ELECTRONICS WORKS COMPETENCIES REQUIRED BY ELECTRONICS TEACHERS FOR EFFECTIVE TEACHING IN TECHNICAL COLLEGES IN OSUN AND OYO STATES

By

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PG/M.Ed/10/57260

DEPARTMENT OF VOCATION TEACHER EDUCATION

FACULTY OF EDUCATION

UNIVERSITY OF NIGERIA, NSUKKA

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TITLE PAGE

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A PROJECT REPORT PRESENTED TO THE DEPARTMENT OF VOCATIONAL TEACHER EDUCATION, UNIVERSITY OF NIGERIA, NSUKKA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTERS DEGREE IN INDUSTRIAL TECHNICAL EDUCATION (ELECTRICAL/ELECTRONICS)

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APPROVAL PAGE

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CERTIFICATION

I, **ARILESERE OPEYEMI MUNIRUDEEN**, a post graduate student in the Department of Vocational Teacher Education and with Registration Number PG/M.Ed/10/57260 has satisfactorily completed the requirements for the course and research works for the Master Degree in Industrial Technical Education (Electrical/Electronics). The work in this project is original and has not been submitted in part or full for other Diploma or Degree of this or any other University.

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DEDICATION

This project report is dedicated to my beloved wife, children and to the blessed memory of my father.

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ABSTRACT

This study investigated electronics works competencies required by electronics teachers for effective teaching in technical colleges in Osun and Oyo states. A survey research design was used for the study. A 60-item questionnaire was used as instrument for data collection and three experts validated the instruments. A reliability coefficient of 0.879 was obtained and 49 electronics teachers were used. Four objectives were stated, research questions asked, and hypotheses formulated and tested at a 0.05 level of significance. Mean and standard deviation were used to answer research questions and the t-test statistic was used to test the hypothesis. The findings revealed that electronics teachers in technical colleges required competencies for effective teaching in the soldering and de-soldering techniques, fault and repair diagnosis techniques in television and radio sets, troubleshooting electronic circuits, testing devices and cards with measuring instruments among others and the result of the null hypothesis shows that there is no significant difference between the mean responses of experienced and less experienced electronic teachers in technical colleges on competencies required to teach electronic devices, electronic circuits, radio communication and television system. This study implies that demonstration method is appropriate method of teaching competencies in electronics works in technical colleges and if competencies identified in this study are used by the teachers, it will help the students to be self reliant when they graduate. The researcher offers recommendations that the government should provide in-service training programmes for electronic teachers, adequate materials and tools for electronic teachers and that competencies should not be used for evaluating electronic teacher for layoffs.

CHAPTER ONE

INTRODUCTION

Background of the Study

Electronics has brought innovations in technology especially in teaching and learning. It has helped to improve the use of equipment by making it digitalized and automatic. It makes Information and Communication Technology (ICT) versatile and increases its use as catalysts and tools for effective teaching.

Electronics is defined by Fred, George and Steber (2009) as the field of engineering and applied physics which deals with the design and application of devices, usually electronic circuits, the operation of which depends on the flow of electrons for the generation, transmission, reception, and storage of information. Theraja (2010) further explained that electronics is the process of applying scientific knowledge in the design, selection of materials, construction, operation and maintenance of electronics devices and equipments. **Electronics can therefore be described as a process of application of electric current which is the flow of electrical charges to circuits in order to accomplish specific task. This circuit consists of different components which** form the devices used in electronics works.

Electronics works is one of the courses in engineering trades offered in Nigeriaœs technical colleges in which at the completion of three years or one year advanced programme, the graduates are awarded National Technical Certificate (NTC) and Advanced National Technical Certificate (ANTC) for the craft level and advanced level respectively (Federal Republic of Nigeria (FRN), 2004). The programme for electronics works in Nigeria technical colleges is designed to produce competent craftsmen and technicians, who could be employable, self reliant or and able to proceed to higher education. According to National Board for Technical Education (NBTE 2001), a craftsman in electronics works is expected to test, diagnose, service and completely repairs any fault relating to electronic units and systems to the manufacturersô specifications. The various sections in electronics works include electronic circuits, electronic devices, radio communication and television system.

In the opinion of Raymond (2008) electronic circuit is a continuous path composed of devices and including a source of electromotive force that drives the current around the circuit. Robert and Louis (2002) also viewed electronic circuit as a structure that directs and controls electric currents, presumably to perform some useful functions. The very name "circuit" according to Naeem (2009) implies that the structure is closed or looped. Therefore, electronic circuit is a connection of various devices of an electric network forming a closed path and is powered by an energy source. The closed path is commonly termed as either loop or mesh. It is this electronic mesh that the students use in calculating appropriate value required for voltage and current when connecting the desired electronic devices.

Electronic devices are resistors, inductors, capacitors and sources among others, in which electric charges can move and bring a change in the characteristics of the charge. Robert and Louis (2002) defined electronic devices to include passive elements such as resistors, inductors, capacitors and active elements such as generators, batteries, operational amplifiers, transistors and integrated circuits. If a circuit element is capable of intensify signal, it is said to be active; otherwise, it is said to be passive. Electronics technical teachers are expected to teach their students to identify passive and active devices and use them to carry out design and construct simple projects in electronics works such as amplifier circuit, power circuit and radio communication circuit (NBTE, 2004).

Radio communication in the view of Gulathi (2009) employs electromagnetic waves propagated through space. Jensen (2000) explained radio as a general term applied to the use of radio waves or Hertzian waves which are electromagnetic waves of frequencies arbitrarily lower than 300GHz. It is propagated in space without artificial guide, common wireless applications such as AM broadcast, television broadcast, FM broadcast, cell phones, wireless computer network and satellite television utilize below 10GHz frequencies. Radio and television sets are also used for providing information and entertainment to the public in virtually every nation in the world.

Teachers of radio communication and television system in technical colleges are to provide the students with knowledge and skills that would enable their graduates undertake repairs with proficiency in radio and communication equipment and create awareness about the basic principle of modulation and demodulation (NBTE, 2001). Radio communication, electronic devices and circuits have minimum standard level of curriculum sets by NBTE in electronics works, thus they may not be achieved in technical colleges as a result of the ineffectiveness in the teaching and learning of electronics works within the study area.

It was also reported in the National Business and Technical Education Board (NABTEB) examination conducted in radio communication, television and electronics devices in May/June, 2002 that the board recorded a 30% failure rate in radio communication, a 60% failure rate in television system, and a 27% failure in electronics devices and circuits (NABTEB, 2002).. This poor performance of students in the study areas might have occurred as a result of ineffective teaching which shows the level of incompetency of the teachers in the technical colleges.

According to Perrot (2012), effective teaching is a mode that produces inquiring, considering and seeking out at the correct results and ability in teaching. Batten, Marland and Khamis (2003) also defined effective teaching as one that produces demonstrable results in terms of the cognitive and affective development of the college students. Effective teaching involves having a sound understanding of how and why certain activities lead to learning, and what factors influence their effectiveness. Teachers make use of a whole range of teaching skills to make sure learning occurs effectively. One of the key features of effective teaching is the use of a diversity of approaches that enables the teacher to elicit and sustain pupilsô interest and involvement in their learning. Much effective teaching involves allowing college students to be more active and to have greater control over the direction and pace of the learning experience (Brophy & Good, 2006).

Effective teachers according to Bush and Kincer (2009) use techniques that best serve the learning needs of their students, help students learn on their own as well as with and from others. Effective teachers closely monitor each studentôs achievements and teach in a way that encourages students to take greater responsibility for their own learning. They make sure their students know what the goals of the learning program are; understand how these goals will be assessed; know whether they are on track to achieve success; and are actively involved in evaluating their own learning. Effective teachers in the opinion of Killen (2008), have a thorough knowledge of their subject content and skills. Through this, they inspire in their students a love of learning. They also understand how college studentsô best learn concepts, content and skills. Effective teachers use their knowledge of learning processes to determine which will be most effective to help the particular students in their classes to learn successfully.

Balon (2010) is of the view that an effective teacher can be valuable for the students, the society, and the country. This is because of the fact that such a teacher educates and teaches the future generation, on whom the future of the society and the nation depends. Teaching according to Obi (2005) involves guiding students to learn. And this guidance depends on teachersô experience. Mayer, Mullens and Moore (2000) asserted that length of teaching experience is very important in teaching.

Berryman (2002) analysed the effect of experience on teacher competence and found out that there is no significant difference between the experienced and less experienced teachers. But experienced teachers tend to be more analytical, more aware of complexity and have more enriched conceptual collection regarding teaching than less experienced teachers (Dunkin, 2002). Therefore in this project while considering the view of Yusuf and Balogun (2011), experienced electronics teacher is a teacher who has been teaching electronics works in the technical college for a period of 6 years or more and less experienced teacher is a teacher who has been teaching electronics works in the technical college for less than 6 years.

Electronics teacher in technical colleges in the opinion of Ingersoll (2003) could be regarded as a professional person who imparts practical skills and knowledge in the field of electronics works to prepare learners for the world of work. Thiam (2001) described electronics works teachers of technical colleges as the persons that possess the necessary technological knowledge and practical skills in electronics works. Electronics work trade is taught by electronic teachers (Okoro, 2006). Electronics teachers are trained in colleges of education (technical), polytechnics and universities. Such teachers in technical colleges are trained in order to teach electronics works competently.

Technical colleges according to Okorie (2001) are the institutions where craftsmen are trained to the craft level and awarded NABTEB certificate. The aim of technical college is to produce graduates with competent skills which could be put into practice to enable them become self reliant. In technical colleges, technical teachers give training on various disciplines such as electronics works, building technology, wood work technology, metal work technology, to mention a few. These disciplines are also called trade subjects. Trade subjects are unique subjects because they are skill oriented and required a level of competency.

Competency is a combination of skills and knowledge needed to perform a specific task in a given context (Jones, Voorhees and Paulson, 2002). Marija and Palmira (2007) also described competency as ability to do something well, measured against a standard especially ability acquired through experience or training. Competency involves skills and attitudes that are observable, measurable and necessary to perform a job independently at a prescribed proficiency level (Sefyrin, 2005). To be competent means to possess adequate skills in order to carry out something to an acceptable standard.

In other words, a competent electronics teacher should posses the skill and knowledge required to effectively teach electronics works in order to set a workshop or repair after the completion of the technical college programme. Also, these competencies will ensure maintenance and repairs of electronic devices, components and radio communication as well as provide instructions on career preparation in order to adequately prepare students for admission into higher learning. This study therefore investigating teachers with experienced and less experienced with the view to determine those that could effectively teach and produce electronics works competent students in Osun and Oyo states.

Osun and Oyo state are one of the states in Nigeria appear to be having electronics dump sites. It is not surprising however when Abel and Afolabi, (2007) reported that Ile-Ife in Osun state has 0.46Kg/person/day of electronics waste, Ibadan in Oyo state has 0.71Kg/person/day and about 55, 200Kg per day of electronics wastes were estimated to be generated in the traditional city of Oyo in Oyo state which indicate that most electronics works graduates are not involved in the repairs and maintenance of electronic equipment and tools within the two states thereby making the people of Osun and Oyo state throw away their electronics goods and thereby become a serious problem to the people within the study areas. This situation necessitated this study which investigates electronics works competencies required by electronics teachers for effective teaching in technical colleges in Osun and Oyo states.

Therefore, there is need for teachers in technical colleges to have competency in electronics works so as to impart adequate and quality knowledge to the electronic college students. Unless electronics teachers possess required competencies to effectively teach studentsô electronics works, the problem of technical college graduates not having the ability to be self reliant and carry out repairs on electronic devices will persist. Hence, this study seeks to find out the electronics works competencies required by electronics teachers for effective teaching in technical colleges in Osun and Oyo states.

Statement of the Problem

The rapid development of the current world of work needs proficient workers mainly in fields which involved modern technologies such as electronics works. This is to ensure rapid development in the country especially in Osun and Oyo states as a result of the quality of teachers which is increasingly judged by college studentsô performance, standard of teaching and the time to plan the lesson during teaching.

The set standards by NBTE for instructional materials required to teach electronic devices, electronic circuit, radio communication and television system in Osun and Oyo states technical colleges have not been adequately met by electronics teachers. This is evident in the results of students in May/ June 2002 (NABTEB, 2002) and May/ June 2005 ï 2009 (NABTEB, 2005-2009). This is because most of the teachers in the study area learnt electronics devices and circuit theoretically and believe that it should be passed to others in the same way. But teachers need competencies to support teaching in order to make teaching mastery-based, student-centered and personalized learning environments.

The personality of a teacher is not only sufficient for effective teaching and has to be coupled with competence which is very important in relation with the classroom atmosphere. The teacher has to efficiently manage the class especially when demonstrating radio communication and television system which requires achieving the set objectives /plans for the class with minimum deviations. But this has not been achieved in the study area because according to Ololube (2009), electronics teachers in technical colleges have been using traditional stereotype of teaching which involve the teacher standing in front of the classroom and teach the college students without combining other methods of teaching.

Also, there are different levels of classroom competencies that teachers should possess in order to create quality in instruction. For example, teachers are expected not only to impart knowledge but also to understand studentôs basic cognitive and social problems; match curricular offering to levels of mental development and translate curricular specifications into relevance. Teaching in modern society involves the task of assisting students to make worthwhile and ensuring competence in their school work and their occupations. If these issues are not resolved, the college students may not appreciate progress towards his or her electronic works learning. Since the main duty of electronic works technical college teachers is to get the individual student to learn, it is their duty also to remove obstacles to learning. Hence, this research is focusing on the investigation of the electronics works competencies required by electronics teachers for effective teaching in technical colleges in Osun and Oyo states.

Purpose of the Study

The major purpose of the study was to investigate the electronics works competencies required by electronics teachers for effective teaching in technical colleges in Osun and Oyo states. Specifically, the study aims to identify electronics works competencies required by electronics teachers for effective teaching of:

1. Electronic devices.
2. Electronic circuits.
3. Radio communication.
4. Television System.

Significance of the Study

The study shall be beneficial to students, teachers, college administrators, industries and society at large. If the electronics works competencies identified are effectively thought to technical colleges students, it will help students to acquire the necessary competencies that are needed in the maintenance and repair of all electronic devices. Therefore, the students will be able to use the knowledge and skills acquired to set-up a business of their own and therefore become self reliant.

This study will provide information for teachers on tools used for identification of appropriate selection of electronic circuits and devices for repair of radio and television sets. Thus, it ensures the public to be free from electronic waste. The study will provide instruction on career preparation in electronics works. This will motivate the students to learn and also encourage the teacher for effective teaching.

On the part of technical college administrators, the findings will provide administratorsô information on electronics works competences where their staff and students require improvement. This information may be used by the administrators to organize short re-training courses in electronics works for their staff for improved performance.

The study will serve as sources of information and literature to educational researchers who wish to conduct similar study in their areas of specialization. The study will guide them on what to do in order to achieve objectives of their studies. They will also extract relevant literatures from the study to build their own.

The society will also benefit from the findings of the study because when the technical colleges produce competent graduates with expected skills that will enable them to repair and have effective maintenance of electronics equipment, thus reducing the problem of quack electronics works technicians thereby, offering good services to the society. This will go a long way in achieving the much needed technological development in Nigeria.

Research Questions

The following research questions were formulated to guide the study.

1 What are the competencies required of electronic teachers to teach electronic devices?

2 What are the competencies required of electronic teachers to teach electronic circuits?

3 What are the competencies required of electronic teachers to teach radio communication?

4 What are the competencies required of electronic teachers to teach television system?

Hypotheses

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

H_{01}: There is no significant difference between the mean responses of experienced and less experienced electronic teachers in technical colleges on competencies required to teach electronic devices.

H_{02}: There is no significant difference between the mean responses of experienced and less experienced electronic teachers in technical colleges on competencies required to teach electronic circuits.

H_{03}: There is no significant difference between the mean responses of experienced and less experienced electronic teachers in technical colleges on competencies required to teach radio communication.

H_{04}: There is no significant difference between the mean responses experienced and less experienced electronic teachers in technical colleges on competencies required to teach television system.

Scope of the Study

This study was restricted to the identification of competencies that would be required by experienced and less experienced electronic teachers to teach electronics works in technical colleges in Osun and Oyo states. The study focuses on competencies required by electronics teachers to teach electronic devices, electronic circuits, radio communication, television system and will not discuss electronic systems, amplifiers, power supply, oscillators, multivibrators, digital electronics and so on.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

The literature reviewed for this study was organized and presented under the following sub-headings.

Conceptual Framework

- Effective Teaching
- Electronics Teacher
- Competency
- Experienced and Less Experienced Teachers
- Electronic Devices
- Electronic Circuit
- Electronic Instruments
- Radio Communication
- Television System

Theoretical Framework

- Competence Theory
- Behaviorism Theory

Review of Related Empirical Studies

Summary of Review of Related Literature

Conceptual Framework

Conceptual framework is the microcosm or condensed picture or mental imagery of the orientation of the research. It gives the research an identity and enables the process of enquiry to move from vague and confusing ideas about what is to be studied and measuring it in the real world (Eboh, 2009).

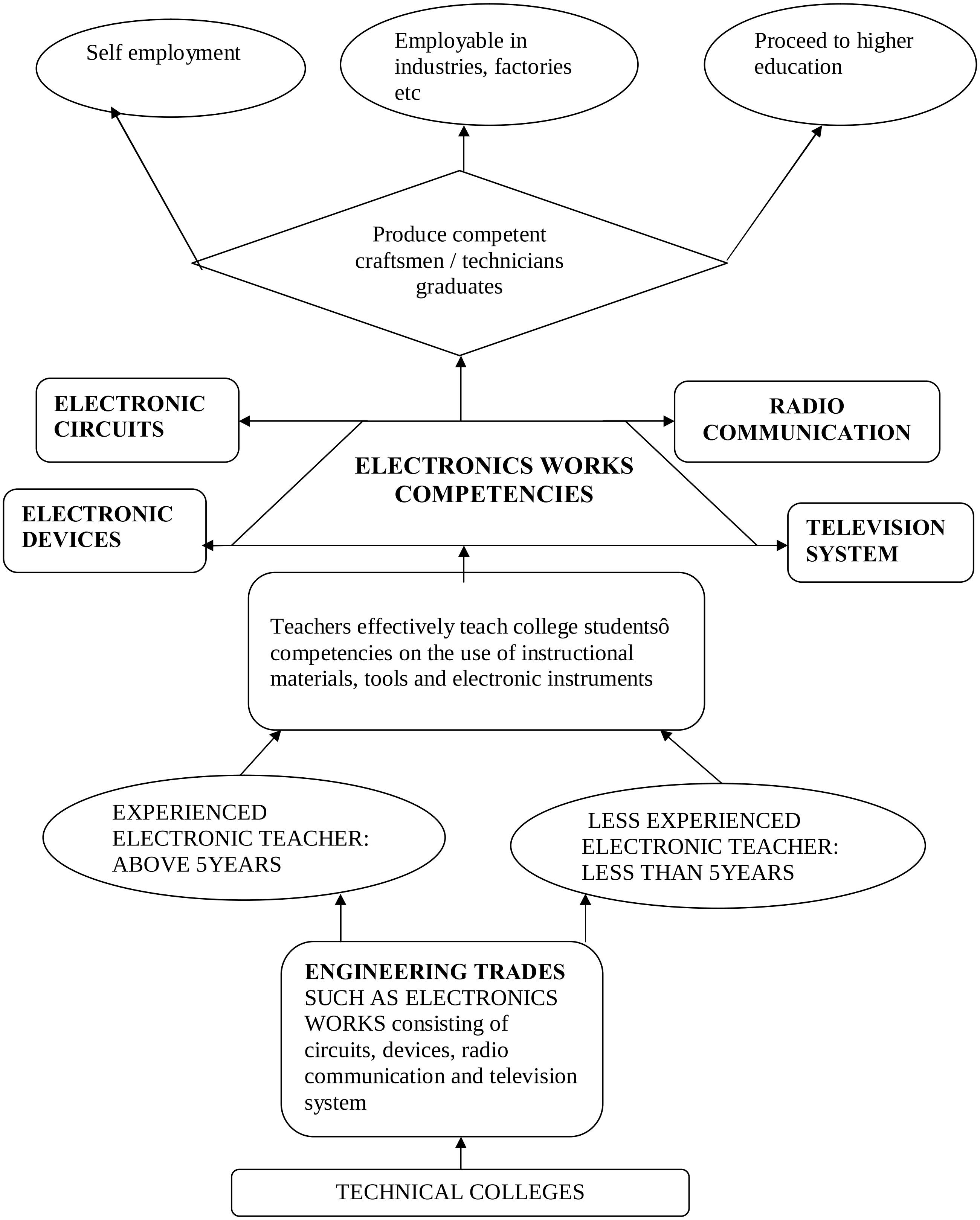


Fig 2.1: Arilesere 2012 Schematic Diagram of Competencies in Electronics Works

Effective Teaching

Teaching is a key to learning. It is a process of making it possible for someone to learn. Tania (2004) stressed that teachers must continue to strive for excellence in their work by making continued effort to maintain and improve their technological skills to ensure effective teaching and learning. The mode of effective teaching is a function of a large number of variables e.g. standards of teaching, the content to teach the students, the time to plan the lesson during the frame of teaching. The research on effective teaching in general suggests that very effective teachers exhibit the following characteristics (Agne, Greenwood & Miller 2004):

- provide students with the maximum opportunity to learn
- maintain an academic focus
- have well-managed classrooms
- have high, rather than low, expectations of what students can achieve
- are business-like and work-oriented
- show enthusiasm
- use strategies to keep students on task, motivated, and productive
- impose structure on the content to be covered
- present new material in a step-by-step manner
- employ direct (explicit) teaching procedures
- use clear instructions and explanations
- use a variety of teaching styles and resources
- frequently demonstrate appropriate task-approach strategies
- monitor closely what students are doing
- adjust instruction to individual needs, and re-teach where necessary
- provide frequent feedback to students

- use high rates of questioning to involve students and to check for understanding
- spend significant amounts of time in interactive whole-class teaching, but also use group work and partner activities when appropriate.

When electronic works teachers possess above characteristics and make use of evaluation techniques such as subjecting students to the same period of time during assessments, using a variety of teaching styles and resources, demonstrate appropriate task-approach strategies and provide frequent feedback to students. Therefore, such electronic works teacher will become effective in his teaching.

Electronics Teacher

The role of the teacher is that of acting as a guide and instrument to assure a comprehensive learning process; thus could be achieved by creating at the same time new instructional models for managing the student´s skills, abilities and knowledge. The teacher will have to develop skill related to the learning contexts that changes the students learning paradigms. Thus, electronic teacherȏs role is multiplied and shifted from being a single transmitter of knowledge to become facilitator and guide of the learning process, researcher and designer of suitable learning materials, collaborator (with other teachers and students) and evaluator (Deggs; Machtmes & Johnson, 2008).

Electronic competent teacher possesses professional technical education certificate that teaches students in electronics technology, supervises activities so that students develop the skills, knowledge, and attitudes related to employment in electronics occupations. The teachers must master the set of competencies to varying degrees, depending on whether they are new or more experienced in order to practice the profession (Hawk, Coble, and Swanson, 2005). The electronic profession requires training which involves the development of a range of competencies linked to various professional functions; For example, designing teaching/learning situations, guiding groups of students through activities, evaluating learning, adapting their teaching methods to specific student needs, managing a class group, working in collaboration with the school team, parents and partners, and making a commitment to their own professional development, are all activities that require teachers to apply a wide range of competencies in various professional situations. The five reference frameworks for professional competencies are stated by Gather-Thurler and Legendre (2000).

S/ N	DOMAIN	COMPETENCIES
1	Commitment to student and student learning	➢ Teachers demonstrate commitment to the well-being and development of all students. ➢ Teachers are dedicated in their efforts to teach and support student learning and achievement. ➢ Teachers treat all students equitably and with respect. ➢ Teachers provide an environment for learning that encourages pupils to be problem solvers, decision makers, lifelong learners, and contributing members of a changing society
2	Professional Knowledge in Electronics	➢ Teachers know their subject matter in electronics and the technical college curriculum ➢ Teachers know a variety of effective teaching and assessment practices. ➢ Teachers know a variety of effective classroom management strategies. ➢ Teachers know how students learn and factors that influence students learning and achievement
3	Professional Practice	➢ Teachers use their professional knowledge and understanding of students, curriculum, legislation, teaching practices, and classroom management strategies to promote the learning and achievement of their students. ➢ Teachers teach and use measuring instruments during practical classes to diagnose faults in electronics devices, electronic circuits, radio communication equipment and television system, ➢ Teachers communicate effectively with students, parents, and colleagues. ➢ Teachers conduct ongoing assessment of studentsô progress, evaluate their achievement, and report results to students and parents regularly. ➢ Teachers adapt and refine their teaching practices through continuous learning and reflection, using a variety of sources and resources. ➢ Teachers use appropriate technology in their teaching practices and related professional responsibilities.
4	Leadership in Learning Communities	➢ Teachers collaborate with other teachers and school colleagues to create and sustain learning communities in their classrooms and in their schools. ➢ Teachers work with other professionals, parents, and members of the community to enhance students learning, pupil achievement, and school programs.
5	Ongoing Professional Learning	➢ Teachers engage in ongoing professional learning and apply it to improve their teaching ➢ Practices. ➢ Teachers receive awards from the government on his acquired level of training and competencies.

Figure 2.2 Professional Roles (Competencies) of Teachers for Effective Services

Source: Gather-Thurler, M. Legendre, M.F. (2000), Clark, C.M., and P.L. Peterson. 1986. Teachers Thought Processes on Core Professional Competencies for the Teaching Profession. In Handbook of Research on Teaching, 3d ed.,edited by M.C. Wittrock. New York: Macmillan

Competency

Kennewell and Morgan (2003) defined competency as a cluster of related knowledge, skills, and attitudes that affect a major part of oneǿs job (a role or responsibility), that correlates with performance on the job, that can be measured against well accepted standards, and can be improved via training and development. A competency is much more than just a description of a work task or activity. It encompasses measures of the competency and addresses the knowledge, skills and attitudes required for a person to perform a job to a required standard. Gupta (1999) defined competencies as ñknowledge, skills, attitudes, values, motivations and beliefs people need in order to be successful on a job.ò The common understanding related to teachersô competencies is divided into three main areas as field competencies, pedagogical competencies and cultural competencies.

Sefyrin (2005) differentiated between competencies and skills based on the presence or absence of a set of real action variables; otherwise, the terms are virtually synonymous. Competencies are exercises in a professional situation, whereas skills are actions that take place in a controlled or, to some extent, artificial context. While individuals must possess knowledge, skills and attitudes in their pool of resources in order to be considered competent, competency also requires something more, namely a context. A skilled person is able to mobilize resources, whereas a competent person is able to do so within a real time and space, and not just in a simulated or controlled time and space.

The requirement of context means that competent people, in the heat of the action, must be able to recognize the demands and constraints of the situation identify the available resources and take action by incorporating, combining and those resources in a way that is relevant to and effective in the circumstances. Competency therefore lies in the ability to construct, not to apply. The ability to act in the heat of the moment requires judgment, presence of mind and smartness. Teachers can therefore be described as interpreters, in that they perceive a situation in a certain way, give it meaning and, where necessary, adapt, invent or improvise to deal with it.

Competencies are defined as ñthe set of knowledge, skills, and experience necessary for future, which manifests in activitiesò (Katane, 2009). Competencies refer to skills or knowledge that leads to superior performance. These are formed through an individual/organizationôs knowledge, skills and abilities and provide a framework for distinguishing between poor performances through to exceptional performance. Competencies can apply at organizational, individual, team, and occupational and functional levels. Competencies are the characteristics of a manager that lead to the demonstration of skills and abilities, which result in effective performance within an organizational area.

Competency is not tool to be used for evaluating people for layoffs. Competency is only a way of talking about what will help people to get results in their jobs. What matters is performanceï being effective and meeting job expectations. The best way to understand performance is to observe what people actually do to be successful rather than relying on assumptions pertaining to trait and intelligence. The best way to measure and predict performance is to assess whether people have key competencies. Competencies can be learnt and developed, can be made visible/accessible, can be linked to meaningful life outcomes that describe how people should perform in the real world.

Electronic works teachers in technical colleges need to possess skill, knowledge and attitudes and then, mobilize their tools, instruments, devices and systems within a real time and space in order to become competent and effective in teaching electronic works in technical colleges.

Experienced and Less Experienced Teachers

The underlying assumption is that experience promotes effectiveness but a number of empirical studies confirm that on average, brand new teachers are effective than those with some experience (Clotfelter, Ladd, and Vigdor 2007a, 2007b; Harris and Sass 2007; Kane, Rockoff, and Staiger 2006; Ladd 2008). Teachers show the greatest productivity gains during their first few years on the job, after which their performance tends to level off. A study using New York City data illustrates the diminishing marginal returns to experience (Boyd et al. 2007). This and other research shows that, on average, The differences between experienced and less experienced teachers relate to complexity and sophistication of their thoughts about teaching.

Brillinger (2004) describes the differences between experienced and less experienced in two stages: Less experienced teacher according to Brillinger cannot regulate the amount of content, ignoring or not paying attention to the learnersô prior knowledge but experienced teachers, on the other hand learn to move to the direct teaching of curriculum, regulate the amount of content but do not adjust the flow to allow more/less when possible, and use recall questions to uncover prior learning of students.

In the opinion of Angell and Scott (2005), experienced teachers were found to plan both long-term (overall curriculum) and short-term (lesson plan), while less experienced ended to focus on short-term planning. The strategies that are planned by experienced teachers to teach specific skills are more than the ones used by less experienced teachers. Unlike experienced teachers who perceive of the class as comprised of unique individuals, less experienced teachers see the class as a whole. Student achievement is very important for experienced teachers, while less experienced teachers pay more attention to class interest.

The role of experience in learning is emphasized in experiential learning theory, Kolb, Boyatzis, and Mainemelis (2001) claim that if pre-service teachers are to be effective, they need ability in four different areas: concrete experience (CE), reflective observation (RO), abstract conceptualization (AC), and active experimentation (AE). Tsui (2003) compared less experienced and experienced teachers in the pre-active and interactive phases of teaching.

She believes that in the pre-active phase, experienced teachers differ from less experienced ones in four main characteristics: Firstly, in the planning process, experienced teachers exercise more autonomy but less experienced teachersô planning is limited to rules and models. Secondly, the planning of experienced teachers is more efficient than less experienced teachers; however, experienced teachers spend much less time planning. Thirdly, experienced teachers are much more flexible in planning because they can change their plans according to context and finally experienced teachers use a rich and integrated knowledge base.

Also, according to Tsui (2003) experienced and less experienced teachers differ from each other from three aspects. The first aspect is efficiency in processing of information in the classroom; experienced teachers have the ability to transmit information. The second point is that experienced teachers are able to select processed information adequately well and finally experienced teachers consider studentsô need and respond to a variety of events in the classroom compare to less experienced teachers.

Electronics Devices

An electronic component or device according to Toncich (2008) is any physical entity in an electronic system whose intention is to affect the electrons or their associated fields in a desired manner consistent with the intended function of the electronic system. Components are generally intended to be in mutual electromechanical contact, usually by being soldered to a printed circuit board (PCB), to create an electronic circuit with a particular function (for example an amplifier, radio receiver, or oscillator). Components may be packaged singly or in more complex groups as integrated circuits. Some common electronic components are capacitors, resistors, diodes, transistors etc

There are two types of components or devices namely active and passive components. Resistors, capacitors, inductors etc, are known as passive components because they can only attenuate the electrical voltage and signals and cannot amplify. Whereas devices like transistors, operational amplifier (Op Amp), integrated circuit can amplify or increase the amplitude and energy associated with the signals. Hence, the transistors and OpAmp come under active devices. These components or devices can be combined in different configurations by interconnecting them with conducting wires to build different useful electronic circuits, power supply and instruments.

The usefulness of the essential electronic measuring instruments such as digital multimeters, regulated power supplies, function generators, oscilloscopes etc cannot be overemphasized. Among its functions is to help in trouble shooting the circuits and identify the faulty components. Electronic devices form the basis of modern analog and digital circuits. Basic analog devices include triode, tetrode, pentode, diodes, bipolar junction transistors (BJTs) and field effect transistors (FETs). Diode based circuits include regulators and rectifiers, simple analog transistor amplifier circuits and operational amplifier circuits while simple digital circuits include AND, OR, NOR logic circuits, I.C timer etc.

The use of transistors resulted in reduction in size and weight of electronic equipments. Further miniaturization of electronic equipments became possible in early 60ǿs with the advent of integrated circuits (ICǿs). Thus IC technology consists in simultaneous fabrication of all components, devices and inters connecting wires of an electronic circuit on a very small semiconductor wafer or chip. Further, a large number of such IC chips are produced simultaneously. This results in reduction of the cost of IC chip. Rapid development in the IC technology resulted in increasing the density of packing is placing more and more components on the same small chip. This progressively gave rise to Small Scale Integration (SSI), Medium Scale Integration (MSI), Large Scale Integration (LSI), Very Large Scale

Integration (VLSI) and Very Very Large Scale Integration (VVLSI). Currently ICôs are popularly used in all electronic instruments and gadgets in preference to circuits using discrete semiconductor devices and components. More recent advances in the field of electronics include the digital circuits, microprocessors, digital computers, optoelectronics, laser technology and so on. Electronics devices will be further explained on the following headings: Resistors, Capacitors, Diodes, Zener diodes, Photo diodes, Variactor diodes, Light emitting diodes, Transistors (Bipolar, FET, UJT, and MOSFET), SCR, TRIAC, DIAC and Integrated Circuits. See appendix E on the list of devices used for teaching electronics in technical colleges.

Resistors

According to Rotterdam (2005), resistors (R) offer resistance to electric current. Electrons flowing through a resistor will lose a little bit of their energy, which results in a potential difference (electric field) across the resistor, opposite in direction to the flow of current. The resistance of a resistor is measured in Ohm (q). Ohm's law describes the relation between current, resistance and potential:

I * R = V or V / R = I

For example, When 1 mA flows through a 3.3kq resistor, there will be 3.3V across it. With 6V across a 120q resistor, a 50mA current will flow through it. A resistor is like a pipe with a kink in it; the kink makes it more difficult for the water to flow through, so the pressure before the kink will be higher than after the kink. The amount of water flowing through (the current) is the same before & after it. The circuit symbols and pictures of fixed and variable resistors are shown below:

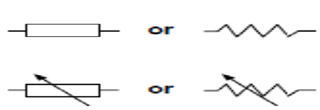


Fig 2.3 Fixed and Variable Resistors

Diodes

Diodes are the most basic of electronic devices and vetry important part of any electronic circuit design because they (and their controlled derivatives such as Thyristors) are used for: providing uni-directional current paths through a circuit, regulating and limiting voltages, power supplies, converting a.c. signals into d.c. (rectification).

Modern diodes are formed through the p-n junction which can be created by doping intrinsic (pure) silicon with group five elements (giving n-type semiconductor) and group three elements (giving p-type semiconductor). This is shown in figure 2.4.

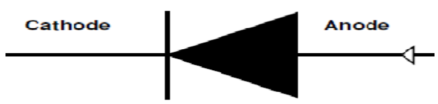


Fig 2.4 Diode

P-n junction diode has a very special feature that it allows the flow of current only in our direction and obstruct the flow of current in another direction. A first-order approximation of diode behaviour is to say that the diode is a perfect conductor (short-circuit) whenever it is forward biased (ie: Vac positive) and a perfect insulator (open-circuit) whenever it is reverse biased (ie: Vac negative).

Zener diode

Zener diode in the opinion of Padma (2009) is a p-n junction silicon diode and its safe inverse voltage or breakdown voltage is kept lower than that of any ordinary diode and each diode is designed to have a specific breakdown voltage which makes the amount of leakage current increases suddenly by increasing the reverse bias. The current flowing through the zener diode on breakdown voltage is called avalanche current or zener current. A zener diode is used in voltage regulator circuit as shown in the fig 2.5 (a voltage regulator circuit controls the voltage variations)

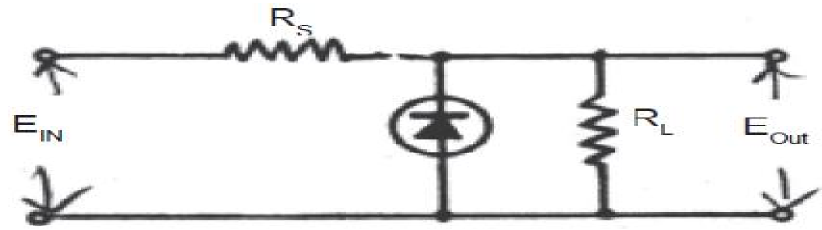


Fig 2.5 Zener Diode

Working Principle of Zener Diode

A zener diode is connected across the voltage to be regulated with a series resistor in opposite polarity. The load resistor is connected in parallel to the zener diode. When the input voltage rises beyond the breakdown voltage of the Zener diode, the conduction of current is started through the series resistor Rs. The magnitude of current flowing through Rs is equal to the sum of the currents i.e. Zener, load current. The magnitude of current through Rs (see fig 2.5) will increase further for increase in the input voltage. But due to the decreased zener resistance, only the magnitude of zener current will increase and not the magnitude of load current (R_2).

Now, there will be more voltage drop across Rs. And the output voltage will remain unchanged. In this way, the circuit can effectively work for small changes of input voltage of even less than one volt. When the diode is connected in reverse bias mode with increase in anode to cathode voltage, due to leakage currents the zener offers breakdown voltage..

Photo diode

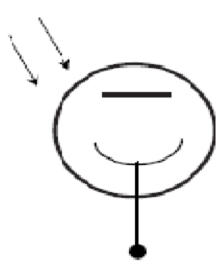


Fig 2.6 Photo diode

In the photo diode, cadmium sulphide or cadmium sulphide-selamide is deposited on a ceramic base and then the device is enclosed in a glass envelope. Cadmium sulphide is a semiconductor and its resistance decreases with the incidence of light rays on it. If the resistance of a photo diode in dense darkness is 10 mega ohms then its resistance will remain only 300 ohms in the presence of 92 foot - candle light. It is used in automatic flash system in photo cameras where the photo diode does not allow the shutter of the camera to get open in dim light.

Variactor diode

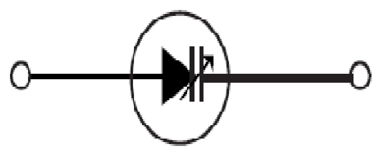


Fig 2.7 Variactor Diode

It is a pn junction diode designed to work at high frequencies. Its internal capacitance depends on the voltage applied across it, whereas in an ordinary diode the same is limited to a minimum possible value. Since the internal capacitance of a varactor diode varies in accordance with the signal applied, hence it is used for amplification, frequency multiplication and switching purposes. The effective capacitance of a varactor diode depends on the reverse bias voltage applied to varactor diode.

Applications

The device can be used in RF tuning circuit tuner in TV receivers in different channels or TV tuners. This type of circuit can be used in remote controlled tuning circuit of receivers.

Light emitting diode

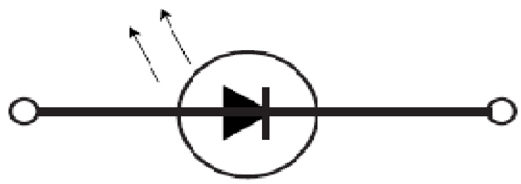


Fig 2.8 Light emitting diode

It is a special type of diode which is different from a conventional semiconductor diode. It employs a gallium-arsenide (ga-as) or gallium phosphide (ga-p) pn junction instead of a germanium or silicon PN-junction. In LED, the rate of recombination of holes and free electrons is much higher due to which energy packets (photons) are released by the pn junction in the form of light rays of visible and infrared spectrum. Common type of LEDôS are operated at a forward bias of IV to 3V and they emit light at a current of 10MA to 15 MA. They are made in four different colours - green, red, yellow and blue.

Applications

1. It is used in remote sensing applications.
2. It is also used as a light indicator in electronic equipments for various visual display purposes.

Transistors

The transistor was developed shortly after the invention of a p-n junction diode. A transistor is used for amplification. Primarily, transistors are of two types: NPN and PNP. A PNP transistor (see figure 2.9) consists of two p-regions and a very thin n-region between them. Similarly, NPN transistor consists of two n-regions and a very thin p-region between them (figure 2.10).

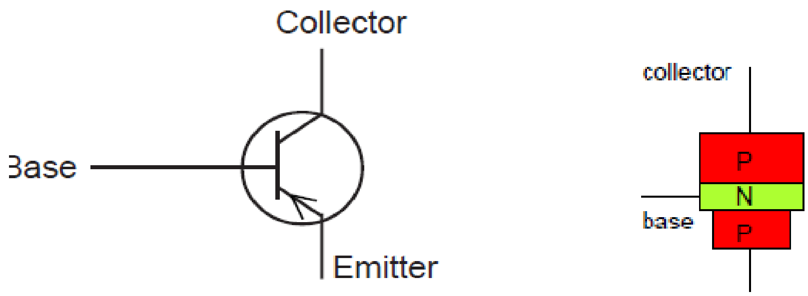


Fig 2.9 PNP Transistor

Fig 2.10 NPN Transistor

Transistors can also be grouped into four based on their manufacturing process. These are

1) Based Junction Transistor (BJT) consists of NPN and PNP transistor.
2) Unijunction Transistor (UJT)
3) Field effect Transistor (FET)
4) Metal Oxide Junction Transistor (MOSFET)

Bipolar Junction Transistor (BJT)

The conduction of current in both types of transistors (NPN and PNP) takes place by the movement of ófree electronsô and óholesô. Such transistors are called bipolar transistors. In the case of Unipolar transistors, the conduction of current takes place either in voltage mode of operation or current mode of operation. Voltage and current amplification is done in both cases.

Working of a p-n-p transistor:

In a PnP transistor, emitter is heavily doped, collector is moderately doped and base thinly doped. A PnP transistor in forward bias state is shown in the figure 2.11 below. Its emitter is connected to the positive and collector to the negative terminal of the battery. A small amount of negative voltage is applied to the base.

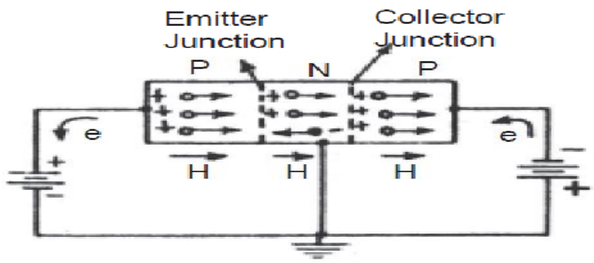


Fig 2.11 Doping of PNP transistor

Transistor configurations

A transistor can be connected in three configurations in a circuit which are called three basic configurations. Input signal can be applied to the three configurations. Between any two electrodes of a transistor and the output can be taken from the third electrode and the electrode kept common. The three basic connections are:

1) Common Base Circuit (CB)
2) Common Emitter Circuit (CE)
3) Common Collector Circuit (CC)

Common base circuit

A common base circuit is shown in the figure 2.12. The input is applied between the base and the emitter and the output is taken from the base and the collector. In this way the base remains common in this circuit. The circuit has low input impedance (50 to 500ɤ) and high output impedance (1 to 10mɤ). The current gain is less than unity.

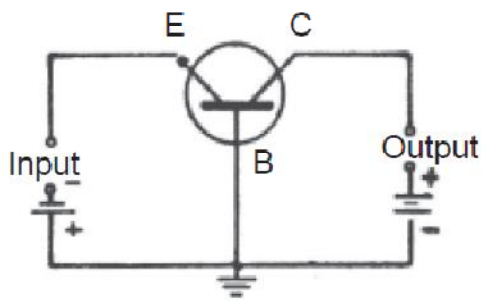


Fig 2.12 Common Base of NPN

Common Emitter Connection

A common emitter circuit is shown in the figure 2.13. The input is applied between the emitter and base and the output is taken from the emitter and collector. In this way, the emitter remains common to both input and output. The circuit has a input impedance is 1Kto 2K. The output impedance is above 100K. The current gain of this circuit is 20-200.

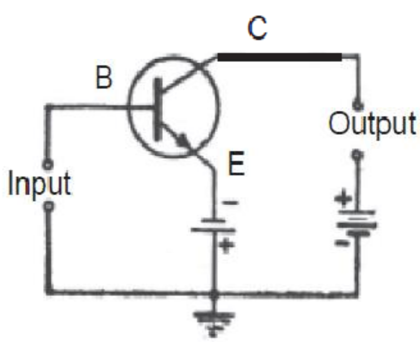


Fig 2.13 Common Emitter of NPN

Common collector Connection

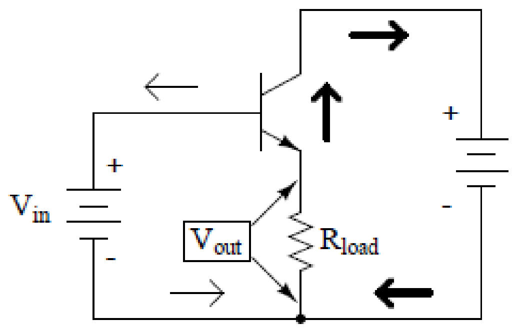


Fig 2.14 Common collector of NPN

Common collector amplifier has collector common to both input and output. It is called the common-collector configuration because (ignoring the power supply battery) both the signal source and the load share the collector lead as a common connection point (see figure 2.14). The common-collector amplifier is also known as an emitter-follower. The output voltage on a common-collector amplifier will be in phase with the input voltage, making the common-collector a non-inverting amplifier circuit. The current gain of a common-collector amplifier is equal to plus 1. The voltage gain is approximately equal to 1 (in practice, just a little bit less). A Darlington pair is a pair of transistors ñpiggybackedò on one another so that the emitter of one feeds current to the base of the other in common-collector form. The result is an overall current gain equal to the product (multiplication) of their individual common collector current gains.

Base current Amplification Factor

The ratio of change in collector current (I_C) to the change in base current (I_B) is known as base current amplification factor. i.e I_C / I_B **I_{CEO} :** In CE configuration, a small collector current flows when the base current is zero. This is collector cutoff current i.e. these are called reverse saturation currents the collector current that flows when base is open and is denoted by I_{CEO} (collector to emitter reverse saturation current). The value of I_{CEO} is much larger than I_{CBO} (collector to base reverse saturation current.

Uni Junction Transistor (UJT)

A UJT is a three terminal semiconductor switching device (Figure 2.15). It consists of N-type silicon far with an electrical connection on each end. The leads to these connections are called base leads base-one B1 and base two B2. Partway along the bar between the two bases, nearer to B2 than B1, a PN Junction is formed between a P-type emitter and the bar. The lead to this junction is called the emitter lead.

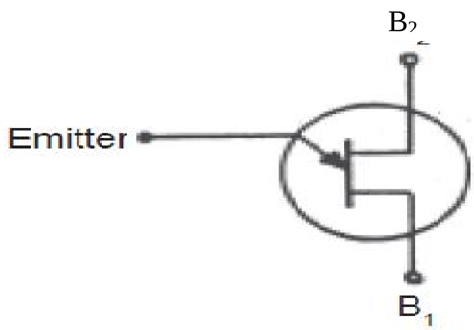


Fig 2.15 Uni Junction Transistor (UJT)

In a common type circuit, B1 is grounded and the positive signal is applied to base-2. The N-region acts as a voltage divider so long as the magnitude of emitter current in the emitter region is zero. Hence a positive potential is maintained on the junction. If the magnitude of emitter voltage is lesser than the voltage present on the base, the transistor will remain in reverse bias state. When the emitter voltage exceeds the voltage present on the base, the transistor will be changed into forward bias state and the holes will start to reach the base-1 region by crossing the emitter junction. In this way, the conduction of emitter current will start and the effective resistance of the junction will be reduced. It will produce a rise in emitter voltage. Hence, the transistor will show a negative resistance characteristic.

Applications

The transistor is used as:

1. Relaxation oscillator
2. Over voltage detector
3. Timer circuit
4. Pulse and voltage sensing circuits.

FET (Field Effect-Transistor)

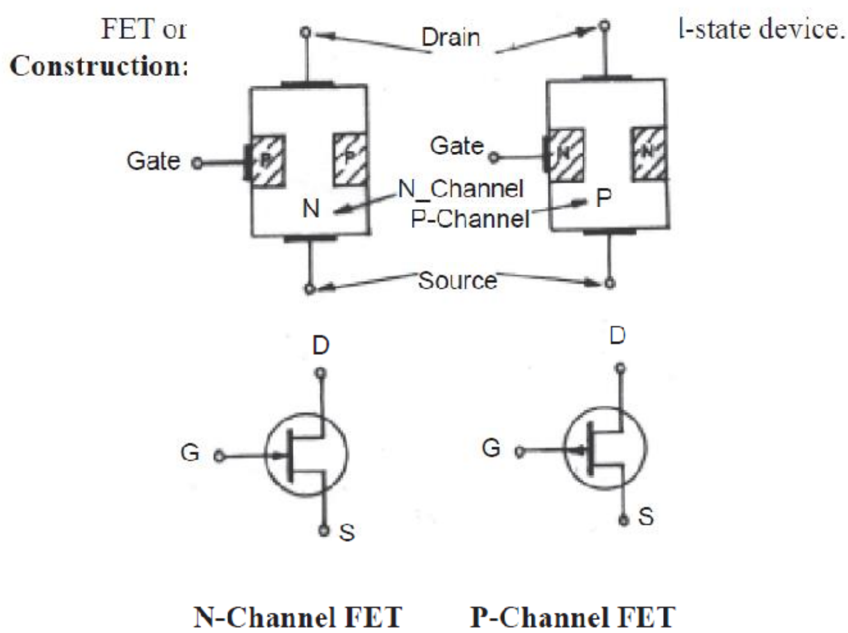


Fig 2.16 Field Effect Transistor (FET)

A FET can be fabricated with either N-channel or P-channel; N channel is preferred. For fabricating N-channel FET, a narrow bar of N-type semiconductor is taken and two P-type junctions are diffused on opposite sides of its middle part as shown in figure 2.16. These two junctions form two P-N diodes or Gates and the area remained between the two gates is called the CHANNEL. The two gates are connected internally and a single connecting lead is brought out of the device which is called the gate terminal. Two leads are joined to the bar, one on each side and they are called the Source and Drain.

Advantages of FET

1) High input impedance

2) Small size, rugged and long life

3) Low noise, good high frequency response

4) Better thermal stability

5) High power gain

6) It is a unipolar device

Applications

1) As input stage in amplifiers in oscilloscopes and other electronic testing instruments

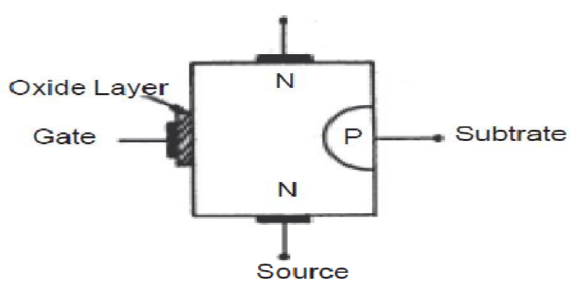
2) In logic circuits

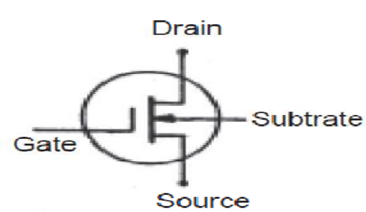
3) As ómixerô stage in FM radio and TV receivers

4) In computers for large scale integration (LSI) in memory circuits.

Metal Oxide Semiconductor FET (MOSFET)

The input impedance of a MOSFET is much more than that of a JFET because of very small gate leakage current. The MOSFET can be used in any of the Drain circuits covered for the JFET.





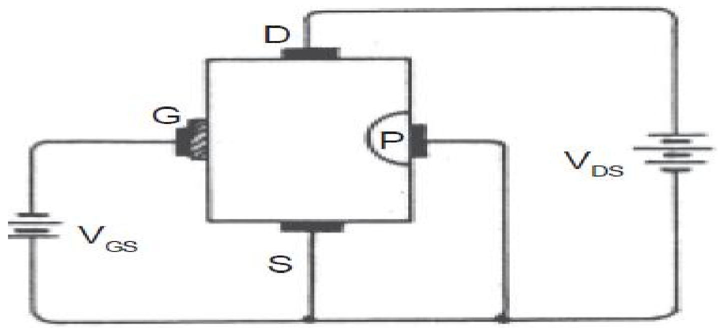


Fig 2.17 Metal Oxide Semiconductor FET (MOSFET)

The above Fig 2.17 shows the circuit of MOSFET instead of gate diode as in JFET, here gate is formed as a small capacitor. The following points are noted:

(i) In a MOSFET, the source to drain current is controlled by the electric field of capacitor formed at the gate.

(ii) Unlike the JFET, a MOSFET has no gate diode. This makes it possible to operate the device with positive or negative gate voltage.

(iii) As the gate forms a capacitor, therefore, negligible gate current flows whether positive or negative voltage is applied to the gate. Consequently, the input impedance of MOSFET is very high, ranging from 1,000M to 10,000,00M

Applications of MOSFET

MOSFET is used in

1) óMixerô operation of FM radio and TV receivers.
2) Voltage variable resistors in computer memories.

Silicon Controlled Rectifier (SCR)

A SCR is a solid state equivalent device of a thyratron (see in figure 2.18). It consists of a P-N alloy junction and a diffused P-N-P silicon transistor joined together. Its main part is the P-N rectifier. The N-P-N transistor is diffused as a dot in the N-Region of the rectifier. These two sections together form a PNPN silicon device. The rectifier has an anode and cathode and the P-N-P dot is called gate. In this way, a SCR has three terminals named anode, cathode and gate shown in figure 2.18

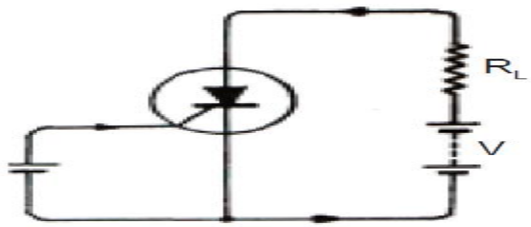


Fig 2.18 Silicon Controlled Rectifier (SCR)

Applications

1) Switching circuits

2) Regulated Power Supplies

3) Radar Modulator

4) Servo System

5) Electronic Ignition System etc.

6) Speed control motor and short circuit protection in electronic Systems

TRIAC

A TRIAC is a three terminal semiconductor switching device which can control alternating current in a load. A TRIAC is equivalent to two SCRôs joined together in parallel. It has two main terminals and one gate as shown in figure 2.19 below.

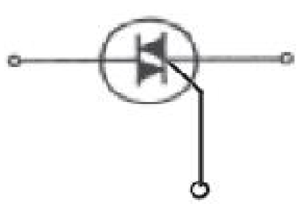


Fig 2.19 Triac

It has the characteristic of keeping its main terminal no.2 on positive or negative potential and then by applying a positive or negative pulse to the main terminal no.1, a conduction of current can start. Once it starts to conduct, the gate will no longer have a control over the conduction of current like a SCR. The conduction of current continues till the value of voltage on the main terminal which falls below the operating voltage.

Applications

1) Used in digital circuits

2) Used as electronic on/off switch controlled by a low-current mechanical switch.

3) As a high power lamp switch

4) As electronic changeover of transformer taps.

DIAC

A DIAC is a two-terminal, three-layer bidirectional device which can be switched from its OFF state to ON state for either polarity of applied voltage.

Fig 2.20 Diac

The DIAC can be constructed in either NPN or PNP form. The fig 2.23 shows the basic structure of a DIAC in PNP form. The two leads are connected to P regions of silicon separated by an N-region. The structure of a DIAC is very much similar to that of a transistor. When the positive or negative applied voltage is equal to or greater than the break down voltage, DIAC begins to conduct and the voltage drop across it becomes a few volts. Conduction then continues until the device current drops below its holding current.

Applications

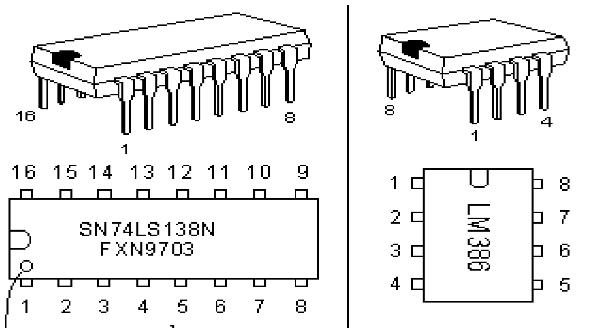
1) DIACS are primarily used for triggering of TRIACS in adjustable phase control of a.c. mains power

2) Light dimming

3) Heat control

4) Universal motor speed control

Integrated Circuit (IC)



Dimple

Fig 2.21 Integrated circuit (IC)

An integrated circuit, commonly referred to as IC, is a microscopic array of electronic circuits and components that has been diffused or implanted onto the surface of a single crystal, or chip, of semiconducting material such as silicon. It is called an integrated circuit because the components, circuits, and base material are all made together, or integrated, out of a single piece of silicon, as opposed to a discrete circuit in which the components are made separately from different materials and assembled later. ICs range in complexity from simple logic modules and amplifiers to complete microcomputers containing millions of elements.

The impact of integrated circuits on peopleôs lives has been enormous. ICs have become the principal components of almost all electronic devices. These miniature circuits have demonstrated low cost, high reliability, low power requirements, and high processing speeds compared to the vacuum tubes and transistors which preceded them. Integrated circuit microcomputers are now used as controllers in equipment such as machine tools, vehicle operating systems, and other applications where hydraulic, pneumatic, or mechanical controls were previously used. Because IC microcomputers are smaller and more versatile than previous control mechanisms, they allow the equipment to respond to a wider range of input and produce a wider range of output. They can also be reprogrammed without having to redesign the control circuitry. Integrated circuit microcomputers are so inexpensive they are even found in children's electronic toys.

According to Baker (2010), Integrated Circuits are usually called ICs or chips. They are complex circuits which have been etched onto tiny chips of semiconductor (silicon). The chip is packaged in a plastic holder with pins spaced on a 0.1" (2.54mm) grid which will fit the holes on stripboard and breadboards. Very fine wires inside the package link the chip to the pins. The pins are numbered anti-clockwise around the IC (chip) starting near the notch or dot. The figure 2.21 shows the numbering for 16-pin and 8-pin ICs, but the principle is the same for all sizes. Integrated Circuits play a very important part in electronics. Most are specially made for a specific task and contain up to thousands of transistors, diodes and resistors. Special purposes IC's such as audio-amplifiers, FM radios, logic blocks, regulators and even a whole micro computer in the form of a micro controller can be fitted inside a tiny package.

Silicon is the most widely used material in designing a chip because it is easy to process and has the perfect temperature range for electronics devices; it is used for almost every component of the IC. Although, elements like gallium arsenides are applied to specialized areas like LEDs, lasers, solar cells and the highest speed integrated circuit. All electronic devices could be effectively thought in Technical Colleges by allowing the student to physically see, touch and use the devices and these will become possible when the teacher has the competence to identify and demonstrate the use of the devices and components in teaching and learning situation.

Electronic Circuit

Before the invention of computers, people used the abacus, mechanical calculators, and electro-mechanical calculators to help process information. These devices were relatively slow because they relied on moving parts to process information. A 'circuit' can be defined as anything from a single component, to systems containing thousands of components**.** Electronic Circuits can be categorised as analog electronic circuits and digital electronic circuits. Analog electronic circuits are different from digital circuits in that the signals are expected to have any value rather than two discrete values. Primitive analog components include the diode, MOSFET, BJT, resistor, capacitor, etc.

Analog circuits

Most analog electronic appliances, such as radio receivers, are constructed from combinations of a few types of basic circuits. Analog circuits use a continuous range of voltage as opposed to discrete levels as in digital circuits. Analog circuits are sometimes called linear circuits although many non-linear effects are used in analog circuits such as mixers, modulators, etc. Good examples of analog circuits include vacuum tube and transistor amplifiers, operational amplifiers and oscillators.

Digital circuits

Digital circuits are electronic circuits based on a number of discrete voltage levels. Digital circuits are the most common physical representation of boolean algebra and are the basis of all digital computers. To most engineers, the terms "digital circuit", "digital system" and "logic" are interchangeable in the context of digital circuits. Most digital circuits use two voltage levels labeled "low"(0) and "high"(1). Often "low" will be near zero volts and "high" will be at a higher level depending on the supply voltage in use. Computers, electronic clocks, and programmable logic controllers (used to control industrial processes) are constructed of digital circuits. Digital signal processors are another example.

Heat Dissipation and Thermal Management of Electronics Circuits

Heat generated by electronic circuitry must be dissipated to prevent immediate failure and improve long term reliability. Techniques for heat dissipation can include heat sinks and fans for air cooling, and other forms of computer cooling such as water cooling. These techniques use convection, conduction, & radiation of heat energy that the teacher who has the competence will demonstrate to the students on how to use various techniques.

Electronic Instruments

Any time a new circuit is designed or repaired; electronic instrument is used to measure the performance of such circuit, electronic component or system. Almost every task requires an oscilloscope, the basic instrument for visualizing the time dependence of electronic signals. A signal or function generator is used to produce periodic signals of the frequency, amplitude, and waveform needed for input to the device under test. The counter/timer can measure time intervals and frequencies very accurately, and the digital multimeter measures voltages, currents, resistance, and it can test silicon diodes and transistors. Electronic Instruments can be grouped into two: Analog instruments and Digital instruments. Examples of the two multimeter instruments are shown in figures 2.22 and 2.23 respectively.

Multimeter

A Multimeter is indeed a multiple meter. It measures dc and ac voltages, currents and in addition resistances. In some recent Digital Multimeters (DMMs), they can measure even frequency, capacitance, etc. Two long probes are used to connect the DMM to a circuit during a measurement. The central dial knob is rotated to choose the parameter that is necessary to measure. When not in use, the knob is kept in OFF position.

Analog instrument

Figure 2.22 Analogue Multimeter

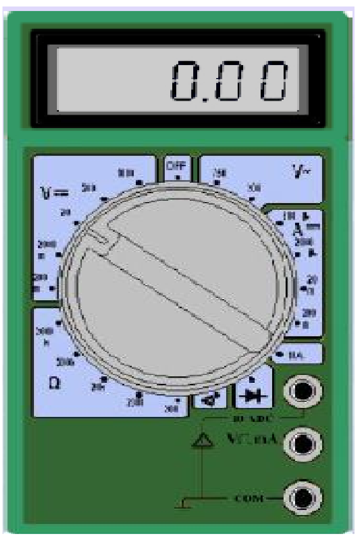


Figure 2.23 Digital Multimeter

Oscilloscope

Oscilloscope has a built-in digital measurement and cursor capability which is very useful for making measurements on the screen. There are a few precautions to observe when operating the oscilloscope:

ÅAvoid burning out the screen. Turn down the intensity for a stationary bright spot, or a very bright line.

ÅAvoid overheating the instrument. Do not block ventilation of the interior by laying books or clothes on the case. This precaution applies to any instrument.

ÅDo not apply more than 400 V to any input terminal.

ÅAvoid serious or fatal injury from electrical shock. Voltages up to 14 kV occur inside the unit. Do not remove the cover or insert anything metallic through the vent holes.

Measuring Resistor

A resistor and some capacitors can be measured through their colour codes and the colour code for resistors can be learned through understanding the sequence of colors: **b**lack, **b**rown, **r**ed, **o**range, **y**ellow, **g**reen, **b**lue, **v**iolet, **g**ray, **w**hite which can be remembered by memorizing this mnemonic: **B**lack **b**ears **r**esting **o**n **y**our **g**ear **b**ring **v**ery **g**ray **w**eather. In order to determine the values of the resistors in Figure 2.24, the resistance should be written using the most appropriate units of kilo ohms or Mega ohms, and include the % tolerance.

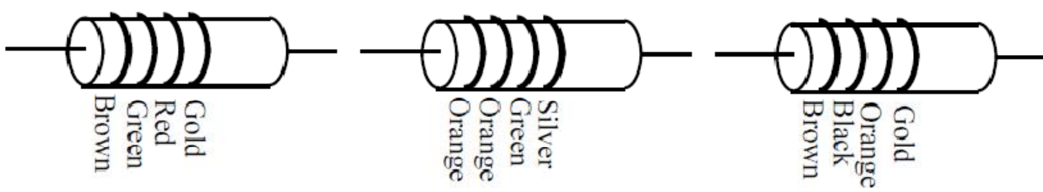


Fig 2.24 Color Coded Resistors

Capacitors can be labeled by using a three-digit number code. The label 224 means 22 with 4zeros, interpreted as a capacitance value in picofarads (224 = 220,000 pF = 220 nF). Another notation is 220 uuF, which means 220 picofarads (uu = micromicro). Examples of capacitors measured in colour code are shown in figure 2.25

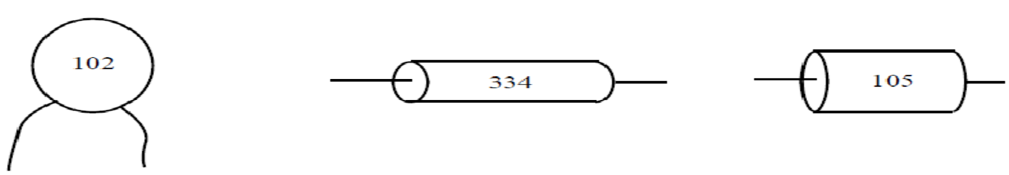


Fig 2.25 Capacitors using colour code

Using Meter to Check Diode

An ohmmeter may be used to qualitatively check diode function. There should be low resistance measured one way and very high resistance measured the other way. When using an ohmmeter for this purpose (see figure 2.26), it is necessary to be sure which test lead is positive and which is negative! The actual polarity may not follow the colors of the leads as you might expect, depending on the particular design of meter. Some multimeters provide a ñdiode checkò function that displays the actual forward voltage of the diode when it is conducting current. Such meters typically indicate a slightly lower forward voltage than what is ñnominalò for a diode, due to the very small amount of current used during the check.

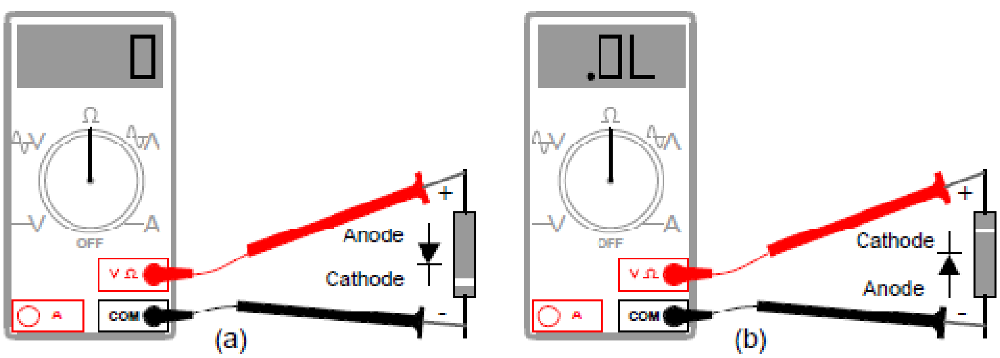


Fig 2.26 Using Meter to check diode

Determination of diode polarity: (a) Low resistance indicates forward bias, black lead is cathode and red lead anode (for most meters) (b) Reversing leads shows high resistance indicating reverse bias.

Meter Check of a Bipolar Transistor

Bipolar transistors are constructed of a three-layer semiconductor ñsandwich,ò either PNP or NPN. As such, transistors register as two diodes connected back-to-back when tested with a multimeterôs ñresistanceò or ñdiode checkò function as illustrated in Figure 2.27. Low resistance readings on the base with the black negative (-) leads correspond to an N-type base in a PNP transistor. On the symbol, the N-type material corresponds to the ñnon pointingò end of the base-emitter junction, the base. The P-type emitter corresponds to ñpointingò end of the base emitter junction the emitter. Some multimeters are equipped with two separate continuity check functions: resistance and ñdiode check,ò each with its own purpose. If the meter has a designated ñdiode checkò function, use that rather than the ñresistanceò range, and the meter will display the actual forward voltage of the PN junction and not just whether or not it Conducts current. Meter readings will be exactly opposite, of course, for an NPN transistor, with both PN junctions facing the other way. Low resistance readings with the red (+) lead on the base are the ñoppositeò condition for the NPN transistor.

According to Rotterdam (2005), if a multimeter with a ñdiode checkò function is used in this test, it will be found that the emitter-base junction possesses a slightly greater forward voltage drop than the collector-base junction. This forward voltage difference is due to the disparity in doping concentration between the emitter and collector regions of the transistor: the emitter is a much more heavily doped piece of semiconductor material than the collector, causing its junction with the base to produce a higher forward voltage drop. Knowing this, it becomes possible to determine which wire is which on an unmarked transistor. This is important because transistor packaging, unfortunately, is not standardized. All bipolar transistors have three wires, of course, but the positions of the three wires on the actual physical package are not arranged in any universal, standardized order.

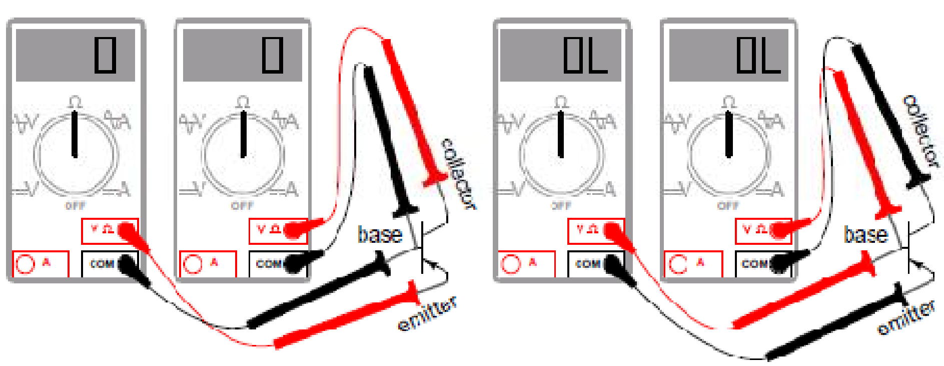


Fig 2.27 Using Meter to check Bipolar Transistor

Meter Check of a JFET **Transistor**

Testing a JFET with a multimeter is relatively easy task, seeing as how it has only one PN junction to test: either measured between gate and source, or between gate and drain (see figure 2.28).

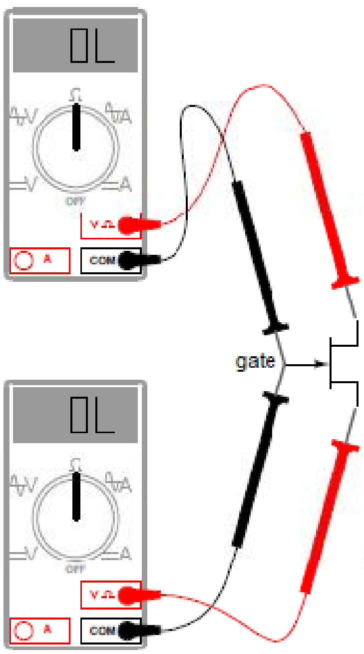


Fig 2.28 Using Meter to check JFET Transistor

A good strategy to follow when testing a JFET is to insert the pins of the transistor into anti-static foam (the material used to ship and store static-sensitive electronic components) just prior to testing. The conductivity of the foam will make a resistive connection between all terminals of the transistor when it is inserted. This connection will ensure that all residual voltage built up across the gate-channel PN junction will be neutralized, thusòopening upò the channel for an accurate meter test of source-to-drain continuity. Since the JFET channel is a single, uninterrupted piece of semiconductor material, there is usually no difference between the source and drain terminals. A resistance check from source to drain should yield the same value as a check from drain to source. This resistance should be relatively low (a few hundred ohms at most) when the gate-source PN junction voltage is zero. By applying a reverse-bias voltage between gate and source, pinch-off of the channel should be apparent by an increased resistance reading on the meter.

Meter check of SCR

A rudimentary test of SCR function, or at least terminal identification, may be performed with an ohmmeter. Because the internal connection between gate and cathode is a single PN junction, a meter should indicate continuity between these terminals with the red test lead on the gate and the black test lead on the cathode shown in Figure 2.29

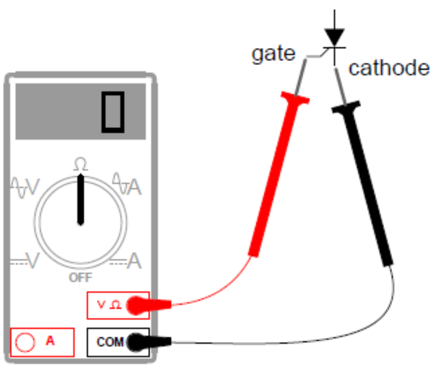


Fig 2.29 Using Meter to check SCR

All other continuity measurements performed on an SCR will show òopenò (òOLò on some digital multimeter displays). It must be understood that this test is very crude and does not constitute a comprehensive assessment of the SCR. It is possible for an SCR to give good ohmmeter indications and still be defective. Ultimately, the only way to test an SCR is to subject it to a load current.

When a multimeter with aòdiode checkò function is used, the gate-to-cathode junction voltage indication may or may not correspond to whatôs expected of a silicon PN junction (approximately 0.7 volts). In some cases, it will read a much lower junction voltage: mere hundredths of a volt. This is due to an internal resistor connected between the gate and cathode incorporated within some SCRs. This resistor is added to make the SCR less susceptible to false triggering by spurious voltage spikes, from circuit ònoiseò or from static electric discharge.

In other words, having a resistor connected across the gate-cathode junction requires that a strong triggering signal (substantial current) be applied to latch the SCR. This feature is often found in larger SCRs, not on small SCRs. Bear in mind that an SCR with an internal resistor connected between gate and cathode will indicate continuity in both directions between those two terminals. A competent teacher in electronic classroom will use measuring instruments to differentiate good components from bad one, measure electrical quantity and use the good components to design useful circuitry.

Radio Communications

Radio communications facilities usually can be installed more quickly than wire communications. Thus, Radio can be used as a primary means of communications during the initial stages of combat operations. Once installed in a vehicle, aircraftt, or ship, the equipment is ready for use and does not require reinstallation. Wire communications require reinstallation with each move. Radio equipment is designed to meet mobility requirements and is used by airmobile, amphibious, mechanized, and dismounted units. Radio lends itself to many modes of operation, such as radiotelephone, radiotelegraph, radio teletypewriter (RATT), visual presentation, and data. All of the modes of operation are securable when required equipment is available.

The simplest radio transmitter consists of a power supply and an oscillator, capable batteries, a generator, an alternating current power source with a rectifier and a filter, or, a direct Current (dc) rotating power source. The Oscillator, which generates RF energy, must contain a circuit to tune the transmitter to the desired operating frequency. The transmitter must also have some device for controlling the emission of the RF Signal. The simplest device is a telegraph key, which is a type of switch for controlling the flow of electric current. As the key is operated, the oscillator is turned on and off for varying lengths of time. The Varying pulses of RF energy produced correspond to dots and dashes. This method is used when transmitting international morse code (IMC). This method is called continuous wave (CW) operation.

Continuous wave (cw) transmitter: A radio transmitter is used to generate rf energy which is Radiated into space. The transmitter may contain only a simple oscillator stage. Usually, the output of the Oscillator is applied to a buffer stage to increase oscillator stability and to a power amplifier which produces greater output. A telegraph key may be used to control the energy waves produced by the transmitter. When the key is closed, the transmitter produces its maximum output. When the key is opened, no output is produced.

Radio waves belong to the electromagnetic radiation family, which includes x-ray, ultraviolet, and visible light. However, unlike water waves, radio waves propagate at the speed of light. Figure 2.30 shows Radio wave amplitude, or strength, which can be visualized as its height being the distance between its peak and its lowest point.

Amplitude, which is measured in volts, is usually expressed in terms of an average value called root-mean-square, or RMS. The frequency of a radio wave is the number of repetitions or cycles it completes in a given period of time. Frequency is measured in Hertz (Hz); one Hertz equals one cycle per second. Thousands of Hertz are expressed as kilohertz (kHz), and millions of Hertz as megahertz (MHz). A typically example of frequency is 2,345,000 Hertz which can be written as 2,345 kHz or 2.345 MHz. Radio wavelength is the distance between crests of a wave. The product of wavelength and frequency is a constant that is equal to the speed of propagation. Thus, as the frequency increases, wavelength decreases, and vice versa. So, the wavelength of a 10 MHz wave is 30 meters, determined by dividing 300 by 10.

Radio signals propagate from a transmitting antenna as waves through space at the speed of light. Different portions of this band are allocated to specific radio services under international agreement. Modulation is the process whereby the phase, amplitude, or frequency of a carrier signal is modified to convey intelligence. HF radio waves can propagate as sky waves, which are refracted from the earthǿs ionosphere, permitting communications over long distances. Radio waves travel from a transmitter to a receiver in three ways (see figure 2.30).

1. Ground Wave The ground wave travels near the ground for short distances, typically 80 kms over land and 300 kms over the sea. This however depends on a number of factors such as operating frequency, transmitted power, type of antenna and terrain (typically HF communications equipment).

2. Direct Wave The direct wave travels in direct line from transmitter to receiver. Direct wave propagation allows communication within line-of-sight (typically VHF communications equipment).

3. Sky Wave The radio wave is transmitted towards the sky, which is then reflected by the ionosphere to a distant receiver. It is by this process that large distances can be achieved (typically HF equipment)

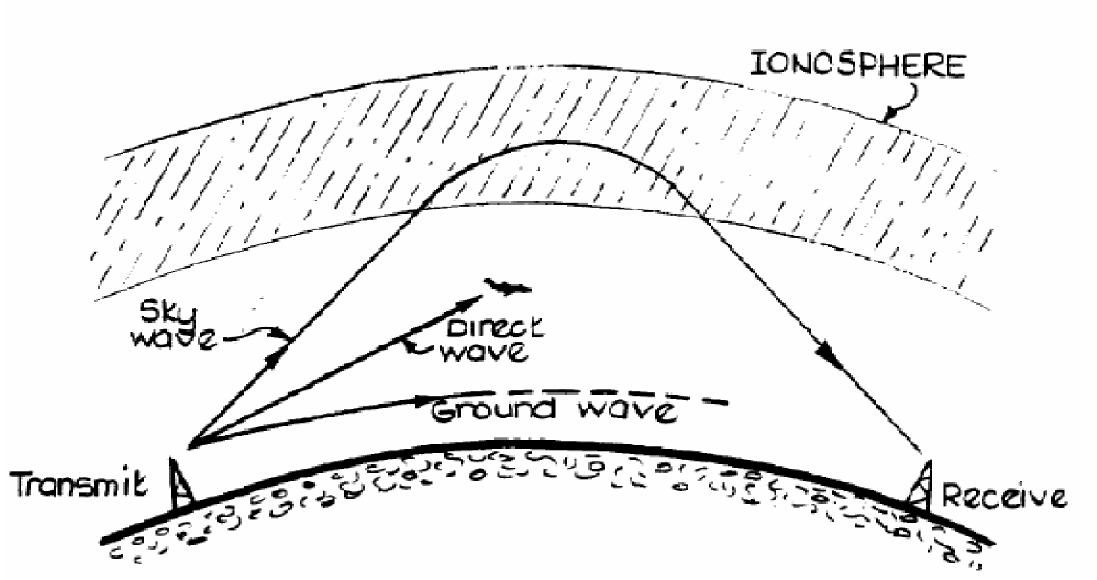


Fig 2.30: Radio wave propagation

There are many factors that affect the propagation of radio waves and the reception of a signal. Some of the factors are; the ionosphere, sunspots, climate, atmospheric, manmade noise, signal characteristics and terrain to mention but few. The radio frequency spectrum is stated below which may enhance the competence of teachers in electronics.

The Radio frequency Spectrum

Medium Frequency (MF)	300 Khz to 3 Mhz
High Frequency (HF)	3Mhz to 30 Mhz
Very High frequency (VHF)	30 Mhz to 300 Mhz
Ultra High Frequency (UHF)	300 Mhz to 3 Ghz.

Television System

The fundamental aim of a television system is to extend the sense of sight beyond its natural limits, along with the sound associated with the scene being televised. Essentially then, a TV system is an extension of the science of radio communication with the additional complexity that besides sound the picture details are also to be transmitted. In most monochrome television systems, the picture signal is amplitude modulated and sound signal is frequency modulated before transmission. The carrier frequencies are suitably spaced and the modulated outputs radiated through a common antenna. Thus each broadcasting station can have its own carrier frequency and the receiver can then be tuned to select any desired station. Figure 2.32 shows a simplified block representation of a TV transmitter and receiver.

Picture Transmission

The picture information is an assemblage of a large number of bright and dark areas representing picture details. These elementary areas into which the picture details may be broken up are known as ópicture elementsö, which when viewed together, represent the visual information of the scene. Thus the problem of picture transimission is fundamentally much more complex, because, at any instant there are almost an infinite number of pieces of information, existing simultaneously, each representing the level of brightness of the scene to be reproduced. In other words the information is a function of two variables, time and space. Ideally then, it would need an infinite number of channels to transmit optical information corresponding to all the picture elements simultaneously.

Presently the practical difficulties of transmitting all the information simultaneously and decoding it at the receiving end seem insurmountable and so a method known as scanning is used instead. Here the conversion of optical information to electrical form and its transmission are carried out element by element, one at a time and in a sequential manner to cover the entire scene which is to be televised. Scanning of the elements is done at a very fast rate and this process is repeated a large number of times per second to create an illusion of simultaneous pick-up and transmission of picture details.

A TV camera, the heart of which is a camera tube, is used to convert the optical information into a corresponding electrical signal, the amplitude of which varies in accordance with the variations of brightness. Fig.2.31 (a) shows very elementary details of one type of camera tube (vidicon) to illustrate this principle. An optical image of the scene to be transmitted is focused by a lens assembly on the rectangular glass face-plate of the camera tube.

Elements of a Television System

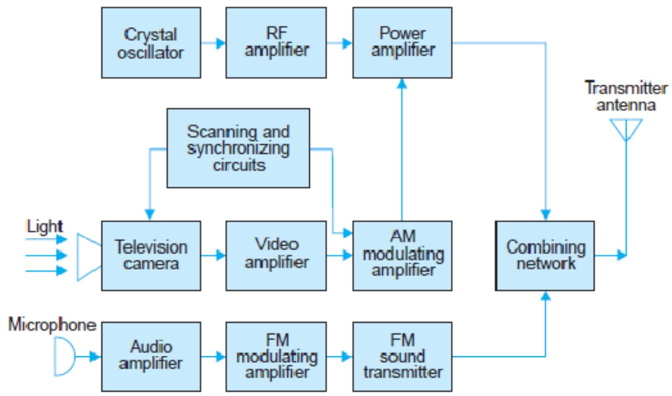


Fig. 2.31 (a) Basic monochrome television transmitter.
Source: Grob, B. & Herndon. C. E. (1999.) *Basic Television and Video Systems*. 6th Ed. New York: McGraw Hill

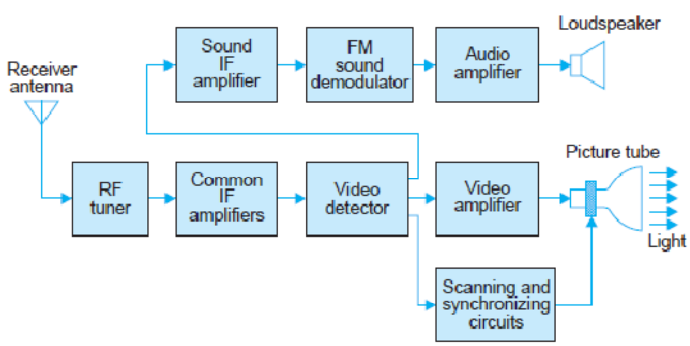


Fig. 2.31 (b) Basic monochrome television receiver.

Source: Grob, B. &. Herndon. C. E (1999). *Basic Television and Video Systems*. 6th Ed. New York: McGraw Hill

Fig. 2.31b is a simplified block diagram of a monochrome television broadcasting system. The side of the glass face-plate has a transparent conductive coating on which is laid a very thin layer of photoconductive material. The photolayer has a very high resistance when no light falls on it, but decreases depending on the intensity of light falling on it. Thus, depending on the light intensity variations in the focused optical image, the conductivity of each element of the photolayer changes accordingly. An electron beam is used to pick-up the picture information now available on the target plate in terms of varying resistance at each point. The beam is formed by an electron gun in the TV camera tube. On its way to the inner side of the glass faceplate it is deflected by a pair of deflecting coils mounted on the glass envelope and kept mutually perpendicular to each other to achieve scanning of the entire target area.

Scanning is done in the same way as one reads a written page to cover all the words in one line and all the lines on the page (see Fig. 2.31 (b)). To achieve this, deflecting coils are fed separately from two sweep oscillators which continuously generate saw-tooth waveforms, each operating at a different desired frequency. The magnetic deflection caused by the current in one coil gives horizontal motion to the beam from left to right at a uniform rate and then brings it quickly to the left side to commence the trace of next line. The other coil is used to deflect the beam from top to bottom at a uniform rate and for its quick retrace back to the top of the plate to start this process all over again. Two simultaneous motions are thus given to the beam, one from left to right across the target plate and the other from top to bottom, thereby covering the entire area on which the electrical image of the picture is available. As the beam moves from element to element, it encounters a different resistance across the target-plate, depending on the resistance of the photoconductive coating. The result is a flow of current which varies in magnitude as the elements are scanned. This current passes through a load resistance RL, connected to the conductive coating on one side and to a dc supply source on the other. Depending on the magnitude of the current a varying voltage appears across the resistance RL and this corresponds to the optical information of the picture.

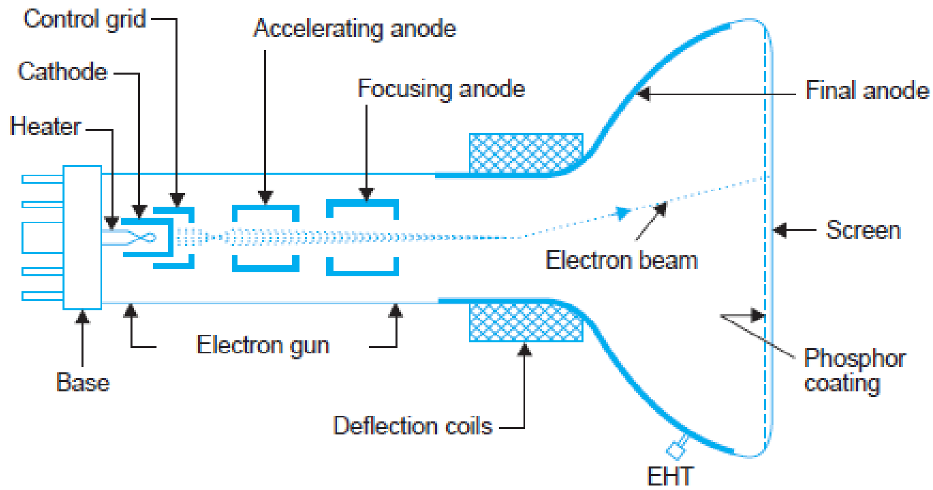


Fig. 2.32: A Simplified cross-sectional view of a Vidicon TV camera tube.

Source: Whitaker J. C. and Benson K. B. (2000.) *Standard Handbook of Video and Television Engineering.* 3rd Ed. New York: McGraw-Hill,

Elements of a Television System

When the scanning beam moves at such a rate that any portion of the scene content does not have time to move perceptibly in the time required for one complete scan of the image, the resultant electrical signal contains the true information existing in the picture during the time of the scan. The desired information is now in the form of a signal varying with time and scanning may thus be identified as a particular process which permits the conversion of information existing in space and time coordinates into time variations only. The electrical information obtained from the TV camera tube is generally referred to as video signal (see figure 2.33). This signal is amplified and then amplitude modulated with the channel picture carrier frequency. The modulated output is fed to the transmitter antenna for radiation along with the sound signal.

Sound Transmission

The microphone converts the sound associated with the picture being televised into proportionate electrical signal, which is normally a voltage. This electrical output, regardless of the complexity of its waveform, is a single valued function of time and so needs a single channel for its transmission. The audio signal from the microphone after amplification is frequency modulated, employing the assigned carrier frequency. In FM, the amplitude of the carrier signal is held constant, whereas its frequency is varied in accordance with amplitude variations of the modulating signal. As shown in Fig.2.32 (a), output of the sound FM transmitter is finally combined with the AM picture transmitter output, through a combining network, and fed to a common antenna for radiation of energy in the form of electromagnetic waves.

Picture Reception

The receiving antenna intercepts the radiated picture and sound carrier signals and feeds them to the RF tuner (see Fig. 2.32b). The receiver is of the heterodyne type and employs two or three stages of intermediate frequency (IF) amplification.

The output from the IF stage is demodulated to recover the video signal. This signal that carries the picture information is amplified and coupled to the picture tube which converts the electrical signal back into picture elements of the same degree of black and white. The picture tube shown in Fig. 2.33 is very similar to the cathode-ray tube used in an oscilloscope. The glass envelope contains an electron gun structure that produces a beam of electrons aimed at the fluorescent screen.

When the electron beam strikes the screen, light is emitted. The beam is deflected by a pair of deflecting coils mounted on the neck of the picture tube in the same way and rate as the beam scans the target in the camera tube. The amplitudes of the currents in the horizontal and vertical deflecting coils are so adjusted that the entire screen, called raster, gets illuminated because of the fast rate of scanning.

The video signal is fed to the grid or cathode of the picture tube. When the varying signal voltage makes the control grid less negative, the beam current is increased, making the spot of light on the screen brighter. More negative grid voltage reduces the brightness. if the grid voltages is negative enough to cut-off the electron beam current at the picture tube there will be no light. This state corresponds to black. Thus the video signal illuminates the fluorescent screen from white to black through various shades of grey depending on its amplitude at any instant. This corresponds to the brightness changes encountered by the electron beam of the camera tube while scanning the picture details element by element. The rate at which the spot of light moves is so fast that the eye is unable to follow it and so a complete picture is seen because of the storage capability of the human eye.

Sound Reception

The path of the sound signal is common with the picture signal from antenna to the video detector section of the receiver. Here the two signals are separated and fed to their respective channels. The frequency modulated audio signal is demodulated after at least one stage of amplification. The audio output from the FM detector is given due amplification before feeding it to the loudspeaker.

Synchronization

It is essential that the same coordinates be scanned at any instant both at the camera tube target plate and at the raster of the picture tube; otherwise, the picture details would split and get distorted. To ensure perfect synchronization between the scenes being televised and the picture produced on the raster, synchronizing pulses are transmitted during the retrace, i.e., fly-back intervals of horizontal and vertical motions of the camera scanning beam. Thus, in addition to carrying picture detail, the radiated signal at the transmitter also contains synchronizing pulses. These pulses which are distinct for horizontal and vertical motion control are processed at the receiver and fed to the picture tube sweep circuitry thus ensuring that the receiver picture tube beam is in step with the transmitter camera tube beam.

Colour Television

Colour television is based on the theory of additive colour mixing, where all colours including white can be created by mixing red, green, and blue lights. The colour camera provides video signals for the red, green, and blue information. These are combined and transmitted along with the brightness (monochrome) signal. Each colour TV system is compatible with the corresponding monochrome system. Compatibility means that colour broadcasts can be received as black and white on monochrome receivers. Conversely colour receivers are able to receive black and white TV broadcasts. This is illustrated in Fig.2.35 where the transmission paths from the colour and monochrome camera are shown to both colour and monochrome receivers.

At the receiver, the three colour signals are separated and fed to the three electron guns of colour picture tube. The screen of the picture tube has red, green, and blue phosphors arranged in alternate dots. Each gun produces an electron beam to illuminate the three colour phosphors separately on the fluorescent screen. The eye then integrates the red, green and blue colour information and their luminance to perceive the actual colour and brightness of the picture being televised. The three compatible colour television systems are NTSC, PAL and SECAM.

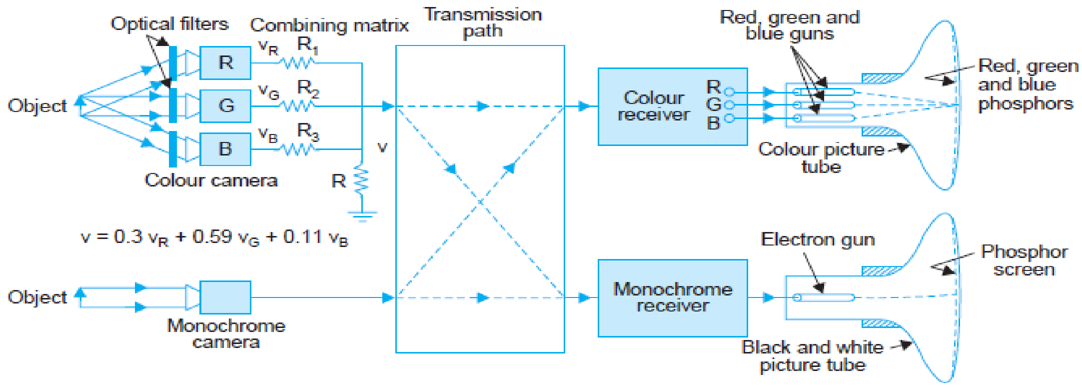


Fig.2.33 Elements of a Colour TV.

Source: Lathi, B.P.(2008) Modern digital and analog communication systems, 3rd ed. Oxford Press, from Analog TV Systems: Monochrome TV Yao Wang Polytechnic University, Brooklyn, NY11201 yao@vision.poly.edu

Colour Receiver Controls

NTSC colour television receivers have two additional controls, known as colour and hue controls. These are provided at the front panel along with other controls. The colour or saturation control varies the intensity or amount of colour in the reproduced picture. For example, this control determines whether the leaves of a tree in the picture are dark green or light green, and whether the sky in the picture is dark blue or light blue. The tint or hue control selects the correct colour to be displayed. This is primarily used to set the correct skin colour, since when flesh tones are correct, all other colours are correctly reproduced. It may be noted that PAL colour receivers do not need any tint control while in SECAM colour receivers, both tint and saturation controls are not necessary. With this knowledge and application of television system, the teachers will be more equipped in his competence. In order to quickly grab the applications of all the devices discussed in this project the reader should endeavour to see appendix E for the list of devices and their applications for teaching electronics in Technical Colleges.

Theoretical Framework

This study was based on the theoretical framework of competency theory which deals with the transposition of competency and learning.

Competency Theory

Competency theory propounded by Azemikhah (2005) states that ñAt the point of transposition, the learner is able to apply performance criteria to new problems or cases independentlyö. The learner is now able to examine new cases, identify, and study new concepts, if any, and using his/her acquired skills to solve problem independently. At that point, the learner is deemed competent and the relationship of ölearning to competencyô is transposed into ócompetency to learningö. When competency and learning are transposed, the learner moves from the öNot yet Competentô position to the óCompetentô position. The learnerøs level of competency and professionalism elevates to a point where it can take care of his/her learning.

ñAt the point of transposition of the competency and learning, the learner becomes self sufficient to learn independently of the facilitator when confronted with new cases or concepts within the precincts or boundaries of the unit of competency. At the point of transposition, the learner enters into the new stage or cycle of learning where the learning depends entirely on the learnerøs competency and thus learning becomes the function of the competency itself.ö (Azemikhah, 2005b). This is also related to the theory of competence propounded by Gilbert (1996).

Gilbert theory of competence states that öKnowledge must come through actionö. There are two elements in performance: the behaviour/activity and the outcome or accomplishment. For example the delivery of training has an activity component (presenting or facilitating) and an outcome (participant learning). For training to support improvements in learner performance, it needs to connect with the learnerøs experiences and current activities in a way that promotes transfer of learning. It is related to competence in that competency based training is a structured approach to training and assessment that is directed toward achieving specific outcomes. It is about assisting individuals to acquire skills and knowledge so they are able to perform a task to a specified standard under certain conditions.

Also, the theory explains gradual process of mastering competencies which are inform of transposition of competence to another one which is what this study is all about. The teachers continue to teach electronics devices, electronic circuits, radio communication and television system until the students master the competencies and use it to pass NABTEB examination, proceed to higher education or become employed or employ others as a result of the mastery of the acquired skills and knowledge.

Review of Related Empirical Studies

Kokko and Lönnblad (2007) carried out research on individual and collective competences in virtual project organisation (VPO). Five government and private technical colleges were randomly selected in Burewala city. Virtual specific individual and collective competences were explored as a literature study and in a qualitative multi-case analysis of 102 semi-structured interviews conducted on the teachers. The analysis revealed that virtual work in a complex distributed context requires special characteristics and skilful operative actions from virtual teachers as well as from the virtual government and private technical colleges. Several new competences were discovered. The findings suggested as a practical implication that developing competences is crucial for the success of virtual working in the context of both the private and government technical schools. It is related to this study in that the study was based on competencies carried out in technical colleges to determine the effectiveness of teachers in virtual environment.

Shetima (2010) carried out a study on the electrical installation competencies required by electrical/ electronics teachers in technical colleges using Bauchi and Gombe States of Nigeria as a frame of reference. Four objectives were stated, research questions asked, and hypotheses formulated and tested at 0.05 level of significance. A questionnaire, titled Electrical Installation Competencies Required by Electrical/Electronics Teachers in Technical Colleges (EICRETC), consisting of 112 items was structured, based on the four broad Electrical installation areas: Domestic installation, Industrial installation, Cable jointing and Winding of Electrical machines administered on 47 Electrical/Electronics teachers in Bauchi and Gombe States. Respondents rated items as required in 112 competencies. Data thus collected were analyzed using the mean and t-test statistics. The study has implication for re-training, in-service training for Electrical/Electronics teachers and therefore recommends involving continuous training on regular basis through workshops, seminars towards the implementation of the finding of the study. It is related to this study because the two studies focus on competencies required by teachers and method of data collection and analysis are the same.

Usun (2004) conducted a study on factors affecting ICT integration on college teaching. The major objective of the study was to determine the instructorsô perception of ICT use in the classroom teaching and the impact of their perceptions on teaching practices. A total of 1,550 faculty members were used. The valid faculty surveys were imported into SPSS for data analysis. Some of the findings made from the study were as flows: The college instructors believed that ICT can be used to foster effective teaching and learning, the participants may have perceived ICT as a potentially innovative and interesting resource and demonstration method of teaching: It is one of the best techniques to produce comparable instructional for students. The findings detected a higher level of usage of ICT by instructors in social science, natural since, engineering and businesses, the college instructors with less than 6 years of teaching experience experienced tended to incorporate ICT less into their teaching than more experienced faculty.

This work is related to the present study because it focuses on the college teaching in which ICT can be used to foster effective teaching and learning. It highlighted demonstration technique of teaching as one of the best teaching techniques. This is relevant to the present study that ICT being a component of electronics and can be used for effective teaching and demonstration method of teaching is one of the best techniques to carry out competencies in teaching and learning.

Hoefort (1978) carried out a study on minimum level of technical competencies relevant for teaching industrial arts electronic in the junior high and middle high schools in New York State and other industrial art electronics teacher education programmes. A content universe of technical categories was generated which the technical area of industrial arts junior and middle school electronics students. The information was then validated by jury of five experts in the field of industrial arts electronics who reviewed the data concerning the theoretical justification and the questionnaire for its appropriateness as data collection instrument. Hoefortôs respondents were both industrial art electronics teacher educators, and the teachers at the junior high and middle high schools in New York. The findings among others establish competency needs of technical staffs in education teachers of middle and high school electronics in the ability to identify and use of hand tools and equipments. Emphasis on those effective domains attributes following directions as pride of work, being dependable and punctual, exhibiting awareness of safety and being conscientious.

Abbas and Niloofar (2012) conducted a study to investigate the perceptions of experienced and less experienced teachers on the effect of intrinsic factors (motivation, self-concept, anxiety and autonomy) on teacher efficacy. 53 experienced teachers who had more than 10 years of experience in teaching and 46 less experienced teachers who had less than 3 years of experience in teaching participated in the study. 4- part questionnaire (each measuring the perceptions of the teachers about one of the intrinsic factors) was administered on all participants. To analyze the obtained data, the responses of the participants to each part of the questionnaire were analyzed using separately. A Mann Whitney U procedure was used to compare the views of experienced and less experienced teachers with regard to each part. Results indicated that there were significant differences between less experienced and experienced teachers as to the effects of intrinsic factors on teacher efficacy. However, the views of experienced and less experienced teachers did not differ significantly when it came to the effect of factors on teacher efficacy.

This study is related to the present work because it focuses on experience and less experienced teachers on the perceptions of the teachers which is one of the main variable this study is investigating.

Summary of Review of Related Literature

The preceding literature discussed competencies of teachers in various institutions in the world. It showed that competency is needed in any workforce before an individual can acquire desired knowledge and skill that will make that individual to attain the set goals. Virtual specific individual and collective competences were also reviewed. It revealed that virtual work in a complex distributed context requires special characteristics and skilful operative actions from virtual team members and leaders as well as from the virtual project organization and its team and a practical implication that developing competences is crucial for the success of virtual working in the context of project organizations.

Electrical installation competencies required by electrical/electronic teacher in technical colleges was discussed. It identified re-training, in-service training for Electrical/Electronics teachers and continuous training on regular basis through workshops and seminars. ICT integration trends and practices in college classrooms were also reviewed in order to determine the instructorsô perception of ICT use in the classroom and the impact of their perceptions on teaching practices. It revealed that ICT can be used to foster effective teaching and learning.

The perceptions of experienced and less experienced teachers were also reviewed as to the effect of intrinsic factors (motivation, self- concept, anxiety and autonomy) on teacher efficacy. Results indicated that there were significant differences between less experienced and experienced teachers as to the effects of anxiety and autonomy on teacher efficacy.

The literature also reviewed minimum level of technical competencies relevant for teaching industrial arts electronics as not to exhibit pride at work, being dependable and punctual, exhibiting awareness of safety and being conscientious. This literature will be concluded by reviewing competency theory and behavioural learning theory as relevant theories to the study. The theories emphasize on the competencies needed by the teachers for the attainment of goals.

However, most of the competencies identified by above mentioned researchers appeared useful for this study, but the researchers did not identify competencies required by electronics teachers in technical colleges in Osun and Oyo state. Hence, there are specific competencies required to effectively teach electronics works in technical colleges especially in the area of teaching techniques and competency evaluation. Based on this therefore, this researcher is convinced of existing gabs between this study and other studies reviewed. It is against this background that the present study is being carried out in order to fill the existing gap.

CHAPTER THREE

METHODOLOGY

This chapter explains the methodology used in conducting the study. The methodology includes; design of the study, area of the study, population for the study, sample and sampling technique**,** instrument for data collection, validation and reliability of the instrument, method of data collection and method of data analysis.

Design of the Study

A descriptive survey research design was adopted for this study. A descriptive survey research according to Ali (2006), tries to unravel the major elements and characteristics of any phenomenon or attitude. The design was appropriate for this study because it attained the purpose of the study by eliciting responses from experienced and less experienced electronics works teachers required for effective teaching in technical colleges.

Area of the Study

The study was carried out in South West Geopolitical Zone of Nigeria, comprising of 14 Government Technical Colleges in Osun and Oyo states. The nine technical colleges from Osun state are Government Technical College Ile-Ife, Government Technical College Osogbo, Government Technical College Iwo, Government Technical College Otun Ayegbaju, Government Technical College Ijebu-Jesa, Government Technical College Osu, Government Technical College Ara, Government Technical College Gbogan and Government Technical College Inisha. The five technical colleges from Oyo states are Government Technical College Ibadan, Government Technical College Iseyin, Government Technical College Ogbomoso, Government Technical College Oyo and Government Technical College Saki.

Population for the Study

The population for this study consists of 49 electronic teachers of technical colleges in the two states (See Appendix D for population distribution table). The staff list which comprises teachers for electrical installation and electronics works for Osun and Oyo States was extracted from Ministry of Education. They are teachers involved in the training and teaching of electrical and electronics students in technical colleges. (The data source is from State Ministries of Education, Department of Science and Technical Education: See Appendix D).

Sample and Sampling Technique

There was no sampling because the population is of a manageable size. The 49 electronics teachers were used for the study.

Instrument for Data Collection

The instrument used to collect the required information from the respondents is a structured questionnaire developed by the researcher titled ñQuestionnaire on Electronics Work Competencies (QEWC)ò (see appendix B and C). A two section questionnaire was designed to elicit information from the respondents. The section A of the questionnaire requested for personal information of the respondents on the variables of qualification and teaching experience. Section B contained 60 items which were clustered into four areas of the research questions. A five point response options was used to determine the competencies required by electronic teachers. Numerical Value was assigned to the options thus:

Very Highly Required (VHR)	5
Highly Required (HR)	4
Moderately Required (MR)	3
Slightly Required (R)	2
Not Required (NR)	1

Validation of the Instrument

The instrument was face validated by three experts from the Department of Vocational Teacher Education and Department of Science Education of the University of Nigeria, Nsukka (see Appendix A).They were requested to vet the items for clarity, relevance and total coverage of electronics work competencies. They went through the instrument and made their criticisms and comments. The instrument was improved in the light of the feedback from these experts and was reduced from 101 to 60 with the inclusion of competencies active verbs. (See Appendix C for details).

Reliability of the Instrument

Prior to conducting the main study, a pilot test was conducted on the teachers of Government Technical Colleges in Agidingbi ï Ikeja and Ikorodu. A total number of 20 teachers responded to the items. Their responses were used in the computation of the reliability coefficient of the instrument. The reliability of the instrument was established using Cronbach Alpha statistical analysis method to determine the internal consistency of the validated instruments. A reliability coefficient of 0.879 was obtained.

Method of Data Collection

The researcher used direct delivery technique to administer copies of the questionnaire to the respondents. To facilitate quick administration, the researcher employed the services of two assistants who helped to administer the questionnaire to the respondents from each of the states and the researcher went round to retrieve the copies of the questionnaire from the research assistants after two weeks at an agreed time and location. Thirty five and 14 copies of questionnaires were administered in Osun and Oyo states respectively. A total of 49 copies of the questionnaire was administered and returned by the respondents.

Method of Data Analysis

The data for the study was statistically analyzed using mean scores to answer the research questions while t-test was used to test the null hypothesis of no significance difference at 0.05 probability level of significance. Statistical Package for Social Sciences (SPSS) was used to ensure accuracy of the analysis of the data collected for the study. Independent sample analysis was conducted on each item of the questionnaire, using SPSS, to answer the research questions and to test the hypotheses respectively.

The overall result for all the items in each section of the questionnaire with regard to the mean, standard deviation and t value was also obtained from SPSS. The boundary limit for each of the responses is stated below:

Response options	**Rating Point**	**Boundary Limit**
Very Highly Required (VHR)	5	4.50 - 5.00
Highly Required (HR)	4	3.50 - 4.49
Moderately Required (MR)	3	2.50 - 3.49
Slightly Required (SR)	2	1.50 - 2.49
Not Required (NR)	1	1.00 - 1.49

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF DATA

In this chapter, the data for this study were analyzed and presented based on research questions and hypotheses that guided the study.

Research Question 1

What are the competencies required of electronic teachers to teach electronics devices?

Data for answering the above research question were derived from section B (items 1-16) of the instrument and are presented in Table 1.

Table 1
Mean ratings of responses of respondents on the area of competencies required for electronic teacher to teach electronic devices

S/N	Competencies in electronic devices	$\overline{X}$	SD	REMARK
1	Demonstrate the soldering techniques of thermionic diodes and semiconductor diodes	4.49	0.79	HR
2	Construct with schematic diagram the characteristics of thermionic diodes and semiconductor diodes.	4.56	0.69	VHR
3	Test a diode rectifier with measuring instrument	4.39	0.84	HR
4	Demonstrate the rectifier action of diode	4.43	0.98	HR
5	Demonstrate the use of measuring instruments to identify types of photoelectric devices	4.08	1.06	HR
6	Show the graphical representation of characteristics of triode and transistor	4.51	0.77	VHR
7	Demonstrate the effect of load on semiconductors and thermionic diodes	4.59	0.68	VHR
8	Measure a simple diode rectifier with multimeter	4.33	0.80	HR
9	Demonstrate graphical effect of triode and transistor	4.18	0.93	HR
10	Examine the effect of filter elements on d.c output using Cathode Ray Oscilloscope (CRO).	4.43	0.68	HR
11	Compare rectifying action of thermionic and semiconductor diodes	4.45	0.50	HR
12	Construct simple project using active and passive devices.	4.53	0.54	VHR
13	Demonstrate the use of oscilloscope to determine various waveforms.	4.51	0.71	VHR
14	Construct photo resistors, photodiodes, photo transistors to make a detecting circuit	4.41	0.67	HR
15	Demonstrate proper soldering and de-soldering techniques	4.65	0.56	VHR
16	Repair a component or foil on a printed circuit board.	4.29	0.71	HR

Note: $\overline{X}$= Mean SD= Standard deviation VHR= Very Highly Required HR= Highly Required

The data presented in Table 1 above shows the respondentsô level of agreement on the area of competencies required for electronic teacher to teach electronics devices in technical colleges. All the items in the table had their mean responses ranged from 4.08 to 4.65 which implied that the respondents agreed that the items are required for effective teaching of electronic devices. The respondents strongly agreed that item 2, 6, 7, 12, 13 and 15 with mean 4.56, 4.51, 4.59, 4.53, 4.51 and 4.65 respectively are very highly required for effective teaching of electronic devices. All the items had their standard deviation ranged from 0.50 to 1.06 which indicated that the respondents were not far from the mean and were close to one another in their opinions on competencies required for electronic teacher to teach electronics devices in technical colleges.

Research Question 2

What are the competencies required of electronic teachers to teach electronics circuits?

Data for answering the above research question were derived from section B (items17 - 30) of the instrument and are presented in Table 2.

Table 2

Mean ratings of responses of respondents on the area of competencies required for electronic teacher to teach electronic circuits.

S/N	Competencies in electronic circuits	$\overline{X}$	SD	REMARK
17	Demonstrate oscillators in electronics circuit	4.59	0.37	VHR
18	Mount the multi-vibrator in electronics circuit panel.	4.49	0.98	HR
19	Construct simple electronics circuit	4.59	0.57	VHR
20	Mount differentiating integrating circuits on the circuit board	4.51	0.77	VHR
21	Build oscillation circuit	4.39	0.86	HR
22	Design signal injector using multi-vibrator circuit	4.53	0.58	VHR
23	Build a stable multi-vibrator and determine the output from the CRO	4.43	0.82	HR
24	Demonstrate the operation of a bi-stable multi-vibrator	4.45	0.71	HR
25	Demonstrate signal flow in a simple power supply circuit	4.49	0.68	HR
26	Troubleshoot circuit with multimeters	4.73	0.53	VHR
27	Demonstrate short and open circuit with multimeter	4.65	0.60	VHR
28	Demonstrate thyristors in controlling circuits	4.45	0.68	HR
29	Interpret a manufacturerǿs data sheet	4.49	0.79	HR
30	Display proper use of function generators, frequency counters, testers etc	4.73	0.60	VHR

The data in table 2 revealed that all the items had their mean responses ranged between 4.39 and 4.73. The respondents strongly agreed that item 17, 19, 20, 22, 26, 27 and 30 with mean 4.59, 4.59, 4.51, 4.53, 4.73, 4.65 and 4.73 respectively are very highly required for effective teaching of electronic circuits. All other items are also required for effective teaching of electronic circuits. This shows that all the respondents agreed to those required competencies for effective teaching to teach electronic circuits. All the items had their standard deviation less than one (SD > 1). This implied that all the respondents were close in their responses about those items as competencies required for electronic teacher to teach electronic circuits.

Research Question 3

What are the competencies required of electronic teachers to teach radio communication?

Data for answering the above research question were derived from section B (items 31- 48) of the instrument and are presented in Table 3.

Table 3
Mean ratings of responses of respondents on the area of competencies required for electronic teacher to teach radio communication

S/N	Competencies in radio communication	$\overline{X}$	SD	REMARK
31	Demonstrate the operation of the various classes of amplifier	4.80	0.50	VHR
32	Build a simple power and voltage amplifier	4.59	0.61	VHR
33	Illustrate A.M. and F.M. including their bandwidth	4.61	0.49	VHR
34	Demonstrate with block diagram radio transmitter and receivers	4.61	0.61	VHR
35	Demonstrate the control of Automatic Frequency Control (AFG) and Automatic Gain Control (AGC).	4.57	0.61	VHR
36	Build a simple power and voltage amplifier	4.69	0.47	VHR
37	Identify different types of transmission lines	4.73	0.53	VHR
38	Use appropriate wave propagation and its importance to wireless communications.	4.51	0.54	VHR
39	Construct AM and FM radio circuit	4.55	0.58	VHR
40	Interpret common frequency bands	4.41	0.70	HR
41	Demonstrate radio circuit tuning and adjustments	4.57	0.61	VHR
42	Demonstrate the relationships between frequency and wavelength	4.43	0.65	HR
43	Demonstrate the use of CRO to detect signals in radio sets	4.41	0.70	HR
44	Illustrate the process of installation and maintenance of car radio	4.50	0.58	VHR
45	Demonstrate between domestic receiver and communication receiver	4.50	0.71	VHR
46	Operate and use various electronics instruments to clear faults in radio sets	4.51	0.50	VHR
47	Examine fault diagnosis techniques in radio receiver	4.61	0.49	VHR

The data in Table 3 shows that items 31 to 48 had their mean responses ranged between 4.43 and 4.80 which implied that those competencies are highly required for effective teaching of radio communication in technical colleges except items 40, 42 and 43 that are required. All the items had their standard deviation less than one ($SD > 1$). This implied that all the respondents were close in their responses about those items as competencies required for electronic teacher to teach radio communication.

Research Question 4

What are the competencies required of electronic teachers to teach television system?

Data for answering the above research question were derived from section B (items 49- 60) of the instrument and are presented in Table 4.

Table 4
Mean ratings of responses of respondents on the area of competencies required for electronic teacher to teach television system

S/N	Competencies in television system	$\overline{X}$	SD	REMARK
49	Show the direction of signals in T.V system	4.61	0.53	VHR
50	Demonstrate operation of monochrome and colour TV receivers	4.59	0.54	VHR
51	Trace and diagnose T.V faults	4.55	0.54	VHR
52	Demonstrate on how picture and sound signals are produced in black and white TV	4.65	0.52	VHR
53	Categorise the frequency of channels VHF and UHF bands with their tuners	4.67	0.52	VHR
54	Construct power supply in a TV receiver.	4.53	0.50	VHR
55	Demonstrate the symptoms and clear fault associated with IF, amplifier and tuner stage of TV receiver	4.57	0.58	VHR
56	Diagnose the associated faults when there is raster but no picture in any TV set	4.43	0.61	HR
57	Demonstrate the use of measuring instruments to clear TV faults	4.76	0.43	VHR
58	Construct synchronizing pulse separator stage generator on CRT of TV system	4.67	0.47	VHR
59	Demonstrate the operation of the colour bar generator to test signal in television system	4.43	0.54	HR
60	Demonstrate the differences between dynamic and static colour convergence in television set.	4.47	0.82	HR

The data presented in Table 4 above shows the respondentsô level of agreement on the area of competencies required for electronic teacher to teach television system in technical colleges. All the items in the table had their mean responses ranged from 4.43 to 4.76 which implied that the respondents agreed that the items are very required for effective teaching of television system except in items 56, 59 and 60 which are all also required. All the items had their standard deviation ranged from 0.43 to 0.82 which indicated that the respondents were not far from the mean and were close to one another in their opinions on competencies required for electronic teacher to teach television system in technical colleges.

Test of Hypotheses

Hypotheses 1

> There is no significant difference between the mean responses of experienced and less experienced electronic teachers in technical colleges on competencies required to teach electronic devices.

Data for testing this hypothesis are presented in Table 5.

Table 5

Two tailed t-test analysis of difference between the mean ratings of experienced and less experienced electronic teachers required to teach competences in electronic devices.

S/N	Items	t-value	Sig-2-tailed	H_o Decision
1	Demonstrate the soldering techniques of thermionic diodes and semiconductor diodes	-1.48	0.15	Not sig
2	Construct with schematic diagram the characteristics of thermionic diodes and semiconductor diodes.	0.43	0.69	Not sig
3	Test a diode rectifier with measuring instrument	0.47	0.64	Not sig
4	Demonstrate the rectifier action of diode	-1.01	0.32	Not sig
5	Demonstrate the use of measuring instruments to identify types of photoelectric devices	1.63	0.11	Not sig
6	Show the graphical representation of characteristics of triode and transistor	0.72	0.47	Not sig
7	Demonstrate the effect of load on semiconductors and thermionic diodes	-2.84	0.09	Not sig
8	Measure a simple diode rectifier with multimeter	-0.56	0.58	Not sig.
9	Demonstrate graphical effect of triode and transistor	-2.02	0.06	Not sig
10	Examine the effect of filter elements on d.c output using Cathode Ray Oscilloscope (CRO).	-0.73	0.47	Not sig
11	Compare rectifying action of thermionic and semiconductor diodes	-1.18	0.25	Not sig
12	Construct simple project using active and passive devices.	-1.44	0.16	Not sig
13	Demonstrate the use of oscilloscope to determine various waveforms.	-0.08	0.93	Not sig
14	Construct photo resistors, photodiodes, photo transistors to make a detecting circuit	0.36	0.72	Not sig
15	Demonstrate proper soldering and de-soldering techniques	-0.03	0.98	Not sig
16	Repair a component or foil on a printed circuit board.	0.98	0.33	Not sig

Note: $H_{o\ =\ \text{Null Hypotheses}}$ Not sig= Not significant

The t-test analysis in Table 5 above showed that the level of significance set by computer for each item ranged from 0.06 to 0.98 which were greater than 0.05 level of significance chosen by the researcher to test the hypothesis. It means that there was no significant difference whatsoever between mean responses of experienced and less experienced electronic teachers on competencies required to teach electronic devices in technical colleges. The null hypothesis (H_{01}) and that of the independent samples and the entire items were therefore, accepted. It can be inferred from the analysis that experienced and less experienced electronic teachers share identical opinions.

Hypotheses 2

There is no significant difference between the mean responses of experienced and less experienced electronic teachers in technical colleges on competencies required to teach electronic circuits.

Data for testing this hypothesis are presented in Table 6.

Table 6

Two tailed t-test analysis of difference between the mean ratings of experienced and less experienced electronic teachers on the competency required in electronic circuits

S/N	Items	t-value	Sig-2-tailed	H_o Decision
17	Demonstrate oscillators in electronics circuit	-0.99	0.33	Not sig
18	Mount the multi-vibrator in electronics circuit panel.	1.80	0.08	Not sig
19	Construct simple electronics circuit	1.74	0.09	Not sig
20	Mount differentiating integrating circuits on the circuit board	1.14	0.26	Not sig
21	Build oscillation circuit	0.43	0.67	Not sig
22	Design signal injector using multi-vibrator circuit	0.19	0.85	Not sig
23	Build a stable multi-vibrator and determine the output from the CRO	-0.52	0.61	Not sig
24	Demonstrate the operation of a bi-stable multi-vibrator	0.42	0.68	Not sig.
25	Demonstrate signal flow in a simple power supply circuit	-0.34	0.74	Not sig
26	Troubleshoot circuit with multimeters	0.18	0.86	Not sig
27	Demonstrate short and open circuit with multimeter	-0.03	0.98	Not sig
28	Demonstrate thyristors in controlling circuits	-0.89	0.38	Not sig
29	Interpret a manufacturerôs data sheet	-0.62	0.54	Not sig
30	Display proper use of function generators, frequency counters, testers, etc	1.31	0.20	Not sig

Table 6 shows the level of significance set by computer for the t-values in all the items ranged from 0.08 to 0.98 which were greater than 0.05 level of significance chosen by the researcher to test the hypotheses. It implied that there was no significant difference between the mean responses of experienced and less experienced electronic teachers on competencies required to teach electronic circuits in technical colleges. The null hypothesis

(H_{02}) and that of independent samples in each item were therefore, accepted. It can be inferred from the analysis that experienced and less experienced electronic teachers share identical opinions.

Hypothesis 3

There is no significant difference between the mean responses of experienced and less experienced electronic teachers in technical colleges on competencies required to teach radio communication.

Data for testing this hypothesis are presented in Table 7.

Table 7

Two tailed t-test analysis of difference between the mean ratings of experienced and less experienced electronic teachers on the competency required in radio communication.

S/N	Items	t-value	Sig-2-tailed	H_o Decision
31	Demonstrate the operation of the various classes of amplifier	1.36	0.18	Not sig
32	Build a simple power and voltage amplifier	0.56	0.58	Not sig
33	Illustrate A.M. and F.M. including their bandwidth	-0.14	0.89	Not sig
34	Demonstrate with block diagram radio transmitter and receivers	-1.51	0.14	Not sig
35	Demonstrate the control of Automatic Frequency Control (AFG) and Automatic Gain Control (AGC).	-1.11	0.27	Not sig
36	Build a simple power and voltage amplifier	-0.53	0.60	Not sig
37	Identify different types of transmission lines	-0.90	0.38	Not sig
38	Use appropriate wave propagation and its importance to wireless communications.	-1.69	0.10	Not sig.
39	Construct AM and FM radio circuit	-1.96	0.06	Not sig
40	Interpret common frequency bands	-1.26	0.22	Not sig
41	Demonstrate radio circuit tuning and adjustments	-0.68	0.50	Not sig
42	Demonstrate the relationships between frequency and wavelength	-2.06	0.06	Not sig
43	Demonstrate the use of CRO to detect signals in radio sets	-0.91	0.37	Not sig
44	Illustrate the process of installation and maintenance of car radio	0.30	0.77	Not sig
45	Demonstrate between domestic receiver and communication receiver	-0.32	0.75	Not sig
46	Operate and use various electronics instruments to clear faults in radio sets	0.45	0.65	Not sig
47	Examine fault diagnosis techniques in radio receiver	-0.72	0.47	Not sig
48	Construct a simple amplifier using thermionic devices and semi conductor devices	0.09	0.93	Not sig

The t-test analysis in Table 7 above showed that the level of significance set by computer for each item ranged from 0.06 to 0.93 which were greater than 0.05 level of significance chosen by the researcher to test the hypothesis. It means that there was no significant difference whatsoever between the mean responses mean responses of experienced and less experienced electronic teachers on competencies required to teach radio communication in technical colleges. The null hypothesis (H_{03}) and that of the independent samples and the entire items were therefore, accepted. It can be inferred from the analysis that experienced and less experienced electronic teachers share identical opinions.

Hypothesis 4

There is no significant difference between the mean responses experienced and less experienced electronic teachers in technical colleges on competencies required to teach television system.

Data for testing this hypothesis are presented in Table 8.

Table 8
Two tailed t-test analysis of difference between the mean ratings of experienced and less experienced electronic teachers on the competency required in television system.

S/N	Competencies required by electronics teachers to teach television system	t-value	Sig-2-tailed	H_o Decision
49	Show the direction of signals in T.V system	-0.65	0.52	Not sig
50	Demonstrate operation of monochrome and colour TV receivers	-2.05	0.48	Not sig
51	Trace and diagnose T.V faults	-1.10	0.28	Not sig
52	Demonstrate on how picture and sound signals are produced in black and white TV	-0.60	0.56	Not sig
53	Categorise the frequency of channels VHF and UHF bands with their tuners	0.90	0.37	Not sig
54	Construct power supply in a TV receiver.	1.40	0.17	Not sig
55	Demonstrate the symptoms and clear fault associated with IF, amplifier and tuner stage of TV receiver	-0.21	0.83	Not sig
56	Diagnose the associated faults when there is raster but no picture in any TV set	0.20	0.84	Not sig.
57	Demonstrate the use of measuring instruments to clear TV faults	-0.07	0.95	Not sig
58	Construct synchronizing pulse separator stage generator on CRT of TV system	0.32	0.75	Not sig
59	Demonstrate the operation of the colour bar generator to test signal in television system	-1.45	0.15	Not sig
60	Demonstrate the differences between dynamic and static colour convergence in television set.	-0.85	0.40	Not sig

Table 8 shows the level of significance set by computer for the t-values in all the items ranged from 0.15 to 0.95 which were greater than 0.05 level of significance chosen by the researcher to test the hypotheses. It implied that there was no significant difference between the mean responses of experienced and less experienced electronic teachers on competencies required to teach television system in technical colleges. The null hypothesis (H_{04}) and that of independent samples in each item were therefore, accepted. It can be inferred from the analysis that experienced and less experienced electronic teachers share identical opinions.

Findings of the Study

The following were the findings of the study:

All items are considered required for effective teaching competencies in electronic devices, electronic circuits, radio communication and television system in technical colleges. The findings revealed among others that electronics teachers in technical colleges required competencies for effective teaching in the soldering and de-soldering techniques, fault and repair diagnosis techniques in television and radio sets, troubleshooting electronic circuits, testing devices and cards with measuring instruments.

Findings of the Hypotheses

There is no significance difference in the mean responses of less experience and experience electronic teachers in the competencies required for effective teaching in all the items. This means that the competencies requirements of experienced and less experienced teachers are the same.

Discussion of the Findings

Electronics works competencies required by electronic teacher for effective teaching were analyzed and ascertained that the teacher needed competencies in electronics devices before any effective teaching will take place. This finding is an indication that the teachers must master the set of competencies to varying degrees, depending on whether they are new or more experienced in order to practice the profession. This is in line with Hawk, Coble and

Swanson (2005) who stated that electronic profession requires training which involves the development of a range of competencies linked to various professional functions; For example, designing teaching/learning situations, guiding groups of students through activities, evaluating learning, adapting their teaching methods to specific student needs and diagnose faults in electronics devices.

The analysis of research question two presented in table 2 provided such finding as competencies required by teacher to effectively teach electronic circuit. The teachers were all agreed that teaching electronics circuits require interpreting manufacturerĝs data sheet, demonstration method of teaching and troubleshooting circuit using multimeter. This agreement was in conjunction with the research carried out by Usun (2004) that demonstration technique of teaching is one of the best techniques of teaching competencies.

According to research question three as analyzed in Table 3, the finding of this table shows all the competencies that are required for electronic teacher to effectively teach radio communication. But the most required competencies are installation and maintenance of car radio, fault and repair diagnosis techniques in Television and Radio sets and illustration of transmitter and receiver in Radio and television sets.

In the analysis of research question four, presented in table 4, the findings revealed that the competencies required for electronic teacher to teach television system involved having a thorough knowledge of television system, diagnose faults in monochrome and colour television sets and construction of power supply in television receiver. This is in line with the opinion of Killen (2008) that having a thorough knowledge of subject content and skill will inspire the students to exhibit love for learning. Thus mastery of knowledge and competencies by electronics teacher promote effective teaching and learning.

The result of the null hypothesis shows that there is no significant difference between the mean responses of experienced and less experienced electronic teachers in technical colleges on competencies required to teach electronic devices, electronic circuits, radio communication and television system. This means that the competencies requirements of experienced and less experienced teachers are the same. Based on this study, experience is not an important variable to effectively teach electronic competencies. But according to Tsui (2003), experienced and less experienced teachers differ from each other from three aspects: processing of information in the classroom, select processed information and studentsô need.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

The chapter presents the summary of the research problem, purpose of the study and its methodology. The major findings, conclusions, recommendations and suggestions for further research are also presented.

Re-Statement of the Problem

The programme of electronics works in Nigeria technical colleges is designed to produce competent craftsmen and technicians, who could be employable, self reliant or and able to proceed to higher education. But this as not being effectively achieved in Osun and Oyo state as a result of traditional method of teaching employed by electronic teachers and teaching was being carried out theoretically without showing any required level of competence. Electronics teachers have failed to get the individual student to learn and do not remove obstacles to learning. As a result, friction and frustration had set in and successful learning did not take place.

Hence, electronic students of technical colleges in the study area experience prolonged trial and error, and consequently perform poorly at the National Technical Certificate Examination (NTCE) and Labour Trade Test Examination. This showed that the resultant poor performance is the effect of incompetence emanated from electronic teacher from the study area. The technical nature of teacherǿs area of specialization requires specific technical competencies for career success. And electronics works consists of courses at technical college level where topics are aimed at studying the technical competencies include electronic devices, electronic circuits, radio communication and television system.

Hence, this research is focusing on the investigation of the electronics works competencies required by electronics teachers for effective teaching in technical colleges in Osun and Oyo states. The specific purpose is to identify electronics works competencies required by electronics teachers for effective teaching in electronic devices, electronic circuits, radio communication and television system.

Summary of Procedures Used

A survey research design was used for the study. The study was carried out in South West Geopolitical Zone of Nigeria, comprising of 14 Government Technical Colleges and covered all the electrical installation and electronics teachers in Osun and Oyo states. The population was made up of 49 electrical installation and electronics teachers in all the states mentioned above. A structured questionnaire titled ñQuestionnaire on Electronics Work Competencies (QEWC)òwith 60 items which consist of two sections was used. Section A consists of items on the personal data about the respondents. Section B consists of items based on the research questions. The response category was structured according to the five point responses of very highly required (VHR), highly required (HR), moderately required (MR), slightly required (SR) and not required (NR).

The instrument was face validated by three (3) experts from the Department of Vocational Teacher Education and Department of Science Education of the University of Nigeria, Nsukka The reliability of the instrument was established using Cronbach Alpha statistical analysis method to determine the internal consistency of the validated instruments. A reliability coefficient of 0.879 was obtained.

The data for the study was statistically analyzed using mean scores to answer the research questions while t-test was used to test the null hypothesis of no significance difference at the probability of 0.05 level of significance. Statistical Package for Social Sciences (SPSS) was used to ensure accuracy of the analysis of the data collected for the study.

The findings revealed that all of the items are required for effective teaching competencies and the result of the null hypothesis shows that there is no significant difference between the mean responses of experienced and less experienced electronic teachers in technical colleges on competencies required to teach electronic devices, electronic circuits, radio communication and television system. This study implies that if electronic teachers do not update their knowledge on the acquired skills, they will not be effective in teaching competencies and length of year of service will not promote effective teaching of competencies.

Major Findings of the Study

The following are the major findings of the study:

1) The length of teaching experience has no relationship with the level of technical competency needs of electronics teachers in Government Technical Colleges.

2) The theoretical and practical competency requirements of electronic teachers in electronic devices, electronic circuits, radio communication and television system should be addressed to include both theoretical and practical competencies with more emphases on practical abilities in competencies.

3) The perceptions of both experienced and less experienced electronic teachers are similar on competency required of for qualitative job performance.

4) The status of electronics teachers has no effect on the technical competency needs for their job performance.

5) There is need for in-service training programme for electronic teachers in Government Technical Colleges.

6) Electronics teachers in technical colleges required competencies for effective teaching in the following areas:

   a) Soldering and de-soldering techniques.

   b) Fault and repair diagnosis techniques in Television and Radio sets.

c) Testing of devices by using Cathode Ray Oscilloscope (CRO) and measuring instruments.

d) Carrying out simple electronic project works.

e) Troubleshooting electronic circuits, devices and cards with measuring instruments.

f) Interpretation of manufacturerôs data sheet.

g) Installation and maintenance of car radio.

h) Maintenance culture of electronic devices.

i) Illustration of transmitter and receiver in Radio and television sets.

Implications of the Study

The result of the study has some implications for education. That is, at the technical college, experience appears to be no determinant of competencies in electronics works. It was clear from the results that all experienced and less experienced were the same in their responses. Therefore, it would be necessary for them to use any appropriate teaching methods that enhance students learning and it had been found out that demonstration method is appropriate method of teaching competencies in electronics works in technical colleges.

The next implication of the findings of the study is that if competencies identified in this study are used by the teachers, it will help the students to be self reliant when they graduate. The study also proved that the electronic teachers desire for more practical competencies in electronics works and only when they are assured of the in-service training opportunity to equip themselves with skills through workshop and site experiences could these needs be met. This accounts for the reason why students of electronics works do not take practical aspect of their studies more seriously since they believe that all their teachers are deficient in practical competencies.

Conclusion

A paramount factor in the teaching of competencies is the teacher. A sound technical college system can flourish if knowledge and skill of serving teachers are improved and the means of improving their knowledge is to attend workshops and seminars where the electronic teachers acquire competencies. This study therefore provides required competencies in electronics works that electronic teachers need for effective teaching. These are: soldering and de-soldering techniques, fault and repair diagnosis techniques in Television and Radio sets, use of Cathode Ray Oscilloscope (CRO) and measuring instruments, simple electronic project works, troubleshooting electronic circuits and cards with multimeter, interpretation of manufacturerôs data sheet, installation and maintenance of car radio, maintenance culture of electronic devices and illustration of transmitter and receiver in radio and television sets.

Recommendations

Based on the findings of the study, the following recommendations are made:

1. Government should make effort to provide in-service training programmes for electronic teachers. Such in-service technical training programme should be in form of workshops, post-graduate programmes, seminars, conferences and any other forms of training that will assist electronic teachers in improving their competencies.
2. Government should recruit adequate number of electronic teachers in technical colleges. This is because most of the technical colleges in the study areas do not have electronic teachers and where they have are not more than one or two (see appendix D).
3. Adequate materials and tools should be provided for electronic teachers as these will improve their competencies when materials are available for use practical class.

4. Competencies should not be used for evaluating electronic teacher for layoffs but this study brought out what teachers actually do to be successful rather than relying on assumptions pertaining to trait and intelligence.
5. Electronics teachers should be encouraged to combine different teaching techniques and emphasis is laid on demonstration methods in teaching competencies.
6. Electronics teachers should also be encouraged to follow all the required competencies in electronics works identified in this study for effective teaching.

Suggestions for Further Research

1) Competencies required by electronics teachers to teach electronic amplifiers, power supply, oscillators, multivibrators and digital electronics in colleges of education.
2) Entrepreneurial competencies required by electronics works students for establishing small scale business.
3) Effect of availability and usage of equipments and materials in the teaching of electronics works in urban and rural technical colleges.

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APPENDIX A

11th July, 2012

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Dear Sir/Madam,

REQUEST FOR INSTRUMENT VALIDATION

I am a postgraduate student from the department of Vocational Teacher Education (VTE) with option in Industrial Technical (Electrical / Electronics), University of Nigeria Nsukka, currently undertaking a research project aimed at finding out ñElectronics works competencies required by electronic teachers for effective teaching in technical colleges in Osun and Oyo Statesò

Attached is a draft copy of the questionnaire a survey instrument for the study, topic of the study, purpose of the study and hypotheses. You are please requested to vet the items for clarity, relevance and total coverage of electronics work competencies, for consistency and stability.

Please use the plain sheet provided for general comments and suggestions you deem necessary, concerning any aspect of electronics works competencies not covered in the instrument. Your responses will be held in strictest confidence.

Thank you.

Yours faithfully

Arilesere, Opeyemi M.
PG/M.Ed/10/57260

APPENDIX B

DEPARTMENT OF VOCATIONAL TEACHER EDUCATION
SCHOOL OF POSTGRADUATE STUDIES
UNIVERSITY OF NIGERIA, NSUKKA

Topic: ELECTRONICS WORKS COMPETENCIES REQUIRED BY ELECTRONICS TEACHERS FOR EFFECTIVE TEACHING IN TECHNICAL COLLEGES IN OSUN AND OYO STATES.

Questionnaire on *Electronics Work* Competencies (QUELWOC)

SECTION A: Background information

Instruction: Check (ã) against the box or fill the gap as applicable to you.

1) Name of the College : G.T.C.:

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é ...

2) Highest Academic Qualification

(i) C & G FTCI	☐	(ii) ANTC/NTC	☐	(iii) C & G FTC/ANTC with ATTC	☐
(iv)B.Sc./B.Ed.	☐	(V) M.Sc	☐	(vi) HND Elect Eng. with PGDE	☐
(vii) M. Sc. / M.Ed	☐	(Viii) B.Sc	☐	(ix) PhD	☐

3) Length of Teaching Experiences

0 ï 2 years ☐

3 ï 5 years ☐

6 years and above ☐

APPENDIX C

SECTION B

Instruction: This section contains a list of competencies required in electronics works required by electronics teachers in technical colleges with a check (ã) indicate required as related to the identified concepts that will best suit the teaching / training programme in electronic circuits, electronics devices, radio communication and television system. The key is as follows.

Very Highly Required	VHR
Highly Required	HR
Moderately Required	MR
Slightly Required	SR
Not Required	NR

Section B: competencies required by electronic teachers to teach electronics devices.

S/N	Electronic teachers should have the ability to:	VHR	HR	MR	SR	NR
1	Demonstrate the soldering techniques of thermionic diodes and semiconductor diodes					
2	Construct with schematic diagram the characteristics of thermionic diodes and semiconductor diodes.					
3	Test a diode rectifier with measuring instrument					
4	Demonstrate the rectifier action of diode					
5	Demonstrate the use of measuring instruments to identify types of photoelectric devices					
6	Show the graphical representation of characteristics of triode and transistor					
7	Demonstrate the effect of load on semiconductors and thermionic diodes					
8	Measure a simple diode rectifier with multimeter					
9	Demonstrate graphical effect of triode and transistor					
10	Examine the effect of filter elements on d.c output using Cathode Ray Oscilloscope (CRO).					
11	Compare rectifying action of thermionic and semiconductor diodes					
12	Construct simple project using active and passive devices.					
13	Demonstrate the use of oscilloscope to determine various waveforms.					

14	Construct photo resistors, photodiodes, photo transistors to make a detecting circuit					
15	Demonstrate proper soldering and de-soldering techniques					
16	Repair a component or foil on a printed circuit board.					

Section C: competencies required by electronic teachers to teach electronics circuits.

S/N	Electronics teachers should have the ability to:	VHR	HR	MR	SR	NR
17	Demonstrate oscillators in electronics circuit					
18	Mount the multi-vibrator in electronics circuit panel.					
19	Construct simple electronics circuit					
20	Mount differentiating integrating circuits on the circuit board					
21	Build oscillation circuit					
22	Design signal injector using multi-vibrator circuit					
23	Build a stable multi-vibrator and determine the output from the CRO					
24	Demonstrate the operation of a bi-stable multi-vibrator					
25	Demonstrate signal flow in a simple power supply circuit					
26	Troubleshoot circuit with Multimeters					
27	Demonstrate short and open circuit with multimeter					
28	Demonstrate thyristors in controlling circuits					
29	Interpret a manufacturerȇs data sheet					
30	Display proper use of function generators, frequency counters, testers, etc					

Section D: competencies required by electronic teachers to teach radio communication.

S/N	Electronics teachers should have the ability to:	VHR	HR	MR	SR	NR
31	Demonstrate the operation of the various classes of amplifier					
32	Build a simple power and voltage amplifier					
33	Illustrate A.M. and F.M. including their bandwidth					
34	Demonstrate with block diagram radio transmitter and receivers					
35	Demonstrate the control of Automatic Frequency Control (AFG) and Automatic Gain Control (AGC).					
36	Build a simple power and voltage amplifier					
37	Identify different types of transmission lines					

38	Use appropriate wave propagation and its importance to wireless communications.					
39	Construct AM and FM radio circuit					
40	Interpret common frequency bands					
41	Demonstrate radio circuit tuning and adjustments					
42	Demonstrate the relationships between frequency and wavelength					
43	Demonstrate the use of CRO to detect signals in radio sets					
44	Illustrate the process of installation and maintenance of car radio					
45	Demonstrate between domestic receiver and communication receiver					
46	Operate and use various electronics instruments to clear faults in radio sets					
47	Examine fault diagnosis techniques in radio receiver					
48	Construct a simple amplifier using thermionic devices and semi conductor devices					

Section E: competencies required by electronics teachers to teach television system.

S/N	Electronics teacher should have the ability to:	VHR	HR	MR	SR	NR
49	Show the direction of signals in T.V system					
50	Demonstrate operation of monochrome and colour TV receivers					
51	Trace and diagnose T.V faults					
52	Demonstrate on how picture and sound signals are produced in black and white TV					
53	Categorise the frequency of channels VHF and UHF bands with their tuners					
54	Construct power supply in a TV receiver.					
55	Demonstrate the symptoms and clear fault associated with IF, amplifier and tuner stage of TV receiver					
56	Diagnose the associated faults when there is raster but no picture in any TV set					
57	Demonstrate the use of measuring instruments to clear TV faults					
58	Construct synchronizing pulse separator stage generator on CRT of TV system					
59	Demonstrate the operation of the colour bar generator to test signal in television system					
60	Demonstrate the differences between dynamic and static colour convergence in television set.					

APPENDIX D

LIST OF TECHNICAL COLLEGES AND ELECTRONIC TEACHER IN OSUN AND OYO STATES

SN	Technical College	Electronics Teacher	Electrical Teacher	State	Population
1	Government Technical College Ile-Ife	0	3	Osun	3
2	Government Technical College Osogbo	5	10	Osun	15
3	Government Technical College Iwo	0	3	Osun	5
4	Government Technical College Otun Ayegbaju	0	2	Osun	2
5	Government Technical College Ijebu-Jesa	0	2	Osun	2
6	Government Technical College Osu	0	2	Osun	2
7	Government Technical College Ara	0	2	Osun	2
8	Government Technical College Gbogan	0	2	Osun	2
9	Government Technical College Inisha	0	3	Osun	3
10	Government Technical College Ibadan	0	5	Oyo	5
11	Government Technical College Iseyin	0	1	Oyo	1
12	Government Technical College Ogbomosho	2	2	Oyo	4
13	Government Technical College Oyo	0	3	Oyo	3
14	Government Technical College Saki	0	2	Oyo	2
	TOTAL	**07**	**42**		**49**

Source: States ministry of education list of staff in Osun and Oyo States.

APPENDIX E

LIST OF DEVICES USED FOR TEACHING ELECTRONICS WORKS

S/N	NAME	USES
1	Resistors	It is used to offer resistance to the flow of electric current
2	Diode	It provides uni-directional current paths through a circuit It regulates and limits voltages in power supplies It converts a.c. signals into d.c. (rectification).
3	Zener Diode	It is used in voltage regulator circuit
4	Photo Diode	It is used in automatic flash system in photo cameras where the photo diode does not allow the shutter of the camera to get open in dim light.
5	Variactor Diode	It is used in RF tuning circuit tuner in TV receivers in different channels or TV tuners. This type of circuit can be used in remote controlled tuning circuit of receivers.
6	Light Emitting Diode	It is used in remote sensing applications. It is also used as a light indicator in electronic equipments for various visual display purposes.
7	Transistor (BJT)	It is used for amplification
8	Unijunction Transistor (UJT)	It is used Relaxation oscillator, Over voltage detector, Timer circuit and Pulse and voltage sensing circuits.
9	Field Effect Transistor (FET)	It is used as input stage in amplifiers in oscilloscopes and other electronic testing instruments, in logic circuits
10	Metel Oxide Semiconductor Field Effect Transistor(MOSFET)	It is used as mixer stage in FM radio and TV receivers In computers for large scale integration (LSI) in memory circuits.
11	Silicon Control Rectifier (SCR)	It is used in switching circuits, regulated power supplies, radar modulator, servo system, electronic ignition system and speed control motor and short circuit protection in electronic Systems
12	TRIAC	It is used in digital circuits, as electronic on/off switch controlled by a low-current mechanical switch. as a high power lamp switch, and as electronic changeover of transformer taps
13	DIAC	DIACS are primarily used for triggering of TRIACS in adjustable phase control of a.c. mains power, also used for Light dimming, heat control and universal motor speed control.
14	Integrated Circuit	I.C is used as controllers in equipment such as machine tools, vehicle operating systems, and other applications where hydraulic, pneumatic, or mechanical controls were previously used and computer system units.
15	Multimeter (Digital & Analogue)	A Multimeter as a multiple meter is used to measure dc and ac voltages, currents and in addition resistances. It is also used for measuring capacitance and frequency

APPENDIX F

STATISTICAL OUTPUT

RESEARCH QUESTION 1

Descriptive Statistics

	N	Mean	Std. Deviation
TEACHINGEXPERIENCE	49	1.5918	.49659
COLLEGENAME	49	6.2245	4.35539
ITEM1	49	4.4898	.79379
ITEM2	49	4.5510	.67888
ITEM3	49	4.3878	.83707
ITEM4	49	4.4286	.97895
ITEM5	49	4.0816	1.05745
ITEM6	49	4.5102	.76710
ITEM7	49	4.5918	.67449
ITEM8	49	4.3265	.80072
ITEM9	49	4.1837	.92811
ITEM10	49	4.4286	.67700
ITEM11	49	4.4490	.50254
ITEM12	49	4.5306	.54398
ITEM13	49	4.5102	.71071
ITEM14	49	4.4082	.67449
ITEM15	49	4.6531	.56092
ITEM16	49	4.2857	.70711
Valid N (listwise)	49		

RESEARCH QUESTION 2

Descriptive Statistics

	N	Mean	Std. Deviation
TEACHINGEXPERIENCE	49	1.5918	.49659
COLLEGENAME	49	6.2245	4.35539
ITEM17	49	5.3061	5.68332
ITEM18	49	4.4898	.98155
ITEM19	49	4.5918	.57440
ITEM20	49	4.5102	.76710
ITEM21	49	4.3878	.86160
ITEM22	49	4.5306	.58102
ITEM23	49	4.4286	.81650
ITEM24	49	4.4490	.70891
ITEM25	49	4.4898	.68076
ITEM26	49	4.7347	.53133
ITEM27	49	4.6531	.59690
ITEM28	49	4.4490	.67888
ITEM29	49	4.4898	.79379
ITEM30	49	4.7347	.56919
Valid N (listwise)	49		

RESEARCH QUE 3

Descriptive Statistics

	N	Mean	Std. Deviation
TEACHINGEXPERIENCE	49	1.5918	.49659
COLLEGENAME	49	6.2245	4.35539
ITEM31	49	4.7959	.49915
ITEM32	49	4.5918	.60959
ITEM33	49	4.6122	.49229
ITEM34	49	4.6122	.60609
ITEM35	49	4.5714	.61237
ITEM36	49	4.6939	.46566
ITEM37	49	4.7347	.53133
ITEM38	49	4.5102	.54476
ITEM39	49	4.5510	.57956
ITEM40	49	4.4082	.70470
ITEM41	49	4.5714	.61237
ITEM42	49	4.4286	.64550
ITEM43	49	4.4082	.70470
ITEM44	49	4.4694	.58102
ITEM45	49	4.4898	.71071
ITEM46	49	4.5102	.50508
ITEM47	49	4.6122	.49229
ITEM48	49	4.5918	.53690
Valid N (listwise)	49		

RESEARCH QUESTION 4

Descriptive Statistics

	N	Mean	Std. Deviation
TEACHINGEXPERIENCE	49	1.5918	.49659
COLLEGENAME	49	6.2245	4.35539
ITEM49	49	4.6122	.53293
ITEM50	49	4.5918	.53690
ITEM51	49	4.5510	.54242
ITEM52	49	4.6531	.52245
ITEM53	49	4.6735	.51590
ITEM54	49	4.5306	.50423
ITEM55	49	4.5714	.57735
ITEM56	49	4.4286	.61237
ITEM57	49	4.7551	.43448
ITEM58	49	4.6735	.47380
ITEM59	49	4.4286	.54006
ITEM60	49	4.4694	.81910
Valid N (listwise)	49		

Hypothesis one

There is no significant difference between the mean responses of experienced and less experienced electronic teachers in technical colleges on competencies required to teach electronics devices.

Group Statistics

	TEACHING EXPERIENCE	N	Mean	Std. Deviation	Std. Error Mean
ITEM1	LESS EXPERIENCED TEACHER	20	4.3000	.65695	.14690
	EXPERIENCED TEACHER	29	4.6207	.86246	.16016
ITEM2	LESS EXPERIENCED TEACHER	20	4.6000	.59824	.13377
	EXPERIENCED TEACHER	29	4.5172	.73779	.13700
ITEM3	LESS EXPERIENCED TEACHER	20	4.4500	.60481	.13524
	EXPERIENCED TEACHER	29	4.3448	.97379	.18083
ITEM4	LESS EXPERIENCED TEACHER	20	4.2500	1.11803	.25000
	EXPERIENCED TEACHER	29	4.5517	.86957	.16148
ITEM5	LESS EXPERIENCED TEACHER	20	4.3500	.74516	.16662
	EXPERIENCED TEACHER	29	3.8966	1.20549	.22385
ITEM6	LESS EXPERIENCED TEACHER	20	4.6000	.59824	.13377
	EXPERIENCED TEACHER	29	4.4483	.86957	.16148
ITEM7	LESS EXPERIENCED TEACHER	20	4.2500	.85070	.19022
	EXPERIENCED TEACHER	29	4.8276	.38443	.07139
ITEM8	LESS EXPERIENCED TEACHER	20	4.2500	.78640	.17584
	EXPERIENCED TEACHER	29	4.3793	.82001	.15227
ITEM9	LESS EXPERIENCED TEACHER	20	3.8500	1.08942	.24360

	EXPERIENCED TEACHER	29	4.4138	.73277	.13607
ITEM10	LESS EXPERIENCED TEACHER	20	4.3500	.48936	.10942
	EXPERIENCED TEACHER	29	4.4828	.78471	.14572
ITEM11	LESS EXPERIENCED TEACHER	20	4.3500	.48936	.10942
	EXPERIENCED TEACHER	29	4.5172	.50855	.09443
ITEM12	LESS EXPERIENCED TEACHER	20	4.4000	.50262	.11239
	EXPERIENCED TEACHER	29	4.6207	.56149	.10427
ITEM13	LESS EXPERIENCED TEACHER	20	4.5000	.68825	.15390
	EXPERIENCED TEACHER	29	4.5172	.73779	.13700
ITEM14	LESS EXPERIENCED TEACHER	20	4.4500	.68633	.15347
	EXPERIENCED TEACHER	29	4.3793	.67685	.12569
ITEM15	LESS EXPERIENCED TEACHER	20	4.6500	.58714	.13129
	EXPERIENCED TEACHER	29	4.6552	.55265	.10262
ITEM16	LESS EXPERIENCED TEACHER	20	4.4000	.59824	.13377
	EXPERIENCED TEACHER	29	4.2069	.77364	.14366

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
ITEM 1	Equal variances assumed	.079	.780	-1.404	47	.167	-.32069	.22842	-.78022	.13884
	Equal variances not assumed			-1.476	46.465	.147	-.32069	.21732	-.75802	.11664
ITEM 2	Equal variances assumed	1.402	.242	.416	47	.679	.08276	.19905	-.31767	.48319
	Equal variances not assumed			.432	45.668	.668	.08276	.19148	-.30275	.46827
ITEM 3	Equal variances assumed	2.560	.116	.429	47	.670	.10517	.24540	-.38850	.59885
	Equal variances not assumed			.466	46.598	.644	.10517	.22581	-.34920	.55954
ITEM 4	Equal variances assumed	.901	.347	-1.062	47	.294	-.30172	.28416	-.87339	.26994
	Equal variances not assumed			-1.014	34.129	.318	-.30172	.29761	-.90647	.30302
ITEM 5c c	Equal variances assumed	.455	.503	1.494	47	.142	.45345	.30349	-.15709	1.06398
	Equal variances not assumed			1.625	46.559	.111	.45345	.27906	-.10809	1.01498
ITEM 6	Equal variances assumed	.858	.359	.677	47	.502	.15172	.22423	-.29938	.60282

	Equal variances not assumed			.724	46.999	.473	.15172	.20969	-.27011	.57356
ITEM 7	Equal variances assumed	28.085	.000	-3.221	47	.002	-.57759	.17931	-.93832	-.21685
	Equal variances not assumed			-2.843	24.400	.009	-.57759	.20318	-.99656	-.15862
ITEM 8	Equal variances assumed	.007	.934	-.552	47	.584	-.12931	.23444	-.60095	.34233
	Equal variances not assumed			-.556	42.111	.581	-.12931	.23261	-.59870	.34008
ITEM 9	Equal variances assumed	3.642	.062	-2.169	47	.035	-.56379	.25992	-1.08668	-.04090
	Equal variances not assumed			-2.021	30.679	.052	-.56379	.27903	-1.13312	.00553
ITEM 10	Equal variances assumed	3.420	.071	-.671	47	.506	-.13276	.19791	-.53091	.26539
	Equal variances not assumed			-.729	46.631	.470	-.13276	.18223	-.49943	.23391
ITEM 11	Equal variances assumed	2.624	.112	-1.149	47	.256	-.16724	.14559	-.46012	.12564
	Equal variances not assumed			-1.157	42.024	.254	-.16724	.14454	-.45893	.12445
ITEM 12	Equal variances assumed	.087	.769	-1.410	47	.165	-.22069	.15651	-.53555	.09417
	Equal variances not assumed			-1.440	43.776	.157	-.22069	.15331	-.52970	.08832
ITEM 13	Equal variances assumed	.000	.995	-.083	47	.935	-.01724	.20874	-.43718	.40270
	Equal variances not assumed			-.084	42.806	.934	-.01724	.20604	-.43282	.39834

ITEM 14	Equal variances assumed	.004	.947	.357	47	.722	.07069	.19785	-.32734	.46872
	Equal variances not assumed			.356	40.632	.723	.07069	.19837	-.33003	.47141
ITEM 15	Equal variances assumed	.031	.862	-.031	47	.975	-.00517	.16476	-.33662	.32628
	Equal variances not assumed			-.031	39.344	.975	-.00517	.16664	-.34214	.33179
ITEM 16	Equal variances assumed	.003	.957	.938	47	.353	.19310	.20578	-.22088	.60709
	Equal variances not assumed			.984	46.305	.330	.19310	.19630	-.20196	.58816

Hypothesis two

There is no significant difference between the mean responses of experienced and less experienced electronic teachers in technical colleges on competencies required to teach electronics circuits.

Group Statistics

	TEACHINGEXPERIENCE	N	Mean	Std. Deviation	Std. Error Mean
ITEM17	LESS EXPERIENCED TEACHER	20	4.5000	.68825	.15390
	EXPERIENCED TEACHER	29	4.8621	.36655	1.36793
ITEM18	LESS EXPERIENCED TEACHER	20	4.7500	.44426	.09934
	EXPERIENCED TEACHER	29	4.3103	1.19832	.22252
ITEM19	LESS EXPERIENCED TEACHER	20	4.7500	.44426	.09934
	EXPERIENCED TEACHER	29	4.4828	.63362	.11766
ITEM20	LESS EXPERIENCED TEACHER	20	4.6500	.58714	.13129
	EXPERIENCED TEACHER	29	4.4138	.86674	.16095
ITEM21	LESS EXPERIENCED TEACHER	20	4.4500	.75915	.16975
	EXPERIENCED TEACHER	29	4.3448	.93640	.17389
ITEM22	LESS EXPERIENCED TEACHER	20	4.5500	.60481	.13524
	EXPERIENCED TEACHER	29	4.5172	.57450	.10668
ITEM23	LESS EXPERIENCED TEACHER	20	4.3500	.98809	.22094
	EXPERIENCED TEACHER	29	4.4828	.68768	.12770
ITEM24	LESS EXPERIENCED TEACHER	20	4.5000	.68825	.15390

	EXPERIENCED TEACHER	29	4.4138	.73277	.13607
ITEM25	LESS EXPERIENCED TEACHER	20	4.4500	.68633	.15347
	EXPERIENCED TEACHER	29	4.5172	.68768	.12770
ITEM26	LESS EXPERIENCED TEACHER	20	4.7500	.44426	.09934
	EXPERIENCED TEACHER	29	4.7241	.59140	.10982
ITEM27	LESS EXPERIENCED TEACHER	20	4.6500	.58714	.13129
	EXPERIENCED TEACHER	29	4.6552	.61388	.11399
ITEM28	LESS EXPERIENCED TEACHER	20	4.3500	.58714	.13129
	EXPERIENCED TEACHER	29	4.5172	.73779	.13700
ITEM29	LESS EXPERIENCED TEACHER	20	4.4000	.94032	.21026
	EXPERIENCED TEACHER	29	4.5517	.68589	.12737
ITEM30	LESS EXPERIENCED TEACHER	20	4.8500	.36635	.08192
	EXPERIENCED TEACHER	29	4.6552	.66953	.12433

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
ITEM 17	Equal variances assumed	1.736	.194	-.822	47	.415	-1.36207	1.65753	-4.69658	1.97244
	Equal variances not assumed			-.989	28.706	.331	-1.36207	1.37656	-4.17871	1.45457
ITEM 18	Equal variances assumed	8.905	.005	1.564	47	.125	.43966	.28109	-.12583	1.00514
	Equal variances not assumed			1.804	38.046	.079	.43966	.24369	-.05365	.93296
ITEM 19	Equal variances assumed	7.803	.008	1.628	47	.110	.26724	.16416	-.06300	.59748
	Equal variances not assumed			1.735	46.972	.089	.26724	.15399	-.04255	.57703
ITEM 20	Equal variances assumed	2.383	.129	1.061	47	.294	.23621	.22267	-.21175	.68417
	Equal variances not assumed			1.137	46.996	.261	.23621	.20771	-.18164	.65406
ITEM 21	Equal variances assumed	.672	.416	.416	47	.679	.10517	.25262	-.40302	.61337
	Equal variances not assumed			.433	45.671	.667	.10517	.24301	-.38407	.59441

ITEM 22	Equal variances assumed	.014	.907	.192	47	.849	.03276	.17060	-.31044	.37596
	Equal variances not assumed			.190	39.599	.850	.03276	.17225	-.31548	.38100
ITEM 23	Equal variances assumed	4.625	.037	-.555	47	.581	-.13276	.23905	-.61367	.34815
	Equal variances not assumed			-.520	31.434	.607	-.13276	.25519	-.65293	.38742
ITEM 24	Equal variances assumed	.260	.613	.415	47	.680	.08621	.20785	-.33194	.50435
	Equal variances not assumed			.420	42.637	.677	.08621	.20543	-.32817	.50059
ITEM 25	Equal variances assumed	.004	.949	-.337	47	.738	-.06724	.19972	-.46903	.33455
	Equal variances not assumed			-.337	41.061	.738	-.06724	.19965	-.47042	.33594
ITEM 26	Equal variances assumed	.421	.520	.166	47	.869	.02586	.15603	-.28802	.33974
	Equal variances not assumed			.175	46.595	.862	.02586	.14808	-.27211	.32384
ITEM 27	Equal variances assumed	.010	.922	-.030	47	.977	-.00517	.17533	-.35789	.34755
	Equal variances not assumed			-.030	42.179	.976	-.00517	.17387	-.35602	.34567
ITEM 28	Equal variances assumed	1.475	.231	-.845	47	.402	-.16724	.19791	-.56539	.23091
	Equal variances not assumed			-.881	45.943	.383	-.16724	.18976	-.54921	.21473
ITEM 29	Equal variances assumed	1.019	.318	-.654	47	.517	-.15172	.23211	-.61867	.31522

	Equal variances not assumed			-.617	32.530	.541	-.15172	.24583	-.65215	.34870
ITEM 30	Equal variances assumed	6.824	.012	1.183	47	.243	.19483	.16476	-.13662	.52628
	Equal variances not assumed			1.309	45.070	.197	.19483	.14889	-.10504	.49470

Hypothesis three

There is no significant difference between the mean responses of experienced and less experienced electronic teachers in technical colleges on competencies required to teach radio communication

Group Statistics

	TEACHINGEXPERIENCE	N	Mean	Std. Deviation	Std. Error Mean
ITEM31	LESS EXPERIENCED TEACHER	20	4.9000	.30779	.06882
	EXPERIENCED TEACHER	29	4.7241	.59140	.10982
ITEM32	LESS EXPERIENCED TEACHER	20	4.6500	.58714	.13129
	EXPERIENCED TEACHER	29	4.5517	.63168	.11730
ITEM33	LESS EXPERIENCED TEACHER	20	4.6000	.50262	.11239
	EXPERIENCED TEACHER	29	4.6207	.49380	.09170
ITEM34	LESS EXPERIENCED TEACHER	20	4.4500	.68633	.15347
	EXPERIENCED TEACHER	29	4.7241	.52757	.09797
ITEM35	LESS EXPERIENCED TEACHER	20	4.4500	.68633	.15347
	EXPERIENCED TEACHER	29	4.6552	.55265	.10262
ITEM36	LESS EXPERIENCED TEACHER	20	4.6500	.48936	.10942
	EXPERIENCED TEACHER	29	4.7241	.45486	.08447
ITEM37	LESS EXPERIENCED TEACHER	20	4.6500	.58714	.13129
	EXPERIENCED TEACHER	29	4.7931	.49130	.09123
ITEM38	LESS EXPERIENCED TEACHER	20	4.3500	.58714	.13129
	EXPERIENCED TEACHER	29	4.6207	.49380	.09170

ITEM39	LESS EXPERIENCED TEACHER	20	4.3500	.67082	.15000
	EXPERIENCED TEACHER	29	4.6897	.47082	.08743
ITEM40	LESS EXPERIENCED TEACHER	20	4.2500	.78640	.17584
	EXPERIENCED TEACHER	29	4.5172	.63362	.11766
ITEM41	LESS EXPERIENCED TEACHER	20	4.5000	.60698	.13572
	EXPERIENCED TEACHER	29	4.6207	.62185	.11547
ITEM42	LESS EXPERIENCED TEACHER	20	4.2000	.69585	.15560
	EXPERIENCED TEACHER	29	4.5862	.56803	.10548
ITEM43	LESS EXPERIENCED TEACHER	20	4.3000	.65695	.14690
	EXPERIENCED TEACHER	29	4.4828	.73779	.13700
ITEM44	LESS EXPERIENCED TEACHER	20	4.5000	.60698	.13572
	EXPERIENCED TEACHER	29	4.4483	.57235	.10628
ITEM45	LESS EXPERIENCED TEACHER	20	4.4500	.75915	.16975
	EXPERIENCED TEACHER	29	4.5172	.68768	.12770
ITEM46	LESS EXPERIENCED TEACHER	20	4.5500	.51042	.11413
	EXPERIENCED TEACHER	29	4.4828	.50855	.09443
ITEM47	LESS EXPERIENCED TEACHER	20	4.5500	.51042	.11413
	EXPERIENCED TEACHER	29	4.6552	.48373	.08983
ITEM48	LESS EXPERIENCED TEACHER	20	4.6000	.50262	.11239
	EXPERIENCED TEACHER	29	4.5862	.56803	.10548

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
ITEM 31	Equal variances assumed	6.845	.012	1.218	47	.229	.17586	.14436	-.11454	.46627
	Equal variances not assumed			1.357	44.254	.182	.17586	.12960	-.08530	.43702
ITEM 32	Equal variances assumed	.624	.434	.551	47	.585	.09828	.17848	-.26079	.45734
	Equal variances not assumed			.558	42.894	.580	.09828	.17606	-.25680	.45335
ITEM 33	Equal variances assumed	.079	.780	-.143	47	.887	-.02069	.14457	-.31153	.27015
	Equal variances not assumed			-.143	40.528	.887	-.02069	.14505	-.31373	.27235
ITEM 34	Equal variances assumed	4.454	.040	-1.580	47	.121	-.27414	.17348	-.62314	.07486
	Equal variances not assumed			-1.506	33.828	.141	-.27414	.18207	-.64422	.09595
ITEM 35	Equal variances assumed	2.572	.115	-1.157	47	.253	-.20517	.17737	-.56199	.15165
	Equal variances not assumed			-1.111	35.037	.274	-.20517	.18462	-.57996	.16961
ITEM 36	Equal variances assumed	1.088	.302	-.544	47	.589	-.07414	.13635	-.34844	.20017
	Equal variances not assumed			-.536	38.993	.595	-.07414	.13823	-.35374	.20546
ITEM 37	Equal variances assumed	2.372	.130	-.925	47	.360	-.14310	.15467	-.45426	.16805
	Equal variances not assumed			-.895	36.072	.377	-.14310	.15988	-.46732	.18112
ITEM 38	Equal variances assumed	.872	.355	-1.746	47	.087	-.27069	.15507	-.58265	.04127
	Equal variances not assumed			-1.690	36.211	.100	-.27069	.16014	-.59541	.05403

ITEM 39	Equal variances assumed	5.273	.026	-2.085	47	.042	-.33966	.16287	-.66730	-.01201
	Equal variances not assumed			-1.956	31.626	.059	-.33966	.17362	-.69347	.01416
ITEM 40	Equal variances assumed	.099	.754	-1.315	47	.195	-.26724	.20329	-.67621	.14173
	Equal variances not assumed			-1.263	35.054	.215	-.26724	.21158	-.69674	.16226
ITEM 41	Equal variances assumed	.104	.748	-.674	47	.503	-.12069	.17901	-.48081	.23944
	Equal variances not assumed			-.677	41.653	.502	-.12069	.17820	-.48040	.23902
ITEM 42	Equal variances assumed	.277	.601	-2.133	47	.038	-.38621	.18104	-.75042	-.02200
	Equal variances not assumed			-2.055	35.402	.047	-.38621	.18798	-.76767	-.00474
ITEM 43	Equal variances assumed	.184	.670	-.890	47	.378	-.18276	.20527	-.59571	.23019
	Equal variances not assumed			-.910	43.894	.368	-.18276	.20087	-.58762	.22210
ITEM 44	Equal variances assumed	.088	.768	.303	47	.763	.05172	.17050	-.29128	.39472
	Equal variances not assumed			.300	39.395	.766	.05172	.17239	-.29685	.40030
ITEM 45	Equal variances assumed	.405	.528	-.322	47	.749	-.06724	.20853	-.48675	.35226
	Equal variances not assumed			-.317	38.272	.753	-.06724	.21242	-.49717	.36268
ITEM 46	Equal variances assumed	.186	.668	.454	47	.652	.06724	.14803	-.23056	.36505
	Equal variances not assumed			.454	40.909	.652	.06724	.14814	-.23195	.36643
ITEM 47	Equal variances assumed	1.523	.223	-.731	47	.468	-.10517	.14379	-.39443	.18409
	Equal variances not assumed			-.724	39.535	.473	-.10517	.14524	-.39882	.18848
ITEM 48	Equal variances assumed	.401	.530	.087	47	.931	.01379	.15769	-.30345	.33103
	Equal variances not assumed			.089	44.031	.929	.01379	.15414	-.29684	.32443

Hypothesis four

There is no significant difference between the mean responses experienced and less experienced electronic teachers in technical colleges on competencies required to teach television system.

Group Statistics

	TEACHINGEXPERIENCE	N	Mean	Std. Deviation	Std. Error Mean
ITEM49	LESS EXPERIENCED TEACHER	20	4.5500	.60481	.13524
	EXPERIENCED TEACHER	29	4.6552	.48373	.08983
ITEM50	LESS EXPERIENCED TEACHER	20	4.4000	.59824	.13377
	EXPERIENCED TEACHER	29	4.7241	.45486	.08447
ITEM51	LESS EXPERIENCED TEACHER	20	4.4500	.51042	.11413
	EXPERIENCED TEACHER	29	4.6207	.56149	.10427
ITEM52	LESS EXPERIENCED TEACHER	20	4.6000	.50262	.11239
	EXPERIENCED TEACHER	29	4.6897	.54139	.10053
ITEM53	LESS EXPERIENCED TEACHER	20	4.7500	.44426	.09934
	EXPERIENCED TEACHER	29	4.6207	.56149	.10427
ITEM54	LESS EXPERIENCED TEACHER	20	4.6500	.48936	.10942
	EXPERIENCED TEACHER	29	4.4483	.50612	.09398
ITEM55	LESS EXPERIENCED TEACHER	20	4.5500	.60481	.13524
	EXPERIENCED TEACHER	29	4.5862	.56803	.10548
ITEM56	LESS EXPERIENCED TEACHER	20	4.4500	.60481	.13524
	EXPERIENCED TEACHER	29	4.4138	.62776	.11657

ITEM57	LESS EXPERIENCED TEACHER	20	4.7500	.44426	.09934
	EXPERIENCED TEACHER	29	4.7586	.43549	.08087
ITEM58	LESS EXPERIENCED TEACHER	20	4.7000	.47016	.10513
	EXPERIENCED TEACHER	29	4.6552	.48373	.08983
ITEM59	LESS EXPERIENCED TEACHER	20	4.3000	.47016	.10513
	EXPERIENCED TEACHER	29	4.5172	.57450	.10668
ITEM60	LESS EXPERIENCED TEACHER	20	4.3500	.81273	.18173
	EXPERIENCED TEACHER	29	4.5517	.82748	.15366

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
ITEM 49	Equal variances assumed	2.472	.123	-.675	47	.503	-.10517	.15579	-.41857	.20823
	Equal variances not assumed			-.648	34.858	.521	-.10517	.16235	-.43481	.22447
ITEM 50	Equal variances assumed	5.149	.028	-2.154	47	.036	-.32414	.15045	-.62681	-.02147
	Equal variances not assumed			-2.049	33.551	.048	-.32414	.15821	-.64581	-.00247
ITEM 51	Equal variances assumed	.001	.971	-1.085	47	.284	-.17069	.15737	-.48728	.14590
	Equal variances not assumed			-1.104	43.424	.276	-.17069	.15459	-.48236	.14098
ITEM 52	Equal variances assumed	.204	.653	-.586	47	.560	-.08966	.15291	-.39726	.21795
	Equal variances not assumed			-.595	42.922	.555	-.08966	.15079	-.39377	.21446
ITEM 53	Equal variances assumed	3.185	.081	.860	47	.394	.12931	.15036	-.17318	.43180
	Equal variances not assumed			.898	46.021	.374	.12931	.14401	-.16057	.41919
ITEM 54	Equal variances assumed	1.799	.186	1.390	47	.171	.20172	.14516	-.09030	.49375
	Equal variances not assumed			1.398	41.900	.169	.20172	.14425	-.08940	.49284

ITEM 55	Equal variances assumed	.154	.696	-.214	47	.832	-.03621	.16951	-.37721	.30479
	Equal variances not assumed			-.211	39.283	.834	-.03621	.17151	-.38304	.31062
ITEM 56	Equal variances assumed	.054	.818	.201	47	.841	.03621	.17980	-.32550	.39791
	Equal variances not assumed			.203	41.993	.840	.03621	.17855	-.32412	.39653
ITEM 57	Equal variances assumed	.018	.893	-.068	47	.946	-.00862	.12762	-.26535	.24811
	Equal variances not assumed			-.067	40.467	.947	-.00862	.12809	-.26742	.25018
ITEM 58	Equal variances assumed	.433	.514	.322	47	.749	.04483	.13902	-.23484	.32450
	Equal variances not assumed			.324	41.763	.747	.04483	.13828	-.23428	.32393
ITEM 59	Equal variances assumed	4.196	.046	-1.398	47	.169	-.21724	.15544	-.52994	.09546
	Equal variances not assumed			-1.450	45.522	.154	-.21724	.14978	-.51882	.08433
ITEM 60	Equal variances assumed	.000	.996	-.845	47	.403	-.20172	.23879	-.68211	.27866
	Equal variances not assumed			-.848	41.489	.402	-.20172	.23799	-.68218	.27873

CRONBACH ALPHA RELIBILITY TEST

Case Processing Summary

		N	%
Cases	Valid	49	64.5
	Excluded[a]	27	35.5
	Total	76	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.738	.879	20