowledge that are contextually based and have high utility for individual learners. This is because learning in CAIM is embedded in a setting that is more like work with an authentic connection to learners' lives. The above explanation indicates that cognitive apprenticeship instructional method if applied as instructional strategy could improve significantly students' academic achievement and retention in auto mechanics technology.

**Technological Advancement in Auto Mechanics Technology**

Auto-mechanics work is an occupation that has been affected by the changes in technology and industrial standards. Current trends in automobiles are challenges by the introduction of digital model assembly into automobile. Ogundola, Popoola and Oke (2010) observed that the applications of micro-electronics in automobiles are both for techno economic advantages and needs imperative. They further explained that techno-economic implication ranges from the direct substitution of microelectronic circuits for old technologies with benefits being that micro electrically controlled products are typically more powerful, more reliable, very often smaller and cheaper. Other new innovations include safety airbags, side airbags, curtains and anti-lock braking system.

Furthermore, new transmission system was introduced for the economy of power and it is controlled electronically in other to improve basically the mechanical systems. The new transmission system includes the cruise control system which serves for both safety and economy; computer controlled auto-active automatic transmission; automatic gearing; and transaxle transmission. Other pertinent new developments are remote controlled power locking systems for engine and doors and for engine demobilization, and torch alarm system. All these are incorporated for security or anti-theft purposes. According to Limbourg (2014), other new systems including power doors, windows and seats, electronic air-conditioning system, and roof glass that are controlled electronically are basically for comfort and convenience. In 1997, the Toyota Motor Corporation became the first to produce a hybrid vehicle. Hybrid automobiles combine an electric motor with batteries that are recharged by a small gas or diesel-powered engine. By relying more on electricity and less on fuel combustion, hybrids have higher fuel efficiency and fewer toxic emissions. In 2004, the Ford Motor Company became the first U.S. automaker to produce a hybrid vehicle (Karan, Ravi & Rachit 2014).

The advancement of technology in automobile industries in the developed and developing countries attests to the fact that auto mechanics technology has greatly become a central focus of many countries economic policies most especially in the advanced countries. Due to the recent advancement in technology in the automobile industry, there have been radical changes which have been observed in the trend towards repair of vehicles. This advancement and continuously evolving technology will require students of auto mechanics work in the technical colleges to have greater knowledge in the areas of both diagnostic, repair and maintenance. The advancement of technology in automobile industry will somehow affect the convectional knowledge for diagnosing and carrying out repairs on vehicles. As new development arises, the vehicle system becomes more complex most especially in terms of maintenance and repair therefore, the need for competent craftsmen becomes imperative considering the fact that latest models of automobile vehicles are made from recent technology.

**Auto Mechanics Trade in Technical Colleges**

Auto mechanics trade in technical college is designed to produce auto mechanics craft men that are competent to carryout preventive maintenance, general repairs and overhauling of various automobile units and components (NBTE, 2013). According to the NBTE, graduates of the programme also called craftsmen or master craftsmen may also wish to take the opportunity for further education.

The auto mechanics programme is offered at two levels (FRN, 2013) leading to the award of National Technical Certificate (NTC) for craftsmen and Advanced National Technical Certificate (ANTC) for master craftsmen. The students on the completion of their programme according to the FRN are opened to three options.

1. Secure employment either at the end of the whole course or after completing one or more modules of employment skills.
2. Set up individual business and become self-employed and be able to employ others.
3. Pursue further education in advanced craft/technical institutions such as polytechnics, colleges of education (technical) and universities.

In pursuance of the goal of technical colleges, FRN (2013) explained that the main feature of the curricular activities for technical colleges is structured in foundation and trade modules. The curriculum for each trade, FGN stressed consists of five components: general education, theory and related courses, workshop practice, industrial training/production work, business management and entrepreneurial training.

Curriculum for auto mechanics technology was designed by NBTE in 1985, while the latest edition is 2001. The curriculum was drawn in modular form and divided into three broad based components: trade theory, practice and related studies; general education and supervised industrial training (NBTE, 2013). The trade theory, practice and related studies deal with studying of the scientific principles involved in the operation of various units and components. Construction and operations of these units and components as well as the study is related to subjects such as metalwork and engineering drawing. On the other hand, general education includes: English language, mathematics, physics, chemistry and economics. While the supervised industrial training programme is internship training designed to equip auto mechanics students with the tricks of the trade.

The modular trade theory and practice component for automobile mechanic is made up of seven modules at the NTC and four modules of the ANTC programme. The NTC modules are: service station mechanic, engine maintenance (petrol), engine reconditioning (Diesel), engine reconditioning (petrol/diesel), transmission reconditioning work, suspension, steering and braking system and auto-electricity/electronics. While the ANTC modules are: major engine repair work, transmission repair work, chassis, suspension, steering and braking systems as well as project work. Each module has goals and specific objectives expected to be accomplished at the end of the instructional programme. However this study shall only cover modules relevant to the research work.

## Technical College Programme in Nigeria

Technical college is an integral part of the total educational system which contributes towards the development of good citizenship by developing the physical, social, civic, cultural and economic competencies of the individual (Ibrahim & Abdullahi 2010). It gives full vocational training intended to prepare students for entry into various occupations. In technical colleges, students are trained to acquire relevant knowledge and skills in different occupations for employment in the world of work (NBTE, 2013). According to FRN (2013), a technical college is a segment of Technical and Vocational Education Training (TVET) designed to produce craftsmen at the post basic school level and master craftsmen in advanced craft level. The goals of technical college programme, as stated in National Policy on Education are: to provide trained manpower in the applied sciences, technology and business, particularly at craft, and advanced craft levels; provide the technical knowledge and vocational skills necessary for agricultural, commercial and economic development; and give training and impart the requisite skills to individuals who shall be self- reliant economically and in tune with latest technology (FRN, 2013).

According to NBTE (2013) the list of available programmes in technical colleges is presented below.

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

10. General education courses: include biology, chemistry, entrepreneurship education, ICT, mathematics, physics, economics, technical drawing.

The programmes in the technical colleges were designed to train craftsmen and artisans for the benefit of the individual and the economy. In order to achieve the mandates of the technical college aims and objectives, the contents were geared towards skill acquisition and employment. However, Osho (2017) observed that products of the technical colleges are found to possess less than satisfactory levels of employable skills as a result of the prevalence poor academic achievement. This necessitated the need to revisit the instructional approach used by the instructors in technical colleges.

**Empirical Studies**

This section highlights salient features of some related empirical studies whose findings are relevant to this study. The review of related empirical studies is arranged under: effect of cognitive apprenticeship instructional method on students' achievement, students' retention, studies on students' interest and gender issues in achievement.

**Effect of CAIM on Students' Achievement**

Farzaneh , Rohani , Ahmad and Kamariah (2015), investigated the effect of internet-based cognitive apprenticeship model (*i*-CAM) on statistics learning among postgraduate students. The study was conducted in University of Putral, Malaysia. The targeted population was the entire 53 postgraduate students of the Institute for Mathematical Research, University of Putral, Malaysia. The quasi experimental design was adopted for the study. The study utilized an internet-based Cognitive Apprenticeship Model (*i*-CAM) in three phases and evaluated its effectiveness for improving statistics problem-solving performance among postgraduate students. The internet-based Cognitive Apprenticeship Model (*i*-CAM) was validated by experts in researchers department. The reliability test of the instrument was also ascertained to be 0.81. The results of the finding showed that, when compared to the conventional mathematics learning model, the *i*-CAM significantly promoted students' problem-solving performance at the end of each phase. In addition, the combination of the differences in students' test scores was considered to be statistically significant after controlling for the pre-test scores. The findings conveyed in the paper confirmed considerable value of *i*-CAM in the improvement of statistics learning for non-specialized postgraduate students.

The study of Farzaneh et. al. (2015) shares some relationship with the present study as both are on the effect of cognitive apprenticeship on student's academic achievement. However the studies adopted different types of treatment, and was conducted in different area of study but are both quasi experimental in nature. The study did not also examine students' interest, retention and gender effects. More so, the study was done in a different culture with a different population, but shares some relationship with the present study as both studies deal with the effect of cognitive apprenticeship on student's academic achievement. Therefore, the findings shall serve as a base-line for the present study.

Abubakar (2012) examined the effect of cognitive apprenticeship instructional method on the achievement of auto mechanics students in Rivers State, Nigeria. A quasi-experimental pre-test design with an experimental and non-equivalent control group was adopted. The population of the study comprised all the 212 second-year auto-mechanics students of the four technical colleges in Rivers State, no sampling was carried out as the entire population of the students was used. The instruments used for data collection was the auto mechanics achievement test. Five research questions and five hypotheses were formulated, mean and standard deviation were used to analyse the data for answering the research questions while analysis of covariance (ANCOVA) was used to test the hypothesis at 0.05 level of significance. The study found that the students taught with cognitive apprenticeship instructional method had higher mean post-test scores in the auto mechanics achievement test than those taught with the conventional lecture method. Based on this, it was recommended that auto mechanics teachers should always adopt cognitive apprenticeship instructional components, namely: modelling, scaffolding, coaching, articulation and exploration. This will enable them to cater for the diverse learning styles of the students.

The study conducted by Abubakar shares some relationship with the present study as both are on the effect of cognitive apprenticeship on student's academic achievement. The studies also adopted the same experimental designs, and the same types of treatment, but different area of study. However the study conducted by Abubakar did not examine students' interest, retention and gender effects, but both studies deal with the effect of cognitive apprenticeship on student's academic achievement. Therefore, the findings shall serve as a base-line for the present study.

Ogundola, Popoola and Oke (2010) conducted a study on the effect of constructivism instructional approach on teaching practical skills to mechanical related trade students in Western Nigeria technical colleges. Elements of constructivism assessed include concept mapping, cooperative work skills and cognitive apprenticeship. Pretest, posttest experimental design with a non-equivalent control group was adopted for the study. A total of 160 randomly selected year two students in mechanical related trades were drawn from four technical colleges spread across the south western Nigeria States.

Forty six of these numbers were placed in the experimental group while sixty were placed in the control group. The research instruments developed, validated and used for data collection were the constructivism lesson plan, conventional lesson plan and the general metalwork achievement test (GMWAT). The GMWAT which was a 30 item objective questions with four options was administered on all the groups before the commencement of teaching (pretest). This was later administered as posttest on the students after the experiment. Three research questions were raised while two hypotheses tested at 0.05 level of significant were used for the study. Frequency counts, mean and standard deviation were employed to answer the research questions while t-test and analysis of covariance (ANCOVA) were used to test the hypotheses. Preliminary results of findings showed a significant difference between the students taught with constructivism teaching approach and those in the control group. Significant difference does not exist between male and female students exposed to the constructivism approach.

The study of Ogundola et. al. (2010) shares some relationship with the present study as both used element of cognitive apprenticeship to investigate the effect of student's academic achievement. However the study did not examine students' interest, retention and gender effects. The study also adopted different types of treatment and was carried out in different area of study, but both studies used element of cognitive apprenticeship to investigate the effect of student's academic achievement. Therefore, the findings shall serve as a base-line to compare the present study.

Augustus (2007) conducted a study on effect of cognitive apprenticeship instructional method on the achievement of auto mechanics students in technical colleges in River State. A quasi experimental pretest posttest design with an experimental and non-equivalent control group was adopted. The population of the study comprised all the 212 second year auto mechanic students in the four technical colleges in Rivers state. Cognitive apprenticeship instructional lesson plans, traditional lesson plans and an auto mechanics achievement test were used as instruments for data collection. Five research questions and five hypotheses were formulated. Mean and standard deviation were used in analyzing the data for the research questions while analysis of covariance (ANCOVA) was used to test hypotheses of 0.05 level of significance. The study found that the students taught with cognitive apprenticeship instructional approach were found to have higher mean posttest scores in the auto mechanics achievement test than those taught with the conventional lecture method

The study conducted by Augustus shares some relationship with the present study as both are on the effect of cognitive apprenticeship on student's academic achievement. The studies also adopted the same experimental designs, and the same types of treatment, but different area of study. However the study conducted by Augustus did not examine students' interest, retention and gender effects, but both studies deal with the effect of cognitive apprenticeship instructional method on student's academic achievement in auto mechanic technology in technical colleges. Therefore, the findings shall serve as a base-line for the present study.

Duncan (1996) in a study titled: cognitive apprenticeship in classroom instruction: implication for industrial and technical education, sought to find out the effects of incorporating the instructional methods of CAIM specifically think aloud modeling and scaffolding into the community college writing classrooms. A non equivalent control group design was used for the study. Also 9 volunteer instructors and 159 students in intact section of writing courses at Danville Area Community College (DACC) in Eastern Illinois were used. The instrument was validated by two research experts. Multivariate Analysis Covariance (MANCOVA) was used to analyse the research scores. Two covariates were used: adjusted group means on both pretest and group means of both post tests were the independent variables. The statistical analysis of the covariates found that CAIM were effective in teaching writing skills. Analysis of the instruments found that the students mean post-test scores were higher at a statistically significant level (P>.05) than those of the control groups. These findings indicate that using think aloud modeling to teach writing tasks is a viable instrument alternative. More so, it can result in increased student's skill development. Hence, the implication of the findings to this study is that cognitive apprenticeship instructional techniques are effective in teaching vocational occupations than the traditional methods.

However the study of Duncan was carried out in U. S. A. with population that has a different cultural background. The study did not also consider gender, students' retention and interest, but shares some relationship with the present study as both are on the effect of cognitive apprenticeship on academic achievement of students. Similarly the studies adopted the same experimental designs, but different area of study, and types of treatment given to the subjects involved in the study. They are both experimental in nature. Therefore, the findings shall serve as a base-line for the present study.

**Effect of CAIM on Students' Retention**

Maigida (2013), determined the effects of cognitive apprenticeship instructional techniques on students' achievement, retention and skill performance in automobile mechanics in North- Central Geo- Political Zone of Nigeria. The study was a pre-test, post-test, non-equivalent control group quasi-experiment which involved groups of respondents in their intact classes assigned to treatment groups. Six research questions and nine hypotheses tested at 0.05 level of significance guided the study. The population of the study consisted of 167 National Technical Certificate (NTC) II students of Automobile Mechanics in Niger State and the Federal Capital Development Authority (FCDA), Abuja. Niger State and the FCDA are found in the North-Central Geo- Political Zone of Nigeria. The sample size of the study was 144 students from which 98 males and 46 females were assigned to two intact classes each of treatment groups (experiment and control). The Experimental group had 71 students (47 males and 24 females), while the Control group had 73 students (51 males and 22 females). The instruments used for data collection were Automobile Mechanics Achievement and Retention Test (AMART) and Automobile Mechanics Skill Performance Test (AMSPT). The AMSPT which had been validated by the test developer National Business and Technical Examination Board (NABTEB) was adopted for the study. To ensure content validation of the test, a Table of Specification was built. The AMART and AMSPT lesson plans were subjected to face and content validation by five experts. The AMART was trial tested for the purpose of determining the psychometric values of the test items. A total of 40 items of the AMART had good difficulty, discrimination and the distracter indices.

The trial test for determining the coefficient of stability of the AMART was carried out using test re-test reliability techniques. The test-retest reliability was determined using Pearson Product Moment Correlation Coefficient and was found to be 0.86. While, the internal consistency of the AMART was checked by Kuder-Richardson 20 (KR20) and was found to be 0.83. The inter-ratter reliability coefficient of AMSPT was determined by Ken dells' coefficient of concordance and was found to be 0.85. Mean and Standard Deviation were used to analyse data collected from the research questions. Whereas Analysis of Covariance (ANCOVA) was used to test the hypotheses that guided the study at .05 level of probability. The study found among others that cognitive instructional techniques were more effective in improving students' achievement, retention and skill performance than conventional teaching methods. There was an influence of gender on students' achievement, retention and skill performance favouring boys, though the effect was not significant. The study found no significant interaction effect of treatments and gender on students' achievement, retention, and skill performance in automobile mechanics. Therefore, irrespective of gender, learners will record improved performance in achievement, retention and skill performance in automobile mechanics when cognitive apprenticeship instructional method is employed for teaching automobile mechanics. The study recommended among others that cognitive apprenticeship instructional method should be incorporated into methodology content of NABTEB Certificates, (NTC and ANTC) of Auto mechanics and should be extended to other vocational and technical areas after its effect have been determined.

The study conducted by Maigida shares some relationship with the present study as both are on the effect of cognitive apprenticeship on student's academic achievement and retention in auto mechanics in technical colleges. Though the study conducted by Maigida did not consider students' interest and was carried out in different locational area of study, but both studies adopted the same experimental designs and the same types of treatment. Therefore, the findings shall serve as a base-line for the present study.

Ozden and Gultekin (2008) investigated the effects of cognitive apprenticeship learning techniques on achievement and retention of knowledge in science subjects in post primary school in Kutahya Abdurrdman Turkey. The study was carried out on two intact classes selected randomly using the quasi experimental design. One of the classes was defined as the experimental group and the other as control group. Both classes were tested before and after the experiment. The study was guided by 2 research questions, while 2 hypotheses were formulated for the study. The instrument used was Science Achievement Test (SAT). The instrument was validated by three experts in the researcher's department. The study lasted three months for a total 18 class hours. During the research process, the experimental group was administered a cognitive apprenticeship teaching approach, while the control group was administered a traditional teaching approach. Analysis of post-test on achievement and retention level tests revealed a significant difference between the groups in favour of cognitive apprenticeship techniques. The findings of the study, revealed that cognitive apprenticeship instructional techniques as a means of instruction in school would improve students' achievement and retention in science subjects.

The study of Ozden and Gultekin shares some relationship with the present study as both are on the effects of cognitive apprenticeship learning techniques on achievement and retention of students. Although both studies differ in area and scope of study and did not consider students' interest, but adopted the same experimental designs. Therefore, the findings shall serve as a base-line to compare the present study.

Ogbuanya and Fakorede (2008) in a study to investigate the effect of learning mode on the psychomotor achievement and retention of automobile mechanic students in technical colleges in Osun and Ogun States, compared students' score in automobile mechanic psychomotor test when taught with cooperative learning and when taught with competitive-learning mode. They also investigated the retention ability of boys and girls in automobile mechanic psychomotor achievement test score under cooperative learning mode and conventional learning mode. The population for the study consisted of 580 automobile technology students in nine technical colleges in Ogun and Osun State. The sample comprised of 96 students drawn from three intact classes through random sampling technique. The researchers used the quasi experimental factorial design; specifically, the pre-test posttest design with experimental and non-equivalent control group was used. The study used intact classes. The instruments for data collection were; Cooperative Learning-Mode, and Conventional Lesson Plan, and the Learning-Mode Psychomotor Achievement Test (LPAT). After validation of the instruments by three experts, the instruments were subjected to test-retest reliability on 30 automobile mechanic students shared into three groups using Pearson Product Moment Correlation Coefficient. The computed result yielded a reliability index of 0.78. The research questions were analyzed using Mean and Standard Deviation. While analysis of covariance (ANCOVA), was used to test the hypotheses at .05 level of significance. Findings of the study showed that: Students taught using cooperative learning mode performed and retained better than those taught using competitive learning mode. Performance of girls in automobile mechanic test score under cooperative learning mode and conventional learning mode was better than boys' scores in psychomotor achievement. The study recommended among others that teachers should incorporate the cooperative learning mode in the art of teaching automobile mechanic in technical colleges. By implication, this study showed that if female students are given the same opportunity as their male counterpart, they could do better.

Ogbuanya and Fakorede study shares common relationship with the present study as both studies are on effect of gender on students' achievement and retention in automobile mechanic. Ogbuanya and Fakorede also used cooperative learning mode which is an element of cognitive apprenticeship instructional method. Both studies are also common in their use of methodology. However, the studies differ in terms of the instructional method used in administering the treatments on the subjects and the geographical location used for the studies. Therefore, the findings shall serve as a base-line to compare the effect of retention and gender for this study.

Igboko (2004) investigated the effect of cognitive constructivism on students' achievement and retention in introductory technology in Owerri, Imo state of Nigeria. Quasi experimental design was used for the study. The entire junior secondary school students in Owerri formed the targeted population. The sample size for the study was 100 students from two secondary schools in Owerri, Imo state of Nigeria. The Introductory Technology Achievement and Retention Test (ITART) was used as the instrument for the study. The instrument was validated by three experts in researchers department. The reliability of the instrument was determined using Pearson Product Moment Correlation Coefficient and was found to be 0.76. Igboko sought to find out whether there was any significant difference between boys and girls in their achievement and retention of learning in introductory technology. The result showed significant difference in favour of boys in achievement and retention.

Igboko study relates to the present study because it intends to investigate the effect of cognitive constructivism which is a broader aspect of cognitive apprenticeship learning techniques on achievement and retention of students. Although the studies differ in area and scope of study and did not consider students' interest, but adopted the same experimental designs. Therefore, the findings shall serve as a base-line to compare the present study. Similarly, the researcher is of the view that reviewing a study on the effect of cognitive constructivism on students' achievement and retention in introductory technology which is a pre vocational subject would assist in the understanding of the effect of cognitive instructional methods in auto mechanics.

**Studies on Interest and Achievement**

Some of the studies that have been conducted on evaluating the effectiveness of specific methods of teaching on student's interest are reviewed as follows:

Adegunle (2016) carried out a study to determine the effect of scaffolding instructional technique on academic achievement and interest of metal work students of technical colleges in Lagos State. Six research questions were answered while nine null hypotheses formulated were tested at 0.05 level of significance. The study adopted quasi experimental design and was carried out in Lagos State. The population for the study was 410 male and female students. The sample size for the study was 114 metalwork second year students which comprised 72 males and 42 females randomly selected from two technical colleges. The instruments for data collection were metalwork cognitive achievement test and metalwork interest inventory.

To ensure content validity of the metalwork cognitive achievement test (MWCAT), a test blue print (Table of Specifications) was built for the test. The, MWCAT, metalwork technology interest inventory, instructional technique, metalwork technology lesson plan and the training plans for metalwork technology teachers and students were subjected to face validation by three experts. The MWCAT was trial tested for the purpose of determining the psychometric indices of the test. A total of 40 items of the MWCAT had good difficulty, discrimination and distractor indices. In addition to face - validation, the metalwork interest inventory was also subjected to construct validation using factor analysis. Out of 62 items, a total of 40 items were finally selected for the interest inventory. The Kuder Richardson 20 (K-R20) was employed for determining the reliability of the metalwork cognitive achievement test, while Cronbach alpha reliability method was used to determine the internal consistency of the metalwork interest inventory and 0.82 was obtained. The data collected were analyzed using Mean, to answer the research questions while analysis of covariance (ANCOVA) was used to test the nine hypotheses formulated.

The study found out that students taught metalwork with scaffolding had a higher mean achievement score than those students taught using traditional teaching method in the achievement test. It was also found that students taught metalwork with scaffolding had a higher mean interest score than those students taught using traditional teaching method. There was a significant difference between the mean achievement scores of students taught metalwork with scaffolding instruction technique and those taught with traditional method. The study also revealed that there was a significant difference between the mean interest scores of students taught metalwork with scaffolding instruction technique and those taught with traditional method. It was therefore recommended that metalwork teachers in technical colleges should adopt the use of the scaffolding instructional technique to teach metalwork trades to students. It was also recommended that facilities that could encourage the use of scaffolding should be provided to metalwork teachers in technical colleges.

The study conducted by Adegunle shares some relationship with the present study as both are on the effect of instructional method on interest and academic achievement of mechanical trade students in technical colleges. Though the study by Adegunle did not consider students' retention and was conducted in different geographical location, but adopted the same experimental design with the present study. Therefore, the findings shall serve as a base-line to compare the present study. Similarly, the researcher is of the view that reviewing a study on the effect of scaffolding instructional method which is a component of cognitive apprenticeship instructional method on students' achievement and interest in metalwork technology which is a subject in auto mechanic trade would assist in the understanding of the effect of cognitive instructional methods in auto mechanics.

Similarly, Oyenuga (2010) conducted a study on the effect of models on interest and academic achievement of auto-mechanics students in technical colleges in Lagos State**.** The purpose of the study was to determine the effect of models on interest and academic achievement of auto-mechanics students in technical colleges in Lagos State. Six research questions and six hypotheses were formulated to guide the study. The research design that was adopted was the quasi-experimental design. The type of quasi experimental design used was the non-equivalent control group which involves two groups. Purposive sampling technique was used to select four out of the five technical colleges used for the study. A simple random sampling technique was adopted to select the technical colleges that were in the experimental and the control group respectively. The year one intact classes were used for the research exercise. The sample consisted of 153 year one auto-mechanics students in the technical colleges. Regular auto-mechanics teachers were trained and used for the study. The instruments used for data collection in this study were: Auto-Mechanics Achievement Test (AMAT) and Auto-Mechanics Interest Inventory (AMII). The AMAT and AMII were developed by the researcher and validated by experts in the Department of Vocational Teacher Education, University of Nigeria, Nsukka. The reliability coefficient of AMAT was found to be 0.61 and that of AMII was 0.81. Mean and standard deviation were used to answer the research questions while the analysis of covariance (ANCOVA) was used for testing the hypotheses at a level of significance of 0.05. The findings of the study were as follows: (1) Using model has a significant effect on the academic achievement and interest of the students in auto-mechanic work. (2) Gender has no effect on the academic achievement of students in auto mechanic work. (3) Gender was a factor on the interest of students in auto mechanic work. (4) Ability level has no effect on the academic achievement and interest of the students in auto-mechanic work. The findings identified the implications of study with respect to teachers, educational planners, tertiary institutions and students. Based on the findings of this research, it was recommended among others that the use of model is paramount in Nigeria technical colleges; government should make available various models of vehicle system for effective teaching and learning in the classroom. Use of model for teaching various concepts in vehicle systems should be incorporated into the technical college and other vocational education curriculum.

The study conducted by Oyenuga shares some relationship with the present study as both are on the effect of interest on academic achievement of auto mechanics students in technical colleges. Though the study by Oyenuga did not consider students' retention and was conducted in different locational areas, but adopted the same experimental design with the present study. Therefore, the findings shall serve as a base-line for the present study.

More so, Musa (2007) investigated on the effect of constructivist instructional approach on senior secondary school students‟ achievement and interest in mathematics. The study sought to determine the effect of constructivist instructional approach on the students' interest and the differential effect of the approach on the achievement of male and female students among others in mathematics. The sample for the study was two sampled intact classes from sampled schools in Umuahia Education Zone of Abia State. Two instruments, Mathematics Achievement Test and Quadratic Equation Interest Scale were used. The instruments were validated by three experts in Mathematics Education Department University of Nigeria, Nsukka. The analysis of data was carried out using mean and ANCOVA. The result of the study indicated that gender was a significant factor in determining the interest of male and female students in mathematics. The mean interest score for males was higher than that of the female.

The study conducted by Musa shares some relationship with the present study as both are on the effect of interest on academic achievement of students. Though the study conducted by Musa did not consider students' retention. Also the study adopted different experimental design and was conducted in different academic area of study, different geographical location of study and different types of treatment. However both studies are on the effect of interest on academic achievement of students. Therefore, the findings shall serve as a base-line for the present study.

Moreso, Olaf and Jurgen (2001) conducted a study on the relationship between interest and achievement. A total number of 602 students from academically selected schools in Germany were tested at three time point--end of Grade 7, Grade 10, and Grade 12 in order to investigate the relationships between academic interest and achievement in mathematics. In addition, gender differences in achievement, interest, and course selection were analyzed. At the end of Grade 10, students opted for either a basic or an Advanced Mathematics course. Data analyses revealed gender differences in favour of boys in mathematics achievement, interest, and opting for an Advanced Mathematics course. Further analyses by means of structural equation modeling show that interest had no significant effect on learning from Grade 7 to Grade 10, but did affect course selection. Also, highly interested students were more likely to choose an advanced course. In addition, results suggest that, Grade 7 to Grade 10, achievement affected interest. Therefore, high achievers expressed more interest than low achievers. The findings underline the importance of interest for academic choices and for self-regulated learning when the instructional setting is less structured.

The study conducted by Olaf and Jurgen shares some relationship with the present study as both are on the effect of interest on academic achievement of students. Though the study did not consider students' retention and also adopted different experimental designs, treatment, location and academic area of study, but are both on the effect of interest on achievement of students. Therefore, the findings shall serve as a base-line for the present study.

**Gender Issues in Achievement**

Some of the studies that have been conducted on evaluating the effect of gender on students' achievement are reviewed as follows:

Eze, Ezenwafor and Obidile (2016) conducted a study on the effect of gender on academic performance and retention in financial accounting in technical colleges in Anambra State. Four research questions guided the study and two null hypotheses were tested at 0.05 level of significance. Quasi experimental design of pretest, posttest non randomized control group was adopted for the study. The population was the entire 168 year two students from all the 11 technical colleges in Anambra State. A sample of 138 was purposively selected to compose the experimental and control groups based on schools that offer accounting and have both male and female students. The instrument for data collection was Accounting Achievement Test (AAT) validated by three experts with reliability coefficient of 0.83. Arithmentic mean was used to analyze data relating to research questions while analysis of covariance (ANCOVA) was used to test the null hypotheses. The findings revealed that male and female students taught financial accounting using problem based teaching method performed better with high post test scores than those taught with lecture method. The findings also revealed that there was no significant differences in the posttest mean scores between male and female students taught financial accounting using the PBTM. Based on the findings it was concluded that adoption of PBTM in teaching of financial accounting would enhance the performance of both male and female students. Consequently, it was recommended among others that accounting teachers should use PBTM which is more practical and stimulating, therefore, enhancing students’ achievement and retention irrespective of gender.

The study of Eze, et. al. (2016) shares some relationship with the present study as both are on gender and its effect on student’s academic achievement. Though the studies adopted different instrument, different academic and geographical location of study, and different types of treatment given to the subjects involved in the study, they are both experimental in nature. Therefore, the findings shall serve as a base-line to compare the effect of gender for the present study.

Igbo, Onu and Obiyo (2015) conducted a study on the impact of gender stereotype on secondary school students' self-concept and academic achievement in Udi education zone, Enugu State. The study investigated the influence of gender stereotype as a predictor of secondary school students' self-concept and academic achievement. The study was guided by four purposes, four research questions, and four hypotheses. The study adopted ex post facto design. The research sample was drawn from eight public senior secondary schools in Udi education zone. 9 schools were randomly selected from the 227 schools. A total of 342 senior secondary school II (SSII) students made up the sample of the study. A 20-item students' stereotype self-concept questionnaire (SSSCQ) was adapted from Marsh's Self Descriptive Questionnaire II (SDQII), and a 10-item students' mathematics achievement test (SMAT) was developed by the researchers with the help of experts in the areas. The instruments were face and content validated and used for the collection of data. In analyzing the data, mean and standard deviation were used in answering the research questions while the *t*- test was used in testing the four hypotheses. The findings of the study indicate that gender stereotype has significant influence on students' self-concept and academic achievement in favor of the male students. On the other hand, school location has significant influence on academic achievement of students but has no significant influence on students' self-concept.

The study of Igbo et. al. (2015 ) is related to the present study in the sense that both studies are on academic achievement of male and female students. However the study differ from the present study in the sense that Igbo, Onu, and Obiyo study was on the impact of gender stereotype on secondary school students' self-concept and academic achievement, while the present study dealt with the effect of cognitive apprenticeship instructional method on academic achievement of students in auto mechanic.

In a similar development Olaoye and Adu (2015) carried out a study to ascertain the effects of problem-based strategies and gender as determinant of grade 9 students' academic achievement in algebra in East London district. Two null hypotheses were formulated and tested at 0.05 level of significance. The population of the study was 1,130 Grade 9 students in the East London district. The sample consisted of 109 Grade 9 students from two schools within East London district. The two schools were purposively selected based on the fact that they were equivalent in status. A 3x2 pre-test and post-test control group quashi-experimental factorial design was adopted for the study. The instrument for data collection was achievement test constructed by the researcher. The instrument was validated by three experts in the researcher department. The finding from the study revealed that there was no significant main effect of gender on students' academic achievement.

Olaoye and Adu study is related to the present study in the sense that both studies are on the effect of instructional method on academic achievement of male and female students. However the study differed from the present study in the sense that Olaoye and Adu study was on the effects of problem-based strategies on academic achievement of grade 9 students' in algebra, while the present study dealt with the effect of cognitive apprenticeship instructional method on academic achievement of students in auto mechanic, while also considering the influence of gender on achievement, retention and interest.

**Summary of Review of Related Literature**

The review of related literature on this study was organized under conceptual framework, theoretical framework, theoretical studies and review of related empirical studies. Conceptual framework covers the concept of cognitive apprenticeship instructional method, academic achievement, retention, students' interest and auto mechanics technology. The theoretical framework dealt with constructivist theory of learning and situated learning theory. These theories were considered appropriate for the study because the theories upheld that teaching students in an environment that allow them to relate learning to the real life situation could enhance their academic achievement and knowledge retention. The theoretical studies cover convectional teaching method, demonstration teaching method, cognitive apprenticeship instructional method, auto mechanics trade in technical college and technical colleges programme in Nigeria. Several related empirical studies were reviewed under relevant headings.

Conclusively, it was noted that though some of the studies reviewed shares some relationship with the present study as both are on the effect of cognitive apprenticeship instructional method on student's academic achievement, but most of the studies adopted different types of treatment. More so, some of the studies were conducted in Nigeria while others were conducted outside the country with population from different socio cultural background. Lastly, none of the reviewed study examined the effect of cognitive apprenticeship instructional method on students' academic achievement, retention and interest in auto mechanic technology in technical colleges in Delta State. Therefore, the reviewed empirical studies revealed no empirical data on the effects of cognitive apprenticeship instructional method on academic achievement, retention and interest of auto mechanic technology students in technical colleges in Delta State. Thus, this study modestly filled this gap.

# CHAPTER THREE

# METHOD

This chapter presents the procedure that was adopted in carrying out the study. The presentation is done under the following sub – headings: design of the study, area of the study, population of the study, sample and sampling technique, instrument for data collection, validation of the instrument, reliability of the instrument, experimental procedure, control of extraneous variables, method of data collection and method of data analysis.

## Research Design

The study adopted the quasi-experimental research design. Specifically, the pre-test post-test non-equivalent control group experimental design was used. According to Nworgu (2015) quasi-experimental design can be used when it is not possible for the researcher to randomly select the subjects and assign them to treatment groups without disrupting the academic programmes of the schools involved in the study. This design was considered suitable because intact classes (non-randomized groups) was assigned to experimental and control groups to determine the effect of cognitive apprenticeship instructional method on students' academic achievement, retention and interest in automobile mechanics.

The design is illustrated below:

| Group | Pre-test | Treatment | Post-test | Retention test |
|---|---|---|---|---|
| E: | O1 | X | O2 | O3 |
| C: | O1 | – | O2, | O3 |

Where;

E represents experimental group

C represents control group

O1 represents pre-test

O2 represents post-test

O3 represents retention test

X stands for treatment using cognitive apprenticeship instructional method.

– stands for no treatment (demonstration teaching method)

………… non equivalent group.

**Area of the Study**

The study was conducted in the six technical colleges in Delta State as shown in Appendix C on page 129. Delta State is located in the south-south geo-political zone of Nigeria. It shares common boundaries with Edo State by the north, Anambra State by the east, Bayelsa State by the south-east. In the south west, it has apparently 122 kilometers of coaster lines bounded by the Bight of Benin on Atlantic Ocean. It has 25 local government areas and 3 senatorial districts. The State is one of the rich oil producing states that houses high tech facility vehicles that require the services of well-trained automobile craftsmen and master craftsmen that are graduates of technical colleges.

Delta State has six technical colleges; these technical colleges conduct NABTEB examinations leading to the award of National Technical Certificate (NTC) and Advanced National Technical Certificate (ANTC) in automobile mechanics. Therefore, the rationale for choosing Delta State is because of persistent poor academic achievement in external examination such as NABTEB conducted in the technical colleges in the state. The analysis of the academic achievement of students in technical colleges in Delta State from 2010 to 2017 is shown in Appendix B on page 128. Also, the researcher is of the view that the technical colleges in Delta State are well equipped with facilities and equipment required to conduct the study.

**Population of the Study**

The population of this study was 237 Vocational (VOC) II students studying automobile mechanics in all the six technical colleges in Delta State. The choice of students in VOC II is based on the fact that they would have studied automobile mechanics in their first year and should have had understanding of the conventional arrangement of the components, their functions and locations. The population distribution of auto mechanics' students by schools and gender is shown as Appendix C on page 129.

## Sample and Sampling Technique

The sample size for the study was 114 VOC II auto mechanics students. The purposive sampling technique was used to sample two schools from the six technical colleges that form the study population. The purposive sampling was based on the number of male and female students offering auto mechanics, availability of professionally qualified staff and availability of instructional facilities for teaching. The breakdown of the sample size consists of 95 male and 19 female VOC II automobile students. In the sampling techniques, a purposive sampling technique was used to assign two intact classes each to experimental and control groups. Each intact class was composed of both male and female students. Hence, 58 students (45 males and 13 females) constituted the experimental group, while 56 students (50 males and 6 females) formed the control group.

## Instrument for Data Collection

The instruments for data collection for the study were Auto Mechanics Achievement Test (AMAT) and Auto Mechanics Interest Inventory (AMII) as shown in Appendix H and I on pages 163 and 170 respectively. The AMAT was adapted by the researcher from the NABTEB past questions in accordance with the table of specification used to allocate questions in content areas as shown in Appendix K on page 181. The instrument consists of two sections. Section A seeks to elicit background information of the students while section B comprised of 40 multiple choice items with four response options (A-D).

The researcher developed six lesson plans each for teaching experimental and control groups. The lesson plans were developed based on the content areas. Each of the lesson plans contained the outcome expected on the achievement, retention and activities that promote interest so that the teacher could aim at attaining them. The lesson plans were designed carefully to address the six levels of cognitive domain in Bloom's taxonomy of educational objectives (Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation) as shown in Appendix K on page 181. Each of the experimental group lesson plans contained at every instructional stage the specific CAIM elements which the instructor in the experimental group applied at different stages of the instruction.

The interest inventory which was used to test the students' interest in auto mechanics was based on five point Likert scales of Strongly Agree (SA), Agree (A), Undecided (U), Disagreed (D), and Strongly Disagreed (SD).

**Validation of the Instrument**

The instrument for data collection was validated by three experts. Two of the experts were from Technology and Vocational Education

Department and one expert from Measurement and Evaluation unit of Educational Foundation Department, all in Nnamdi Azikiwe University, Awka. The experts were given the topic, purpose of the study, research questions, hypotheses, contents to be covered, the lesson plan and the instruments. Based on the experts' corrections and suggestions, preliminary screening and revision of the instruments were made by the researcher after the approval of the researcher supervisor.

**Reliability of the Instrument**

Copies of AMAT were administered to 30 vocational II auto mechanics students in Benin technical college in Edo State. Benin technical college was used because it did not form part of the study institutions but uses the same entry requirement as the study institutions. The instrument was given to the class teacher to administer to the students in 60 minutes. Thereafter the class teacher handed over the instrument to the researcher for the reliability test. The reliability of the instrument was determined using Kuder – Richardson 21 (K-R21) formula. This is because the test items were dichotomously scored. Nworgu (2015) explained that K-R21 is a method of rational equivalence for estimating a test's internal consistency usually used when items are dichotomously scored. The reliability coefficient of 0.75 was obtained (Appendix L on page 182).

A trial test of the Auto Mechanics Interest Inventory (AMII) was also carried out. The instrument was administered on the same year two auto mechanics students of Benin technical college, in Edo State. The Cronbach Alpha reliability coefficient was used to calculate the degree of internal consistency of the test instrument. This is because the test items were on rating scale. The reliability coefficient of 0.81 was obtained (Appendix M on page 185).

**Experimental Procedures**

The researcher sought and obtained permission from the authorities concerned for the involvement of their colleges, teachers and students in the study. The study lasted for nine weeks (one week for pre test and briefing of teachers involved, six weeks for treatment and two weeks extra for the retention test). The researcher used the first week to brief the teachers on the method to be used before the commencement of the experiment. After briefing the teachers involved in the exercise a pre-test was administered to both groups (experimental and control groups) by the regular auto mechanics' teachers in the participating colleges to determine the initial abilities and interest of the students prior to the experiment. Teaching commenced on the second week and ended on the seventh week. The teaching was conducted during the normal lesson periods of the schools using intact classes. The regular auto mechanics teachers taught their classes using the time-table of their various schools. This was to avoid students becoming suspicious of the exercise.

The experimental group was taught using cognitive apprenticeship instructional method while the control group was taught using the demonstration method. The primary focus of the teaching process was concentrated on identification, functions and coupling of the various components of the vehicle engine and vehicle transmission system shown in Appendix N in page 188.

Teaching for the experimental group was designed specifically to employ the CAIM elements described in figure 1 on page 45. The instructional activities were deliberately sequenced through modelling, coaching and scaffolding. Also consistent with the CAIM methods approach (as defined in this study), students in the experimental groups were systematically encouraged to engage in articulation, reflection and exploration during each teaching and learning experience by sharing ideas on areas of difficulties and defining problems to be solved.

At the end of the treatment, post test was administered to both experimental and control groups using AMAT test items by the auto mechanics teachers and their assistants. Also, interest inventory on auto mechanics work was also administered to both groups. The exercise provided a post-test data for each of the dependent variables (achievement, retention and interest) after the treatment. The AMAT was re-administered as retention test after two weeks interval, but with the original test questions reshuffled.

**Control of Extraneous Variables**

Some extraneous variable that could disrupt the study if not well controlled were controlled as follows:

**Initial Group Difference:** Randomization is one of the techniques used to control initial group difference in research studies. However, in the current study, randomization was not used because the process will alter normal school activities. Hence, intact class was used. Thus to control the initial differences of subjects in these intact classes, analysis of covariance (ANCOVA) was used for data analysis.

**Experimental Bias:** To reduce experimental bias (Hawthorne effect) that might influence the outcome of the study, the regular class teachers in the colleges sampled, taught their own students. Hence, the researcher was not directly involved in the administration of the research instruments and treatments. This ensured that the students did not know that an experiment was going on and thus fake the result.

**Teachers' Variability:** In order to ensure uniformity in standard, the development of the teaching instruments (CAIM and demonstration lesson plans) was personally prepared by the researcher. The researcher also ensured that the teachers used the lesson plans in their instructional delivery.

**Instructional Situation Variable:** To ensure uniformity in the instructional process, the teachers were given training and detailed explanation on the instructional techniques for both the control and experimental groups. The instructional techniques were done in line with the framework of cognitive apprenticeship instructional techniques shown in figure 1 on page 45. The researcher in each of the cases demonstrated the lessons. Request was made for the participating teachers (research assistants) to ask questions for clarifications where necessary.

**Effect of Pre-test and Post-test :** In order to minimize influence of memory loss and forgetfulness, the time lag between pre-test and pos-test was seven weeks and two weeks between the post-test and delay post-test. The AMAT test items was reshuffled and produced in different colour question papers for the delay post test. The relative short period was to minimize the effect of maturation.

**Students' Interaction:** To ensure no interaction between the students in the control and the experimental groups, the schools selected for the study were located far from each other. The schools were in different senatorial district of the state.

**Method of Data Collection**

The teachers involved in the study were asked to administer the AMAT and AMII to the students in both groups before and after the treatment**.** The AMAT questions were reshuffled and differentiated with colours and re-administered on the students as retention test by the same teachers. The researcher marked the students' responses of the test and statistically analyzed the data.

**Method of Data Analysis**

The data collected was analyzed using mean scores and analysis of covariance (ANCOVA). The mean was used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the null hypotheses at 0.05 level of significance. In the test of the null hypotheses using ANCOVA**,** when the p-value was less or equal to the level of significance (0.05), the null hypothesis was rejected**.** Also when the p-value was greater than the level of significance (0.05), the null hypothesis was not rejected.

# CHAPTER FOUR

## PRESENTATION AND ANALYSIS OF DATA

The data collected based on the research questions and hypotheses after the experiment were analyzed and presented in this chapter.

**Research Question 1:** What is the difference between the academic achievement mean scores of students taught auto mechanics using cognitive apprenticeship instructional method and those taught using demonstration teaching method?

**Table 1**

***Mean and Standard Deviation for Pre-test and Post-test Achievement Scores of Students***

| | | Academic Achievement | | | | |
|---|---|---|---|---|---|---|
| Groups | No | Pretest Mean | Stand dev | Post test Mean | Stand dev | Mean Gain |
| Experimental | 58 | 20.38 | 4.20 | 71.57 | 8.96 | 51.19 |
| Control | 56 | 19.13 | 3.72 | 44.70 | 6.33 | 25.57 |

Table 1 shows the mean and standard deviation of academic achievement mean scores of students in experimental and the control groups. The mean scores indicate that the experimental group had higher mean scores during and after pretest. The mean gain for experimental group is 51.19 while that of the control group is 25.57. This shows that the experimental group achieved more than the control group.

**Research Question 2:** What is the difference between the retention mean scores of students taught auto mechanics using cognitive apprenticeship instructional method and those taught using demonstration teaching method?

**Table 2**

***Mean and Standard Deviation for Retention Scores of Students***

| Groups | | Retention Scores | |
|---|---|---|---|
| | No | Mean | Stand dev |
| Experimental | 58 | 67.27 | 8.45 |
| Control | 56 | 40.23 | 6.42 |

Table 2 shows the retention mean scores and standard deviation of students in experimental and the control groups. The mean scores indicated that the experimental group had higher retention scores. This shows that the experimental group retained what was taught them than those in demonstration group.

**Research Question 3:** What is the difference between the interest mean scores of students taught auto mechanics using cognitive apprenticeship instructional method and those taught using demonstration teaching method?

**Table 3**

***Mean and Standard Deviation for Interest Scores of Students***

| | | Interest Mean Scores | | | | |
|---|---|---|---|---|---|---|
| Groups | | Pretest | | Post test | | |
| | No | Mean | Stand dev | Mean | Stand dev | Mean Gain |
| Experimental | 58 | 45.24 | 6.31 | 75.24 | 9.21 | 30.00 |
| Control | 56 | 45.12 | 6.36 | 47.71 | 9.25 | 2.59 |

Table 3 shows the mean and standard deviation of interest mean scores of students in experimental and the control groups. The mean scores indicate that the experimental group have higher mean scores during and after pretest. The mean gain for experimental group is 30.00 while that of the control group is 2.59. This shows that the experimental group gained more interest than the control group.

**Research Question 4:** What is the difference between the academic achievement mean scores of male and female students taught auto mechanics using cognitive apprenticeship instructional method?

**Table 4**

***Mean and Standard Deviation for Academic Achievement Scores of Male and Female Students in Experimental Group***

| | | Gender Achievement | | | | |
|---|---|---|---|---|---|---|
| Experimental Groups | | Pretest | | Post test | | |
| | No | Mean | Stand dev | Mean | Stand dev | Mean Gain |
| Male | 45 | 20.02 | 3.88 | 73.84 | 8.59 | 53.82 |
| female | 13 | 21.62 | 5.14 | 63.69 | 4.96 | 42.07 |

Table 4 shows that male students had a higher academic achievement mean scores in the experimental group. Male mean gain is 53.82 while female mean gain is 42.07

**Research Question 5:** What is the difference between the retention mean scores of male and female students taught auto mechanics using cognitive apprenticeship instructional method?

**Table 5**
***Mean and Standard Deviation for Retention Scores of Male and Female Students in Experimental Group***

| Experimental Groups | Retention Scores | | |
|---|---|---|---|
| | No | Mean | Stand dev |
| Male | 45 | 69.33 | 8.15 |
| Female | 13 | 60.15 | 4.94 |

Table 5 shows that male students had higher retention mean scores in experimental group. Male retention mean score is 69.33 while female retention mean score is 60.15.

**Research Question 6:** What is the difference between the interest mean scores of male and female students taught auto mechanics using cognitive apprenticeship instructional method?

**Table 6:** ***Mean and Standard Deviation for Interest Mean Scores of Male and Female Students in Experimental Group***

| | | Gender Interest Scores | | | | |
|---|---|---|---|---|---|---|
| Experimental Groups | | Pretest | | Post test | | |
| | No | Mean | Stand dev | Mean | Stand dev | Mean Gain |
| Male | 45 | 44.84 | 6.32 | 76.22 | 9.14 | 31.38 |
| female | 13 | 46.62 | 6.35 | 71.85 | 8.99 | 25.23 |

Table 6 shows that male had higher post test mean interest than female students. The post test interest mean score of male students is 31.38 while that of female students is 25.23.

**Hypothesis 1:** There is no significant difference between the academic achievement mean scores of students taught auto mechanics using cognitive apprenticeship instructional method and those taught using demonstration method.

**Table 7**
***ANCOVA for Differences in Academic Achievement of Students***

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 20589.088[a] | 2 | 10294.544 | 168.902 | .000 |
| Intercept | 13799.495 | 1 | 13799.495 | 226.407 | .000 |
| Pretest | 14.625 | 1 | 14.625 | .240 | .625 |
| Method | 19894.341 | 1 | 19894.341 | 326.405 | .000 |
| Error | 6765.439 | 111 | 60.950 | | |
| Total | 415738.000 | 114 | | | |
| Corrected Total | 27354.526 | 113 | | | |

a. R Squared = .753 (Adjusted R Squared = .748)

Table 7 shows that there is a significant effect of treatment in the post test achievement of students in the experimental and control groups $F(1, 113) = 326.405$, $p < 0.05$. This means that there is a significant difference in the mean achievement scores of students in experimental and control group. Therefore, the hypothesis that there is no significant mean difference in the achievement of students taught with cognitive apprenticeship instructional method and demonstration method is rejected.

**Hypothesis 2:** There is no significant difference between the retention mean scores of students taught auto mechanics using cognitive apprenticeship instructional method and those taught using demonstration method.

**Table 8**

***ANCOVA for Differences in retention mean scores of Students***

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 25462.489[a] | 2 | 12731.244 | 827.139 | .000 |
| Intercept | 64.972 | 1 | 64.972 | 4.221 | .042 |
| Posttest | 4625.066 | 1 | 4625.066 | 300.487 | .000 |
| Method | 166.039 | 1 | 166.039 | 10.787 | .001 |
| Error | 1708.502 | 111 | 15.392 | | |
| Total | 359487.000 | 114 | | | |
| Corrected Total | 27170.991 | 113 | | | |

a. R Squared = .937 (Adjusted R Squared = .936)

Table 8 shows that there is a significant effect of treatment in the post test retention mean score of students in the experimental group and the control groups $F(1, 113) = 10.787$, $p < 0.05$. This means that there is a significant difference in the academic achievement mean scores of students in experimental and control group. Therefore, the hypothesis that there is no significant difference in the retention mean scores of students in experimental and control group is rejected.

**Hypothesis 3:** There is no significant difference between the interest mean scores of students taught auto mechanics using cognitive apprenticeship instructional method and those taught using demonstration method.

**Table 9**

***ANCOVA for Differences in interest mean scores of Students***

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 1194.277[a] | 2 | 597.139 | 2.214 | .114 |
| Intercept | 3372.553 | 1 | 3372.553 | 12.503 | .001 |
| pretestinterest | 1040.565 | 1 | 1040.565 | 3.858 | .052 |
| Gender | 76.279 | 1 | 76.279 | .283 | .596 |
| Error | 29940.740 | 111 | 269.736 | | |
| Total | 465392.000 | 114 | | | |
| Corrected Total | 31135.018 | 113 | | | |

a. R Squared = .038 (Adjusted R Squared = .021)

Table 9 shows that there is no significant effect of treatment in the post test interest mean score of students in the experimental group and control groups $F(1, 113) = 0.283$, $p > 0.05$. This means that there is no significant difference in the interest mean scores of students in experimental and control group. Therefore, the hypothesis that there is no significant mean difference in the interest mean scores of students in experimental and control group is not rejected.

**Hypothesis 4:** There is no significant difference between the academic achievement mean scores of male and female students taught auto mechanics using cognitive apprenticeship instructional method.

**Table 10:** ***ANCOVA for Differences in Female and Male Students' Achievement Mean Scores in Experimental Group***

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 1046.692[a] | 2 | 523.346 | 8.151 | .001 |
| Intercept | 9589.945 | 1 | 9589.945 | 149.354 | .000 |
| pretest | 7.149 | 1 | 7.149 | .111 | .740 |
| gender | 1040.393 | 1 | 1040.393 | 16.203 | .000 |
| Error | 3531.532 | 55 | 64.210 | | |
| Total | 301661.000 | 58 | | | |
| Corrected Total | 4578.224 | 57 | | | |

a. R Squared = .229 (Adjusted R Squared = .201)

Table 10 shows that there is significant effect of treatment in the post test achievement mean score of male and female students in the experimental group $F(1, 113) = 16.203$, $p< 0.05$. This means that there is significant difference between the academic achievement mean scores of male and female students in experimental group. Therefore, the hypothesis of no significant difference in the interest mean scores of male and female students in experimental group is rejected.

**Hypothesis 5:** There is no significant difference between the retention mean scores of male and female students taught auto mechanics using cognitive apprenticeship instructional method.

**Table 11:** ***ANCOVA for Differences in Female and Male Students' Retention Mean Scores in Experimental Group***

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 1094.822[a] | 2 | 547.411 | 9.961 | .000 |
| Intercept | 1676.371 | 1 | 1676.371 | 30.505 | .000 |
| Posttest | 174.429 | 1 | 174.429 | 3.174 | .080 |
| Genderexp | 392.762 | 1 | 392.762 | 7.147 | .010 |
| Error | 2967.494 | 54 | 54.954 | | |
| Total | 262353.000 | 57 | | | |
| Corrected Total | 4062.316 | 56 | | | |

a. R Squared = .270 (Adjusted R Squared = .242)

Table 11 shows that there is significant effect of treatment in the retention mean score of male and female students in the experimental group $F(1, 113) = 7.147$, $p < 0.05$. This means that there is significant difference in the retention mean scores of male and female students in experimental group. Therefore, the hypothesis that there is no significant mean difference in the retention mean scores of male and female students in experimental group is rejected.

**Hypothesis 6:** There is no significant difference between the interest mean scores of male and female students taught auto mechanics using cognitive apprenticeship instructional method.

**Table 12:** ***ANCOVA for Differences in Female and Male Students' Interest Mean Scores in Experimental Group***

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 549.145[a] | 2 | 274.573 | 3.521 | .036 |
| Intercept | 3247.418 | 1 | 3247.418 | 41.639 | .000 |
| cogninterestpre | 355.994 | 1 | 355.994 | 4.565 | .037 |
| genderexp | 256.887 | 1 | 256.887 | 3.294 | .075 |
| Error | 4289.476 | 55 | 77.990 | | |
| Total | 333192.000 | 58 | | | |
| Corrected Total | 4838.621 | 57 | | | |

a. R Squared = .113 (Adjusted R Squared = .081)

Table 12 shows that there is no significant effect of treatment in the interest mean score of male and female students in the experimental group $F(1, 113) = 3.294$, $p > 0.05$. This means that there is no significant difference between the interest mean scores of male and female students in experimental group. Therefore, the hypothesis that there is no significant mean difference in the interest mean scores of male and female students in experimental group is not rejected.

**Summary of Findings**

From the analyses presented in this chapter the following findings of the study were made.

1. Auto mechanics students taught using CAIM had higher academic achievement mean score than the students taught using demonstration method.

2. Auto mechanics students taught using CAIM had higher retention mean score than the students taught using demonstration teaching method.
3. Auto mechanics students taught using CAIM had higher interest mean score than those taught using demonstration teaching method.
4. Male auto mechanics students taught using CAIM had higher academic achievement mean score than the female auto mechanics students taught using CAIM.
5. Male auto mechanics students taught using CAIM had higher retention mean score than the female auto mechanics students taught using CAIM.
6. The interest mean score of male auto mechanics students taught using CAIM was higher than the interest mean score of female auto mechanics students taught using CAIM.
7. There was significant difference between the academic achievement mean scores of auto mechanics students taught using CAIM and those taught using demonstration teaching method in the achievement test.
8. There was significant difference in retention mean scores of auto mechanics students taught using CAIM and those taught using demonstration method in the retention test.

9. There was no significant difference in the interest mean scores of auto mechanics students taught using CAIM and those taught using demonstration teaching method.
10. There was significant difference between the academic achievement mean scores of male and female auto mechanics students taught using CAIM.
11. There was significant difference in the retention mean scores of male and female auto mechanics students taught using CAIM.
12. There was no significant difference in the interest mean scores of male and female auto mechanics students taught using CAIM.

# CHAPTER FIVE

# DISCUSSION, CONCLUSION AND RECOMMENDATIONS

This chapter focused on discussion of findings, conclusion, implications of the study, recommendations, limitation of the study and suggestions for further study.

## Discussion of Findings

Findings of this study were discussed under relevant headings as follows:

Effect of cognitive apprenticeship instructional method on academic achievement of students in auto mechanics technology

Effect of cognitive apprenticeship instructional method on retention ability of students in auto mechanics technology

Effect of cognitive apprenticeship instructional method on interest of students in auto mechanics technology

Effect of cognitive apprenticeship instructional method on male and female students' achievement in auto mechanic technology

Effect of cognitive apprenticeship instructional method on retention ability of male and female students' in auto mechanic technology

Effect of cognitive apprenticeship instructional method on interest of male and female students in auto mechanic technology

**Effect of cognitive apprenticeship instructional method (CAIM) on academic achievement of students in auto mechanics technology**

The study revealed that students who were taught auto mechanics technology using CAIM achieved higher post test scores than those taught using demonstration teaching method. This could be as a result of activities that were incorporated in CAIM components, which may have strengthened the cognitive ability of students. This result is in line with the findings of Farzaneh , Rohani , Ahmad and Kamariah (2015), Abubakar (2012) and Ozden and Gultekin (2008) which reported respectively that CAIM had significant effect on post-test achievement scores of students. However, the result of this study differ with the findings of Maigida (2013) which reported that though, cognitive apprenticeship instructional techniques was more effective in improving students' achievement but with high significant difference in favour of boys in auto mechanic technology. This could be due to the fact that both studies were conducted in different geographical location with population from different socio cultural background.

**Effect of cognitive apprenticeship instructional method (CAIM) on retention ability of students in auto mechanics technology**

Results of the study revealed that students taught using CAIM retained better what they have learnt over a period of time than those taught with demonstration teaching method. This means that the teaching method used in teaching the students was significant on students' retention. This finding is in line with Maigida (2013), Abubakar (2012) and Ozden and Gultekin (2008) who found that, students who were subjected to CAIM were able to retain the concepts taught than those students taught using other teaching method. This could be as a result of activities and experiences involved in CAIM which made the students to develop their own knowledge meaning and retain the concept taught.

**Effect of cognitive apprenticeship instructional method (CAIM) on interest of students in auto mechanics technology**

Results of the study revealed that students taught with demonstration method had a moderate interest mean score, but those taught with CAIM had a higher interest mean score than those taught using demonstration teaching method. This means that students in auto mechanic had interest for the trade but for the use of CAIM in teaching, the students' interest increased significantly. This could be as a result of activities and experiences involved which made the students' interest to increase. This finding is in line with Adegunle (2016), Oyenuga (2010) and Musa (2006) who found that, students' interest could be enhanced when instructional method that increases students' participation is used for instruction. However the results of this study differ from the findings of Olaf and Jurgen (2001) which showed that students' interest had no significant effect on instructional method used by the teacher, but on academic choice of the students.

**Effect of cognitive apprenticeship instructional method (CAIM) on male and female students' achievement in auto mechanic technology**

Findings of the study revealed that the academic achievement of male and female students taught auto mechanics using CAIM did not differ significantly in post test mean scores. This indicated that CAIM was effective and has the potential of improving students' academic achievement in auto mechanics technology irrespective of gender. This result is in line with the findings of Eze, Ezenwafor and Obidile (2016), Olaoye and Adu (2015) and Ogundola, Popoola and Oke (2010) which reported that if female students are given the same opportunity as their male counterparts, they could do better. However, the results of this study differ with the findings of Igboko (2004) which showed significant difference in favour of boys in achievement and retention. This could be due to the fact that both studies are in different subject area and were conducted in different geographical location with population from different socio cultural background.

**Effect of cognitive apprenticeship instructional method (CAIM) on retention ability of male and female students' in auto mechanic technology**

Findings of the study revealed that male and female students taught auto mechanics using CAIM differ slightly in retention ability in favor of male students. This indicated that CAIM was effective and has the potential of improving students' retention ability in auto mechanics technology irrespective of gender. This result is in line with the findings of Eze, Ezenwafor and Obidile (2016), Olaoye and Adu (2015) and Ogundola, Popoola and Oke (2010) which reported that if instructional method that promotes gender active involvement, is used for teaching, the retention ability of both male and female students could be enhanced.

**Effect of cognitive apprenticeship instructional method (CAIM) on the interest of male and female students in auto mechanic technology**

Findings of the study revealed that the interest of male and female students taught auto mechanics using CAIM did not differ significantly in post test mean scores. This indicated that cognitive apprenticeship instructional method was effective and has the potential of improving the interest of both male and female students in auto mechanics technology. This result is in line with the findings of Adegunle (2016), Oyenuga (2010) and Musa (2006) which reported that if instructional method that promote gender active involvement is used for instruction, the interest of both male and female students could be enhanced.

## Conclusion

Based on the findings of the study, it was concluded that cognitive apprenticeship instructional method is an effective method for improving students' academic achievement, retention and interest in auto mechanics technology. Irrespective of gender, the use of CAIM showed significant improvement in academic achievement, retention and interest of auto mechanics students in technical colleges. Thus CAIM could be used in teaching and learning of auto mechanics technology to enhance academic achievement, retention of knowledge and interest of students in auto mechanic trade.

**Implications of the Study**

The findings of this study have some educational implications. It was found that cognitive apprenticeship instructional method increased students' academic achievement, retention and interest in auto mechanics technology. This implies that if teachers of auto mechanics technology involve their students actively in the teaching and learning process through the application of cognitive apprenticeship instructional method, they will acquire in-depth knowledge which will help them retain the concepts and knowledge in auto mechanics technology.

The result also indicated that there is no significant difference between male and female academic achievement taught auto mechanics using CAIM. Thus, the cognitive apprenticeship instructional method favoured both male and female students equally, showing that the method is effective in instructional delivery in auto mechanics technology for both male and female students.

**Recommendations**

Based on the findings of this study, the following recommendations were made:

1. Cognitive apprenticeship instructional method should be formally adopted as a method of instruction in technical colleges.
2. Teachers of auto mechanics technology should acquire the knowledge and skills for using cognitive apprenticeship instructional method through in-service training, conferences, seminars and workshops.
3. School administrators should encourage auto mechanics teachers to use cognitive apprenticeship instructional method by providing opportunities for in-service training to equip them with competencies needed in it.
4. Curriculum designers should incorporate cognitive apprenticeship instructional method as an instructional strategy for teaching auto mechanics technology in vocational institutions.
5. Education stakeholders and relevant professional associations such as Nigerian Association of Teachers of Technology (NATT), Association of Vocational and Technical Educators of Nigeria (AVTEN) should sponsor further research on the efficacy of cognitive apprenticeship instructional

method on other technology subject areas so as to arrest the declining academic achievement of students in technical colleges.

6. Government, through the Ministry of Education should ensure the provision of adequate instructional materials at post basic school level of vocational institutions to facilitate the use of cognitive apprenticeship instructional method in the teaching of auto mechanics technology.

**Limitation of the Study**

1. Poor enrolment rate of female students in auto mechanic trade restricted the sample size used for female students as it would have been better if there were more of them. However, this does not invalidate the study since the few currently available participated actively.

**Suggestions for Further Research**

The following suggestions were made for further study.

1. This study was limited to teaching and learning of auto mechanic trade. Similar studies should be conducted in other areas of technology trade such as the effect of cognitive apprenticeship instructional method on students' academic achievement in electronics, applied electricity, technical drawing, wood work, or metal work to mention but a few in technical colleges.
2. The study was conducted in technical colleges in Delta State. Similar studies should be carried out in other educational institutions and secondary schools

in the state such as the effect of cognitive apprenticeship instructional method on students' academic achievement in auto mechanic trade in tertiary institutions in Delta state.

3. The study was carried out in Delta State, therefore, similar study should be replicated to cover a wider geographical area, such as the effect of cognitive apprenticeship instructional method on students' academic achievement in auto mechanic trade in technical colleges in Nigeria.

# REFERENCES


Abubakar, M. I. (2012). Effect of Cognitive Apprenticeship Instructional Method on Auto-Mechanics Students. *Assumption University Journal of Technology, 16 (2),* 89-98

Adegunle, F. O. (2016). Effect of Scaffolding instructional method on students achievement and interest in metalwork technology in technical colleges in Lagos State. *PhD Thesis* Submitted to the Department of Vocational Teacher Education, University of Nigeria, Nsukka.

Adekoya, Y. M & Olatoye, R. A. (2011). Effects of demonstration, peer-tutoring and lecture teaching strategies on senior secondary school students' achievement in an aspect of agriculture science. *Pacific Journal of Science and Technology,* 12(1), 320-332.

Adelakun, O. J. (2011) Human capital development and economic growth in Nigeria. *European Journal of Business and Management 3 (9), 29-39*

Akani, O. (2015). Impact of instructional scaffolding on students achievement in Chemistry in Secondary School in Ebonyi State, Nigeria. *International Journal of Education, Learning and Development,* 3(7), 74-83

Akinbobola , A. O & Ikitde, G. A (2011). Strategies for teaching mineral resources to Nigeria secondary school science students. *African Journal of Social Research and Development, 3 (2),* 130-138.

Amaechi, O. J & Thompson, C. G (2016)**.** Practical skills in technical and Vocational training programmes in Nigeria**.** *International Journal of Scientific Research Engineering & Technology, 5 (12),* 78 –82

Asogwa, E. E. (2011). Transforming Nigeria undergraduate through information competency, information impact. *Journal of Information and Knowledge Management, 2(3),* 60.

Audu, R., Abdulkadir, M. & Abdul, B. K (2013) Technical Vocational Education (TVE) Institutions and Industries Partnership: Necessity for Graduates Skills Acquisition. *International Journal of Scientific and Research Publications*,3(4), Augustus, N. (2007). Effect of cognitive apprenticeship instructional method on the achievement of auto mechanics students in Rivers state. *Unpublished P.hD Thesis.* Department of Vocational Teacher Education, University of Nigeria, Nsukka

Aziz, G. (2003). Cognitive apprenticeship, technology, and the Contextualization of learning environments. *Journal of Educational Computing, Design & Online learning 4, Fall, 2003.*

Baker, M. A & Robinson, J. S (2017) Effect of two different pedagogical delivery methods on students' retention of knowledge over time. *Journal of Agricultural Education*, 59(1), 100-118

Bandura A. (1 997). *Social Learning Theory*. Englewood Cliffs, NJ: Prentice-Hall.

Cabibihan J. J. (2013). Effectiveness of student engagement pedagogies in a mechatronics module: A 4-year multi-cohort study. *Journal of the NUS Teaching Academy*, *3 (4)*, 125-149.

Casem, R. Q. (2013). Scaffolding instructional strategy in teaching Mathematics: Its effects on students' performance and altitude. *Comprehensive Journal of Education Research, 1(1),* 9-19

Cawthon, S. W., Alycia H., & Robin J. (2010). "Cognitive Apprenticeship in an Online Research Lab for Graduate Students in Psychology." *International Journal of Web-Based Learning and Teaching Technologies,* 5 (1): 1-15.

Chukwu, A. (2012). Promoting studnets's interest in mathematics using local games. *International Journal of Arts and Technology,* 2(1), 54-56

Collins A., Brown J.S & Holum, A. (2004). Cognitive Apprenticeship: mastering knowledge. Retrieved on 2nd February, 2010 from http://en.wikipedia.org/wiki/cognitiveapprenticeship

Daluba, N. E. (2013). Effect of Demonstration Teaching Method on Students' Achievement in Agricultural Science. *World Journal of Education* 3 (6), 61- 67

Darabi, A. A. (2005). Application of cognitive apprenticeship model to a graduate course in performance systems analysis: a case study. *Educational Technology Research Development, 53 (1),* 49–61.

Dorgu, T. E. (2015) Different teaching methods: A panacea for effective curriculum implementation in the classroom. *International Journal of Secondary Education, 3 (6),* 77-87

Duncan,S. I. (1996). Cognitive apprenticeship in classroom instruction: implication for industrial and technical teacher education. *Journal of industrial teacher education, 33 (3),* 66-86.

Eze, T. I, Ezenwafor J.I & Obidile I.J. (2016). "Effect of problem-based teaching methods on students' academic performance and retention in financial accouting in technical colleges in Anambra State". *Schola Journal of Arts, Humanity and Social Science, 4 (6),* 6343-639.

Eze, T. I, Ezenwafor, J. I & Molokwu, L. I. (2015). Effect of meta-learning teaching method on the academic performance of building trades students in technical colleges in South-east Nigeria. *International Journal of Vocational and Technical Education, 7 (10),* 101-108

Eze, T. I & Osuyi S.O. (2018). "Effect of problem-based teaching methods on students' academic performance in electrical installation and maintenance work in technical colleges in Edo state" *International Journal of Development and Sustainability, 7 (2),* 666-678.

Fadairo, O. O. (2009) Strategies for improving the of Automobile Technology Students Interest in Technical Colleges in Ogun State. *M.Sc Thesis* Presented to Department of Vocational Teacher Education University of Nigeria Nsukka.

Fatokun F. K. V & Eniayeju A. P (2014), Enhancing students' achievement, interest and retention in Chemistry through an integrated teaching/learning approach. *British Journal of Education, Society & Behavioural Science 4 (12):* 1653-1663.

Farzaneh S., Rohani A., Ahmad, F. M. & Kamariah A. B. (2015). *Effect of internet-based cognitive apprenticeship model (i-CAM) on Statistics learning among postgraduate students* www.http.10.1371/journal.pone.0129938.

Federal Republic of Nigeria (2013). *National Policy on Education (6th ed).* Lagos: NERDC Press.

Garner, J.K. (2012) Cognitive Apprenticeship Learning. In: Seel N.M. (eds) *Encyclopedia of the Sciences of Learning*. Boston: Springer.

Gerard, P. & Eric P. (2011). A cognitive apprenticeship approach to engineering education: the role of learning styles. *Journal of the Higher Education Academy, 6 (1*)

George, R. (2016) A cross-domain analysis of change in students' attitude towards science and attitudes about the utility of scienc. *International Journal of Science Education,* 6, 571-589

Glazer, E. M & Hannafin, M. J. (2006). The collaborative apprenticeship model: situated professional development within school settings. *Teaching Teacher Educ., 22 (2),* 179–193.

Ibrahim, Y. U & Abdullahi, S.M. (2010). Repositioning the facilities in technical college workshop for efficiency: A case study of North Central Nigeria. *Journal of STEM Teachers Education 47 (3)*

Ibritam, K. S; Udofia, N. & Onweh, V. Z. (2015). Assessing the potency of scaffolding and Demonstration instructional methods on student's achievement in Technical Colleges in Akwa Ibom State. *Advances in Research, 3(1),* 92- 101.

Igbo, J. N, Onu, V.C & Obiyo N. O. (2015), Impact of gender stereotype on secondary school students' self-concept and academic achievement. *Sage Journal, 5(1)*

Igboko, K.O. (2004). Effects of cognitive constructivism on the achievement and retention of students of introductory technology. *Unpublished PhD Dissertation*. University of Nigeria, Nsukka.

Jimoh, J. A. (2010). Comparative Effects of Two and Three Dimensional Techniques of AutoCad on Spatial Ability, Interest and Achievement of National Diploma Students in Engineering Graphics. *Unpublished Ph.D Thesis*. University of Nigeria, Nsukka.

Joda, F. M (2019). Effects of Instructional Scaffolding Strategy on Senior Secondary Biology Students' Academic Achievement and Retention in Taraba State, Nigeria. *Eductional Quarterly Reviews* 2(2) 269-275

Joda, F. M. & Mohamed, A. A. (2017). Effect of Guided Inquiry teaching method on senior secondary school Biology students Academic Achievement and Retention in Yola Education Zone, Adamawa State, Nigeria. *Multidisciplinary Journal of Science, Technology and Vocational Education, 5(1),* 89-96 .

Karan, C. P., Ravi P & Rachit S, (2014). Hybrid vehicle: A study on technology. *International Journal of Engineering Research and Technology (IJERT) 3 (12).*

Limbourg, G. S. (2014). *Understanding of the principle of automobile technology*. Los Angeles:Premium publishing Incops.

Liu T.C. (2005). Web-based cognitive apprenticeship model for improving pre-service teacher' performance and attitude towards instructional planning: design and field experiment. *Educational Technology and Society. 8 (2),* 136-149.

Maigida, J.F. (2013) Effect of Cognitive Apprenticeship Instructional Method on Student's Achievement, Retention and Skill Performance in Automobile Mechanics. *PhD Thesis* Submitted to the Department of Vocational Teacher Education University of Nigeria Nsukka.

Masaruf, M. (2015) The role of vocational and technical education for improving national economy for sustainable development: Curriculum issues. *IOSR Journal of Research & Method in Education 5(3),* 12-18

McCabe, J. A. (2014). *Learning and Memory Strategy Demonstrations for the Psychology Classroom.* Baltimore: Goucher College.

Musa, S. A. A. (2007). The effect of constructivist teaching method on students' achievement and interest in Mathematics in secondary schools in Kogi State. *Journal of Vocational and Technical Educators, 1 (1),* 12-17.

National Board for Technical Education (2013). *National Technical Certificate Examination (craft level) Syllabus for Engineering Trades based on the NBTE Modular Curricular.* Kaduna: NBTE.

National Business and Technical Examination Board (2013). Report on performance of students in NTC examination.

National Business and Technical Examination Board (2017). Chief Examiner's Report on performance of students in NTC and NBC examination. Fiesta Printing Press Ltd., Benin City, Nigeria.

Ndinechi, G. I. & Obidile, I. J. (2013). Strategies considered effective for teaching accounting in tertiary institutions in Anambra State. *Journal of Nigeria Accounting Association (NAA) 4 (2),* 133-143.

Nonye, A. & Nwosu, B. O. (2011). Effects of Instructional Scaffolding on the achievement of male and female students in Financial Accounting in Secondary Schools in Abakaliki Urban of Ebonyi State, Nigeria. *Current Research Journal of Social Sciences, 3(2),* 66-70.

Nwachukwu, C. F. (2016). *Designing Appropriate Methodology in Vocational and Technical Education for Nigeria*. Nsukka: Fulladu Publishing Co.

Nworgu, B. G. (2015). *Educational research: Basic Issues and Methodology* Ibadan: Wisdom Publishers.

Odagboyi, I. A (2015). The Effect of Gender on the Achievement of Student in Biology Using the Jigsaw Method. *Journal of Education and Practice.6 (17),* 176.

Ogbuanya, T. C. and Fakorede, S. O. A. (2008). *Effect of Learning Mode on the Psychomotor Achievement of Automobile Technology Students in the Technical Colleges.* In B. G. Nworgu (Eds). *Education in the Information Age: Global Challenges and Enhancements Strategies,* 149 – 155; Nsukka; University Trust Publishers.

Ogundola I. P, Popoola A. A & O. Oke O.J (2010). Effect of constructivism instructional approach on teaching practical skills to mechanical related trade students in western Nigeria technical colleges. *International NGO Journal 5 (3)*, 059-064. Available online at http:// www.academicjournals.org/INGOJ

Ogunkunle R. A & Onwunedo A. H (2014). Effect of differentiated instructional strategies on students retention In geometry in FCT senior secondary schools, Abuja. *Global Journal of Educational Research* 13, 1-7 www.globaljournalseries.com

Okorie E.U (2012) Basic Science and Technology Teacher Capacity Dev:Beyond Pedagogy. *International Journal of Education Research, 12 (1),*37-38

Olaf K. & Jurgen B. (2001). The relationship between interest and achievement. *Journal for Research in Mathematics Education 32 (5)*, 448-470.

Olaoye, O. & Adu, E. O. (2015), Problem-based Learning Strategies and Gender as a Determinant of Grade 9 Students' Academic Achievement in Algebra. *International Journal of Education Science 8 (3),* 85-92

Olatubosun, E. O. (2015). Effects of scaffolding strategy on learners' academic achievement in integrated science at the Junior Secondary School level. *European Scientific Journal*, 9(19), 149-155.

Omeje, H.A. (2011) Effect of project based learning instructional techniques on interest and retention of low ability students in woodwork. *Journal of Nigeria association of Teachers of Technology, 7(3)*, 29-33

Osho, S. O. (2017). The future of Auto-mechanics work Students in Nigerian Technical Colleges. A paper presented at a Seminar organized by the Department of Technical Education, Tai Solarin University of Education, Ijagun. On 28th April.

Osuyi S.O & Ainetor U.A (2018). Effect of Demonstration Teaching Method on Students' Academic Performance in Basic Electricity in Technical Colleges in Edo State. *Journal of Education in Developing Areas (JEDA)* 26 (2), 37 – 45.

Oyenuga, A. O. (2010). Effect of Models on Interest and Academic Achievement of Auto-mechanics Students in Technical Colleges in Lagos State. *PhD Thesis* Presented to the Department of Vocational Teacher Education, University of Nigeria, Nsukka

Ozden, M. & Gultekin, M. (2008). The effects of brain-based learning on academic achievement and retention of knowledge in science course. retrieved 10th October, 2009 from *http://ejee.southwestern.edu*.

Ronald, H. H (2009) Teacher effectiveness and student achievement: Investigating a multilevel cross classified model. *Journal of Educational Administration*, *47(2)*, 227-249

Santrock, J. W (2010). Adolescence 13th Edition. New York: McGraw- Hill.

Tella, A (2010). Impart of motivation on students academic achievement and learning outcomes in Mathematics among secondary school students in Nigeria. *Eurasia Journal of Mathematics; Science; and Technology Education*. *3 (2)*, 149-156.

Teo, O.H. Cooper, C. & Eric, B. (2015), Effect of cognitive apprenticeship-based instructional coaching on science teaching efficacy beliefs.

Tompkins, E. K. (2016). Application of cognitive apprenticeship model to library instruction. *City University of New York Academic Works.* http://academicworks.cuny.edu/kb_pubs/22

Uduafemhe, M.E. (2015). Comparative effects of scaffolding and collaborative instructional approaches on secondary school students psychomotor achievement in Basic Electronics in North-central Nigeria. *International Organization of Scientific Research. 5(6),* 23-31

UNESCO (2007). *Worldwide action in education: scientific, technical and vocational education*. Retrieved on 30th September, 2009 from www.education.unesco.org.

UNESCO & ILO (2001). *Technical and Vocational Education and Training (TVET) for the twenty first century*. recommendations. Paris: UNESCO/ILO.

UNESCO & NBTE (2003). *Revised curricular for technical and polytechnics.* Paris: UNESCO.

Vander Wall, S.Y. (2007). *Evolutionary change in automotive technology: long term development, Artifacts, producers and consumers*. Retrieved on 30th January, 2010 from http://home.tm.tue.n1/svdulal.

Vanessa, P. D & Kerry, J. B (2014). The Cognitive Apprenticeship Model in Educational Practice. *Handbook of research on educational communications and technology* 3, 425–439

Vincent, E. O & Akpan U. T (2014) Instructional strategies and students'academic performance in electrical installation in technical colleges in Akwa Ibom State: Instructional skills for structuring appropriate learning experiences for students. *International Journal of Educational Administration and Policy Studies, 6 (5)*, 80-86.

Vygotsky, L.S. (1978). *Mind in Society: The Development of Higher Psychological Processes.* Cambridgu: Haward University Press.

# APPENDICES

# Appendix A

## Letter of Transmittal

Tech. & Voc. Edu. Department,
Faculty of Education,
Nnamdi Azikiwe University
PMB 5025, Awka,
Anambra State.
3rd June, 2019.

The Principal,

-------------------------------------------------------

-------------------------------------------------------

Sir/Madam,

**Permission to Use Your School for Experimental Study**

I am a post graduate student of the above name institution. I am caring out a research study on the **effect of cognitive apprenticeship instructional method on students' academic achievement, retention and interest in auto mechanics technology in technical colleges in Delta State.** Therefore, I seek your permission for the involvement of your teachers, students, workshop and other relevant instructional facilities within the period of the exercise. The exercise shall be carried out by auto mechanics teachers in your school during the normal lesson period. Therefore the school activities will not be disrupted within the period of this exercise.

Thanks for your anticipated prompt response

Yours faithfully

Okotubu O, Johnbull

## Appendix B

## Analysis of Technical College Students Academic Achievement in Auto Mechanics in May/June NABTEB Examination from 2010 to 2017 in Delta State

| Male | | | | | Female | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **A** | **C** | **P** | **F** | **A** | **C** | **P** | **F** | **Total Enrolled** |
| **2010** | 2 | 7 | 11 | 24 | 0 | 1 | 2 | 6 | 53 |
| **2011** | 0 | 3 | 16 | 19 | 0 | 2 | 3 | 5 | 48 |
| **2012** | 4 | 10 | 6 | 25 | 0 | 3 | 2 | 8 | 58 |
| **2013** | 0 | 8 | 4 | 23 | 0 | 2 | 0 | 7 | 44 |
| **2014** | 0 | 13 | 3 | 18 | 0 | 0 | 4 | 2 | 40 |
| **2015** | 0 | 19 | 5 | 16 | 0 | 1 | 0 | 4 | 45 |
| **2016** | 0 | 13 | 4 | 14 | 0 | 0 | 1 | 6 | 38 |
| **2017** | 0 | 7 | 17 | 21 | 0 | 3 | 3 | 4 | 55 |
| **Total** | **6** | **80** | **66** | **160** | **0** | **12** | **15** | **42** | **381** |
| **%** | **1.57%** | **20.99%** | **17.32%** | **41.99%** | **0%** | **3.14%** | **3.93%** | **11.02%** | **100%** |

**Source:** School copy of the NABTEB results in Principal's Office in Technical Colleges in Delta State.

## Appendix C

**Population Distribution of Auto Mechanics Students for 2018/19 Academic Session in Technical Colleges in Delta State**

| S/NO | NAME OF INSTITUTION | Male | Female | TOTAL |
|---|---|---|---|---|
| 1 | Agbor Technical College, Agbor | 45 | 13 | 58 |
| 2 | Issele-Uku Technical College, Issele-Uku | 32 | 08 | 40 |
| 3 | Utagba-Ogbe Technical College, Kwale | 22 | 12 | 34 |
| 4 | Ofagbe Technical College, Ofagbe | 18 | 07 | 25 |
| 5 | Otor-Ogor Technical College, Ughelli | 21 | 03 | 24 |
| 6 | Sapale Technical College, Sapele | 50 | 6 | 56 |
| | TOTAL | 188 | 49 | 237 |

**Source**: Students' Register for 2018/2019 Academic Session in Vice Principals' Admin. Office in the Technical Colleges in Delta State.

**Appendix D**

**Auto-Mechanics Achievement Test (AMAT) (Pre Test)**

Subject: MVM

Class: Vocational II

Time Allowed: 60 minutes

Name of Technical College: ----------------------------------------------

Name of Student: ---------------------------------------------------------

SEX: Male ( ) Female ( )

INSTRUCTION: Attempt all questions. Choose the correct answer from the alternatives lettered A – D. Circle or tick the letter that bears the option chosen by you.

1. The part of the engine that drives the flywheel is called? (a) The propeller shaft (b) The flywheel (c) The camshaft (d) The crankshaft.

2. The part of the engine that connects the piston to the crankshaft is called? (a) The propeller shaft (b) The flywheel (c) The camshaft (d) The connecting rod.

3. The part of the engine that connects the piston to the connecting rod is called? (a) The gudgeon pin (b) The flywheel (c) The camshaft (d) The crankshaft.

4. The following engine parts are driven by the crankshaft except? (a) The propeller shaft (b) The flywheel (c) The camshaft (d) The oil pump

5. The part of the engine that compresses the air fuel mixture in combustion

chamber is called? (a) The piston (b) The flywheel (c) The camshaft (d) The crankshaft

6. The part of the engine that ensures the lubrication of the cylinder is called? (a) The piston (b) The flywheel (c) The rings (d) The crankshaft.

7. The part of the engine that ignites the air fuel mixture in the combustion chamber is called? (a) The piston (b) The spark plug (c) The camshaft

(d) The crankshaft.

8. The oil in the engine settles in the ----------- when the engine is not running.

(a) tank (b) crank case (c) sump (d) oil filter.

9. The part of the engine that allows the air fuel mixture to enter into the combustion chamber during the induction stroke is called? (a) The piston (b) The rings (c) The inlet valve (d) The exhaust valve

10. The part of the engine that allows the burnt gasses in the combustion chamber to escape during the exhaust stroke is called? (a) The piston (b) The rings (c) The inlet valve (d) The exhaust valve

11. The part of the engine that pushes the valves to open during the induction or exhaust stroke is called? (a) The piston (b) The spark plug(c) The camshaft (d) The tappet

12. The part of the engine where combustion occurs during the compression stroke is called? (a) The piston (b) The combustion chamber (c) The camshaft (d) The

valves.

13. The part of the engine that sprays the oil in the sump to other components inside the engine is called? (a) The cam web (b) The cam shaft (c) The crankshaft (d) The piston valves.

14. The part of the engine that serves as housing to other components inside the engine is called? (a) The cam web (b) The cam shaft (c) The crankshaft (d) The crank case.

15. The gudgeon pin is made hollow to reduce--------- (a) weight (b) heat (c) tension (d) friction

16. Compression rings are used (a) to make the piston stronger (b) to make the piston lighter (c) to make the piston a gas-tight fit (d) to make the piston rotate freely

17. The crankshaft damper is a small flywheel which normally rotate with the (a) crankshaft (b) rotor (c) wheel shaft (d) none of the above

18. The shape of the crankshaft is related to the number and the shape of the arrangement of the (a) cylinder (b) piston (c) connecting rod (d) all of the above

19. The piston apex is called? (a) The crown (b) The tip (c) The roof (d) None of the above

20. The piston serves as a/an (a) moveable gas-tight plunger in the cylinder (b) energy builder in the engine (c) heat protector (d) oil sieve in the engine

21.The part of the vehicle transmission system that is between the flywheel and the gearbox is called? (a) Flywheel (b) Gear box (c) Clutch unit

(d) Propeller shaft

22. The part of the vehicle transmission system that is between the gearbox and the road wheel is called? (a) Flywheel (b) Gear box (c) Clutch unit (d) Propeller shaft

23. The part of the vehicle transmission system that enables the driver to vary its speed is called? (a) Flywheel (b) Gear box (c) Clutch unit (d) Propeller shaft

24. The part of the gear that transmits the drive from the engine fly wheel to the gear unit is called? (a) Driver gear (b) Driven gear (c) Secondary drive (d) Idler gear.

25. The part of the gear that transmits the drive from the gear unit to the driving shaft of the vehicle transmission system is called? (a) Driver gear (b) Driven gear (c) Primary drive (d) Idler gear.

26. The gear responsible for reverse drive is called? (a) Driver gear (b) Driven gear (c) Primary drive (d) Idler gear.

27. The rear wheel drive uses the propeller shaft while the front wheel drive uses the (a) main drive (b) front drive (c) back drive (d) half shaft

28. Which of these is not a component of the clutch unit (a) clutch plate (b) friction plate (c) clutch disc (d) Idler

29. The shaft that transmits the drive from the engine flywheel to the gear box is called? (a)Primary shaft (b) Secondary shaft (c) Tertiary shaft (d) Clutch shaft.

30. The shaft that transmits the drive from the gearbox to the driven shaft is called? (a)Primary shaft (b) Secondary shaft (c) Tertiary shaft (d) Clutch shaft

31. The main function of the flywheel is to retain some of the energy given to the crankshaft during the (a) Suction stroke (b) Power stroke (c) Compression stroke (d) Exhaust stroke

32. The base of the poppet valve is called (a) The land (b) The trunk (c) The tip (d) The bottom

33. During the power stroke (a) The compressed gas is ignited by a spark bridging the spark plug electrodes (b) The inlet valve open drawing a mixture of air and fuel into the cylinder (c) The uncompressed gas is ignited by a spark bridging the spark plug electrodes (d) The piston remain static and no spark bridged the spark plug electrode

34. Exhaust valve opens (a) During the power stroke (b) During the suction stroke (c) During the exhaust stroke (d) During the compression stroke

35. During the compression stroke (a) The piston compresses the air fuel mixture. (b) The piston hangs (c) The piston moves down (d) The piston start to rise

36. The four stroke cycle comprises of (a) Exhaust, power and compression strokes (b) Compression and induction strokes (c) Power, compression and exhaust strokes (d) Induction, compression, power and exhaust strokes

37. In the construction of the piston, the following material are used except (a) Cast iron (b) Steel alloys (c) Aluminium alloys (d) Copper alloys

38. Passage of lubricating oil up to the combustion chamber is prevented by (a) The piston rings (b) The sump (c) The gudgeon pin (d) Connecting rod

39. The reciprocating movement of the piston is converted into rotary movement by the (a) Camshaft (b) Connecting rod (c) The crankshaft (d) Cylinder block

40. The cylinder head may be detachable or permanently attached to (a) The cylinder block (b) The sump (c) The engine cover (d) The gasket

**Answers to Test Items**

1.D 2.D 3.A 4.A 5.A 6.C 7.B 8.C 9.C 10.D 11.D 12.B 13.A 14.D 15.A 16.C 17.A 18.D 19.A 20.A 21.C 22.D 23.B 24.A 25.B 26.D 27.D 28.D 29.A 30.B 31.B 32.A 33.A 34.C 35.A 36.D 37.A 38.A 39.B 40.A

## Appendix E

## Auto-Mechanics Interest Inventory (AMII) Pre Test

Class: Vocational II

Time Allowed: 60 minutes

Name of Student: -------------------------------------------------------------

Name of Technical College: -------------------------------------------------

SEX: Male ( ) Female ( )

INSTRUCTION: Please tick (X) to indicate the degree to which you agree or disagree

NOTE: SA(Strongly Agreed), A ( Agreed), UD (Undecided, D (Disagreed) and SD (Strongly Disagreed)

| **S/N** | **Interest Statements** | **Response Options** | | | | |
|---|---|---|---|---|---|---|
| | | **SA (5)** | **A (4)** | **UD (3)** | **D (2)** | **SD (1)** |
| 1 | Auto-mechanics lesson is very interesting. | | | | | |
| 2 | Auto-mechanics lesson is easy to understand | | | | | |
| 3 | I only develop interest in auto-mechanics lesson few weeks ago. | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | The method of teaching auto mechanics within the past six weeks has increased my interest in auto-mechanics | | | | | |
| 5 | I paid more attention in auto mechanics lesson within the past six weeks. | | | | | |
| 6 | Auto-mechanics class period should be extended | | | | | |
| 7 | When I am alone, I like revising automotive lessons | | | | | |
| 8 | I attend auto-mechanics class regularly. | | | | | |
| 9 | I like discussing about auto-mechanics subjects. | | | | | |
| 10 | I like doing assignments on auto-mechanics subjects. | | | | | |
| 11 | I am always active during auto-mechanics lesson. | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 12 | I don't usually like to take permission to absent myself from auto-mechanics class. | | | | | |
| 13 | I take interest in calling the auto-mechanics teacher when he fails to come to the class on time. | | | | | |
| 14 | I am not always happy when auto-mechanics teacher misses his class, | | | | | |
| 15 | I prefer auto-mechanics option to any other option in vocational trade. | | | | | |
| 16 | I enjoy auto-mechanics practical classes | | | | | |
| 17 | I like Auto-mechanics lessons because it involves students in series of practical activities | | | | | |
| 18 | I take interest in handling automotive faults during | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | practical | | | | | |
| 19 | The aspects of automotive systems that I like are more than the aspect that I hate. | | | | | |
| 20 | I pay much interest in auto-mechanics lessons more than in any other general subjects. | | | | | |
| 21 | I take interest in anything involving automotive system. | | | | | |
| 22 | I always wish that lessons on automotive systems should continue after its time is up. | | | | | |
| 23 | I enjoy reading books on auto-mechanics technology. | | | | | |
| 24 | The strategies adopted in teaching auto-mechanics subject affect my interest in auto-mechanics. | | | | | |
| 25 | I like auto-mechanics lessons | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | because real objects in motor vehicle are used for teaching the students. | | | | | |
| 26 | I engage myself in auto-mechanics assignments during other lesson period | | | | | |
| 27 | I do extra studies on auto-mechanics apart from the normal lessons. | | | | | |
| 28 | I like auto-mechanics because most of the lessons are carried out in the workshop. | | | | | |
| 29 | I enjoy participating in auto-mechanics lesson | | | | | |
| 30 | It is better to use other subjects periods for auto-mechanic. | | | | | |

## Appendix F

## Lesson Plan for Experimental Group

### Week 1

**Class:** Vocational II

**Duration:** 90 Minutes

**Topic:** Pretest for both Experimental and Control Group

### Lesson Plan for Week 2

**Class:** Vocational II

**Duration:** 90 Minutes

**Topic:** Vehicle Engine Top Cylinder

**Specific Objectives:** It is expected that at the end of the lesson, the students should be able to:
**i.** Identify the various components of the engine top cylinder
**ii.** Indicate where the engine top cylinder is positioned in the vehicle engine
**iii.** State the functions of the engine top cylinder
**iv.** Describe how to dismantle and couple the engine top cylinder

**Instructional Material:** Vehicle engine top cylinder, charts, lesson notes, chalkboard and chalk.

**Entry Behaviour:** The students have previous knowledge of the various types of the vehicle engine.

**Instructional Procedure:**

| Steps | CAIM Elements | Teacher's Activities | Students' Activities |
|---|---|---|---|
| Step 1 | Modelling | Teacher presents the model of the various parts of the vehicle engine top cylinder for identification by students. | Students identify the various parts of the vehicle engine top cylinder modelled by the teacher. |
| Step 2 | Coaching | Teacher and students | Students and teacher |

| | | | |
|---|---|---|---|
| | | dismantle and couple the vehicle engine top cylinder presented before the students. | dismantle and couple the vehicle engine top cylinder presented before them. |
| Step3 | Scaffolding | Teacher guide the students to dismantle and couple the vehicle engine top cylinder | Students dismantle and couple the vehicle engine top cylinder presented before them with minimal assistance from the teacher. |
| Step 4 | Articulation | Teacher observes the students as the students dismantle and couple the vehicle engine top cylinder. | Students repeat the process of dismantling and coupling of the vehicle engine top cylinder. |
| Step 5 | Reflection/Conclusion | Teacher makes the necessary corrections in the students work. | Students compare their work with that of the teacher and co-students |
| Step 6 | Exploration | Teacher provides other types of vehicle engine top cylinder similar to the one he has modelled and ask students to dismantle and answer the following questions i. Mention the components of the engine top cylinder.<br>**ii.** Identify where the top cylinder is positioned in the engine.<br>iii. State the function of the engine top cylinder?<br>iv. Describe how the engine top cylinder could be coupled. | Students dismantle other types of vehicle engine top cylinder similar to the type the teacher has modeled and answer the teacher's questions by identifying the various parts. |

## Lesson Plan for Week 3

**Class:** Vocational II

**Duration:** 90 Minutes

**Topic:** Vehicle Engine Piston and Rings

**Specific Objectives:** It is expected that at the end of the lesson, the students should be able to:
**i.** Identify the various components of the vehicle engine piston and rings
**ii.** Indicate where the piston and rings is positioned in the engine
**iii.** State the functions of piston and rings
**iv.** Describe how to dismantle and couple the components of the vehicle engine piston and rings

**Instructional Material:** Engine piston and rings, charts, lesson notes, chalkboard and chalk.

**Entry Behaviour:** The students have previous knowledge of the coupling of the engine top cylinder.

**Instructional Procedure:**

| Steps | CAIM Elements | Teacher's Activities | Students' Activities |
|---|---|---|---|
| Step 1 | Modelling | Teacher presents the model of the various parts of the vehicle engine piston and rings for identification by students. | Students identify the various parts of the engine piston and rings modelled by the teacher. |
| Step 2 | Coaching | Teacher and the students dismantle and couple the engine piston and rings presented before the students. | Students and teacher dismantle and couple the engine piston and rings presented before them. |
| Step3 | Scaffolding | Teacher guide the students to dismantle and couple the engine piston and rings | Students dismantle and couple the engine piston and rings presented before them with minimal assistance |

| | | | |
|---|---|---|---|
| | | | from the teacher. |
| Step 4 | Articulation | Teacher observes the students as the students dismantle and couple the engine piston and rings | Students repeat the process of dismantling and coupling of the engine piston and rings |
| Step 5 | Reflection/Conclusion | Teacher makes the necessary corrections in the students work. | Students compare their work with that of the teacher and co- students |
| Step 6 | Exploration | Teacher provides other types of the engine piston and rings similar to the one he has modeled and ask students to dismantle and answer the following questions i. Identify the components of engine piston and rings.<br>**ii.** Identify where the piston and rings is positioned in the engine.<br>iii. What is the function of the piston and rings?<br>iv. Describe how the engine piston and rings could be dismantled and coupled. | Students dismantle other types of engine piston and rings similar to the type the teacher has modeled and answer the teacher's questions by identifying the various parts. |

## Lesson Plan for Week 4

**Class:** Vocational II

**Duration:** 90 Minutes

**Topic:** Coupling of Engine Valves and Tappets

**Specific Objectives:** It is expected that at the end of the lesson, the students should be able to:

**i.** Identify the various components of the engine valves and tappets
**ii.** Indicate where engine valves and tappets is positioned in an engine
**iii.** State the functions of the engine valves and tappets
**iv.** Describe how to dismantle and couple the components of the engine valves and tappets

**Instructional Material:** Engine valves and tappets, charts, lesson notes, chalkboard and chalk.

**Entry Behaviour:** The students have previous knowledge of the coupling of the engine piston and rings..

**Instructional Procedure:**

| **Steps** | **CAIM Elements** | **Teacher's Activities** | **Students' Activities** |
|---|---|---|---|
| Step 1 | Modelling | Teacher presents the model of the various parts of the engine valves and tappets for identification by students. | Students identify the various parts of the engine valves and tappets modelled by the teacher. |
| Step 2 | Coaching | Teacher and the students dismantle and couple the engine valves and tappets presented before the students. | Students and teacher dismantle and couple the engine valves and tappets presented before them. |
| Step3 | Scaffolding | Teacher guide the students to dismantle and couple the engine valves and tappets | Students dismantle and couple the engine valves and tappets presented before them with minimal assistance from the teacher. |
| Step 4 | Articulation | Teacher observes the students as the students dismantle and couple the engine valves and tappets | Students repeat the process of dismantling and coupling of the engine valves and tappets |
| Step 5 | Reflection/Conclusion | Teacher makes the necessary corrections in the students work. | Students compare their work with that of the teacher and co- students |
| Step 6 | Exploration | Teacher provides other types of the engine | Students dismantle other types of engine valves |

| | | | |
|---|---|---|---|
| | | valves and tappets similar to the one he has modeled, and ask students to dismantle and answer the following questions i. Identify the components of engine valves and tappets engine.<br>**ii.** Identify where the engine valves and tappets is positioned in the engine.<br>iii. What is the function of the engine valves and tappets<br>iv. Describe how the engine valves and tappets could be dismantled and coupled. | and tappets similar to the type the teacher has modeled and answer the teacher's questions by identifying the various parts. |

## Lesson Plan for Week 5

**Class:** Vocational II

**Duration:** 90 Minutes

**Topic:** Coupling of Engine Connecting Rod

**Specific Objectives:** It is expected that at the end of the lesson, the students should be able to:
**i.** Identify the various components of the engine connecting rod
**ii.** Indicate where the connecting rod is positioned in the engine
**iii.** State the functions of the engine connecting rod
**iv.** Describe how to dismantle and couple the engine connecting rod.

**Instructional Material:** Engine connecting rod, charts, lesson notes, chalkboard and chalk.

**Entry Behaviour:** The students have previous knowledge on the coupling of engine valves and tappets

**Instructional Procedure:**

| Steps | CAIM Elements | Teacher's Activities | Students' Activities |
|---|---|---|---|
| Step 1 | Modelling | Teacher presents the model of the various parts of the engine connecting rod for identification by students. | Students identify the various parts of engine connecting rod modeled by the teacher. |
| Step 2 | Coaching | Teacher and the students dismantle and couple the engine connecting rod presented before the students. | Students and teacher dismantle and couple the engine connecting rod presented before them . |
| Step3 | Scaffolding | Teacher guide the students to dismantle and couple the engine connecting rod | Students dismantle and couple the engine connecting rod presented before them with minimal assistance from the teacher. |
| Step 4 | Articulation | Teacher observes the students as the students dismantle and couple the engine connecting rod | Students repeat the process of dismantling and coupling of the engine connecting rod |
| Step 5 | Reflection/Conclusion | Teacher makes the necessary corrections in the students work. | Students compare their work with that of the teacher and co- students |
| Step 6 | Exploration | Teacher provides other types of the engine connecting rod similar to the one he has modeled, and ask students to dismantle and answer the following questions i. Identify the components of | Students dismantle other types of engine connecting rod similar to the type the teacher has modeled and answer the teacher's |

| | | | |
|---|---|---|---|
| | | engine connecting rod.<br>**ii.** Identify where the connecting rod is located in the engine.<br>iii. What is the function of the connecting rod<br>iv. Describe how the engine connecting rod could be dismantled and coupled. | questions by identifying the various parts. |

**Lesson Plan for Week 6**

**Class:** Vocational II

**Duration:** 90 Minutes

**Topic:** Coupling of Engine Crankshaft

**Specific Objectives:** It is expected that at the end of the lesson, the students should be able to:
**i.** Identify the various components of the engine crankshaft
**ii.** Indicate where the crankshaft is positioned in the engine
**iii.** State the functions of the engine crankshaft
**iv.** Describe how to dismantle and couple the engine crankshaft

**Instructional Material:** Engine crankshaft, charts, lesson notes, chalkboard and chalk.

**Entry Behaviour:** The students have previous knowledge on the coupling of engine connecting rod

**Instructional Procedure:**

| **Steps** | **CAIM Elements** | **Teacher's Activities** | **Students' Activities** |
|---|---|---|---|
| Step 1 | Modelling | Teacher presents the model of the various parts of the engine crankshaft for identification by students. | Students identify the various parts of the engine crankshaft modelled by the teacher. |

| | | | |
|---|---|---|---|
| Step 2 | Coaching | Teacher and the students dismantle and couple the engine crankshaft presented before the students. | Students and teacher dismantle and couple the engine crankshaft presented before them . |
| Step3 | Scaffolding | Teacher guide the students to dismantle and couple the engine crankshaft | Students dismantle and couple the engine crankshaft presented before them with minimal assistance from the teacher. |
| Step 4 | Articulation | Teacher observes the students as the students dismantle and couple the engine crankshaft | Students repeat the process of dismantling and coupling of the engine crankshaft |
| Step 5 | Reflection/Conclusion | Teacher makes the necessary corrections in the students work. | Students compare their work with that of the teacher and co- students |
| Step 6 | Exploration | Teacher provides other types of the engine crankshaft similar to the one he has modeled and ask students to dismantle and answer the following questions i. Identify the components of engine crankshaft<br>**ii.** Identify where the crankshaft is positioned in the engine.<br>iii. What is the function of the crankshaft<br>iv. Describe how the engine crankshaft could be dismantled and coupled. | Students dismantle other types of engine crankshaft similar to the type the teacher has modeled and answer the teacher's questions by identifying the various parts. |

## Lesson Plan for Week 7

**Class:** Vocational II

**Duration:** 90 Minutes

**Topic:** Vehicle Transmission System

**Specific Objectives:** It is expected that at the end of the lesson, the students should be able to:

**i.** Mention the parts of the vehicle transmission system
**ii.** Indicate where each part is positioned
**iii.** State the functions of each part
**iv**. Describe the processes involve in coupling of the vehicle transmission system

**Instructional Material:** Vehicle transmission system, charts, lesson notes, chalkboard and chalk.

**Entry Behaviour:** The students have previous knowledge of the various components of the vehicle engine.

**Instructional Procedure**

| **Steps** | **CAIM Elements** | **Teacher's Activities** | **Students' Activities** |
|---|---|---|---|
| Step 1 | Modelling | Teacher presents the model of the various parts of vehicle transmission system for identification by students. | Students identify the various parts of the transmission system modelled by the teacher. |
| Step 2 | Coaching | Teacher and students dismantle and couple the various component of the vehicle transmission system for identification | Students and teacher dismantle and couple the various components of the vehicle transmission system for identification |

| | | | |
|---|---|---|---|
| Step 3 | Scaffolding | Teacher assists the students to dismantle and couple the various component of the vehicle transmission system. | Students dismantle and couple the various components of the vehicle transmission system with minimal assistance from the teacher |
| Step 4 | Articulation | Teacher supervised the students as the students dismantle and couple the various component of the vehicle transmission system. | Students repeat the dismantling and coupling i of the components of the vehicle transmission system |
| Step 5 | Reflection/Conclusion | Teacher makes the necessary corrections in the students work. | Students compare their work with that of the teacher and co-students. |
| Step 6 | Exploration | Teacher provides other types of the vehicle transmission system similar to the one he has modeled and ask students to dismantle and answer the following questions<br>: i. Pick the vehicle transmission system part and mention the name of such part.<br>**ii.** Pick the vehicle transmission system part and show where it is positioned in a vehicle.<br>**iii.** What is the function of the various parts identified?<br>**iv**. Describe how the transmission system could be dismantled and coupled. | Students dismantle other types of the vehicle transmission system similar to the type the teacher has modeled to answer the teacher's questions by indentify the component parts. |

## Appendix G

## Lesson Plan for Control Group

### Week 1

**Class:** Vocational II

**Duration:** 90 Minutes

**Topic:** Pretest for both Experimental and Control Group

### Lesson Plan for Week 2

**Class:** Vocational II

**Duration:** 90 Minutes

**Topic:** Vehicle Engine Top Cylinder

**Specific Objectives:** It is expected that at the end of the lesson, the students should be able to:

**i.** Identify the various components of the engine top cylinder

**ii.** Indicate where the engine top cylinder is positioned in the vehicle engine

**iii.** State the functions of the engine top cylinder

**iv.** Describe how to dismantle and couple the engine top cylinder

**Instructional Material:** Vehicle engine top cylinder, charts, lesson notes, chalkboard and chalk.

**Entry Behaviour:** The students have previous knowledge of the various types of the vehicle engine.

**Instructional Procedure:**

| **Steps** | **Instructional Strategies** | **Teacher's Activities** | **Students' Activities** |
|---|---|---|---|
| Step 1 | Demonstration | Teacher presents the vehicle engine top cylinder for identification | Students observe the teacher as he presents the vehicle engine top cylinder |
| Step 2 | Demonstration | Teacher dismantles the vehicle engine top cylinder presented before the students for identification. | Students observe the teacher as he dismantles the various components of the vehicle engine top cylinder for identification. |
| Step3 | Discussion | The teacher tells the students the name and the location of the various parts that makes up the vehicle engine top cylinder | Students listen to the teacher. |
| Step 4 | Discussion | The teacher explains in details the function of each of the vehicle engine top cylinder. | Students listen to the teacher. |
| Step 5 | Demonstration | Teacher couples the vehicle engine top cylinder presented before the students. | Students observe the teacher as he couples the various components of the vehicle engine top cylinder |
| Step 6 | Conclusion | Teacher review all the concept presented to the students | Students listen attentively |
| Step 7 | Evaluation | The teacher ask the students the following questions:<br>**i**. What are the components of the vehicle engine top cylinder<br>**ii.** Identify where the engine top cylinder is positioned in the | Students answer the teacher's questions to ascertain their level of comprehension of the lesson. |

| | | | |
|---|---|---|---|
| | | engine.<br>**iii.** State the function of the engine top cylinder?<br>**iv**. Describe how the engine top cylinder could be coupled. | |

## Lesson Plan for Week 3

**Class:** Vocational II

**Duration:** 90 Minutes

**Topic:** Vehicle Engine Piston and Rings

**Specific Objectives:** It is expected that at the end of the lesson, the students should be able to:

**i.** Identify the various components of the vehicle engine piston and rings

**ii.** Indicate where the engine piston and rings is positioned in the vehicle engine

**iii.** State the functions of the vehicle engine piston and rings

**iv.** Describe how to dismantle and couple the vehicle engine piston and rings

**Instructional Material:** Vehicle engine piston and rings, charts, lesson notes, chalkboard and chalk.

**Entry Behaviour:** The students have previous knowledge of the various types of the vehicle engine top cylinder.

**Instructional Procedure:**

| Steps | Instructional Strategies | Teacher's Activities | Students' Activities |
|---|---|---|---|
| Step 1 | Demonstration | Teacher presents the vehicle engine piston and rings for identification | Students observe the teacher as he presents the vehicle engine piston and rings |

| | | | |
|---|---|---|---|
| Step 2 | Demonstration | Teacher dismantles the vehicle engine piston and rings presented before the students for identification. | Students observe the teacher as he dismantles the various components of the vehicle engine piston and rings for identification. |
| Step3 | Discussion | The teacher tells the students the name and the location of the various parts that makes up the vehicle engine piston and rings | Students listen to the teacher. |
| Step 4 | Discussion | The teacher explains in details the function of each of the vehicle engine piston and rings | Students listen to the teacher. |
| Step 5 | Demonstration | Teacher couples the vehicle engine piston and rings presented before the students. | Students observe the teacher as he couples the various components of the vehicle engine piston |
| Step 6 | Conclusion | Teacher review all the concept presented to the students | Students listen attentively. |
| Step 7 | Evaluation | The teacher ask the students the following questions:<br>**i**. What are the components of the vehicle engine piston and rings<br>**ii.** Identify where the piston and rings is positioned in the engine.<br>**iii.** State the function of the engine piston and rings.<br>**iv**. Describe how the vehicle engine piston and rings could be dismantled and coupled. | Students answer the teacher's questions to ascertain their level of comprehension of the lesson. |

## Lesson Plan for Week 4

**Class:** Vocational II

**Duration:** 90 Minutes

**Topic:** Vehicle Engine Valves and Tappets

**Specific Objectives:** It is expected that at the end of the lesson, the students should be able to:

**i.** Identify the various components of the vehicle engine valves and tappets

**ii.** Indicate where the engine valves and tappets is positioned in the vehicle engine

**iii.** State the functions of the vehicle engine valves and tappets

**iv.** Describe how to dismantle and couple the vehicle engine valves and tappets

**Instructional Material:** Vehicle engine valves and tappets, charts, lesson notes, chalkboard and chalk.

**Entry Behaviour:** The students have previous knowledge of the various types of the vehicle engine piston and rings.

**Instructional Procedure:**

| Steps | Instructional Strategies | Teacher's Activities | Students' Activities |
|---|---|---|---|
| Step 1 | Demonstration | Teacher presents the vehicle engine valves and tappets for identification | Students observe the teacher as he presents the vehicle engine valves and tappets |
| Step 2 | Demonstration | Teacher dismantles the vehicle engine valves and tappets presented before the students for identification. | Students observe the teacher as he dismantles the various components of the vehicle engine valves and tappets |
| Step3 | Discussion | The teacher tells the students the name and the location of the various parts that makes up the vehicle engine valves and tappets | Students listen to the teacher. |

| | | | |
|---|---|---|---|
| Step 4 | Discussion | The teacher explains in details the function of each of the vehicle engine valves and tappets | Students listen to the teacher. |
| Step 5 | Demonstration | Teacher couples the vehicle engine valves and tappets presented before the students. | Students observe the teacher as he couples the various components of the vehicle engine valves and tappets |
| Step 6 | Conclusion | Teacher review all the concept presented to the students | Students listen attentively |
| Step 7 | Evaluation | The teacher ask the students the following questions:<br>**i**. What are the components of the vehicle engine valves and tappets<br>**ii.** Identify where the engine valves and tappets is positioned in the vehicle engine.<br>**iii.** State the function of the engine valves and tappets<br>**iv**. Describe how the vehicle engine valves and tappets could be dismantled and coupled. | Students answer the teacher's questions to ascertain their level of comprehension of the lesson. |

## Lesson Plan for Week 5

**Class:** Vocational II

**Duration:** 90 Minutes

**Topic:** Vehicle Engine Connecting Rod

**Specific Objectives:** It is expected that at the end of the lesson, the students should be able to:

**i.** Identify the various components of the vehicle engine connecting rod

**ii.** Indicate where the engine connecting rod is positioned in the vehicle engine

**iii.** State the functions of the vehicle engine connecting rod

**iv.** Describe how to dismantle and couple the vehicle engine connecting rod

**Instructional Material:** Vehicle engine connecting rod charts, lesson notes, chalkboard and chalk.

**Entry Behaviour:** The students have previous knowledge of the various types of the vehicle engine valve and tappets.

**Instructional Procedure:**

| **Steps** | **Instructional Strategies** | **Teacher's Activities** | **Students' Activities** |
|---|---|---|---|
| Step 1 | Demonstration | Teacher presents the vehicle engine connecting rod for identification | Students observe the teacher as he presents the vehicle engine connecting rod |
| Step 2 | Demonstration | Teacher dismantles the vehicle engine connecting rod before the students for identification. | Students observe the teacher as he dismantles the various components of the vehicle engine connecting rod |
| Step3 | Discussion | The teacher tells the students the name and the location of the various parts that makes up the vehicle engine connecting rod | Students listen to the teacher. |
| Step 4 | Discussion | The teacher explains in details the function of each of the vehicle engine connecting rod | Students listen to the teacher. |
| Step 5 | Demonstration | Teacher couples the vehicle engine connecting rod presented before the students. | Students observe the teacher as he couples the various components of the vehicle engine connecting rod. |
| Step 6 | Conclusion | Teacher review all the concept presented to the students | Students listen attentively |
| Step 7 | Evaluation | The teacher ask the students the following questions:<br>**i**. What are the components of the | Students answer the teacher's questions to ascertain their |

| | | | |
|---|---|---|---|
| | | vehicle engine connecting rod<br>**ii.** Identify where the engine connecting rod is positioned in the vehicle engine.<br>**iii.** State the function of the engine connecting rod<br>**iv**. Describe how the vehicle engine connecting rod could be dismantled and coupled. | level of comprehension of the lesson. |

## Lesson Plan for Week 6

**Class:** Vocational II

**Duration:** 90 Minutes

**Topic:** Vehicle Engine Crank Shaft

**Specific Objectives:** It is expected that at the end of the lesson, the students should be able to:

**i.** Identify the various components of the engine crank shaft

**ii.** Indicate where the engine crank shaft is positioned in the vehicle engine

**iii.** State the functions of the engine crank shaft

**iv.** Describe how to dismantle and couple the engine crank shaft

**Instructional Material:** Vehicle engine crank shaft, charts, lesson notes, chalkboard and chalk.

**Entry Behaviour:** The students have previous knowledge of the various types of the vehicle engine connecting rod

**Instructional Procedure:**

| Steps | Instructional Strategies | Teacher's Activities | Students' Activities |
|---|---|---|---|
| Step 1 | Demonstration | Teacher presents the vehicle engine crank shaft for | Students observe the teacher as he presents the |

| | | | |
|---|---|---|---|
| | | identification | vehicle engine crank shaft. |
| Step 2 | Demonstration | Teacher dismantles the vehicle engine crank shaft before the students for identification. | Students observe the teacher as he dismantles the various components of the engine crank shaft. |
| Step3 | Discussion | The teacher tells the students the name and the location of the various parts that makes up the vehicle engine crank shaft | Students listen to the teacher. |
| Step 4 | Discussion | The teacher explains in details the function of each of the vehicle engine crank shaft | Students listen to the teacher. |
| Step 5 | Demonstration | Teacher couples the vehicle engine crank shaft presented before the students. | Students observe the teacher as he couples the various components of the engine crank shaft. |
| Step 6 | Conclusion | Teacher review all the concept presented to the students | Students listen attentively |
| Step 7 | Evaluation | The teacher ask the students the following questions:<br>**i**. What are the components of the vehicle engine crank shaft<br>**ii.** Identify where the crank shaft is positioned in the vehicle engine.<br>**iii.** State the function of the engine crank shaft<br>**iv**. Describe how the vehicle engine crank shaft could be dismantled and coupled. | Students answer the teacher's questions to ascertain their level of comprehension of the lesson. |

## Lesson Plan for Week 7

**Class:** Vocational II

**Duration:** 90 Minutes

**Topic:** Vehicle Transmission System

**Specific Objectives:** It is expected that at the end of the lesson, the students should be able to:

**i.** Identify the various components of the vehicle transmission system

**ii.** Indicate where the various components of the vehicle transmission system is positioned in the vehicle

**iii.** State the functions of the various transmission systems in a vehicle

**iv.** Describe how to dismantle and couple the vehicle transmission system

**Instructional Material:** Vehicle transmission system, charts, lesson notes, chalkboard and chalk.

**Entry Behaviour:** The students have previous knowledge of the various types of the vehicle crank shaft.

**Instructional Procedure:**

| **Steps** | **Instructional Strategies** | **Teacher's Activities** | **Students' Activities** |
|---|---|---|---|
| Step 1 | Demonstration | Teacher presents the vehicle transmission system for identification | Students observe as the teacher presents the vehicle transmission system. |
| Step 2 | Demonstration | Teacher dismantles the vehicle transmission system before the students for identification. | Students observe as the teacher dismantles the components of the vehicle transmission system. |
| Step3 | Discussion | The teacher tells the students the name and the location of the various parts that makes up the vehicle transmission system. | Students listen to the teacher. |

| | | | |
|---|---|---|---|
| Step 4 | Discussion | The teacher explains the function of vehicle transmission system. | Students listen to the teacher. |
| Step 5 | Demonstration | Teacher couples the vehicle transmission system presented before the students. | Students observe as the teacher couples the components of the vehicle transmission system vehicle. |
| Step 6 | Conclusion | Teacher review all the concept presented to the students | Students listen attentively |
| Step 7 | Evaluation | The teacher ask the students the following questions:<br>**i**. What are the components of the vehicle transmission system<br>**ii.** Identify where the various components of the transmission system is positioned in the vehicle<br>**iii.** State the function of the various components of the vehicle transmission system<br>**iv**. Describe how the vehicle transmission system could be dismantled and coupled. | Students answer the teacher's questions to ascertain their level of comprehension of the lesson. |

## Appendix H

## Auto-Mechanics Achievement Test (AMAT) (Post Test)

Subject: MVM

Class: Vocational II

Time Allowed: 60 minutes

Name of Technical College: -----------------------------------------------

Name of Student: -----------------------------------------------------------

SEX: Male ( ) Female ( )

INSTRUCTION: Attempt all questions. Choose the correct answer from the alternatives lettered A – D. Circle or tick the letter that bears the option chosen by you.

1. The part of the engine that drives the flywheel is called? (a) The propeller shaft (b) The flywheel (c) The camshaft (d) The crankshaft.

2. The part of the engine that connects the piston to the crankshaft is called? (a) The propeller shaft (b) The flywheel (c) The camshaft (d) The connecting rod.

3. The part of the engine that connects the piston to the connecting rod is called? (a) The gudgeon pin (b) The flywheel (c) The camshaft (d) The crankshaft.

4. The following engine parts are driven by the crankshaft except? (a) The propeller shaft (b) The flywheel (c) The camshaft (d) The oil pump

5. The part of the engine that compresses the air fuel mixture in combustion chamber is called? (a) The piston (b) The flywheel (c) The camshaft (d) The crankshaft

6. The part of the engine that ensures the lubrication of the cylinder is called? (a) The piston (b) The flywheel (c) The rings (d) The crankshaft.

7. The part of the engine that ignites the air fuel mixture in the combustion chamber is called? (a) The piston (b) The spark plug (c) The camshaft (d) The crankshaft.

8. The oil in the engine settles in the ----------- when the engine is not running. (a) tank (b) crank case (c) sump (d) oil filter.

9. The part of the engine that allows the air fuel mixture to enter into the combustion chamber during the induction stroke is called? (a) The piston (b) The rings (c) The inlet valve (d) The exhaust valve

10. The part of the engine that allows the burnt gasses in the combustion chamber to escape during the exhaust stroke is called? (a) The piston (b) The rings (c) The inlet valve (d) The exhaust valve

11. The part of the engine that pushes the valves to open during the induction or exhaust stroke is called? (a) The piston (b) The spark plug(c) The camshaft (d) The tappet

12. The part of the engine where combustion occurs during the compression stroke is called? (a) The piston (b) The combustion chamber (c) The camshaft (d) The valves.

13. The part of the engine that sprays the oil in the sump to other components inside the engine is called? (a) The cam web (b) The cam shaft (c) The crankshaft (d) The piston valves.

14. The part of the engine that serves as housing to other components inside the engine is called? (a) The cam web (b) The cam shaft (c) The crankshaft (d) The crank case.

15. The gudgeon pin is made hollow to reduce--------- (a) weight (b) heat (c) tension (d) friction

16. Compression rings are used (a) to make the piston stronger (b) to make the piston lighter (c) to make the piston a gas-tight fit (d) to make the piston rotate freely

17. The crankshaft damper is a small flywheel which normally rotate with the (a) crankshaft (b) rotor (c) wheel shaft (d) none of the above

18. The shape of the crankshaft is related to the number and the shape of the arrangement of the (a) cylinder (b) piston (c) connecting rod (d) all of the above

19. The piston apex is called? (a) The crown (b) The tip (c) The roof (d) None of the above

20. The piston serves as a/an (a) moveable gas-tight plunger in the cylinder (b) energy builder in the engine (c) heat protector (d) oil sieve in the engine

21.The part of the vehicle transmission system that is between the flywheel and the gearbox is called? (a) Flywheel (b) Gear box (c) Clutch unit

(d) Propeller shaft

22. The part of the vehicle transmission system that is between the gearbox and the road wheel is called? (a) Flywheel (b) Gear box (c) Clutch unit (d) Propeller shaft

23. The part of the vehicle transmission system that enables the driver to vary its speed is called? (a) Flywheel (b) Gear box (c) Clutch unit (d) Propeller shaft

24. The part of the gear that transmits the drive from the engine fly wheel to the gear unit is called? (a) Driver gear (b) Driven gear (c) Secondary drive (d) Idler gear.

25. The part of the gear that transmits the drive from the gear unit to the driving shaft of the vehicle transmission system is called? (a) Driver gear (b) Driven gear (c) Primary drive (d) Idler gear.

26. The gear responsible for reverse drive is called? (a) Driver gear (b) Driven gear (c) Primary drive (d) Idler gear.

27. The rear wheel drive uses the propeller shaft while the front wheel drive uses the (a) main drive (b) front drive (c) back drive (d) half shaft

28. Which of these is not a component of the clutch unit (a) clutch plate (b) friction plate (c) clutch disc (d) Idler

29. The shaft that transmits the drive from the engine flywheel to the gear box is called? (a)Primary shaft (b) Secondary shaft (c) Tertiary shaft (d) Clutch shaft.

30. The shaft that transmits the drive from the gearbox to the driven shaft is called? (a)Primary shaft (b) Secondary shaft (c) Tertiary shaft (d) Clutch shaft

31. The main function of the flywheel is to retain some of the energy given to the crankshaft during the (a) Suction stroke (b) Power stroke (c) Compression stroke (d) Exhaust stroke

32. The base of the poppet valve is called (a) The land (b) The trunk (c) The tip (d) The bottom

33. During the power stroke (a) The compressed gas is ignited by a spark bridging the spark plug electrodes (b) The inlet valve open drawing a mixture of air and fuel into the cylinder (c) The uncompressed gas is ignited by a spark bridging the spark plug electrodes (d) The piston remain static and no spark bridged the spark plug electrode

34. Exhaust valve opens (a) During the power stroke (b) During the suction stroke (c) During the exhaust stroke (d) During the compression stroke

35. During the compression stroke (a) The piston compresses the air fuel mixture. (b) The piston hangs (c) The piston moves down (d) The piston start to rise

36. The four stroke cycle comprises of (a) Exhaust, power and compression strokes (b) Compression and induction strokes (c) Power, compression and exhaust strokes (d) Induction, compression, exhaust, and power strokes

37. In the construction of the piston, the following material are used except (a) Cast iron (b) Steel alloys (c) Aluminium alloys (d) Copper alloys

38. Passage of lubricating oil up to the combustion chamber is prevented by (a) The piston rings (b) The sump (c) The gudgeon pin (d) Connecting rod

39. The reciprocating movement of the piston is converted into rotary movement by the (a) Camshaft (b) Connecting rod (c) The crankshaft (d) Cylinder block

40. The cylinder head may be detachable or permanently attached to (a) The cylinder block (b) The sump (c) The engine cover (d) The gasket

## Appendix I

### Auto-Mechanics Interest Inventory (AMII) Post Test

Class: Vocational II

Time Allowed: 60 minutes

Name of Student: ---------------------------------------------------------

Name of Technical College: -----------------------------------------------

SEX: Male ( ) Female ( )

INSTRUCTION: Please tick (X) to indicate the degree to which you agree or disagree

NOTE: SA(Strongly Agreed), A ( Agreed), U (Undecided), D (Disagreed) and SD (Strongly Disagreed)

| **S/N** | **Interest Statements** | **Response Options** | | | | |
|---|---|---|---|---|---|---|
| | | **SA (5)** | **A (4)** | **U (3)** | **D (2)** | **SD (1)** |
| 1 | Auto-mechanics lesson is very interesting. | | | | | |
| 2 | Auto mechanics lesson is easy to understand | | | | | |
| 3 | I developed interest in auto mechanics few weeks ago | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | The method of teaching auto mechanics within the past six weeks has increased my interest in auto-mechanics | | | | | |
| 5 | I paid more attention in auto mechanics lesson within the past six weeks. | | | | | |
| 6 | Auto-mechanics class period should be extended | | | | | |
| 7 | When I am alone, I like revising automotive lessons | | | | | |
| 8 | I attend auto-mechanics class regularly. | | | | | |
| 9 | I like discussing about auto-mechanics subjects. | | | | | |
| 10 | I like doing assignments on auto-mechanics subjects. | | | | | |
| 11 | I am always active during auto-mechanics lesson. | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 12 | I don’t usually like to take permission to absent myself from auto-mechanics class. | | | | | |
| 13 | I take interest in calling the auto-mechanics teacher when he fails to come to the class on time. | | | | | |
| 14 | I am  not always happy when auto-mechanics teacher misses his class, | | | | | |
| 15 | I prefer auto-mechanics option to any other option in vocational trade. | | | | | |
| 16 | I enjoy auto-mechanics practical classes | | | | | |
| 17 | I like Auto-mechanics lessons because it  involves students in series of practical activities | | | | | |
| 18 | I take interest in handling automotive faults during | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | practical | | | | | |
| 19 | The aspects of automotive systems that I like are more than the aspect that I hate. | | | | | |
| 20 | I pay much interest in auto-mechanics lessons more than in any other general subjects. | | | | | |
| 21 | I take interest in anything involving automotive system. | | | | | |
| 22 | I always wish that lessons on automotive systems should continue after its time is up. | | | | | |
| 23 | I enjoy reading books on auto-mechanics technology. | | | | | |
| 24 | The strategies adopted in teaching auto-mechanics subject affect my interest in auto-mechanics. | | | | | |
| 25 | I like auto-mechanics lessons | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | because real objects in motor vehicle are used for teaching the students. | | | | | |
| 26 | I engage myself in auto-mechanics assignments during other lesson period | | | | | |
| 27 | I do extra studies on auto-mechanics apart from the normal lessons. | | | | | |
| 28 | I like auto-mechanics because most of the lessons are carried out in the workshop. | | | | | |
| 29 | I enjoy participating in auto-mechanics lesson | | | | | |
| 30 | It is better to use other subjects periods for auto-mechanic. | | | | | |

## Appendix J

## Auto-Mechanics Achievement Test (AMAT) (Delay Post Test)

Subject: MVM

Class: Vocational II

Time Allowed: 60 minutes

Name of Technical College: -----------------------------------------------

Name of Student: ----------------------------------------------------------

SEX: Male ( ) Female ( )

INSTRUCTION: Attempt all questions. Choose the correct answer from the alternatives lettered A – D. Circle or tick the letter that bears the option chosen by you.

1. The part of the engine that drives the flywheel is called? (a) The propeller shaft (b) The flywheel (c) The camshaft (d) The crankshaft.

2. The part of the engine that connects the piston to the crankshaft is called? (a) The propeller shaft (b) The flywheel (c) The camshaft (d) The connecting rod.

3. The part of the engine that connects the piston to the connecting rod is called? (a) The gudgeon pin (b) The flywheel (c) The camshaft (d) The crankshaft.

4. The following engine parts are driven by the crankshaft except? (a) The propeller shaft (b) The flywheel (c) The camshaft (d) The oil pump

5. The part of the engine that compresses the air fuel mixture in combustion

chamber is called? (a) The piston (b) The flywheel (c) The camshaft (d) The crankshaft

6. The part of the engine that ensures the lubrication of the cylinder is called? (a) The piston (b) The flywheel (c) The rings (d) The crankshaft.

7. The part of the engine that ignites the air fuel mixture in the combustion chamber is called? (a) The piston (b) The spark plug (c) The camshaft (d) The crankshaft.

8. The oil in the engine settles in the ----------- when the engine is not running.
(a) tank (b) crank case (c) sump (d) oil filter.

9. The part of the engine that allows the air fuel mixture to enter into the combustion chamber during the induction stroke is called? (a) The piston (b) The rings (c) The inlet valve (d) The exhaust valve

10. The part of the engine that allows the burnt gasses in the combustion chamber to escape during the exhaust stroke is called? (a) The piston (b) The rings (c) The inlet valve (d) The exhaust valve

11. The part of the engine that pushes the valves to open during the induction or exhaust stroke is called? (a) The piston (b) The spark plug(c) The camshaft (d) The tappet

12. The part of the engine where combustion occurs during the compression stroke is called? (a) The piston (b) The combustion chamber (c) The camshaft (d) The

valves.

13. The part of the engine that sprays the oil in the sump to other components inside the engine is called? (a) The cam web (b) The cam shaft (c) The crankshaft (d) The piston valves.

14. The part of the engine that serves as housing to other components inside the engine is called? (a) The cam web (b) The cam shaft (c) The crankshaft

(d) The crank case.

15. The gudgeon pin is made hollow to reduce--------- (a) weight (b) heat

(c) tension (d) friction

16. Compression rings are used (a) to make the piston stronger (b) to make the piston lighter (c) to make the piston a gas-tight fit (d) to make the piston rotate freely

17. The crankshaft damper is a small flywheel which normally rotate with the (a) crankshaft (b) rotor (c) wheel shaft (d) none of the above

18. The shape of the crankshaft is related to the number and the shape of the arrangement of the (a) cylinder (b) piston (c) connecting rod (d) all of the above

19. The piston apex is called? (a) The crown (b) The tip (c) The roof (d) None of the above

20. The piston serves as a/an (a) moveable gas-tight plunger in the cylinder (b) energy builder in the engine (c) heat protector (d) oil sieve in the engine

21.The part of the vehicle transmission system that is between the flywheel and the gearbox is called? (a) Flywheel (b) Gear box (c) Clutch unit (d) Propeller shaft

22. The part of the vehicle transmission system that is between the gearbox and the road wheel is called? (a) Flywheel (b) Gear box (c) Clutch unit (d) Propeller shaft

23. The part of the vehicle transmission system that enables the driver to vary its speed is called? (a) Flywheel (b) Gear box (c) Clutch unit (d) Propeller shaft

24. The part of the gear that transmits the drive from the engine fly wheel to the gear unit is called? (a) Driver gear (b) Driven gear (c) Secondary drive (d) Idler gear.

25. The part of the gear that transmits the drive from the gear unit to the driving shaft of the vehicle transmission system is called? (a) Driver gear (b) Driven gear (c) Primary drive (d) Idler gear.

26. The gear responsible for reverse drive is called? (a) Driver gear (b) Driven gear (c) Primary drive (d) Idler gear.

27. The rear wheel drive uses the propeller shaft while the front wheel drive uses the (a) main drive (b) front drive (c) back drive (d) half shaft

28. Which of these is not a component of the clutch unit (a) clutch plate (b) friction plate (c) clutch disc (d) Idler

29. The shaft that transmits the drive from the engine flywheel to the gear box is called? (a)Primary shaft (b) Secondary shaft (c) Tertiary shaft (d) Clutch shaft.

30. The shaft that transmits the drive from the gearbox to the driven shaft is called? (a)Primary shaft (b) Secondary shaft (c) Tertiary shaft (d) Clutch shaft

31. The main function of the flywheel is to retain some of the energy given to the crankshaft during the (a) Suction stroke (b) Power stroke (c) Compression stroke (d) Exhaust stroke

32. The base of the poppet valve is called (a) The land (b) The trunk (c) The tip (d) The bottom

33. During the power stroke (a) The compressed gas is ignited by a spark bridging the spark plug electrodes (b) The inlet valve open drawing a mixture of air and fuel into the cylinder (c) The uncompressed gas is ignited by a spark bridging the spark plug electrodes (d) The piston remain static and no spark bridged the spark plug electrode

34. Exhaust valve opens (a) During the power stroke (b) During the suction stroke (c) During the exhaust stroke (d) During the compression stroke

35. During the compression stroke (a) The piston compresses the air fuel mixture. (b) The piston hangs (c) The piston moves down (d) The piston start to rise

36. The four stroke cycle comprises of (a) Exhaust, power and compression strokes

(b) Compression and induction strokes (c) Power, compression and exhaust strokes (d) Induction, compression, exhaust, and power strokes

37. In the construction of the piston, the following material are used except (a) Cast iron (b) Steel alloys (c) Aluminium alloys (d) Copper alloys

38. Passage of lubricating oil up to the combustion chamber is prevented by (a) The piston rings (b) The sump (c) The gudgeon pin (d) Connecting rod

39. The reciprocating movement of the piston is converted into rotary movement by the (a) Camshaft (b) Connecting rod (c) The crankshaft (d) Cylinder block

40. The cylinder head may be detachable or permanently attached to (a) The cylinder block (b) The sump (c) The engine cover (d) The gasket

## Appendix K

**Table of Specifications for Construction of AMAT**

| Content | Knowledge | Comprehen | Application | Analysis | Synthesis | Evaluation | Total questions |
|---|---|---|---|---|---|---|---|
| | 20% | 30% | 20% | 20% | 5% | 5% | 100% |
| Four stroke operation (30%) | 2 | 4 | 2 | 2 | 1 | 1 | 12 |
| Cylinder head and block assembly (10%) | 1 | 1 | 1 | 1 | - | - | 4 |
| Piston and connecting rod assembly (30%) | 2 | 4 | 2 | 2 | 1 | 1 | 12 |
| Crank shaft (20%) | 2 | 2 | 2 | 2 | - | - | 8 |
| Flywheel disc and clutch plate assembly (10%) | 1 | 1 | 1 | 1 | - | - | 4 |
| | 8 | 12 | 8 | 8 | 2 | 2 | 40 |

# Appendix L

## Determining the Estimate of Reliability Coefficient of the Instrument (AMAT) using Kuder Richardson Formula 21

## Frequency Table of the Test Scores

| Score(X) | Freq.(F) | FX | x | (X-x) | $(X-x)^2$ | $\Sigma F(X-x)^2$ |
|---|---|---|---|---|---|---|
| 34 | 1 | 34 | 25.06 | 8.94 | 79.92 | 79.92 |
| 32 | 2 | 64 | 25.06 | 6.94 | 48.16 | 96.32 |
| 31 | 2 | 62 | 25.06 | 5.94 | 35.28 | 70.57 |
| 30 | 3 | 90 | 25.06 | 4.94 | 24.40 | 73.21 |
| 29 | 1 | 29 | 25.06 | 3.94 | 15.52 | 15.52 |
| 28 | 4 | 112 | 25.06 | 2.94 | 8.64 | 34.57 |
| 27 | 3 | 81 | 25.06 | 1.94 | 3.77 | 11.29 |
| 25 | 4 | 100 | 25.06 | -0.06 | 0.0036 | 0.0144 |
| 22 | 2 | 44 | 25.06 | -3.06 | 9.36 | 18.73 |
| 21 | 2 | 42 | 25.06 | -4.06 | 16.48 | 32.97 |
| 18 | 3 | 54 | 25.06 | -7.06 | 49.84 | 149.53 |
| 16 | 1 | 16 | 25.06 | -9.06 | 82.08 | 82.08 |
| 12 | 2 | 24 | 25.06 | -13.06 | 170.56 | 341.12 |
| **Total** | **30** | **752** | | | | **1005.844** |

$$Mean = \frac{\text{EFX}}{\text{EF}}$$

$$Mean = \frac{752}{30}$$

= **25.06**

$$SD = \frac{\sqrt{\text{EF}\,(\text{X}-\text{x})^2}}{\text{N}-1}$$

$$SD = \frac{\sqrt{1005.844}}{30-1}$$

$$SD = \frac{\sqrt{1005.844}}{29}$$

**SD = 5.89**

**Therefore, Variance ($S^2$) =** $5.89^2$

**$S^2$ = 34.68**

**Kuder Richardson Formula 21** $(\mathbf{K - R21}) = \frac{\boldsymbol{K}}{\boldsymbol{K-1}} [\mathbf{1} - \frac{\ddot{x}(\mathbf{K}-\ddot{x})}{\boldsymbol{KS^2}}]$

Where,

$\ddot{x}$= Mean of test score

K= Number of items of the instrument

$S^2$ = Variance of the total test score

From the test,

$\ddot{x}$ =25.06

K = 40

$S^2$ = 34.68

$$\mathrm{K - R21} = \frac{40}{40-1} [1 - \frac{25.06(40-25.06)}{40\ (34.68)}]$$

$$= \frac{40}{39} [1 - \frac{374.3964}{1387.684}]$$

= 1.0345 [1- 0.2697994644]

= 1.0256 x 0.7302

= 0.74889

= **0.75**

## Appendix M

## Determining the Estimate of Reliability of the Instrument (AMII) Using the Cronbach Alpha Reliability Coefficient (α)

### Frequency Table of the AMII Scores

| X | F | FX | x | (X – x) | (X – x)² | ΣF(X – x)² |
|---|---|---|---|---|---|---|
| 47 | 2 | 94 | 59.8 | -12.8 | 163.84 | 327.68 |
| 48 | 2 | 96 | 59.8 | -11.8 | 139.24 | 278.48 |
| 49 | 2 | 98 | 59.8 | -10.8 | 116.64 | 233.28 |
| 50 | 2 | 100 | 59.8 | -9.8 | 96.04 | 192.08 |
| 51 | 2 | 102 | 59.8 | -8.8 | 77.44 | 154.88 |
| 59 | 3 | 177 | 59.8 | -0.8 | 0.64 | 1.92 |
| 60 | 5 | 300 | 59.8 | 0.2 | 0.04 | 0.2 |
| 61 | 2 | 122 | 59.8 | 1.2 | 1.44 | 2.88 |
| 62 | 1 | 62 | 59.8 | 2.2 | 4.84 | 4.84 |
| 67 | 2 | 134 | 59.8 | 7.2 | 51.84 | 103.68 |
| 68 | 1 | 68 | 59.8 | 8.2 | 67.24 | 67.24 |
| 69 | 1 | 69 | 59.8 | 9.2 | 84.64 | 84.64 |
| 70 | 2 | 140 | 59.8 | 10.2 | 104.04 | 208.08 |
| 75 | 1 | 75 | 59.8 | 15.2 | 231.04 | 231.04 |
| 79 | 2 | 158 | 59.8 | 19.2 | 368.64 | 727.28 |
| **Total** | **30** | **1795** | | | | **2618.2** |

$$Mean = \frac{\mathrm{EFX}}{\mathrm{EF}}$$

$$Mean = \frac{1795}{30}$$

= **59.8**

$$SD = \frac{\sqrt{\mathrm{EF}\,(\mathrm{X-x})^2}}{\mathrm{N-1}}$$

$$SD = \frac{\sqrt{2618.2}}{30-1}$$

$$SD = \frac{\sqrt{2618.2}}{29}$$

SD = 9.5016

Therefore, Variance ($s^2$) = $9.5016^2$

**$S^2$ = 90.28**

**Cronbach's Alpha Reliability Coefficient (α) =** $\frac{N}{N-1}\left[\frac{1-\sum S1^2}{S^2}\right]$

Where,

$S_1{}^2$= Number of **s**ingle item of the instrument

N = Number of items of the instrument

$S^2$ = Variance of the total test score

From the table,

N = 30

$S_1{}^2$= 19.90

$S^2$ = 90.28

$$\alpha = \frac{30}{30-1}\left[\frac{1-19.90}{90.28}\right]$$

$$\alpha = \frac{30}{29}\left[1 - 0.220425\right]$$

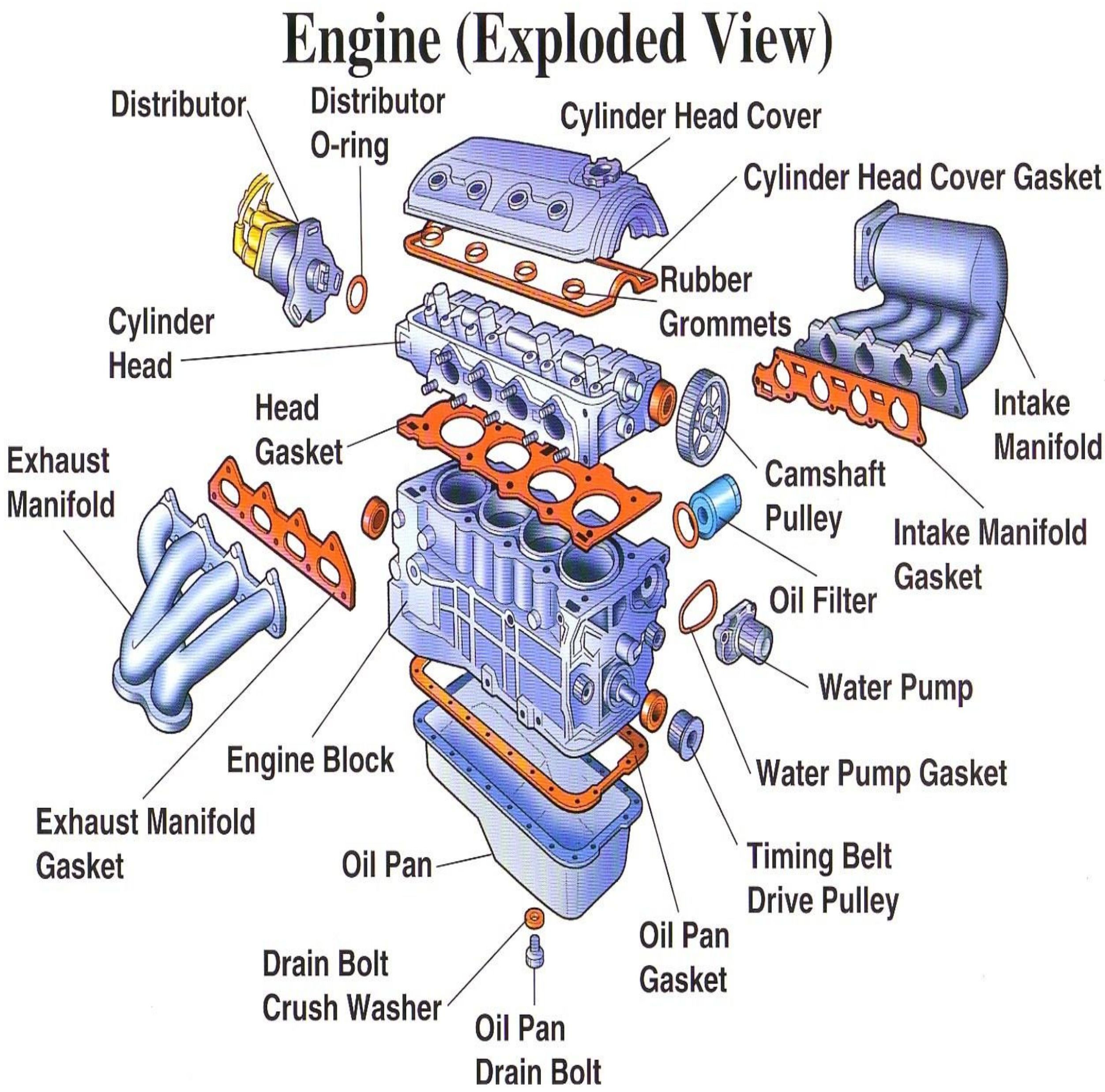
α =1.0345 X 0.779575

= 0.8065

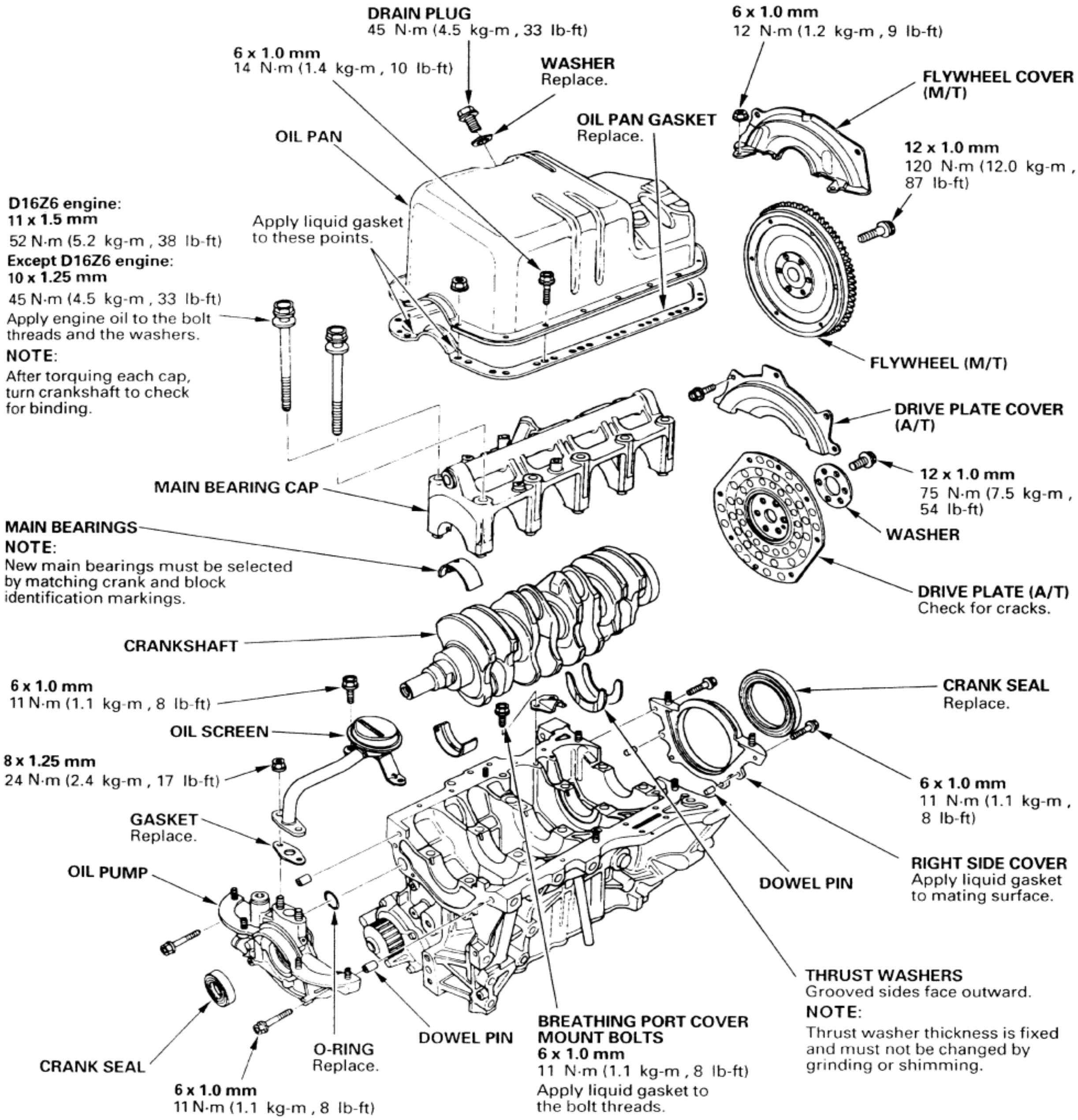
**= 0.81**

**Appendix N**

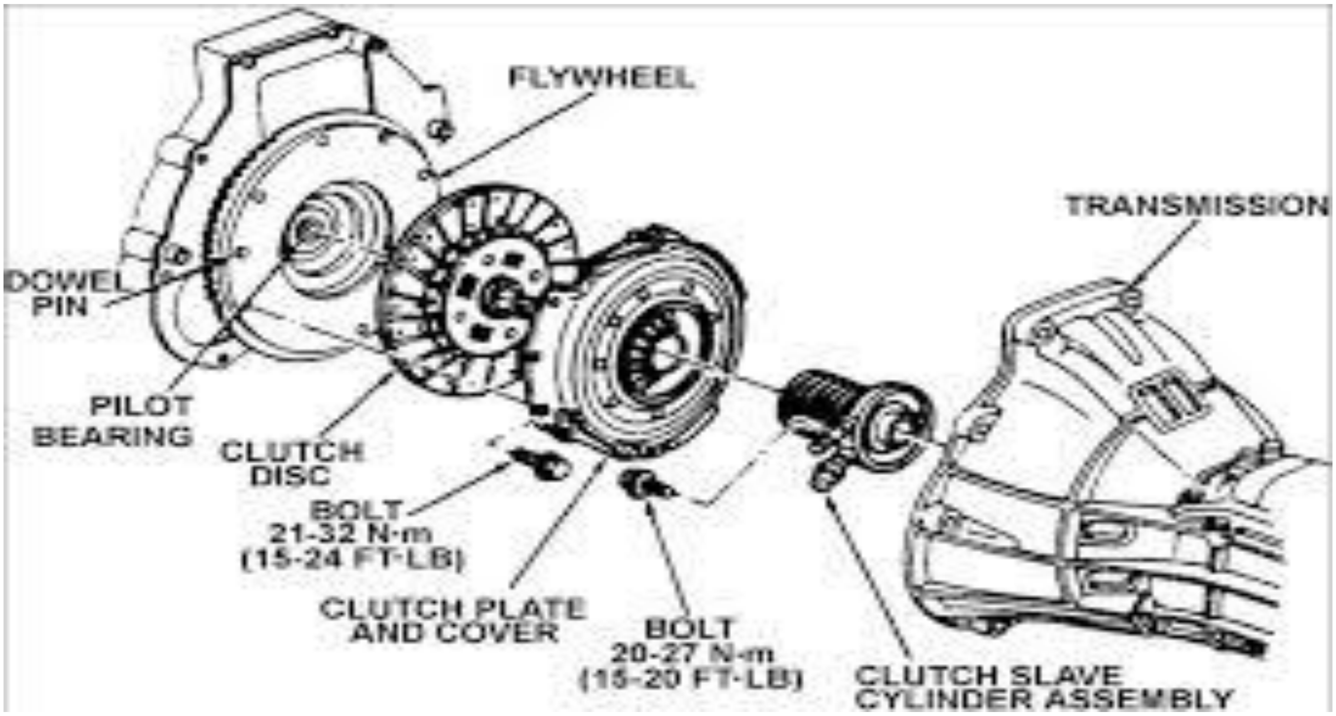
**Components of Vehicle Engine and Vehicle Transmission System**

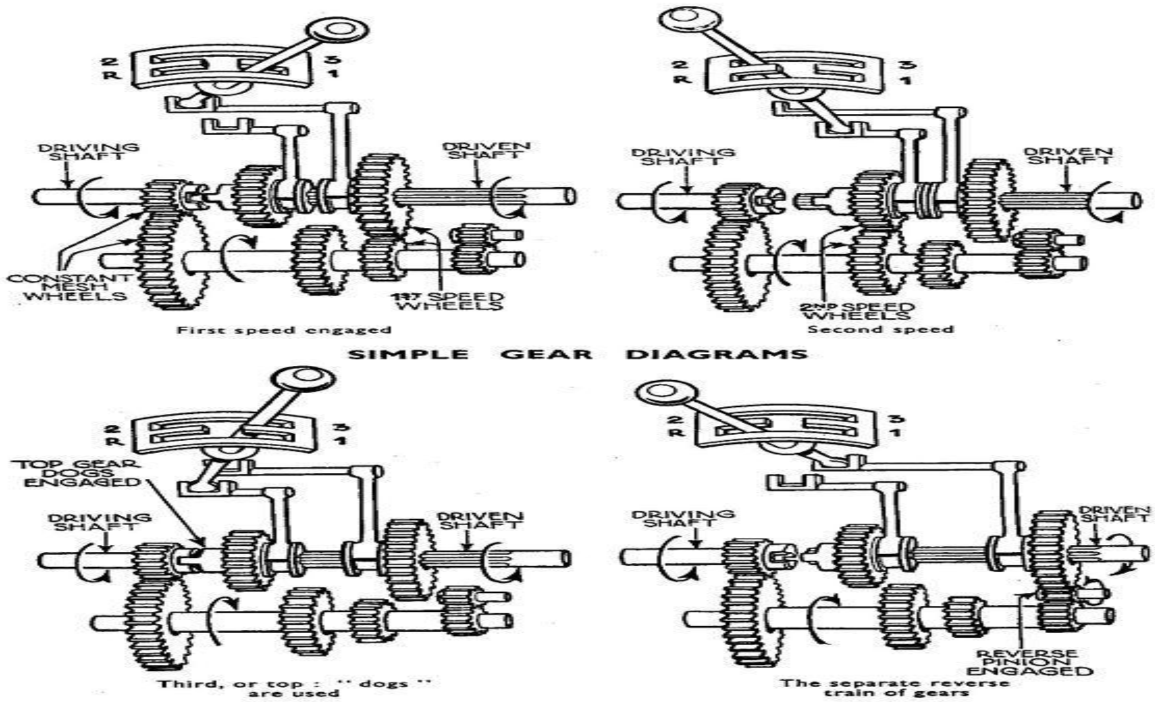


**NOTE:**
- Apply liquid gasket to the mating surfaces of the right side cover and the oil pump before installing them.

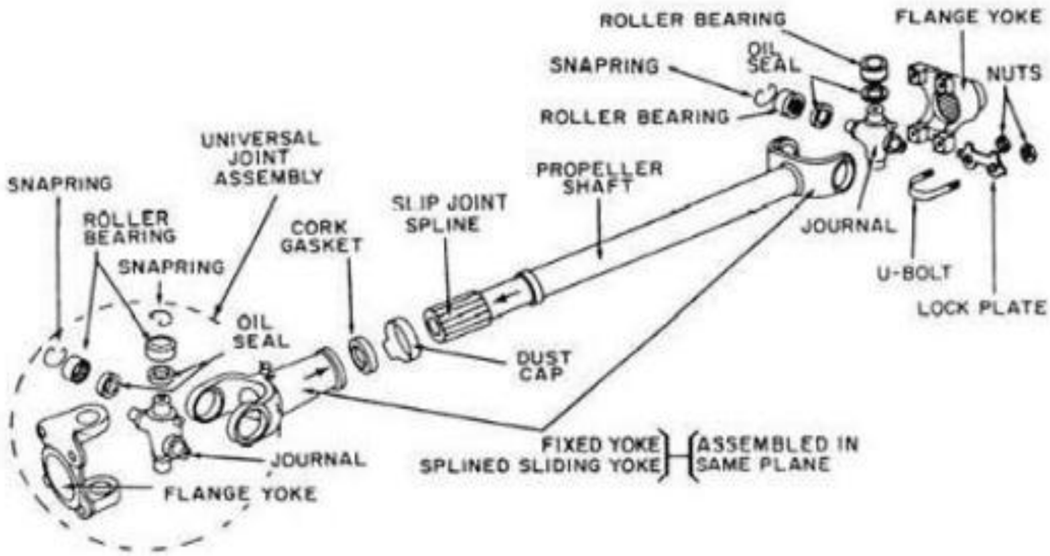


## Exploded View of the Clutch Unit



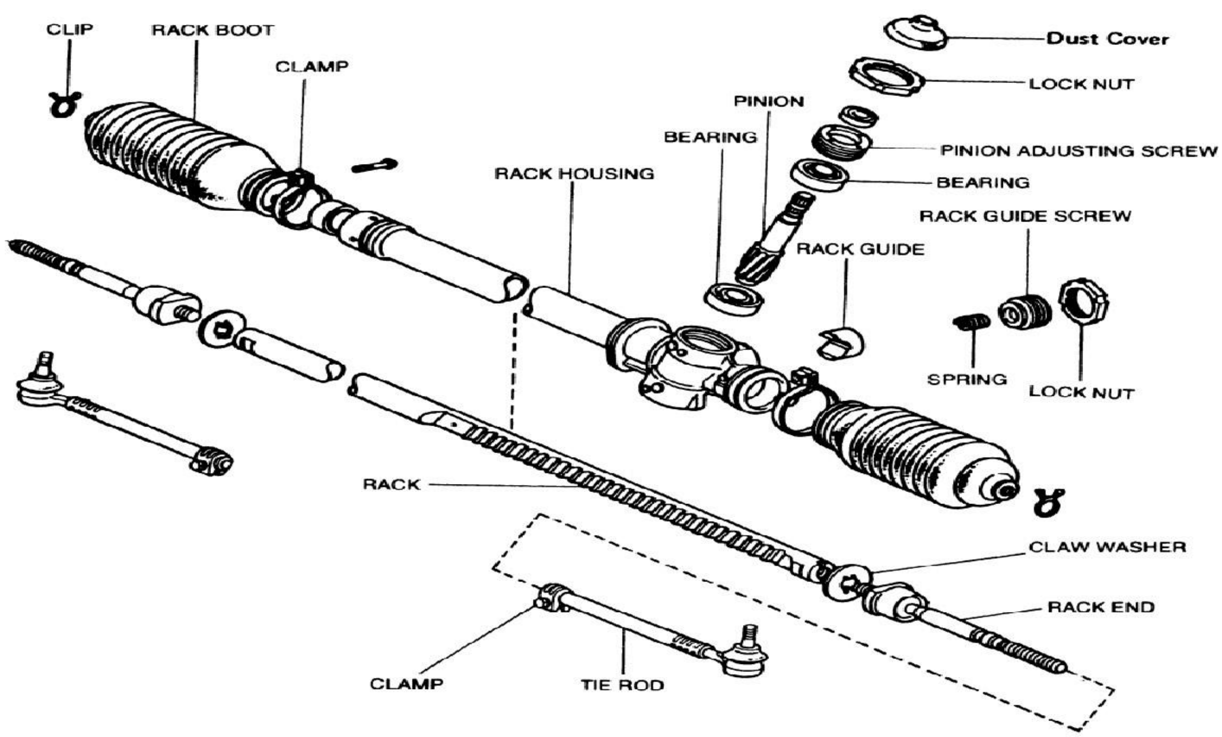



# Introduction of Propeller Shaft




COMPONENTS OF PROPELLER SHAFT

### Half and Pinion Shaft



# Appendix O
# SPSS-20 Output Data

```
GET
  FILE='C:\Users\USER\Desktop\COMMUNICATION BEHAVIOUR.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
NEW FILE.
DATASET NAME DataSet2 WINDOW=FRONT.

SAVE OUTFILE='C:\Users\USER\Desktop\johnbulldata.sav'
  /COMPRESSED.
MEANS TABLES=pretest posttest retention pretestinterestposttestinterest BY
method gender
  /CELLS MEAN COUNT STDDEV.
```

## Means

**Notes**

| | | |
|---|---|---|
| Output Created | | 09-AUG-2019 17:34:38 |
| Comments | | |
| Input | Data | C:\Users\USER\Desktop\johnbull data.sav |
| | Active Dataset | DataSet2 |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 114 |
| Missing Value Handling | Definition of Missing | For each dependent variable in a table, user-defined missing values for the dependent and all grouping variables are treated as missing. |
| | Cases Used | Cases used for each table have no missing values in any independent variable, and not all dependent variables have missing values. |
| Syntax | | MEANS TABLES=pretest posttest retention pretestinterestposttestinterest BY method gender /CELLS MEAN COUNT STDDEV. |
| Resources | Processor Time | 00:00:00.06 |
| | Elapsed Time | 00:00:00.23 |

```
[DataSet2] C:\Users\USER\Desktop\johnbull data.sav
```

**Case Processing Summary**

| | Cases | | | | | |
|---|---|---|---|---|---|---|
| | Included | | Excluded | | Total | |
| | N | Percent | N | Percent | N | Percent |
| pretest * method | 114 | 100.0% | 0 | 0.0% | 114 | 100.0% |
| posttest * method | 114 | 100.0% | 0 | 0.0% | 114 | 100.0% |
| retention * method | 114 | 100.0% | 0 | 0.0% | 114 | 100.0% |
| pretestinterest * method | 114 | 100.0% | 0 | 0.0% | 114 | 100.0% |
| posttestinterest * method | 114 | 100.0% | 0 | 0.0% | 114 | 100.0% |
| pretest * gender | 114 | 100.0% | 0 | 0.0% | 114 | 100.0% |
| posttest * gender | 114 | 100.0% | 0 | 0.0% | 114 | 100.0% |
| retention * gender | 114 | 100.0% | 0 | 0.0% | 114 | 100.0% |
| pretestinterest * gender | 114 | 100.0% | 0 | 0.0% | 114 | 100.0% |
| posttestinterest * gender | 114 | 100.0% | 0 | 0.0% | 114 | 100.0% |

**pretest posttest retention pretest interest posttest interest * method**

| method | | pretest | posttest | retention | Pretest interest | Posttest interest |
|---|---|---|---|---|---|---|
| Cognitive apprenticeship | Mean | 20.3793 | 71.5690 | 67.2759 | 45.2414 | 75.2414 |
| | N | 58 | 58 | 58 | 58 | 58 |
| | Std. Deviation | 4.19619 | 8.96213 | 8.44755 | 6.31153 | 9.21347 |
| demonstration | Mean | 19.1250 | 44.6964 | 40.2321 | 45.1071 | 47.7143 |
| | N | 56 | 56 | 56 | 56 | 56 |
| | Std. Deviation | 3.71759 | 6.32720 | 6.41870 | 6.35804 | 9.25147 |
| Total | Mean | 19.7632 | 58.3684 | 53.9912 | 45.1754 | 61.7193 |
| | N | 114 | 114 | 114 | 114 | 114 |
| | Std. Deviation | 4.00067 | 15.55877 | 15.50649 | 6.30668 | 16.59913 |

**pretest posttest retention pretest interest posttest interest * gender**

| gender | | pretest | posttest | retention | Pretest interest | posttest interest |
|---|---|---|---|---|---|---|
| male | Mean | 19.4842 | 58.3474 | 53.6421 | 44.8632 | 61.2000 |
| | N | 95 | 95 | 95 | 95 | 95 |
| | Std. Deviation | 3.83673 | 16.55023 | 16.57280 | 6.33566 | 17.11140 |
| female | Mean | 21.1579 | 58.4737 | 55.7368 | 46.7368 | 64.3158 |
| | N | 19 | 19 | 19 | 19 | 19 |
| | Std. Deviation | 4.59786 | 9.44792 | 8.44487 | 6.08132 | 13.86063 |
| Total | Mean | 19.7632 | 58.3684 | 53.9912 | 45.1754 | 61.7193 |
| | N | 114 | 114 | 114 | 114 | 114 |
| | Std. Deviation | 4.00067 | 15.55877 | 15.50649 | 6.30668 | 16.59913 |

```
UNIANOVA posttest BY method WITH pretest
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /CRITERIA=ALPHA(0.05)
  /DESIGN=pretest method.
```

## Univariate Analysis of Variance

**Notes**

| | | |
|---|---|---|
| Output Created | | 09-AUG-2019 17:35:58 |
| Comments | | |
| Input | Data | C:\Users\USER\Desktop\johnbull data.sav |
| | Active Dataset | DataSet2 |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 114 |
| Missing Value Handling | Definition of Missing | User-defined missing values are treated as missing. |
| | Cases Used | Statistics are based on all cases with valid data for all variables in the model. |
| Syntax | | UNIANOVA posttest BY method WITH pretest /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /CRITERIA=ALPHA(0.05) /DESIGN=pretest method. |
| Resources | Processor Time | 00:00:00.03 |
| | Elapsed Time | 00:00:00.23 |

```
[DataSet2] C:\Users\USER\Desktop\johnbull data.sav
```

**Between-Subjects Factors**

| | | Value Label | N |
|---|---|---|---|
| method | 1.00 | Cognitive apprentiship | 58 |
| | 2.00 | demonstration | 56 |

**Tests of Between-Subjects Effects**

Dependent Variable: posttest

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 20589.088[a] | 2 | 10294.544 | 168.902 | .000 |
| Intercept | 13799.495 | 1 | 13799.495 | 226.407 | .000 |
| pretest | 14.625 | 1 | 14.625 | .240 | .625 |
| method | 19894.341 | 1 | 19894.341 | 326.405 | .000 |
| Error | 6765.439 | 111 | 60.950 | | |
| Total | 415738.000 | 114 | | | |
| Corrected Total | 27354.526 | 113 | | | |

a. R Squared = .753 (Adjusted R Squared = .748)

```
UNIANOVA posttest interest BY method WITH pretest interest
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /CRITERIA=ALPHA(0.05)
  /DESIGN=pretest interest method.
```

**Notes**

| | | |
|---|---|---|
| Output Created | | 09-AUG-2019 17:36:51 |
| Comments | | |
| Input | Data | C:\Users\USER\Desktop\johnbull data.sav |
| | Active Dataset | DataSet2 |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 114 |
| Missing Value Handling | Definition of Missing | User-defined missing values are treated as missing. |
| | Cases Used | Statistics are based on all cases with valid data for all variables in the model. |
| Syntax | | UNIANOVAposttestinterest BY method WITH pretestinterest<br>/METHOD=SSTYPE(3)<br>/INTERCEPT=INCLUDE<br>/CRITERIA=ALPHA(0.05)<br>/DESIGN=pretestinterest method. |
| Resources | Processor Time | 00:00:00.03 |
| | Elapsed Time | 00:00:00.14 |

## Univariate Analysis of Variance

```
[DataSet2] C:\Users\USER\Desktop\johnbull data.sav
```

**Between-Subjects Factors**

| | | Value Label | N |
|---|---|---|---|
| method | 1.00 | Cognitive apprentice ship | 58 |
| | 2.00 | demonstration | 56 |

**Tests of Between-Subjects Effects**

Dependent Variable: posttest interest

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 22604.533[a] | 2 | 11302.267 | 147.067 | .000 |
| Intercept | 3457.183 | 1 | 3457.183 | 44.985 | .000 |
| Pretest interest | 1015.565 | 1 | 1015.565 | 13.215 | .000 |
| method | 21486.535 | 1 | 21486.535 | 279.586 | .000 |
| Error | 8530.484 | 111 | 76.851 | | |
| Total | 465392.000 | 114 | | | |
| Corrected Total | 31135.018 | 113 | | | |

a. R Squared = .726 (Adjusted R Squared = .721)

```
UNIANOVA posttest BY gender WITH pretest
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /CRITERIA=ALPHA(0.05)
  /DESIGN=pretest gender.
```

## Univariate Analysis of Variance

**Notes**

| | | |
|---|---|---|
| Output Created | | 09-AUG-2019 17:37:50 |
| Comments | | |
| Input | Data | C:\Users\USER\Desktop\johnbull data.sav |
| | Active Dataset | DataSet2 |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 114 |
| Missing Value Handling | Definition of Missing | User-defined missing values are treated as missing. |

| | | |
|---|---|---|
| | Cases Used | Statistics are based on all cases with valid data for all variables in the model. |
| Syntax | | UNIANOVA posttest BY gender WITH pretest<br>/METHOD=SSTYPE(3)<br>/INTERCEPT=INCLUDE<br>/CRITERIA=ALPHA(0.05)<br>/DESIGN=pretest gender. |
| Resources | Processor Time | 00:00:00.00 |
| | Elapsed Time | 00:00:00.06 |

```
[DataSet2] C:\Users\USER\Desktop\johnbull data.sav
```

**Between-Subjects Factors**

| | | Value Label | N |
|---|---|---|---|
| gender | 1.00 | male | 95 |
| | 2.00 | female | 19 |

**Tests of Between-Subjects Effects**

Dependent Variable: posttest

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 708.218[a] | 2 | 354.109 | 1.475 | .233 |
| Intercept | 8299.669 | 1 | 8299.669 | 34.574 | .000 |
| pretest | 707.965 | 1 | 707.965 | 2.949 | .089 |
| gender | 13.471 | 1 | 13.471 | .056 | .813 |
| Error | 26646.308 | 111 | 240.057 | | |
| Total | 415738.000 | 114 | | | |
| Corrected Total | 27354.526 | 113 | | | |

a. R Squared = .026 (Adjusted R Squared = .008)

```
UNIANOVA posttest interest BY gender WITH pretest interest
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /CRITERIA=ALPHA(0.05)
  /DESIGN=pretest interest gender.
```

## Univariate Analysis of Variance

**Notes**

| | | |
|---|---|---|
| Output Created | | 09-AUG-2019 17:38:31 |
| Comments | | |
| Input | Data | C:\Users\USER\Desktop\johnbull data.sav |
| | Active Dataset | DataSet2 |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 114 |
| Missing Value Handling | Definition of Missing | User-defined missing values are treated as missing. |
| | Cases Used | Statistics are based on all cases with valid data for all variables in the model. |
| Syntax | | UNIANOVA posttest interest BY gender WITH pretest interest<br>/METHOD=SSTYPE(3)<br>/INTERCEPT=INCLUDE<br>/CRITERIA=ALPHA(0.05)<br>/DESIGN=pretest interest gender. |
| Resources | Processor Time | 00:00:00.00 |
| | Elapsed Time | 00:00:00.13 |

```
[DataSet2] C:\Users\USER\Desktop\johnbull data.sav
```

**Between-Subjects Factors**

| | | Value Label | N |
|---|---|---|---|
| gender | 1.00 | male | 95 |
| | 2.00 | female | 19 |

**Tests of Between-Subjects Effects**

Dependent Variable: posttest interest

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 1194.277[a] | 2 | 597.139 | 2.214 | .114 |
| Intercept | 3372.553 | 1 | 3372.553 | 12.503 | .001 |
| pretestinterest | 1040.565 | 1 | 1040.565 | 3.858 | .052 |
| gender | 76.279 | 1 | 76.279 | .283 | .596 |
| Error | 29940.740 | 111 | 269.736 | | |
| Total | 465392.000 | 114 | | | |
| Corrected Total | 31135.018 | 113 | | | |

a. R Squared = .038 (Adjusted R Squared = .021)

**Notes**

| | | |
|---|---|---|
| Output Created | | 09-AUG-2019 17:39:36 |
| Comments | | |
| Input | Data | C:\Users\USER\Desktop\johnbull data.sav |
| | Active Dataset | DataSet2 |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 114 |
| Missing Value Handling | Definition of Missing | User defined missing values are treated as missing. |
| | Cases Used | Statistics for each analysis are based on the cases with no missing or out-of-range data for any variable in the analysis. |
| Syntax | | T-TEST GROUPS=method(1 2)<br>/MISSING=ANALYSIS<br>/VARIABLES=retention<br>/CRITERIA=CI(.95). |
| Resources | Processor Time | 00:00:00.00 |
| | Elapsed Time | 00:00:00.02 |

```
UNIANOVA retention BY method WITH posttest interest
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /CRITERIA=ALPHA(0.05)
  /DESIGN=posttest interest method.
```

## Univariate Analysis of Variance

**Notes**

| | | |
|---|---|---|
| Output Created | | 10-AUG-2019 16:40:26 |
| Comments | | |
| Input | Data | C:\Users\USER\Desktop\johnbull data.sav |
| | Active Dataset | DataSet1 |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 114 |
| Missing Value Handling | Definition of Missing | User-defined missing values are treated as missing. |
| | Cases Used | Statistics are based on all cases with valid data for all variables in the model. |
| Syntax | | UNIANOVA retention BY method WITH posttest interest /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /CRITERIA=ALPHA(0.05) /DESIGN=posttest interest method. |
| Resources | Processor Time | 00:00:00.02 |
| | Elapsed Time | 00:00:00.13 |

```
[DataSet1] C:\Users\USER\Desktop\johnbull data.sav
```

**Between-Subjects Factors**

| | | Value Label | N |
|---|---|---|---|
| method | 1.00 | Cognitive apprenticeship | 58 |
| | 2.00 | demonstration | 56 |

**Tests of Between-Subjects Effects**

Dependent Variable: retention

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 21179.041[a] | 2 | 10589.520 | 196.169 | .000 |
| Intercept | 4384.574 | 1 | 4384.574 | 81.224 | .000 |
| Posttest interest | 341.618 | 1 | 341.618 | 6.328 | .013 |
| method | 4165.293 | 1 | 4165.293 | 77.161 | .000 |
| Error | 5991.950 | 111 | 53.982 | | |
| Total | 359487.000 | 114 | | | |
| Corrected Total | 27170.991 | 113 | | | |

a. R Squared = .779 (Adjusted R Squared = .775)

```
MEANS TABLES=pretest posttest BY method BY gender
  /CELLS MEAN COUNT STDDEV.
```

## Means

**Notes**

| | | |
|---|---|---|
| Output Created | | 10-AUG-2019 17:17:18 |
| Comments | | |
| Input | Data | C:\Users\USER\Desktop\johnbull data.sav |
| | Active Dataset | DataSet1 |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 114 |
| Missing Value Handling | Definition of Missing | For each dependent variable in a table, user-defined missing values for the dependent and all grouping variables are treated as missing. |
| | Cases Used | Cases used for each table have no missing values in any independent variable, and not all dependent variables have missing values. |
| Syntax | | MEANS TABLES=pretest posttest BY method BY gender /CELLS MEAN COUNT STDDEV. |
| Resources | Processor Time | 00:00:00.03 |
| | Elapsed Time | 00:00:00.05 |

```
[DataSet1] C:\Users\USER\Desktop\johnbull data.sav
```

**Case Processing Summary**

| | Cases | | | | | |
|---|---|---|---|---|---|---|
| | Included | | Excluded | | Total | |
| | N | Percent | N | Percent | N | Percent |
| pretest * method * gender | 114 | 100.0% | 0 | 0.0% | 114 | 100.0% |
| posttest * method * gender | 114 | 100.0% | 0 | 0.0% | 114 | 100.0% |

**Report**

| method | gender | | pretest | posttest |
|---|---|---|---|---|
| cognitievaprentiship | male | Mean | 20.0222 | 73.8444 |
| | | N | 45 | 45 |
| | | Std. Deviation | 3.87585 | 8.58634 |
| | female | Mean | 21.6154 | 63.6923 |
| | | N | 13 | 13 |
| | | Std. Deviation | 5.14034 | 4.95622 |
| | Total | Mean | 20.3793 | 71.5690 |
| | | N | 58 | 58 |
| | | Std. Deviation | 4.19619 | 8.96213 |
| demonstration | male | Mean | 19.0000 | 44.4000 |
| | | N | 50 | 50 |
| | | Std. Deviation | 3.77424 | 6.34067 |
| | female | Mean | 20.1667 | 47.1667 |
| | | N | 6 | 6 |
| | | Std. Deviation | 3.31160 | 6.17792 |
| | Total | Mean | 19.1250 | 44.6964 |
| | | N | 56 | 56 |
| | | Std. Deviation | 3.71759 | 6.32720 |
| Total | male | Mean | 19.4842 | 58.3474 |
| | | N | 95 | 95 |
| | | Std. Deviation | 3.83673 | 16.55023 |
| | female | Mean | 21.1579 | 58.4737 |
| | | N | 19 | 19 |
| | | Std. Deviation | 4.59786 | 9.44792 |
| | Total | Mean | 19.7632 | 58.3684 |
| | | N | 114 | 114 |
| | | Std. Deviation | 4.00067 | 15.55877 |

```
MEANS TABLES=retention BY method BY gender
  /CELLS MEAN COUNT STDDEV.
```

## Means

**Notes**

| | | |
|---|---|---|
| Output Created | | 10-AUG-2019 17:36:31 |
| Comments | | |
| Input | Data | C:\Users\USER\Desktop\johnbull data.sav |
| | Active Dataset | DataSet1 |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 114 |
| Missing Value Handling | Definition of Missing | For each dependent variable in a table, user-defined missing values for the dependent and all grouping variables are treated as missing. |
| | Cases Used | Cases used for each table have no missing values in any independent variable, and not all dependent variables have missing values. |
| Syntax | | MEANS TABLES=retention BY method BY gender /CELLS MEAN COUNT STDDEV. |
| Resources | Processor Time | 00:00:00.03 |
| | Elapsed Time | 00:00:00.05 |

```
[DataSet1] C:\Users\USER\Desktop\johnbull data.sav
```

**Case Processing Summary**

| | Cases | | | | | |
|---|---|---|---|---|---|---|
| | Included | | Excluded | | Total | |
| | N | Percent | N | Percent | N | Percent |
| retention * method * gender | 114 | 100.0% | 0 | 0.0% | 114 | 100.0% |

**Report**

retention

| method | gender | Mean | N | Std. Deviation |
|---|---|---|---|---|
| Cognitive apprenticeship | male | 69.3333 | 45 | 8.15197 |
| | female | 60.1538 | 13 | 4.94716 |
| | Total | 67.2759 | 58 | 8.44755 |
| demonstration | male | 39.5200 | 50 | 6.13202 |
| | female | 46.1667 | 6 | 6.11283 |
| | Total | 40.2321 | 56 | 6.41870 |
| Total | male | 53.6421 | 95 | 16.57280 |
| | female | 55.7368 | 19 | 8.44487 |
| | Total | 53.9912 | 114 | 15.50649 |

```
MEANS TABLES=pretest interest posttest interest BY method BY gender
  /CELLS MEAN COUNT STDDEV.
```

## Means

**Notes**

| | | |
|---|---|---|
| Output Created | | 10-AUG-2019 18:10:49 |
| Comments | | |
| Input | Data | C:\Users\USER\Desktop\johnbull data.sav |
| | Active Dataset | DataSet1 |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 114 |
| Missing Value Handling | Definition of Missing | For each dependent variable in a table, user-defined missing values for the dependent and all grouping variables are treated as missing. |
| | Cases Used | Cases used for each table have no missing values in any independent variable, and not all dependent variables have missing values. |
| Syntax | | MEANS TABLES=pretestinterestposttestinterest BY method BY gender /CELLS MEAN COUNT STDDEV. |
| Resources | Processor Time | 00:00:00.05 |
| | Elapsed Time | 00:00:00.05 |

```
[DataSet1] C:\Users\USER\Desktop\johnbull data.sav
```

**Case Processing Summary**

| | Cases | | | | | |
|---|---|---|---|---|---|---|
| | Included | | Excluded | | Total | |
| | N | Percent | N | Percent | N | Percent |
| Pretest interest * method * gender | 114 | 100.0% | 0 | 0.0% | 114 | 100.0% |
| Posttest interest * method * gender | 114 | 100.0% | 0 | 0.0% | 114 | 100.0% |

**Report**

| method | gender | | Pretest interest | Posttest interest |
|---|---|---|---|---|
| Cognitive apprenticeship | male | Mean | 44.8444 | 76.2222 |
| | | N | 45 | 45 |
| | | Std. Deviation | 6.31720 | 9.13756 |
| | female | Mean | 46.6154 | 71.8462 |
| | | N | 13 | 13 |
| | | Std. Deviation | 6.34479 | 8.99858 |
| | Total | Mean | 45.2414 | 75.2414 |
| | | N | 58 | 58 |
| | | Std. Deviation | 6.31153 | 9.21347 |
| demonstration | male | Mean | 44.8800 | 47.6800 |
| | | N | 50 | 50 |
| | | Std. Deviation | 6.41631 | 9.64141 |
| | female | Mean | 47.0000 | 48.0000 |
| | | N | 6 | 6 |
| | | Std. Deviation | 6.03324 | 5.51362 |
| | Total | Mean | 45.1071 | 47.7143 |
| | | N | 56 | 56 |
| | | Std. Deviation | 6.35804 | 9.25147 |
| Total | male | Mean | 44.8632 | 61.2000 |
| | | N | 95 | 95 |
| | | Std. Deviation | 6.33566 | 17.11140 |
| | female | Mean | 46.7368 | 64.3158 |
| | | N | 19 | 19 |
| | | Std. Deviation | 6.08132 | 13.86063 |
| | Total | Mean | 45.1754 | 61.7193 |
| | | N | 114 | 114 |
| | | Std. Deviation | 6.30668 | 16.59913 |

```
UNIANOVA retention BY method WITH posttest
  /RANDOM=method
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /CRITERIA=ALPHA(0.05)
  /DESIGN=posttest method.
```

## Univariate Analysis of Variance

**Notes**

| | | |
|---|---|---|
| Output Created | | 10-AUG-2019 18:37:15 |
| Comments | | |
| Input | Data | C:\Users\USER\Desktop\johnbull data.sav |
| | Active Dataset | DataSet1 |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 114 |
| Missing Value Handling | Definition of Missing | User-defined missing values are treated as missing. |
| | Cases Used | Statistics are based on all cases with valid data for all variables in the model. |
| Syntax | | UNIANOVA retention BY method WITH posttest /RANDOM=method /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /CRITERIA=ALPHA(0.05) /DESIGN=posttest method. |
| Resources | Processor Time | 00:00:00.02 |
| | Elapsed Time | 00:00:00.13 |

```
[DataSet1] C:\Users\USER\Desktop\johnbull data.sav
```

**Between-Subjects Factors**

| | | Value Label | N |
|---|---|---|---|
| method | 1.00 | Cognitive apprenticeship | 58 |
| | 2.00 | demonstration | 56 |

**Tests of Between-Subjects Effects**

Dependent Variable: retention

| Source | | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Intercept | Hypothesis | 64.972 | 1 | 64.972 | 2.508 | .175 |
| | Error | 127.705 | 4.929 | 25.907[a] | | |
| posttest | Hypothesis | 4625.066 | 1 | 4625.066 | 300.487 | .000 |
| | Error | 1708.502 | 111 | 15.392[b] | | |
| method | Hypothesis | 166.039 | 1 | 166.039 | 10.787 | .001 |
| | Error | 1708.502 | 111 | 15.392[b] | | |

a. .070 MS(method) + .930 MS(Error)

b. MS(Error)

**Expected Mean Squares**[a,b]

| Source | Variance Component | | |
|---|---|---|---|
| | Var(method) | Var(Error) | Quadratic Term |
| Intercept | .986 | 1.000 | Intercept |
| posttest | .000 | 1.000 | posttest |
| method | 14.124 | 1.000 | |
| Error | .000 | 1.000 | |

a. For each source, the expected mean square equals the sum of the coefficients in the cells times the variance components, plus a quadratic term involving effects in the Quadratic Term cell.

b. Expected Mean Squares are based on the Type III Sums of Squares.

```
UNIANOVA retention BY method WITH posttest
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /CRITERIA=ALPHA(0.05)
  /DESIGN=posttest method.
```

## Univariate Analysis of Variance

**Notes**

| | | |
|---|---|---|
| Output Created | | 10-AUG-2019 18:37:43 |
| Comments | | |
| Input | Data | C:\Users\USER\Desktop\johnbull data.sav |
| | Active Dataset | DataSet1 |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 114 |
| Missing Value Handling | Definition of Missing | User-defined missing values are treated as missing. |
| | Cases Used | Statistics are based on all cases with valid data for all variables in the model. |
| Syntax | | UNIANOVA retention BY method WITH posttest<br>/METHOD=SSTYPE(3)<br>/INTERCEPT=INCLUDE<br>/CRITERIA=ALPHA(0.05)<br>/DESIGN=posttest method. |
| Resources | Processor Time | 00:00:00.00 |
| | Elapsed Time | 00:00:00.13 |

```
[DataSet1] C:\Users\USER\Desktop\johnbull data.sav
```

**Between-Subjects Factors**

| | | Value Label | N |
|---|---|---|---|
| method | 1.00 | Cognitive apprenticeship | 58 |
| | 2.00 | demonstration | 56 |

**Tests of Between-Subjects Effects**

Dependent Variable: retention

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 25462.489[a] | 2 | 12731.244 | 827.139 | .000 |
| Intercept | 64.972 | 1 | 64.972 | 4.221 | .042 |
| posttest | 4625.066 | 1 | 4625.066 | 300.487 | .000 |
| method | 166.039 | 1 | 166.039 | 10.787 | .001 |
| Error | 1708.502 | 111 | 15.392 | | |
| Total | 359487.000 | 114 | | | |
| Corrected Total | 27170.991 | 113 | | | |

a. R Squared = .937 (Adjusted R Squared = .936)

```
UNIANOVA posttest BY gender WITH pretest
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /CRITERIA=ALPHA(0.05)
  /DESIGN=pretest gender.
```

## Univariate Analysis of Variance

**Notes**

| | | |
|---|---|---|
| Output Created | | 10-AUG-2019 19:02:37 |
| Comments | | |
| Input | Active Dataset | DataSet3 |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 58 |
| Missing Value Handling | Definition of Missing | User-defined missing values are treated as missing. |
| | Cases Used | Statistics are based on all cases with valid data for all variables in the model. |
| Syntax | | UNIANOVA posttest BY gender WITH pretest /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /CRITERIA=ALPHA(0.05) /DESIGN=pretest gender. |
| Resources | Processor Time | 00:00:00.02 |
| | Elapsed Time | 00:00:00.23 |

```
[DataSet3]
```

**Between-Subjects Factors**

| | | Value Label | N |
|---|---|---|---|
| gender | 1.00 | male | 45 |
| | 2.00 | female | 13 |

**Tests of Between-Subjects Effects**

Dependent Variable: posttest cognitive apprenticeship

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 1046.692[a] | 2 | 523.346 | 8.151 | .001 |
| Intercept | 9589.945 | 1 | 9589.945 | 149.354 | .000 |
| pretest | 7.149 | 1 | 7.149 | .111 | .740 |
| gender | 1040.393 | 1 | 1040.393 | 16.203 | .000 |
| Error | 3531.532 | 55 | 64.210 | | |
| Total | 301661.000 | 58 | | | |
| Corrected Total | 4578.224 | 57 | | | |

a. R Squared = .229 (Adjusted R Squared = .201)

```
UNIANOVAcognretention BY genderexp WITH posttest
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /CRITERIA=ALPHA(0.05)
  /DESIGN=posttest genderexp.
```

## Univariate Analysis of Variance

**Notes**

| | | |
|---|---|---|
| Output Created | | 10-AUG-2019 19:12:10 |
| Comments | | |
| Input | Data | C:\Users\USER\Desktop\johnbull data.sav |
| | Active Dataset | DataSet1 |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 114 |
| Missing Value Handling | Definition of Missing | User-defined missing values are treated as missing. |
| | Cases Used | Statistics are based on all cases with valid data for all variables in the model. |
| Syntax | | UNIANOVAcognretention BY genderexp WITH posttest /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /CRITERIA=ALPHA(0.05) /DESIGN=posttest genderexp. |
| Resources | Processor Time | 00:00:00.05 |
| | Elapsed Time | 00:00:00.08 |

```
[DataSet1] C:\Users\USER\Desktop\johnbull data.sav
```

**Between-Subjects Factors**

| | | Value Label | N |
|---|---|---|---|
| genderexp | 1.00 | male | 44 |
| | 2.00 | female | 13 |

**Tests of Between-Subjects Effects**

Dependent Variable: cognretention

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 1094.822[a] | 2 | 547.411 | 9.961 | .000 |
| Intercept | 1676.371 | 1 | 1676.371 | 30.505 | .000 |
| posttest | 174.429 | 1 | 174.429 | 3.174 | .080 |
| genderexp | 392.762 | 1 | 392.762 | 7.147 | .010 |
| Error | 2967.494 | 54 | 54.954 | | |
| Total | 262353.000 | 57 | | | |
| Corrected Total | 4062.316 | 56 | | | |

a. R Squared = .270 (Adjusted R Squared = .242)

```
UNIANOVAcogninterestpost BY genderexp WITH cogninterestpre
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /CRITERIA=ALPHA(0.05)
  /DESIGN=cogninterestpregenderexp.
```

# Univariate Analysis of Variance

**Notes**

| | | |
|---|---|---|
| Output Created | | 10-AUG-2019 19:19:00 |
| Comments | | |
| Input | Data | C:\Users\USER\Desktop\johnbull data.sav |
| | Active Dataset | DataSet1 |
| | Filter | <none> |
| | Weight | <none> |
| | Split File | <none> |
| | N of Rows in Working Data File | 114 |
| Missing Value Handling | Definition of Missing | User-defined missing values are treated as missing. |
| | Cases Used | Statistics are based on all cases with valid data for all variables in the model. |
| Syntax | | UNIANOVAcogninterestpost BY genderexp WITH cogninterestpre<br>/METHOD=SSTYPE(3)<br>/INTERCEPT=INCLUDE<br>/CRITERIA=ALPHA(0.05)<br>/DESIGN=cogninterestpregenderexp. |
| Resources | Processor Time | 00:00:00.03 |
| | Elapsed Time | 00:00:00.05 |

[DataSet1] C:\Users\USER\Desktop\johnbull data.sav

**Between-Subjects Factors**

| | | Value Label | N |
|---|---|---|---|
| genderexp | 1.00 | male | 45 |
| | 2.00 | female | 13 |

**Tests of Between-Subjects Effects**

Dependent Variable: cogn interest post

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 549.145[a] | 2 | 274.573 | 3.521 | .036 |
| Intercept | 3247.418 | 1 | 3247.418 | 41.639 | .000 |
| cogninterestpre | 355.994 | 1 | 355.994 | 4.565 | .037 |
| genderexp | 256.887 | 1 | 256.887 | 3.294 | .075 |
| Error | 4289.476 | 55 | 77.990 | | |
| Total | 333192.000 | 58 | | | |
| Corrected Total | 4838.621 | 57 | | | |

a. R Squared = .113 (Adjusted R Squared = .081)