EFFECTS OF IMPROVISED INSTRUCTIONAL MEDIA ON NIGER STATE SECONDARY SCHOOL STUDENTS'ACHIEVEMENT IN SELECTED BIOLOGY CONCEPTS

This study investigated the effects of improvised instructional media on secondary school students' achievement in biology in Niger State. It also investigated gender and ability levels effects on achievement. Two hundred and seventy (270) students were drawn from nine public senior secondary schools. The design adopted was pretest posttest control group factorial design. The treatment involved teaching the experimental group 1 with the use of improvised models, the experimental group 2 with developed video DVD instructional package and the control group with lecture method. A 40-item Structured Biology Achievement Test (SBAT) was developed and validated for data collection. Its reliability coefficient was found to be 0.83. Seven hypotheses were tested at 0.05 level of significance. The ANOVA Statistic was used to test the hypotheses. Scheffe's post hoc test was conducted where significant difference existed among more than two groups. The major findings of the study showed that-there were significant differences between the groups (1 (models) and 2 (video DVD)) respectively and the control group. ($F_{-cal.}$ 83:12 > $F_{-tab.}$ 3.92; P < 0.05) and ($F_{-cal.}$ 112.9 > $F_{-tab.}$ 3.92; p<0.05). There were also significant differences between the male and female experimental groups (1 and 2) respectively and male and female control group. ($F_{-cal.}$ 28.38> $F_{-tab.}$ 2.68; P < 0.05) and ($F_{-cal.}$ 48.58 > $F_{-tab.}$ 2.68; P< 0.05). There were significant differences between the three ability levels of students (high, average and low) in both experimental groups 1 and 2 and their counterparts in the control group. ($F_{-cal.}$ 9.11 > $f_{-tab.}$ 2:29; P< 0.05) and ($F_{-cal.}$ 22.48 > F_{-tab}. 2.29; P< 0.05). Based on the above findings, it was recommended among others that the use of improvised instructional media should be fully encouraged in the absence of instructional media resources; either improvised models or video DVD package could be used by teachers of biology and other science subjects.

CHAPTER ONE

INTRODUCTION

1.1: Background to the Study

The importance of science as a requirement for the development of any nation is no longer in dispute. Science has contributed in no small measure to the development and comfort of the modern world. For instance, for any nation to attain the status of self-reliance, science must be an important component of the knowledge to be given to all citizens of that nation irrespective of race, creed or sex (Nsofor, 2001). Indeed, science has come to be recognized as the foundation upon which the bulk of the present day technological breakthrough is built. No wonder Abilu (2005) expressed the opinion that Nigerian citizens should pursue science, technology and mathematics education to prevent Nigeria from being perpetual slave to the developed world. The prestige and political power of any nation also resides largely in its level of scientific achievement.

Consequently, the pursuit of science as an imperative endeavor for achieving prosperity and advancement is conspicuous in the national development plans of many developed and developing nations. In Nigeria, these facts underscore the importance and priority accorded science as manifested in various policy statements and steps that encourage her citizens to pursue science courses (Federal Republic of Nigeria (FRN), 2004). Such policies include the establishment of special science schools, increasing the ratio of students' enrolment in sciences in tertiary institutions (60:40 in favour of science), and the introduction of basic science in primary school curriculum. All these are done with the hope that a solid foundation in the sciences would equip millions of Nigerian students for successful science-based careers, thereby contributing to the much-needed scientific and technological advancement.

Unfortunately, literature in science education is replete with the fact that the performance of science students in Nigerian schools still leaves much to be desired right from the primary school through secondary school to the tertiary level of education (Adewunmi, 1992; Kareem, 2003; West African Examination Council,2007;). A general review of Nigerian students’ performances in the three science subjects {Biology, Chemistry, Physics} in the West African Senior Secondary Certificates Examination (WASSCE) from 2000 to 2007 revealed fluctuations and down-ward trends in students' performance (See AppendixA). Appendix A reveals that the students' performance in the sciences, which are the foundation subjects for scientific and technological take-off, is not encouraging, especially in biology.

Biology is one of the science based career and compulsory subject for senior secondary school. Biology, an integral part of the natural science, is of Greek origin, coined from 'bios', meaning 'life' and ‘logos’ meaning 'the study of life (Ewusie, 1980). Biology is conceptualized as a unique life subject which deals with animate objects, their structure, function, growth, origin, evolution and distribution. Being a science of life, biology occupies an important position in the school curriculum. It is designed ultimately to educate individuals who may or may not pursue biological related careers, but could at least acquire the knowledge as prerequisite for pursuing careers in science related disciplines.

Basic principles and applications of biology have led to the design and production of a number of artificial organs in the body. Also the applications of these basic principles of biology (as in biotechnics and genetic engineering) have made man to perpetuate desired favorable traits in the production of high breeds of crops and animals through hybridization and cloning respectively. The knowledge of biology helps in conservation of natural resources and checkmating population explosion. The inherent potentials of biology may explain why biology is recognized and accorded a special position in the school curriculum as the only core science subject made compulsory for both arts and science students at senior secondary school level of the Nigerian education system. Thus, it has become very popular among students as evidenced by large enrolment rate (see Appendix A)

Bearing these points in mind, one expects students' performance in biology to justify its continuous popularity among them. But on the contrary, it is sad to note that the students' performance in the subject is not encouraging. For example, the percentage passes at credit level and above in Biology between 2000 and 2005 fluctuated between 19.3% and 42.2%. It increased from 19% in 2000 to 42% in 2003 and decreased again to 29.08% in 2004. Since credit pass in biology is a prerequisite for admission into most disciplines at the tertiary level of education, it then means that only these few students, who sat for WASSCE in the year 2000 to 2007, were qualified to get admission into the university, while the remaining students would have no admission into any Nigerian University.

Similarly, when students' result in biology is compared with that of other sciences like Physics and Chemistry, Biology result is usually the poorest (Ezekannaya and Ikeagu (2004). The analysis in table of appendix A reveals that most of the students who sat for biology between 2000 and 2007 failed while majority secured ordinary pass grade, which will not qualify them for admission into any tertiary institution. There were very few students who passed at credit level, for instance, in the year 2000, out of 620,291 students who sat for Biology examination, 315,919 representing 50.93% failed. Also, 184,603 representing 29.76% had ordinary pass while only 119,769 representing 19.30% passed at credit level and above.

Similarly in the year 2001, 995,346 students sat for the examination, 468,216 (47.04%) failed, 295,654 (29.70%) had ordinary pass and only 231,475 (23.25%) passed with credit and above. In 2003, 1,005,553 students sat for the examination, 266,222 (26.47%) failed, 271,058 (26.95%) had pass and 424,636 (42.22%) passed with credit and above. The trend continues till date. A close look at the failure rate of students in biology, chemistry and physics (as evidenced in Appendix A) showed that biology ranked the highest with the mean percentage failure of 42.82 % as against 31.52% and 25.56 % for chemistry and physics respectively.

Specifically, a review of Niger State students' performances in biology, chemistry and physics showed the same trend of high enrolment figure and high failure rate in biology. This was evident from the analysis of the statistics of entries and results for May/June WASSCE 2000-2008 as shown in (see Appendix B). From the analysis of the results in appendix B above, it could be observed that students who registered for biology almost doubled or tripled those who registered for physics and chemistry. It is also clear that despite the high enrolments for biology, students' performance is poor. Even though students' performance in the three science subjects is generally poor over the years, it is lamentable that the performance in biology from 2000 to 2008 has been found to be the poorest of the three science subjects. This is because it has the mean percentage failure of 65.29% against 53.91% and 45.58% for chemistry and physics respectively. Furthermore, it can be deduced from the result that the percentage of students that passed biology at credit level and above was consistently less than 20%.

This trend in students' performance in biology is supported by the WAEC Chief Examiners’ report which had consistently remarked that from 1992 up to date, there is no appreciable improvement in students' performance in the WASSCE biology results. This unimpressive performance in biology has been very disturbing and if it is not checked, it may jeopardize the placement chances of students into tertiary institutions not only in biology related areas but also in other science based disciplines. These problems have raised a-lot of eyebrows in Nigeria and constitute a major catalyst for initiating the present study.

The desire to know the causes of the problem of poor performance in biology has been the focus of researchers in recent times and has culminated into diverse researches. Ajayi (1998) reported that students perform poorly in biology because the classes are usually too large and heterogeneous in terms of cognitive ability level, while Bassey (2002) observed that the laboratories in schools are sub-standard and ill equipped. In continuation, Bassey pointed out that in some laboratories where there are few equipment and materials; they are not in good condition, usually they face technical, operational and maintenance problems owing to sophistication in construction and operation. The few that are in good conditions are not enough to go round the students. In support of this, Adelakun (2003) echoed that there is serious shortage of instructional materials in schools while Adebimpe (1997): 55 lamented thus:

> There is a total or partial absence, inadequacy of the science teaching resources, grossly inadequate finances for the purchase of science equipment, galloping inflation, rising enrolment of students, general downward trend in students' performance in science, poor maintenance culture and at times uncooperative attitude of some school heads towards science and science equipment.

Foin (2001) went further to identify population explosion in schools, where the student in-take out-weighed the number of staff available, classrooms and other school facilities as other factors that contributes to poor performance of students in biology.

Ibe (2004) and Madu, (2004), in their various studies on why students perform poorly in biology, revealed that the excessive use of expository method of teaching where the instruction is more teacher-centered is a factor. Nsofor (1991), Nateinyin (1995) and Ameh and Gunstone (1996) reported that misconceptions and difficulty of certain biology concepts are also among the causes of poor performance in it. Ojiaku (2003) shared the same view and pointed out that students blamed their poor performance in biology on the complex nature of most concepts especially those relating to the internally situated organs and systems which ordinarily they do not have access to. Such complex and abstract internal systems include digestive system, excretory system, respiratory system, nervous system, and blood circulatory system among others. Okwo, Amaka, Okoye, Ugwu and Onyeka (2008) further noted that the students rated excretion and circulation highest in complexity.

The question that comes up at this juncture is how best could these concepts be effectively taught in the classroom? It has therefore become necessary for researchers to continue the search for solutions to the multifarious problems confronting the teaching and learning of biology concepts like the ones highlighted above. Reacting to the above demand, Adewoyin (1991) pointed out that most of the problems confronting the teaching and learning of biology concepts could be alleviated if instructional technology is employed. Instructional technology according to (Adewoyin 1991) is a component of educational technology which seeks to improve learning by ensuring the installation of efficient and effective instructional system and managing the human and other resources optimally. Indeed, instructional technology is technology applied to education. It comprises of such components as the teacher, learner, subject matter and instructional media. When these components, especially instructional media are efficiently manipulated and managed in any instructional process, learning becomes effective. Based on this, Onasanya and Adegbija (2007) emphasized on the need for massive use of instructional media in the classroom.

Instructional media are projected and non-projected information carrying technologies that constitute an integral part of the instructional process used for the delivery of educational information very quickly, widely and effectively (Adewoyin, 1991). Some of the wide ranging instructional media materials that could be used for biology instruction in secondary schools are non-projected two and three-dimensional materials (charts, diagrams, models and others) and projected media materials (film strips, audio-tapes, video CD and DVD and others). Umeoduagu (2000) emphasized that for effective instructional processes, emphasis should be more on those media materials that appeal to more than one sense of perception. This remark is based on the fact that learning experiences, which evoke the involvement of as many sense organs as possible enable the teacher to convey meaningful information to the learners and stimulate students to receive and process all the necessary information for the development of cognitive, affective and psychomotor skills. This is what has drawn attention to research into models and video (DVD) instructional package. Of all non-projected media material mentioned earlier, model is the only 3-dimensional medium and thus has appeal to many senses of perception. Model simplifies complex objects and accent important features with color, texture and illumination. Model scales down or scales up objects to an observable size. Video DVD also has appeal to many senses of perception, and in addition has an advantage of making knowledge reach a lot of students simultaneously. Video DVD enables the teacher to process instruction, enhance its presentation, supervision and management. The importance of these media materials in the teaching and learning process cannot be overemphasized. But are these instructional media materials available in our schools?

As important as these media materials are, it has been widely reported by a growing body of research that the improvised version of such media materials are not available in most Nigerian schools, also foreign types are not readily available (Ezeudu, 2000; Adelakun, 2003; Thomas, 2004; Gana, 2006). Specifically, Thomas (2004) pointed out that complete models either improvised or foreign for teaching the concept of blood circulation and excretion in man are not available in most secondary schools in Niger State. Similarly Gana (2006) made it clear that most secondary schools in Niger State do not have functional video instructional packages (tape, CD or DVD) in any subject area.

Based on the foregoing, Adebimpe (1997) warned that teachers should not use the absence or inadequacy of instructional media as an excuse to resort to poor teaching and learning, instead they should resort to improvisation as an alternative approach towards keeping science teaching and learning afloat and meaningful during such a difficult time. This is in line with the view of Maduabum (1983), he emphasized that if science is best learned with concrete objects, then teachers have no option than to devise methods of complying through improvisation. Improvisation is the act of using local materials obtained from the local environment or designed by either the teacher or with the help of local personnel to enhance instruction (Balogun, 1982; Adebimpe, 1997). Improvisation could also be referred to as the act of using alternative materials or resources to facilitate instruction whenever there is lack or shortage of some commercially produced instructional teaching materials. However in the act of improvisation, Araromi (1998) cautioned that improvised instructional materials must necessarily serve the purpose for which it is intended. It should not just be provision of a piece of media as a substitute for what is not available. The present work is a step in this direction. Two sets of models imaging the two concepts of excretion and circulation were improvised, video DVD instructional package were produced and their effects on students' achievement in biology were sought

Media effects on learning outcome are common in the field of Educational Technology. Examples of such studies are those of Okobi, (1994), Okoro and Etukudo, (2001), Otegbayo, (2005), and Kutigi, (2006). Okobi (1994) investigated the effects of Video Tape and Slide Tape Instruction on students' performance in social studies; Okoro and Etukudo, (2001) investigated the effects of Computer Aided Instruction (CAL) and Extrinsic Motivation Traditional Method on students' performance in chemistry; Otegbayo, (2005) investigated the effects of Audio and Film Package on the teaching and learning of phonetics in junior secondary schools, while Kutigi, (2006) investigated the effects of Audio Tape and CAL on the teaching and learning of oral English at senior secondary school level. Of all the researches mentioned, no known work has been reported on the effects of video (DVD) instructional package and instructional model on students' achievement in biology.

Again, prominent among the prevalent problems in the school system are those of the influence of students' ability level (high, average and low) and gender differentials on learning outcome. It is a common feature in the conventional classroom to find students of mixed academic ability lumped together to be given the same treatment as if they have everything in common. This phenomenon has been a point of concern to researchers in the recent times and this was investigated in this study. Gender issues also have been linked with performance of students in academic tasks in several studies (Awoniyi, 2000; Balogun, 2000). Some studies revealed that male students perform better than female students in science while others revealed that female students are better than their male counter parts. Some studies could not even find any form of influence being exerted by gender on academic performance. Despite various studies to examine the relationship between gender, ability level and students' academic performance, the issues are still far from being conclusive. It is therefore reasoned that a considerable amount of empirical research evidence is still required before a definite and convincing pattern of relationship can emerge. These issues essentially set forth the problems that were investigated in this study.

1.2: Statement of the Problem

Biology is regarded as "most popular" of the three basic sciences (Biology, Chemistry, and Physics) that students are exposed to at secondary school level, but when students' result in public examination in this subject is compared to other sciences, biology result is usually the poorest (Ajayi, 1998 and Nsofor, 2007). Indeed the performance of students in science generally and biology in particular has been quite unsatisfactory over the years (Adewunmi, 1992; Kareem, 2003 WAEC, 2007;). The examining bodies such as the West African Examination council (WAEC) and National Examination Council (NECO) (2000-2008) have repeatedly recorded mass failure in the subject. This particular problem has prevented the educational system in Nigeria from producing required scientists and technologists (Gusen 2001). Also the poor performance of students in science (Biology) has implications on university admission and might explain the reason for the introduction of remedial programs in some Nigerian Universities.

Researchers have traced the issue of unsatisfactory performance of students in biology to a number of problems such as methods of instruction used by teachers, abstract and complex nature of biology concepts and most importantly the unavailability or inadequate supply of instructional materials in schools (Ojiaku, 2003: Adelakun, 2003). Stressing further on the problem of instructional materials, Adebimpe (1997) reiterated that the shortage of instructional materials is really a serious issue in Nigerian educational system. With these multifarious problems in the school system, most teachers resort to the teaching of science(biology) concepts with only "chalk" and "talk" method or by the use of 2- dimensional materials (poster, chart, diagram, and others).

According to Martins and Oyebanji (2000), this situation in the school system has made the teaching and learning of biology boring, uninteresting, and even meaningless to most students. These students in turn develop phobia while nursing the impression that science is meant for a gifted few with special mental ability. This situation has enhanced the undesirable existence of a preponderant class majority of mere on-lookers learning about science (biology) and not learning science. Consequently the product of the educational system usually constitutes a generation of graduates who are not committed to science and who cannot reason critically or analytically and so cannot transfer what is learnt to a new but similar situation Osisioma (2005). Therefore, as a step towards addressing these abnormalities and the inadequacies of instructional materials in secondary schools, this study attempted to develop complete models and video DVD instructional package for teaching the biology concepts of blood circulation and excretion and investigate their effectiveness on students' achievement.

1.3 Purpose of the Study

The of this study was to investigate the effects of video DVD and improvised models on students' achievement in biology. Specifically, the study intended

1. To investigate the effects of improvised models and lecture method on students' achievement in biology.
2. To investigate the effects of improvised models and lecture method on gender in biology.
3. To investigate the effects of improvised models and lecture method on students' ability in biology.

4. To investigate the effects of video DVD and lecture method on students' achievement in biology.
5. To investigate the effects of video DVD and lecture method on gender in biology.
6. To investigate the effects of video DVD and lecture method on students' ability in biology.
7 To investigate the effect of improvised models and video DVD on students' achievement in biology.

1.4: Research Questions.

In order to find solutions to the problems raised, the study addressed the following research questions:

1. What are the effects of Improvised models and Lecture method on Students' Achievement in Biology?
2. What are the effects of Improvised models and Lecture method on gender in Biology?
3. What are the effects of Improvised models and Lecture method on students' ability in Biology?
4 What are the effects of Video DVD and lecture method on Students' Achievement in Biology?
5 What are the effects of Video DVD and lecture method on gender in Biology?
6 What are the effects of Video DVD and lecture method on Students' ability in Biology?
7 What are the effects of Video DVD and Improvised models on Students' Achievement in Biology?

1.5: Research Hypotheses

Based on the research questions, the following null hypotheses were tested;

HO_1 There is no significant difference in the mean achievement of students taught with improvised models and those taught with lecture method.

HO_2 There is no significant difference in the mean achievement of students taught with improvised models and those taught with lecture method irrespective of gender.

HO_3 There is no significant difference in the mean achievement of students' based on their ability levels taught using improvised models and those taught with lecture method.

HO_4 There is no significant difference in the mean achievement of students taught using developed video DVD Instructional package and those taught with lecture method.

HO_5 There is no significant difference in the mean achievement of students taught with developed video DVD Instructional package and those taught with lecture method irrespective of gender.

HO_6 There is no significant difference in the mean achievement of student's based on their ability levels taught using developed video DVD instructional package and those taught with lecture method.

HO_7 There is no significant difference in the mean achievement of students taught using improvised models and those taught with video DVD Instructional package.

1.6: Scope / delimitation of the Study

This study developed instructional models and video DVD instructional package and found their effects on secondary school students' achievement in selected biology concepts in Niger State. It was conducted in co-educational senior secondary schools selected from 146 Government secondary schools (77 co-educational and 69 single sex schools) distributed within the three educational zones (A, B, C) in Niger State.

The study was delimited to senior secondary two students (SS II) because the concepts treated in this study were selected from their curriculum. The aspects of the biology concepts focused on were human blood circulation, and excretion. It also examined the influence of gender and ability levels on students' achievement when taught using improvised instructional models and video DVD instructional package.

1.7: Significance of the study

It is expected that the teaching and learning process, students, teachers, teacher trainees, curriculum developers, policy makers, parents, government and the nation at large would benefit from the findings in the following ways: The result of this study will have positive impacts on teaching and learning of biology in secondary schools. It will re-emphasize the need for teachers to always enrich the teaching-learning process with instructional media. This would encourage head, hand and heart co-ordination on learners and promote harmonious interaction between learners and the materials to be learnt. This in turn would relieve passivity, monotony, excessive verbalism, thereby preventing biology from being taught in a manner that produces in the mind of learners a feeling of boredom and distaste for biology. The instructional media developed will enhance the teaching and learning of the structure and function of human heart, components of blood circulatory system and mechanism of blood circulation in man, structure of urinary system, mammalian kidney and mechanism of excretion in man (urine formation).

Findings from the research will have positive impacts on the students' participation and interest in biology in the sense that the developed media used would be readily available for the learners' use during and after the lesson. This would enable the learner to study a particular concept over and over at his / her own pace. This procedure would provide for individual differences, eliminate tension in learners, make learning easy, simple, and enjoyable and invariably culminate in better mastery of the subject matter. Specifically, the model being 3-dimensional would enable the learners to see and touch the features. Consequently, it will provide cognitive bridge to lead them from abstraction to a nodding acquaintance with reality. By the use of video- tape instructional package, the interest of the learners for irrelevant movies and entertainment programs could systematically be transferred to a more productive and educative pursuit. Also the learners listening skill which is vital to efficient learning would be improved upon.

It is expected that the media improvised will have positive effects on students' performance, and would stimulate and encourage biology teachers' innovativeness, resourcefulness, ingenuity and challenge them to use what they have to get what they need. Again, the biology teacher is expected to benefit from this study, because the use of videotape instructional package could provide some more positive approach to the problem of large classes, while the use of model would aid the teaching of abstract and complex biology concepts.

The findings from this study would attract the attention of teacher training institutions to incorporate and emphasize more on the techniques for the production and utilization of electronic and non-electronic instructional media in their programs. This is to ensure that the teachers have the requisite knowledge, skills, attitude and interest to generate and manipulate media materials in the teaching and learning process. The importance of media in teaching process cannot be over emphasized but media do not teach by themselves, they require the efforts of the teacher to make them effective.

The study would keep science curriculum developers abreast of the need to always spell out specific instructional medium in relation to curriculum content. This is to give direction and confidence to the teacher whose job it is to put the curriculum into use and to ensure the attainment of specific objectives of learning science.

When the findings of this study get to the policy makers, they would enable them to lay more emphasis on the introduction of improvisation as a course in all tertiary institutions. This will equip Nigerians, most especially teachers, with the skills that will enable them to improvise whenever there is lack of first hand materials. This may also require the policy makers to emphatically make it a matter of policy that science teachers and other supportive staff in education must be sponsored to attend refresher courses, seminars, workshops and conferences to keep them abreast of the global developments in science education in general and their specific areas of specialization in particular.

The findings of this study on the students' performance in the selected concepts will encourage the development of similar models for teaching other biology concepts. This ultimately will lead to improved performance generally in Biology as a discipline. Equally, success in biology will enhance success in related professions, which is capable of improving the economic and social status of families in particular and the nation in general.

It is hoped, that the fundamental issue in this study which is improvisation, wi1l be of great benefit to the government: This is because the economics of education is generally economics of scarcity. Therefore, no matter how generous and rich the government might be, they are generally not in position to provide the schools with all the instructional media they need. Thus the improvised media in this study would compliment the costly imported prototypes, increase the number of biology instructional materials available in schools and help in conserving foreign exchange.

The study would be of immense benefit to the nation as it could lead to the turn out of learners with solid foundation in science (biology) to meet the demands of science and technology of the new millennium. This study may serve as a springboard for future researchers who might wish to embark on a similar study but on other concepts in biology or other discipline such as chemistry or physics.

1.8: Operational Definition of Terms

The following key terms which featured in this research are defined below as they were used in this study;

Improvised Instructional Media: These are biological models (internal structure of the heart, blood circulatory system, excretory system and kidney nephron) and video DVD instructional package improvised by the researcher using materials available in the environment to serve as channels through which message, information, ideas and knowledge are disseminated to the learners. They are locally improvised devices that can be used to enhance the quality of an instruction.

Ability Levels: This entails rating of academic level of the sampled students in biology as high, average and low achievers. The rating was based on their performance in their last terminal examination in biology. The students were divided into three levels - upper 25% as high achievers, middle 50% as medium achievers, and lower 25% as low achievers.

Video DVD Instructional Package: This is an audio-visual self developed programmed instruction on biology concepts of blood circulation and excretion stored in a DVD plate that can be used in the teaching and learning process.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter contains the review of various works and concepts considered relevant to this study. Areas reviewed include:

2.2 Conceptual Framework:

2.2.1 Educational Technology: Meaning and Scope

2.2.2 Instructional Media: Nature and Scope

2.2.3 Improvisation in the Teaching and Learning of Science

2.2.4 Biology in Secondary School Curriculum

2.2.5 Blood Circulation and Excretion Mechanisms in Man

2.3 Influence of Ability levels and Gender on Students' Academic Performance

2.4 Theoretical Framework on Instructional Media and Learning

2.5 Empirical Framework on Instructional Media and Learning

2.6 Summary of Reviewed Literature

2.2 Conceptual Framework

This study is rooted on some basic concepts whose clarifications are considered necessary. These concepts were discussed under these headings:

2.2.1 Educational Technology: Meaning and Scope

Educational technology is a relatively new field of study which is developing very fast. Commenting on this, Chapin and Messiele (1992) asserted that educational technology is rapidly becoming one of the most important and widely discussed issues among researchers and/or scholars in education. With the rapid development in educational technology, the concept has come to mean different things to different people who have variously expressed their views. For instance, Lumsdaine (1964) defined educational technology as media bone out of communication revolution which can be used for instructional purposes alongside the teacher and chalkboard. This definition emphasized product (gadgets or machines) and people. To Hoban (1965), educational technology is a complex, integrated organization of men and machines, of ideas, of procedures and of management. This definition emphasized three elements of educational technology- men, their technological and scientific ideas, procedures and management with machines. Men here represent teaching staff, pupils, administrators and other resource persons. While procedures and management represents planning, identification of needs, resources, constraints, evaluation and use of research findings in human learning and machines represent mechanical hardware and software.

In another dimension, Encyclopedia of Education (1969) explained educational technology as the purposeful utilization in combination or separately of objects, techniques, devices, events and relationships to increase the effectiveness of educational process. The helpfulness of educational technology to the understanding of instructional process also finds support in the studies of (Dada, 1984; Ajayi-Depemu and Talabi, 1986; Akanbi, 1988; Adebute, 1991; Momoh, 1997; Obodozie, 2002; Mohammed, 2004; Nwadibia, 2005 and Olumba, 2007). Substantial amount of these researches carried out centered on the specific role played by educational technology devices. These researches confirmed educational technology as a strong force in facilitating effective communication, resulting in higher level of performance in any learning situation. Looking differently at educational technology, Davies (1978) presented three approaches to educational technology, namely; the hardware approach, the software approach and the system approach. To him, the hardware approach is seen as the traditional approach to educational technology because it assumed that a technology of machine is intimately related to a technology of teaching. It stressed that educational technology is the application of physical science and engineering to the problems of education. Therefore in this approach, educational technology is seen as a means of mechanizing or automating the teaching-learning process with certain advantages.

The second approach which is the software approach saw educational technology as a systematic way of designing, presenting and evaluating instruction. This approach laid emphasis on the technology of message design, which involves (i) the identification of appropriate aims, goals and objectives (ii) the selection of relevant and suitable subject matter (iii) the choosing of effective and contrasting learning and teaching strategies, methodologies, activities and experiences and (iv) the evaluation of not only the success of the resulting learning outcomes but also the effectiveness of the very strategies employed. This implies that software approach embraces the whole curriculum process.

The third approach is system approach; it saw educational technology as a systematic process of managing ideas, people, hardware, software and the environment in identifying and solving educational problems. This approach focused rather more deeply on the process as well as the products of teaching and learning. It is the application of system analysis concept to education. Here the major concerns are the quality and relevance of the overall learning experience. It would be dictated that these three approaches covered the transmission, reception of knowledge and information, the purposeful shaping of behavior and the means of enhancing the worthwhile-ness of the process. Commenting on the three approaches to educational technology, Agun and Imogie (1988) argued that they did not in actual fact represent different views but different stages in the development of the field of educational technology as presented on figure 2.2.

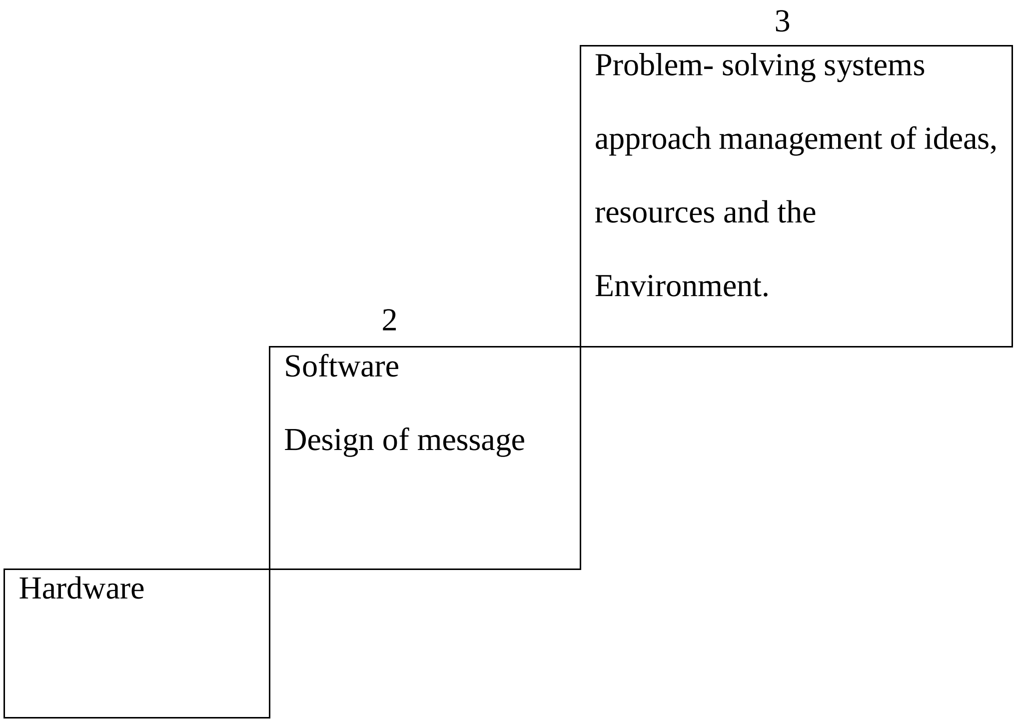


Fig 2.1: Stages in the development of the field of Educational Technology

Source: Agun and Imogie 1988:4

In a bid to streamline these views, in 1972, the Association for Educational Communication and Technology (AECT) of the United State of America set up a committee to that effect. In 1979, the AECT came up with a universally accepted definition of Educational Technology as a complex, integrated process, involving people, procedures, ideas, devices and organization for analyzing problems and devising, implementing, evaluating and managing solutions to those problems involved in all aspects of human learning. The above definition of educational technology as remarked by Agun and Imogie (1988) is more lucid, concise, and yet comprehensive enough as an adequate synthesis of the various definitions earlier given. It helped to stress the four major components of Educational technology namely- Educational Management Functions- Educational development functions – learning Resources- learner.

Educational technology from all indications includes all educational processes, strategies and activities designed to achieve excellence in education. Ogunrati (1982) remarked that educational technology involves principles and methods which bring together men and resources in a systematic bid to effectively resolve educational problems. Adewoyin (1991:4) shared this view and added that Educational technology (in its holistic form) is for, and about people, process and products integrated in a systematic manner to enhance learning efficiency and effectiveness. Also that the attitude of mind, the methods, the philosophy behind the determination of what to learn, the production and use of those mechanical hardware and software, the assessment of the effectiveness and efficiency of all the procedures, the adequacy of the teaching-learning environment and the application of systems approach are integral part of educational technology.

From all these and from other perspectives, Dike (1999) deduced that educational technology includes all of the following:

- The production of teaching and learning materials, the storage, retrieval and dissemination of information.
- The psychological aspects of learning, audio and visual methods of presentation, curriculum, planning, development and application.
- The allocation of resources, the cost and effectiveness of media in education, the design of learning spaces and the problems of innovation.

- The efficient and effective communication of knowledge and development of skills.

Dike (1999) maintained that educational technology covers the whole process of education and aims specifically at the improvement of teaching-learning process. Adewoyin (1991) completely agreed with this, and remarked that when educational technology is wisely and judiciously applied in all its ramifications to the teaching-learning process, it has the potentials to provide solution to some of the educational problems, such as:

- Shortage of adequately qualified teachers at all levels. This could be handled through educational technology by development of modules and audiotapes and video tapes which could be reproduced and utilized extensively.
- Inadequate programs and facilities for the training of teachers. Here educational technology can assist by helping to develop appropriate competency-based teacher education program on the use of micro-teaching facilities and strategies.
- Poor and inadequate funding of education. Educational technology here can help through improvisation. A good educational technologist could use local materials in the environment in the construction of inexpensive but effective teaching materials as typified in this study.
- Inadequate equipment, materials and facilities. Again, educational technology here can assist in the development and production of inexpensive, low technologies as well as the determination and development of alternative strategies.
- Inadequate and irrelevant curriculum. Educational technology can assist in the development of new curriculum contents and design as well as the establishment of flexible instructional strategies including programmed materials and modules.

- Rote learning. By the use of different frames of reference and the evocation of the various senses, educational technology should help to remove rote learning.

2.2.1a Trend of Educational Technology

According to Adewoyin (1991), no single individual can be credited with the invention and development of educational technology. In continuation, Adewoyin pointed out that the evolution of Educational technology was a gradual process and dates back to the stone age period during which visual aids such as stones, pebbles, sticks and cowries were used to enhance effective communication and learning. The evolution was also as a result of the contribution of several individuals and organizations. The Egyptian Hieroglyphics (visuals) marked the beginning of writing, the Old Persian and Assyrian cuneiform served as media for human expression and communication of idea. As noted by Agun and Imogie (1988), the sophists who lived in Athens in about the last half of the fifth century BC were probably the first educational technologists. They were noted to be the first people to develop techniques of analysis in teaching. This is because it was observed that their lectures were carefully prepared and delivered in a systematic manner. Others that contributed to the development of Educational Technology were educators such as Socrates (479-399 BC), Plato (428-349 BC) and St. Thomas Aquinas, the philosopher. These people emphasized on the right method to be employed in instruction, the sequence to be followed and the type of evaluation to be adopted.

In 1450 AD, John Guttenberg made a significant contribution to the development of Educational Technology by inventing a printing press which revolutionized the communication process. This invention gave birth to the age of books which increased accessibility to recorded information. In addition to this invention, other Greek teachers, prominent among whom were Protagoras, Propilcos and Hippas evolved new techniques of teaching and encouraged the use of apparatus in the teaching and learning process, while Lancaster introduced the use of bold letters in writing and the use of different colours on charts. Pestalozzi, Rabelis, and Cornelius made their marks, recommending that learning should commence from concrete to abstract; Rabelis advocated for the use of real objects and Cornelius advocated for the use of many text books with illustrations and pictures.

Educational Psychologists were not left out in the evolution of Educational Technology. Thorndike, (1874-1944), Pavlov, Skinner, Maria Montessori (1870-1952) Robert Gagn all made their marks. They carried out various experiments with animals and evolved new theories of learning. Skinner is the originator of the branch of programmed instruction known as linear programming. Maria Montessori advocated that in learning, learning activities should be ranked with different ages.

From the foregoing, it could be said that no single individual or field could be credited with the evolution of Educational Technology. Educational Technology is an eclectic field and not an island, which is to say that it borrows relevant ideas from other fields such as Engineering, Psychology, Sociology, Cybernetics and others. Adewoyin (1991) pointed out that analysis of the work of these contributors revealed that they had in their minds the following ideas, principles and methods in common:

- The nature and characteristics of learners.
- Learners' individual differences and learning styles.
- Methodology of teaching and learning.
- Application and coordination of the senses in learning.
- Motivation, Reinforcement, stimulus response mechanism which include immediate knowledge results
- Learning activities (including the participatory role of learners).

The above ideas form the corner stone upon which effective learning ultimately rests and which, in actual fact is the main concern of Educational Technology.

In Africa, the development of certain aspects of educational technology was fostered by the early missionaries such as David Livingstone. David encouraged the use of visual materials which gave rise to the formation of the audio-visual movements by the mid 1950s. This movement introduced the use of audio-visual materials in the teaching and learning situations. In Nigeria, the practice of Educational Technology started with the use of simple teaching aids. Onyebunwa (1999) revealed that resources in different local environments in Nigeria were utilized as aids to facilitate teaching and learning. In Yoruba land for instance, Ayo, marbles and pegs (small sticks) were used by pupils in schools. In Ibo land, cowries and sticks were effectively used, while in the Northern part of the country, beads, pebbles have long been used effectively in teaching and learning. Okafor (2000) explained that the practice of educational technology in Nigeria is as old as western education. Up till the fifties, the term "teaching aids" was used to aid learners. Simple addition and subtraction was taught with the use of counting sticks and pebbles. This was however done at junior primary school level. Maps and globes were used to teach subjects like Geography and History. Abdullahi (2001) agreed that the use of educational technology in teaching and learning is not absolutely new, perhaps what is new are the technological innovations and the great challenges which education demands posed to the teaching and learning process.

1932 witnessed the establishment of the first Radio receiving station in Lagos which transmitted certain amount of educational programs to learners (Ogunrati 1982). According to Ogunranti, the educational program broadcasted at this period was limited to English language. In 1947, Adewoyin (1991) noted that an instructional material production center was opened in Lagos. In 1951, Nigerian Broadcasting Services (NBS) was established to inherit and continue educational broadcasting program for teachers and pupils. This was the situation until when the NBS was instituted into the Nigerian Broadcasting Corporation (NBC) in 1957.

According to Olusola (1982) the year 1959 marked another turning point in the history of the application of Educational Technology in Nigeria. Television was introduced as a better medium which could be used to educate the masses. In 1974, the Abadina Media Resources Center was established by the University of Ibadan. It was the first resource center in Nigeria. The center was equipped with a wide range of instructional materials for effective teaching and learning at the primary school level. Following this step, in 1977, the National Educational Technology Center (NETC) was established in Kaduna by the Federal Government of Nigeria. The center was responsible for the following charges:

- Local production of instructional materials that bear relevance to the environmental and cultural talents and resources.
- Training of teachers and student-teachers in the application of educational technology through workshops, seminars, short courses and attachment training.
- Training of personnel in the various fields of educational technology i.e. in audio-visual aids, educational television and radio broadcasting, photographic and cinematographic services, instructional graphics and self-instructional materials.
- Production and transmission of educational programs on radio and television for primary, secondary and teacher training colleges.
- Preparing the young ones for formal education through the broadcasting of pre-school educational programs.
- Operation of a National library of Educational Resource materials.

- The Monitoring of the marketing of imported instructional materials in the country and ensuring that such materials are not only educationally sound but are also relevant to the cultural needs of the Nigerian child.
- Providing consultancy services in the field of educational technology to the federal and state governments as well as individual institutions.
- Establishment and maintenance of instructional media facilities which cannot be easily duplicated by individual institutions.

According to Adelu, 1984) the efforts of the Federal Government to promote Educational Technology in Nigeria were complemented by the state media services and ministries of education. Today in Nigeria, educational technology is a popular course run by colleges of education and universities (Nsukka, Ibadan, Ife, Zaria, Ilorin, Benin and Minna) where NCE, first degree, masters and PhD are awarded. The Nigerian Association for Educational Media and Technology also contributed to the development of educational technology through conferences, symposia, seminars, workshops and publications. The association has in various ways helped in clarifying various misconceptions regarding the concept of educational technology.

2.2.1b Instructional Technology

According to Momoh (1997), educational technology has a broad scope. It is eclectic in nature, includes a unique integration of theories and system approach which draws ideas from nearly all the fields - Psychology (learning theories), Sociology (human relation theories), Cybernetics (information handling techniques), and Management theories. Ogunmilade (1984) lent support to this and pointed out that educational technology is a system made up of different sub-systems, Designs, Management, Production, Research and Evaluation. He stated that these components work together and complement each other for the full value of educational technology to be realized. Educational technology lays emphasis on improvement in Education generally with particular reference to instructional process. The aspect of educational technology which deals with instruction is called Instructional Technology.

Instructional technology can best be described as that component of educational technology which seeks to improve learning by ensuring the installation of effective and efficient instructional systems and managing the human and other resources optimally to bring this about (Adewoyin 1991). Adewoyin (1991) clarified that instructional technology performs this function not only by defining problems but also by designing, organizing, sequencing, evaluating, managing and recycling data and information for improved performance in subsequent efforts. Instructional technology according to Rahman (2002) is viewed as an integrated and systematic method of designing, planning, implementing and evaluating the total process of learning and teaching in terms of specific objectives, research, information on human learning and process of communication. Instructional technology is "a systematic way of designing, carrying out and evaluating the process of teaching and learning based upon researches in human learning and communication and employing a combination of human and non-human resources to bring about more effective instruction". The above descriptions of instructional technology imply that for improvement of teaching and learning, systematic planning and the skillful use of the products of technology are basic pre-requisites.

In a similar view, the Association for Educational Communications and Technology (AECT) described instructional technology as a systematic way of designing, carrying out, and evaluating the total process of teaching and learning in terms of specific objectives based on research in human learning and communication and employing a combination of both human and non-human resources to bring about a more effective instruction. The above description by the AECT indicates that instructional technology entails the use of machines, devices, Media and techniques with the source of power that make teaching and learning easier, interesting and effective. The use of technology as part of the process of learning becomes relevant and as such technology must be adapted to the unique nature of the learner and the social expectations of the learner and the society. Instruction must therefore be planned from the curriculum. The curriculum must aim at achieving the goals of education.

Balogun (1980) noted that while educational technology consists of such elements as curriculum and instruction, administration, management, supportive and maintenance components; instructional technology comprises of such components as teacher, learner, content, media, method and evaluation. This indicates that instructional technology is leaner centered, systematic, innovative and a problem solving approach. While educational technology is technology applied to education, instructional technology is specifically technology applied to instruction. Educational technology therefore subsumes instructional technology as shown in fig.2.3

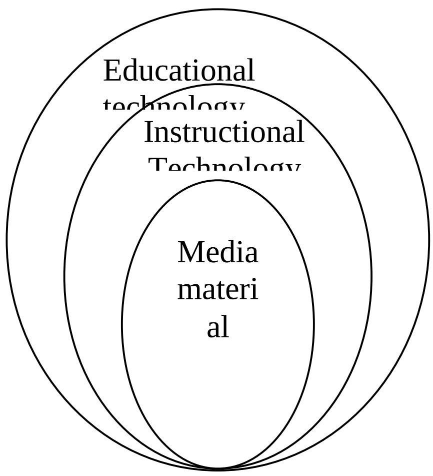


Fig 2.2: Relationship between Educational Technology and Instructional Technology

Source: Adewoyin 1991:5

In stressing the importance of instructional technology in developing nations including Nigeria, Okeke (1997) said that in many developing countries, technologies will rejuvenate the traditional teaching method like in a world of social change characterized by a world of technological innovation. He also itemized computers, video tapes, radio, projectors, etc. as the various media employed for instruction. This emphasized that instructional technology is mainly concerned with shifting emphasis from the method of using chalk and repetitive talking to the use of combined human and technological media to reach a greater number of learners with most adequate information, knowledge and stimuli.

s Essential elements of instructional technology include identification of educational problems that should be resolved, understanding of the audience and their needs, establishment of prints in problem solving, examination of various alternatives for solving educational problems, analysis of messages which would lead to the achievement of objectives and development of evaluation techniques between the instructor and the learner. Instructional Technology subsumes instructional media.

2.2.2 Instructional Media: Nature and Scope

Ogunrati (1984) described media as a part of educational technology, which is defined as a go-in-between, a carrier of messages from one to the other. On a general note, most media have the capacity to diffuse information, to show color, motion, systematic representation and synchronize picture and sound. According to Adewoyin, (1991:70) “media are channels through which, messages, information, ideas and knowledge are conveyed and/or disseminated. They are the tools or instruments through which stimuli can be passed and/or obtained".. To Adeniran (2002) media are collection of materials and equipment that can be used to help communication between two or more system. They are essentially a working group organized around some devices to affect a control of communication. Gusen (2001) agreed with this and remarked that the effect of technological development on communication is clearly evident all around us and most Nigerians are conscious of the effect and influence of the media. Dopemu (1988) pointed out that there is hardly any home or industry around the world that does not employ the media as a means of receiving or putting a story across. Media has occupied a part of our daily life that without it, effective communication becomes impossible.

Adewoyin (1991) opined that media as information carriers are generally characterized by the following points:

- Some are audio in nature (radio, microphone), some are visual in nature (models, charts) yet, others are Audio-visual in nature (films, videotape, and television).
- Some are big (television, computer assisted instruction) and some are small (models, charts, films).
- Some are static (pictures, maps) while some are dynamic (motion films and television).
- Some are in the realm of mass media (radio, press and television).
- Some are locally designed and produced while others are commercially produced:

When these media are used for instructional purposes, they are called instructional or educational media, (Adewoyin 1991). In continuation, Adewoyin stated that instructional media refer to all educational resources-graphics, photographic, electronic or mechanized means of arresting, processing visual or verbal information or a combination of both. Simply put, instructional media refer to all forms of communication through which teaching and learning takes place. To Akanbi (1993), media materials are information carriers designed specifically to fulfill objectives in a teaching-learning situation. These materials can be used to record, store, preserve and transmit or retrieve information. They can also be referred to and be used as sources to obtain knowledge, new ideas and teachers can also use them to present learning tasks. They are also seen as those resources which are manipulated, seen, heard, or talked about plus the instrument which facilitate such activities. Obianwu and Azubike (1994) and Adeniran (2002) described instructional media as all those devices such as man, machines and materials which can be used by educators to present a complete body of information in teaching and learning process for effective instruction.

The importance of instructional media cannot be overemphasized. Obianwu and Azubike (1994) discovered that people generally remember: 10% of what they read; 20% of what they hear; 30% of what they see; 50% of what they see & hear; 70% of what they say; and 90% of what they say as they do a thing. Adewoyin (1991) summarized some of the values of instructional media (model) in these words:

- Instructional media increases retention and recall of whatever is seen and manipulated. Media increases rate of learning and save teachers precious time which can be used for other gainful activities.
- With instructional media, learning becomes real, concrete and immediate. Media add aural & visual dimension to learning. They broaden their knowledge, increase their level of understanding and discourage rote-learning.
- Media help to individualize instruction. It enables students to learn at their own pace and time.
- Instructional media makes education equal to all varying degrees e.g. rural and remote dwellers, nomads, deaf, dumb, blind and others.

- Instructional media helps in focusing attention and in motivating learners.
- Instructional media lend support, authority or authenticity to whatever the teacher says.
- Instructional media provides experiences that may not otherwise be available to learners
- Instructional media helps in clarifying complex events or situations and in magnifying or reducing objective events.
- Instructional media enlists students' participation.
- Instructional media helps to educate more people in less time.

Hahm (2003) categorized instructional media into four groups namely mediating media, obligatory media, optional media and criterion media.

- Mediating media are media that are placed between the learner and the object he wishes to learn, that is, they are used to bring into sharp focus what has to be learnt in order to acquire the required skills. Examples are microscope, telescope, quadrant and others.
- Obligatory media are those media that are compulsory and must be obtained and used if objectives are to be achieved. Examples are chalkboard, pens, pencil, paper, maps.
- Optional media are those media, which are not compulsory for the achievement of the teacher's objectives but if found and used will lead to the enrichment of classroom presentation. Thus, while optional media aid learning, learning is not entirely predicated on them. Examples are charts, sketches, flannel graphs or magnetic boards or the use of tape recorder for language teaching instead of the conventional language laboratory.

- Criterion media are media-like models or mock-ups used by students in practicing a skill in order to achieve mastery. They are media resources that provide invaluable simulation opportunities and experiences in a learning situation when direct and immediate hands (of professional jobs) may be absent or dangerous. For instance, pilots learning to fly by first being exposed to flight simulators and following their successful training move further up with exposure to real plane.

Instructional media could be classified into various categories or systems, for ease of selection and application. Abimbade (1997) had attempted a taxonomy that put instructional media into three classes. These are print, non-print and electronic media. This classification is clearly shown diagrammatically in Fig 2.1.

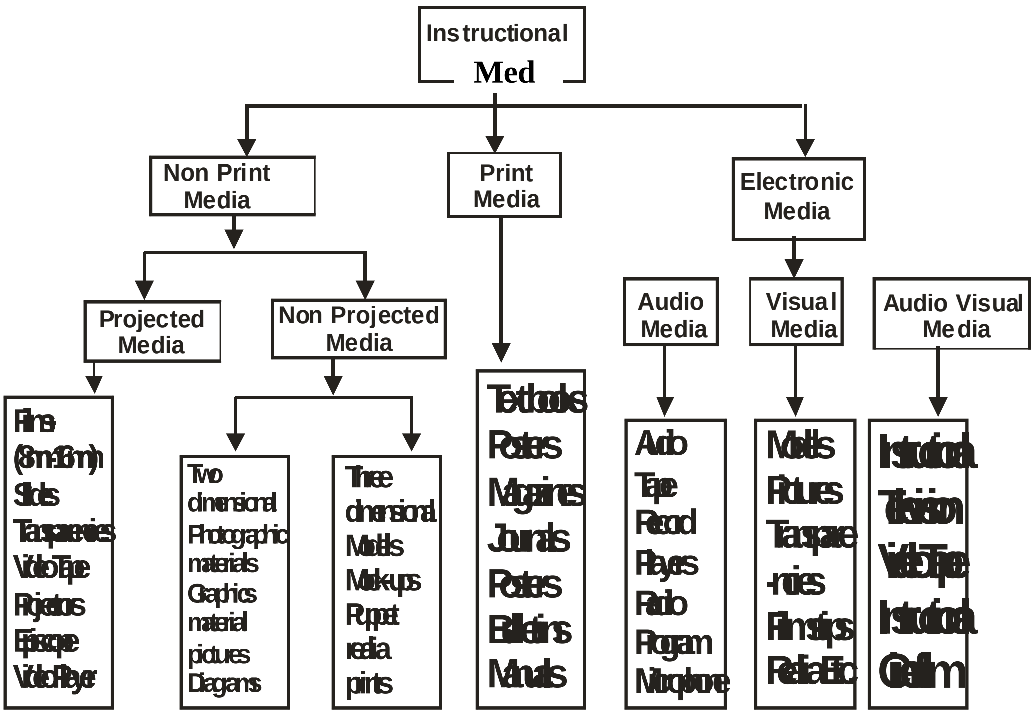


Fig 2.3: Classification of Instructional Media

Source Abimbade 1997:46

Print media refers to such items as books, posters, magazines just to mention but a few which avail the learners with avenues of acquiring facts, information, knowledge, skills, principles and encouragement.

1. Non-print media are the materials (consumables/software) and the machines, equipment, tools or gadgets (hardware) that carry and transmit the instructional contents. They are further classified into projected media and non-projected media.

- Projected media are the materials containing information which can be projected on the screen via electricity e.g. films, slides, film-strips, transparencies, using their projectors.
- Non-projected media are materials that need no projection, they do not require light source. This class includes two dimensional and three dimensional objects. Two dimensional media are easily described by reference to their length and breadth only. They are mostly representative, for example, photographic and graphic material; flat picture, diagrams, and inscriptions on chalkboard. Three dimensional media are described by their natural forms, which include the measurement of length, breadth or height, for example model, mock-ups, puppet, realia, and others.

2. Electronic media are information carrying devices which can be used for disseminating information. They may be small or big. This group is further classified into Audio media, visual media and audio-visual media.

Audio media are teaching and learning devices that carry sound alone and mostly appeal to the sense of hearing. For example audiotapes, record players, recording from radio programs, microphone and human voice, while visual media are teaching and learning devices that can be seen alone and mostly appeal to the sense of sight. Examples include pictorial ones and three dimensional objects. They can be projected and non-projected visuals. However, Audio-visual media are teaching and learning devices that combine sound and vision. They provide students with audio and visual experiences by appealing to the senses of sight and hearing at the same time. For example video taped instruction, instructional television and cine films. The instructional media materials employed in this study are three dimensional non-projected media (models) and audio visual electronic media (video DVD).

2.2.2a Instructional Media in the Teaching- Learning Process

Instructional media are used in raising the quality of instruction. Supporting this view, Adeniran (2002) pointed out that the developing countries in particular have seen the new media as a way to raise the quality of instruction faster than it could be raised by increasing and up grading the teacher corps, to supplement even good teaching. However the economic strength of a country will help to determine the type of media to be used for transforming the educational system of that country.

Adeniran (2002) observed that in the developed countries of the world, teachers and learner alike have been exposed to the use of Educational media via sophisticated gadgetry and new strategies that could enhance teaching/learning. The International

Yearbook for Educational and Instructional Technology (IYEIT) (1999) cited in Adeniran (2002) lent support to this and discussed extensively the different uses of instructional media in many developed and the third world countries in the following paragraphs. Thus Thailand decided to use low-cost radio to equalize some of the opportunities between the metropolitan and small town and village schools. Upper Volta and Niger decided to combine radio and slides in teaching agriculture and health to their people. Columbia decided to teach functional literacy to its people by means of radio broadcast and by a social newspaper delivered to study groups in villages. Right now, Thailand, Upper Volta and Niger use television for teaching. It is interesting to note that in Nigeria, radio, television, films and slides are not only used in teaching agriculture and health education but also in teaching other subject matter areas. The conviction that instructional technology could quickly transform educational opportunities made the United States pay for establishing instructional television in the territory of American Samao. Instructional television was installed in Niger and Ivory Coast with large grants and technical assistance from France. Elsalvador was also to obtain large grants and loans from the United State, France and UNESCO when it decided to make television a major element in her educational development policy.

In continuation, Adeniran 2002 noted that about seventy years ago, Australia as a rich country did not find it difficult to decide to use radio and correspondence study to teach hundreds of students in the remote part of the country far from any school. The United State, Japan, Sweden, France and others experimented with instructional television because they were accustomed to technology, believed in its potential, and were wealthy enough to make up for experimental failures. Instructional media were used for extending learning opportunities especially to working adults, without indefinitely multiplying campuses and schools. For instance, according to IYEIT (1999) Telekolleg

(Technical Preparatory school) in Germany was built around television and weekend classes. In Britain according to Hahm (2003), the Open University, now the largest in Britain, is teaching almost 50,000 students by a combination of television, radio, correspondence study and tutorial opportunities. India has been using mostly puppets, filmstrips and radio to reach its largely illiterate people, but now India has one of the most sophisticated communication satellites in the world with which to beam education and development to 2,400 of its remote villages. Iran is planning a national system of educational television with or without satellite (Adeniran (2002). Indonesia decided to install instructional television in 1976 and Korea which is embarking upon a revision of its national curriculum is making major use of programmed instruction and of instructional television relayed from captive balloons, moved two miles above the earth in extending educational programs to its populace.

In the United States, a number of universities have decided upon the use of media to extend their teaching beyond their campuses. For example Stamford University has decided upon the use of media to extend teaching beyond its campuses, uses low-cost high frequency television in a number of its engineering classes to employees in nearby industries and laboratories. The University of Illinois has a programmed large number of self instructional courses on its huge computer in order to offer the opportunity to people in some hundreds of cities within and elsewhere studying such courses.

The role of instructional media in teaching-learning process cannot be over emphasized. Kareem (2003) confirmed this assertion and stated that all teaching can be greatly improved by the use of audio-visual media because they can make the learning experience memorable. When used intelligently, they can promote the most effective kind of learning in adults as well as in children. A range of vicarious experiences is provided by audiovisual media. Most students can learn about New-York or Abuja through the film, or by seeing them in the map without traveling to any of the places. Consequently Gusen (2001) asserted that: a school will be an interesting place if it proves to be a place where students have interesting experiences, where they see, hear, touch, taste, plan, make, do and try. When motivated, pupils engage in exploratory activities and as their curiosity cause them to probe, they become educated. This applies to students of all levels of ability and age (from primary schools through university. Umeoduagu (2000) submitted that students' participation is a necessity for positive learning, whether the lessons are verbalized or visualized and there must be student participation either before, during or after the use of audiovisual media.

When the school provides many of these rich experience it will promote effective learning and carry on the kind of education that will foster permanent learning. Kereem (2003) stated that research concerning the use of various learning resources has resulted in the general conclusion that where audiovisual media are used, learning environment is highly stimulating and the students appear to take greater interest in learning. Debes (1978) pointed out that educational media does seem to have had some success from the visual literacy point of view by putting the software into the hands of the students. The student has the opportunity to capture his world and his true visual arrays developed by and for himself. By using the visual illiteracy tools, Debes indicated that children develop more easily and are more highly motivated in the development of their schoolwork.

However, Gbodi (1998), noted that for more than a decade, the argument about whether media do influence learning has been with us. According to her, the famous assumption that media have no effect on learning is probably the most unduly quoted and debated in educational technology. Clark (1983) said that there are no learning benefits to be gained from employing different media in instruction. He explained that many studies from the early days of educational technology which appeared to show a learning difference brought about by an instructional medium had actually confounded medium and method, or medium and novelty, or medium and amount of effort invested in instructional design. This reassessment led Clark (1983) to the strong conclusion that media research should come to an end until someone could come up with a novel theory to relaunch it on a more useful basis. Nevertheless Cobb (1997) argued that the issue could be resolved in a more principled manner with one minor adjustment to Clark's position. In the light of this argument, the researcher feels that media should have influence on learning. This view was supported by a study carried out by Onyegegbu (2001). Onyegegbu came out with the findings that the use of instructional media improved performance of students more than the conventional instruction.

There is therefore the need for instructional media to be available in schools and colleges in Nigeria so that pupils could play and interact with them. They should know how to handle any media and operate any equipment if any concept is to be fully internalized by them. Instructional media provide the teacher with means of extending his students' horizon of experiences. Salawu and Taiwo (2001) stressed that reading a book and memorizing a series of conditions or a list of causes may not be rich enough in meaning, but learners need actual and realistic, although frequently vicarious experience built insight that will serve as a basis for forming new relationships from unfamiliar verbal medias. They contended that motion pictures, television and carefully prepared slide-tape sequences would be particularly valuable and they therefore suggested that such 'real' experience be utilized in many teaching situations to assist the teacher in overcoming the physical difficulties of presenting the subject matter. Salawu and Taiwo (2001) therefore stressed strongly the need for teachers to produce and utilize various resources (Films, slides, transparencies, globes and maps, models, video package, real things) to enhance clarity of communication and to increase speed of comprehension. The present study is focused on video package and models.

2.2.2b Video Package and Instructional Process

Video tape, (CD or DVD) is a medium of transmitting information in the form of sound and image to be displayed on the screen of cathode ray tube. Video DVD which is common in many studies uses magnetic tape similar to the audio recording. This makes it possible to record anything and play it back immediately spanning 20 to 180 minutes in colour or black and white (Onasanya, 2004). Video instruction is a form of non-directive teaching technique in which the teacher produces an instructional video package and put on for the learner to view. At interval he may choose to stop playing and explain certain points or factors or probably wait till the end of the lesson to do so. Learne rs are given the opportunity to view this production over and over again. With many homes having a video system, it becomes easier for learners to learn at their own convenient or leisure time. Having the advantage of playback mechanism, it can be played, rewind, and replayed by the learner. This is to concretize learning. It can also be stopped several times to allow room for discussion and questions on difficult concepts. Video DVD package is thus an important tool in individualized learning.

Agommuoh and Nzewi (2003) provided support for the use of videotapes in teaching and learning process. They indicated that the package could be used to provide real experiences in almost all fields of learning. In continuation, Agommuoh and Nzewi added that videotapes have the potentials of increasing the probability that students will learn more, retain better and even improve their performance of the skills they are expected to develop. According to Adekunle (2005), well-recorded programmes help to meet the challenges of not only representing the event, but also offering the viewer a functional equivalence of the experience. The video package gives the learner the opportunity to see and hear an instructor, offers opportunity for behavior modeling, demonstration, and instruction on abstract concepts. It offers a popular easy-to-use format for instructional materials. Almost all students have access to a video player in the home and they are also used in some schools. In the learning of science using video work, Nneji (2000) clarified that video instruction possess the capacity to enhance quality learning, seeks to arouse interest, modifying attitude, clarify concepts. In continuation, Nneji (2000) added that video instruction stimulates thinking, summarizes, demonstrates and concretize knowledge that could otherwise only be talked about in abstract terms, and serves as a spring-board for further learning. Video instruction also breaks the old traditional learning technique, to bring about better-motivated learning.

Still on the efficacy of video instructional package, Ayogu (2000) stated that when video package is used to compliment instruction, they can:

- Reduce abstractions in class lesson;
- Reduce boredom among students and teacher;
- Conserve the teacher's energy;
- Allow learning autonomy among students,
- Restructure the learning environment;
- Make learning interesting and motivating to students;
- Minimize the problems of large class size;
- Promote students' participation in STM lessons,
- Reduce problem of insufficient learning resources, and encourage individualized learning

According to Amamize (2001), the flexibility of a video package makes it an effective learning tool as students can manipulate it almost as easily as a book.

However in spite of its usefulness, Ogunmilade (1993) pointed out that if not handled by the right personnel, video as an instructional technique could be misused. If it is not properly used, students may enjoy just viewing it as any other film or probably documentary or entertainment rather than a learning experience. Films should also be carefully selected; so as to ensure that it goes along the line of instruction. Emphasis should be placed on relevant facts or ideas. Another major problem stressed by Ogunmilade (1993) with the video and television system is that it is not easily adapted to the rural areas especially where there is no light; it cannot find any relevance there. Even in urban areas, the teacher is at the mercy of PHCN, who may or may not provide light, thus probably resulting into a shift in schedule. Another problem is cost in terms of purchasing the video machine and production of the video instructional package. Many state governments find it difficult to purchase video packages for the resources centers, talk more of buying it for schools. Video is also a very fragile material that needs handling with great care, thus it should not be entrusted to untrained hands during classroom presentation. Lack of spare parts is also responsible for its irregular use in schools, and also when damaged, it is usually very difficult to put it to good use again.

According to Ajelabi (2000), in a good video instructional package production, the focus should be on teaching – learning goals. The message focus of the video instruction must be carried from the educational goals and objectives. It is of vital importance that information that can bring about distraction and irrelevancies should and must be avoided. The teacher should be conscious of the quality, sound, vision of the video package. He should be able to perceive, control materials and build them into opportunities for the learner to learn and respond to what they have been taught. This therefore translates that the teacher must and should be well-prepared. To achieve effective and quality recording of instructional packages, Ajelabi (2000) added that the following steps must be put in mind:

- Start with an idea
- Express this idea in form of clearly stated behavioral objectives; consider the students' interest and activities within the grips of the learner.
- Write out your script. Build into the script activities and opportunities for learners' participation and where questions are appropriate.
- Ensure that where the recording would take place, is well lighted. All equipment must be test run to check proper functioning. Check all adaptors, sockets and connecting cables.
- Recording crews must be ready and handy.

Ajelabi (2000) reiterated that in the selection or production of video instructional package, the following guidelines would be useful.

- Select/produce instructional packages that are relevant to the objectives and content of the lesson, preview selected/produced package and note key elements, prepare a study guide, prepare your follow-up activities, check gadgets and fix minor faults that could disturb smooth viewing
- get trained personnel to handle actual viewing or else practice on your own.
- Introduce the instructional package, giving a small talk on what the students are about to see.
- Ensure that students know what to look for and where to ask questions.
- Explain the study guide (if any)
- Show the package and keep quiet, do not run commentaries when running the film.

- If you must interpret a particular thing/fact pause and do so
- When filming is completed, carrying out prepared follow-up activities – it can be in form of test, quiz, project or discussion.
- Use the result of the follow-up activities to evaluate students
- Decide from the result of the evaluation if to show the package again or not.

2.2.2c Principles of Selection, Production and Utilization of Instructional Media

The identification and selection of the most appropriate media is a formidable task for the teacher. So the wise choice of appropriate media by the teacher determines to a large extent the success of the students in fulfilling the instructional objectives. Therefore, the teacher being the principal actor must select the most appropriate media for his/her instructional activities and also decide exactly what media materials to be used in a particular course. To facilitate better judgment therefore, the teacher must develop professional attitudes towards the selection and intelligent application of instructional situation.

However, Essien (2001) noted that owing to the wide variety of instructional media materials and their composite capabilities, difficulties often arise as to which one to select or produced for use. Continuing, he remarked that more often than not, it is intuition and subjectivity that form the basis of decisions about instructional materials selection or production. To this effect, it should be made clear here that media selection should better be analytical rather than intuitive. Akudolu (2002) emphasized that a medium of instruction must be selected on the basis of its potentials for implementing stated objectives. This implies that for any instructional media properly selected, the objective is the reference point. The teacher should not be biased or subjective; he should not choose a particular medium because of his personal interest in it even though it cannot serve the objectives of the lesson.

Adewoyin (1991) suggested that availability of media scale of preference and experience of users along with the size and content of instruction should constitute intrinsic consideration in media selection decisions. In a summary, Adewoyin (1991) outlined the following as factors to be considered when selecting media:-

Instructional objectives: He maintained that teachers' instructional objectives which could be cognitive, affective or psychomotor in nature should be considered. He suggested the selection of audio media where the objective is cognitive and audio media if it is affective or psychomotor.

Availability: Adewoyin clarified that before any form of media is selected, the teacher must ascertain whether such media exist or not. If not available, the teacher must be sure whether it could be borrowed or improvised. If not sure, it should not be selected.

Target Audience characteristics: the age, level, interest and the background of learners should be taken into consideration when selection is being made of any media.

Teachers' Capability: The teacher must ensure that he/she is capable of utilizing effectively the form of media he wants to select.

Cost: Financial implications of whatever media to be selected should be considered. Thus issues of availability of adequate fund for procurement and cost effectiveness for production should be settled before selection is made.

Dynamic factors: These factors include the concentration and size of target audience, the desire level of learners' participation and available time. They should be taken into consideration when selecting media for use..

Apart from knowing what to select and/or how to select instructional media, Agun and Imogie (1988) emphasized that in Nigeria a teacher who is concerned with and about the quality of his/her classroom instruction may have to produce much of the media materials needed. This is because it has been reported variously that commercially produced media materials are not always readily available for improving instruction. Consequently, one of the commonest problems in our schools today is that students learn and forget due to too many theoretical expressions by the teacher to the students who are passive listeners (Martins and Oyebanji 2000). At this point, Abdullahi (2003) pointed out that the need for change is inevitable and teachers in this technological age need to strive to meet up with new innovations.

The indispensability of the new innovation is hinged on the modern practice of educational learning which are predicted on activity and on the sensor exposure of the child. This is so because of the great advancement from verbal instructions to modern method of teaching through various information systems. Educational technologists should therefore keep abreast of current changes in their field, adapt to new ones through the production of instructional materials. Teachers are supposed to be innovative, creative and resourceful in order to meet up with the challenges and be effective in educational processes.

To facilitate effectiveness among teachers, Dopemu (1988:109) outlined the following guidelines for producing media materials.

- The production of materials should be guided by the objectives of instruction. That is, the material should be planned, designed and produced to achieve specific learning objectives guided by overall curriculum objectives.
- After the selection of learning objectives, the producer must identify the characteristics of the learners (need, interest, background, experiences, and weakness of the learners) for whom the materials will be used. This information will guide the selection of the content of the message, the method of presentation,

the amount of information to be presented, and the medium or media to carry the message.

- Select the content of the message that the materials will carry to relate and be relevant to the achievement of the stated objectives.
- Determine the cost. The cost to be determined should include cost for designing and developing the prototypes. The productions of any media should be aimed at the product being cost effective.
- Design and produce the material. Observe the rule of clarity, legibility, simplicity, durability and portability or manageability.
- Test the materials for effectiveness. This could be done on a sample population in order to determine the instructional effectiveness of such materials. The feedback from the try-out can then be used to improve the instructional quality of the material.

The selection, production and utilization of instructional materials are inter-related, but Akanbi (1993) noted that the availability of good, selected and produced media does not guarantee a successful utilization. Adewoyin (1991) made it clear that effective utilization of media requires that the teacher must be physically, mentally and psychologically fit to carry out his\her job. He must know the procedure of operating the media materials selected or produced. In order words, the personality of the presenter and his background in audiovisual training are very important to the successful utilization of instructional media.

As an aid to instructional media utilization, Akanbi (1993; 85) and Adewoyin (1991; 97) gave the following hints:

- The teacher has to prepare the environment ready; this would involve an advance visit to the classroom or hall where the media would be used. This enables the teacher to check for adequate ventilation, electrical plug outlet and any other needs.

- He has to prepare the class. Students must be well arranged, well seated and free from all hindrances.
- The hardware has to be checked to ensure its proper functioning. The display height for non-projected media must be such that students at the back row of the classroom can pick the details in the picture. The source of light must be directed to the media. A preview of the software for projected media is also very important. This is to ensure a proper sequencing of objectives, learners' activities, and assignment of time for the use of the software within the class period.
- The teacher must ensure effective and judicious use of media by establishing relationships between oral delivery, media delivery, and other activities so that the learners would have a meaningful holistic experience rather than disjoined array of activities. Media can also be used at any time (beginning, middle) during instruction to introduce the lesson, clarify misconceptions, pass and explain information, widen students' horizon and to summarize the topic.
- The teacher should ensure that there is evaluation at the end of the lesson on the effectiveness of the media in relation to the instructional objective. This will lead to necessary modification.

2.2.2d Rationale for Instructional Media

Instructional media facilitate the teaching and learning process in classroom setting. Without an intelligent use of instructional media by teachers, the quality of instruction rendered is likely to be poor. Thus, when quality is lacking, it is likely to affect the academic performance of students. This assumption holds true for all disciplines.

Teachers mostly neglect the use of appropriate instructional media to reinforce their teaching because of ignorance of their benefits or laziness which may be attributed to either lack of time or inexperience in their preparation. Adeniran (2002) and Adewoyin (1991) emphasized the need for teachers to:

i) bring the world into the classroom through the use of instructional media and

ii) Use teaching aids as adjunct to tools and media in the teaching process.

Teaching is never an easy endeavor as many teachers thought. It involves teacher's competence in the use of instructional methods. Optimum performance in the learning task would occur only when appropriate instructional media are employed in teaching. The use of these media would spur curiosity and eagerness among students to master performance skills. Essien (2001) believed that instruction should be channeled towards a specific goal. Teachers should endeavor to deliver their lesson using the most appropriate teaching materials which will motivate, stimulate and capture the interest of their students to learn and remember what is learnt and put into practice the learnt skills.

In the National Policy on Education (FGN 2004), the Federal Government has emphasized the application of educational technology in Nigerian schools. It stated that educational technology is the process of applying scientific knowledge devices and techniques to the identification, analysis and solution of educational problems. Unfortunately, this motivation has not found its proper place in Nigerian schools. Okeke (1998) asserted that teachers have not yet tuned themselves to the importance and use of instructional media in facilitating teaching-learning process. Essien (2001), clearly illustrated how the use of media (simple visual media) facilitated and eased better understanding and capture of more authentic information with better view of images and general sharpening of intelligence.

Governments and various agencies of educational technology have supplied different instructional media and outreach services to these schools. In spite of these efforts, it has been observed that in Nigeria today, the method of teaching science (biology) subjects by the teachers is devoid of modern technological devices and techniques, resulting in poor assimilation and understanding of the subject matter by the students. (Abdullahi 2003) and Okeke (1997) rightly pointed out that Nigeria cannot achieve the objectives of education if teachers continue to rely heavily on traditional "talk and chalk" method of teaching. For teachers to use media in instruction there is the need to provide empirical evidence on the effectiveness of these media.

Two opposing school of thoughts can be identified in relation to the values of instructional media. Essien (2001) for example, examine the reports of a policy study by Stanford institute for the United States office of education which concludes that; 'the use of educational media has probably not changed instruction in any essential way except to make it considerably more expensive'. In the same vein, Hahm (2003) reported of an experiment where learners in a completely resource based learning system scored significantly lower than their counterparts in a traditional classroom that had only an audio laboratory. But the scanty negative reports are drowned by avalanche of high premium and unquestionable account attached to the use of instructional media over the entire world at all levels of instruction and training. The intrinsic pedagogic and psychological values of instructional media cannot be overstressed anyway. Hahm (2003) however, reaffirmed teacher's indispensability within the instructional situation, which proved that the teacher cannot be completely eliminated from the teaching-learning situation, irrespective of its wealth of instructional media. Teacher's presence along with few relevant instructional media, adequately utilized, can produce more significant learning outcomes than a wealth of resources without a teacher's influence, no matter how remotely attached the teacher is.

However, Abdullahi (2003) pointed out that a teacher can capitalize on media capabilities to promote the learners' perception, understanding, and transfer of training, reinforcement and retention of learnt media. Essien (2001) says that the teacher can use instructional resources to arrest and sustain attention, present facts and information, teach concept and principles, guide thinking and induce transfer of learning, Nneji (2000) agreed that learners not only prefer media packed presentations but also achieve significantly higher than learners exposed to verbalized traditional classroom instruction only. Generally speaking, therefore, the government is of the view that instructional media can be used at all levels of educational programs and for all instructional tasks. They can be used to:

- Introduce and develop a lesson, a speech or a whole program.
- Organize and present concrete facts or abstract concepts and ideas.
- Remediate any instructional task, situation, program or unit.
- Review an instructional program or lesson unit.
- Evaluate lesson, unit of instruction or program.
- Stimulate discussion, inquiry or diagnosis.
- Facilitate the development of attitude and moral far beyond years of verbal sermonization.
- Provide for direct interaction of learners with the social, cultural and physical realities of the far away parts of the world as well as the immediate environment.
- Bring learners into easy and direct contact with and exploration of all process, media, events, situations, changes in time, speed and space which otherwise would be inaccessible.

- Promote voluntary study based on increased interest, motivation and attention.
- Provide learners with a systematic and scientific basis for worth-while, functional and productive learning experiences and activities naturally from concrete to abstract.

2.2.3 Improvisation in the Teaching and Learning of Science

Improvisation has been examined and defined variously by several researchers in science education (Akinmoyewa, 1992; Fajola, 1992; Maduabum, 1996; Olagunju, 1998). According to Hornby and Cowie (1985), to improvise is to provide, make or do something quickly in time of need using whatever happens to be available. To Akinmoyewa (1992), improvisation is the act of designing a replica of something to make it function or play the role of the real thing using available material. This is to say that improvisation does not just mean the provision of a mere substitute. It would imply a deliberate effort on the part of the teacher to provide intended.

Improvisation in science teaching also refers to the act of using alternative materials and resources to facilitate instruction whenever there is lack of or shortage of specific first hand teaching material (Maduabum 1996). Fajola (1992) described improvisation from the level of creativity involved. According to him; there are three levels which are:

- Improvisation as a mere substitute.
- Improvisation as a creation of substitute.
- Improvisation as an original creation.

Eyetsemitan (2004) shared this view and described these levels of improvisation as role substitution and role simulation. Improvisation is seen as a role substitute or mere substitute when the original material is slightly modified in order to perform novel function in an experimental set up. For instance a glass cup substituting a beaker or drinking straw for delivery tube. Improvisation as a creation of substitute is illustrated with model creation, drawing charts, pictures and cartoon. The third level-original creation or role simulation is when actual construction of material is undertaken by the teacher with the aid of the local carpenter or other craftsmen as an emergency measure because the needed material is not available or too expensive and not affordable.

Adebimpe (1997) and Momoh (2004) lent support to the above descriptions and summarized that improvisation in all its usage means any of the following:

- Substituting a material for another to serve the same purpose.
- Altering a device or an idea to serve different functions
- Converting a teaching material or equipment into another form.
- Originating or formulating totally new material for serving a particular function
- Initiating or devising an idea or material as a means of solving an instructional problem at hand.

In continuation, Adebimpe made it clear that improvisation in science teaching should be seen as making available for use materials which the teacher provides in the absence of the readymade standard materials in order to facilitate learning or make lesson more interesting. All said and done and for the purpose of this study, improvisation as defined by Mohammed (1997) and Olagunju (1998) will be adopted which states that improvisation is an act of using alternative materials obtainable from the local environment or designed or constructed by the teacher or with the help of local person to facilitate instruction.

Implicit in these definitions is the important role of the teacher in improvisation as demonstrated by Adebiyi, 1998; Orisabiyi, 2002; Tauheed, 2002; Obaba, 2003; Ibrahim, 2004 who improvised models for biology instruction using moldable clay soil. Adebiyi improvised a model of dicot and monocot stem, Orisabiyi improvised a model of human skin, Tauheed improvised a model of Nephron, Obaba and Ibrahim improvised aquarium. The teacher, therefore, is central in ensuring functional improvisation. For a teacher to be able to make effective use of improvisation in the teaching process, he must of necessity be imaginative, clever, creative and skillful. This is because the use of locally available material as substitute for the real thing is not mere quest work. The teacher must know what he wants and be quite sure of what he is doing. Owolabi, (2000), completely agreed with this view and outlined he skills below as basic requirements for any science teacher to effectively improvise materials.

A keen sense of Observation: Ability to carefully observe is one of the most important skills for improvisation. The teacher needs to observe and identify various resources around him which can be used in improvising the needed materials. Such resources can be found from the immedate environment. They can also be from books- resource book, laboratory manual, text books and others. A keen sense of observation will also help the teacher to carefully look at an original piece of material to be improvised, follow in detail diagrams and instructions given in guide books for improvisation

Creativity and designing: Creativity involves making use of all the teacher's previous knowledge, experience and skills needed to make something new and workable. Designing on the other hand involves the ability to draw, making out lines and patterns. Creativity and designing are both important skills in improvisation.

Selectivity: This involves the ability of the teacher to be selective and sure of materials being improvised. Such materials should:

- Be valid and authentic to knowledge and skills to be taught,
- Cover topic intensively and extensively,
- Be relevant to the fulfillment of the objectives of the topic,
- be simple, readily replicable and durable,
- be relatively cheap.
- not differ significantly in quantity and reliability from conventional type,
- Appeal to the senses,
- Attract and hold attention
- Focus the attention of learners on the essentials to be learnt at the proper time.

Basic woodwork and better work skills: These skills are necessary to carry out improvisation. This is because wood and metal are the most common materials used in improvisation of science material. It is therefore necessary for the teacher to be able to know how to use basic tools like saws, chisels and land smoothing planers. However, it is necessary to point out that a teacher does not have to be an expert in woodwork in order to carry out improvisation. All that is necessary is the resourcefulness and the determination of the teacher.

Iwuozor (2000) opined that the issue of improvisation in science teaching is so important that no amount of discussion on it can be too much. In continuation, he remarked that it is one thing to improvise and another thing for the improvised to be effectively used. According to Iwuozor (2000) any teacher who intends to achieve maximum result from the use of improvised materials should be guided by the following hints:

General principles: The teacher should have comprehensive knowledge of the subject matter to be taught and thorough understanding of the learning process generally.

Review of materials: The teacher should check for accuracy of the information contained in the material and confirm that the material is in good order before the time for use.

According to Wasagu (2000) and Eyetsemitan (2004), improvisation for science teaching has both intrinsic and extrinsic values. The intrinsic values of improvisation consists of the aesthetic nature of such production which as a result of the producer's ingenuity, creative tendencies and productivity which makes the production good in itself irrespective of the educational goals that could be achieved when it is applied in the teaching-learning process. The extrinsic values on the other hand include the following among others:

- It presents next to real situations to students in the absence of real thing, in other words, it fills the vacuum that otherwise would have existed in teaching and learning process and provide a frame of reference on which students can focus their attention during classroom activities
- It enables the supplementing of verbal description and explanation with observable or touchable/ manipulable objects thereby creating a context to focus discussion, thus making teaching and learning process easier.
- It is necessary as a way of widening inquiry, curiosity, creativity and productive application of intellect as well as a means of local application of the universality of science.
- It helps to take care of population explosion by providing more materials which would have been very expensive to procure. Thus it promotes the possibility of self sustenance by the school.
- It has pragmatic or instrumental value since it is used in achieving specific educational goals.

2.2.3a Rationale for improvisation

The need to improvise some materials or substitute for others dates back to the genesis of experimental science (Soyibo 1993). This is when the earliest pioneering scientists had to originate both their ideas and the materials needed to empirically demonstrate and authenticate their validity. However, it became prominent after the Second World War when UNESCO sponsored a small publication meant for science teachers in war devastated areas. Realizing that the publication is useful not only to war devastated areas but wherever there is little or no equipment for science teaching, it was expanded and has given birth to the present UNESCO source book for science teaching.

In Nigeria, the need for improvisation of materials become more urgent and relevant from the 1970's when the Nigerian school system began to experience population explosion. This has given birth to greater demand for classroom instructional facilities and equipment (Aguele 2000). This view was also confirmed by Akinrotohum (2000) when he noted that public and private secondary schools are growing in Nigeria at an alarming rate. The ever-thick students' population in these schools justifies such growth. The problem however is the inability of the owners of these schools to provide adequate teaching materials required for effective learning in the areas of science in general and biology in particular. Judging from the economic and political climate in the country, things are not likely to improve, consequently, the demand for instructional materials, tools and equipment will continue to increase. The only visible way to cope with this high demands in the school system is to improvise as much as possible.

Biology as a science is activity-oriented. The suggested method for teaching it which is guided-discovery method is resource based a consequence of the nature of the subject as a living and practical subject. This suggests that the mastery of biology concepts cannot be fully achieved without the use of instructional materials. Maduabum

(1989:56) shared this view and pointed out that "a professionally qualified science teacher no matter how well trained would be unable to put his ideas into practice if the school setting lacks the equipment and materials necessary for him/her to translate his competence into reality". The importance of instructional media material in the teaching and learning of science cannot be over emphasized. Yet many science educators (Frazer, Okebukola and Jegede, 1992; Soyibo, 1993; Mohammed 1997; Thomas 2004; Gana 2006) have shown that materials for teaching and learning science in Nigerian schools are very much in short supply. The need to improvise some materials as substitutes for the non-available therefore becomes imperative. Nwosu (2000) remarked that improvisation should be an important and integral part of teaching and learning process. Improvisation makes one to use self made equipment and materials made to one's specification (NTI 1990). Any biology teacher, who is conversant with certain visual materials like models and charts bought from science equipment supplying companies, would be amazed at the quality of some of these materials. Sometimes, these materials are too detailed for the level of students a teacher is teaching. Some others play down on the part that would have interested the students. Examples, of these are seen with the models of the skin, the eye, the ear and the chart of the circulation of the blood and respiration. Teachers made models and charts display only those features that need to be known by the students. In addition, the teacher employs various devices such as illumination that will aid the understanding of the concept. Consequent upon this stand, the need to improvise in this study still finds its place.

The claim of huge amount of money being expended on education notwithstanding, one of the major problems confronting curriculum reforms and innovation in Nigeria can be traced to unavailability of funds and the consequent inadequate or non-availability of teaching learning materials. Mogbo (1990) as cited in

Eyetsemitan (2004) noted that elaborate equipment made by commercial manufacturers is prohibitively expensive and in most cases they are not readily available in the market. Mogbo (1990) as cited in Eyetsemitan (2004) specifically stated that 74% of the standard factory made instructional materials which were needed for teaching was either in short supply or nonexistent. Adekola (1997) emphasized that high cost of materials negate their use for ordinary classroom teaching. The sky rocketing cost of standard instructional material is a cause of need for improvisation in science teaching.

In a period of economic recession, there is little hope that sufficient funds would be provided by the government for the purchase of standard science teaching materials for the science schools. This situation is further compounded by the galloping inflation in the country and unrelated-ness of some of the standard sophisticated materials and equipment. With the limited government resources, the teachers' ingenuity to improvise becomes tasking for learning to be effective and productive. Consequently, the need to improvise more science instructional materials from locally available materials appears more mandatory now. Nwosu (2000) visioned that the call for improvisation is very appropriate and that the present financial predicament in the face of ever demanding changing curricular and educational policies gives added impetus to drive towards improvisation in schools.

Aguele (2000) summarized the reasons why improvisation may be needed in schools and stated that:

- Improvisation becomes imperative in a situation where there are scarce resources and facilities.
- Improvisation provides a cognitive "bridge" between abstraction and reality.

- Improvisation undertaken by a teacher enables him to rethink and research for cheaper, better and faster methods of making the teaching and learning process easier for students.
- Improvisation helps in focusing teaching to key classroom discussion.
- Improvisation presents next to real situation to students in the absence of real things.
- Improvisation saves cost and in addition, the teacher makes positive efforts towards effective instruction.

Nwankoby (1988) is of the opinion that the rationale for improvisation will not only be to produce materials that are comparable in quality and utility to those produced in the industrialized world's but also to tailor the development specifically to the educational needs of the learners and areas served by the improvised material. This is because failure of most of the foreign audio-visual materials is usually attributed to their sole reliance on electricity as the only source of power. Most of them are designed with little or no regards to the fact that some rural areas do not have electricity. It is only through improvisation that this problem could be tackled by finding alternative to hitherto, strictly A-C-powered materials and equipment in the market today. Adekola (1997) added that the sizes of materials can also call for improvisation. Materials that are too big and cannot be brought to the classroom or are too small to be seen can be made available for classroom use through improvisation. Akinmuyewa and Delu (1994) supported this and stated that where an airplane is to be used for teaching in a class, an airplane could be made to suit the classroom size and teaching purpose through improvisation. Consequent upon the foregoing discussions, what comes to mind here is, what is improvisation? The need for improvisation in the teaching-learning process cannot be over emphasized.

2.2.3b Constraints on improvisation in the teaching and learning of Science

Improvisation of science teaching resources is not a come-easy-go-easy affair. There are problems confronting it, which can be broadly classified as technical and human factors.

Technical Factor

These include teaching and financial factors. Teaching factors according to Dareng and Timku (1997) relate to the degree of accuracy and precision inherent in the improvised material. They noted that the degree of accuracy and precision of the factory made material is lost when they are improvised. However, Mohammed (1997) enlightened that a way of combating this problem is to seek the assistance of local personnel in the construction of certain improvised materials. The teacher should supervise the construction to ensure that they conform to specifications. Other teaching factors are the problems inherent in the use of improvised materials. Such include, ease / difficulty of handling, durability of the materials, cleanliness / compactness and convenience or otherwise at use.

Financial factors deal with the question of how cheap or expensive improvised materials are availability of funds for the purchase of raw materials and/or handy simple workshop tools or their availability in the school. Reacting to the above, Yoloye (1989) and Boateng (1986) retorted that whether improvised materials cost less than standard ones or not, the issue is that they still cost money. This money is usually not readily available for the teacher.

Human Factor:

On the other hand, the human factors, which seem more crucial are problems associated with the teacher's professional commitments, creative ability, technical skills, ingenuity and competence. The problem of commitment is very serious because improvisation requires creative imagination. If a teacher is not committed to improving his instruction, he will not creatively think of substitutes for materials and how to improvise them. Maduabum (1990) identified lack of adequate professional training as a major problem militating against the effective improvisation in teaching science. Danjuma, Abdullahi and Gero (1997) conducted research on factors affecting chemistry teacher's attitude towards improvisation. The study used thirty two (32) chemistry teachers drawn from fourteen (14) selected secondary schools in Bauchi and Gombe states of Nigeria. A 22- item attitudinal questionnaire was administered. The result of the study showed that there is a significant difference between the mean scores of trained and untrained, and also between the experienced and inexperienced chemistry teachers on attitude towards improvisation respectively. This is an indication that training could be a factor in determining teacher's attitude to improvisation. Nwaizugbe (1991) agreed with this and remarked that many teachers find it difficult to improvise instructional materials because of poor training exposure and lack of basic tools for improvisation. Maduabum (1996) made it clear that improvisation demands adventure, creativity, curiosity and perseverance on the part of the teachers and such skills are only realizable through well planned training programe on improvisation. This, Maduabum emphasized that this is yet to be solidly rooted into other teacher training programme.

Mohammed (1991) observed that the problem in Nigeria is that very few teachers practice improvisation, while majority depend on either imported equipment or nothing.

Akinsola (2000) clarified the above observation through a study he carried out in Kontagora to investigate the ability of primary school teachers towards improvisation. He used 13 female and 9 male teachers, a total of 22 teachers drawn from five primary schools. They were given 3-item questionnaires and were instructed to indicate which of the materials they could improvise. The result proved that primary school teachers have poor ability to improvise and there was no appreciable difference between the performance of female and male teachers. Eyetsemitan (2004) similarly noted that many Nigerian science teachers were aware of possibility of improvisation but many exhibited negative attitude towards it. He almost discovered that most teachers claim that improvisation is time consuming, fund depleting and a needless coloration.

2.2.4 Biology in the Senior Secondary School Curriculum

Biology is one of the science subjects in the Nigerian secondary school curriculum. Richman (2001:44) defined it as “the scientific study of all forms of life including plants, animals and microorganism”. It deals with the internal, external and behavioral aspects of all living organisms. Richman (2001) described these aspects as the “numerous field” of Biology and listed them as cytology (the study of cells); embryology (the study of developments), genetics (the study of heredity); biochemistry (the study of chemical structure of living things), morphology (the study of anatomy), taxonomy (the identification, names and classification of organisms) and physiology (the study of how organisms function and respond to stimuli).

Biology is traditionally divided into two components, which are Botany (the study of plants) and Zoology (the study of animals). Plants and animals are regarded as living organisms because they engage in certain processes such as nutrition (feeding), respiration, movement, growth ,excretion, sensitivity(irritability) and reproduction (Ewusie 1980). Plants and animals have different features, sizes, characteristics and so on. All these diversified features lead to the concept of taxonomy of living forms where organism are classified under kingdoms, phyla (division is used for plants only), classes, orders, families, genus and species.

Biology, as a discipline, has experienced a number of changes since its inception. Kareem (2003) observed that biology was "largely descriptive, weak in quantitative and lacking in strong conceptual foundation that marked physics and chemistry up till the beginning of 20^{th} century. This position, however, changed towards the middle of the century and emphasis shifted to morphological biology. The current Nigerian secondary school biology curriculum is a product of research conducted by the Comparative Education Study and Adaptation Centre (CESAC), University of Lagos, which was then critiqued in a workshop in 1984. The Joint Consultative Committee (JCC) and in particular, its Reference Committee on Secondary Education fine-tuned the recommendation of CESAC in April 1985. This was finally adopted by the Federal Government in that same year (Federal Ministry of Education, 2004) as the biology curriculum for senior secondary schools in Nigeria.

The Biology Curriculum, therefore, is the learning experiences (topics) that students are exposed to at a particular level in order to attain the set goals. The Secondary School biology curriculum has seven basic conceptual headings which are biology and life, interaction in nature, micro-organism man and health, unit of life, living organism in its environment, sexual reproduction and the new organism, and variability heredity and evolution. The senior secondary biology syllabus is spirally or concentrically arranged. This spiral arrangement ensures that the concepts learnt in SSS 1 also feature in SSS II and SSS III but in higher orders. The objectives of the Biology curriculum for senior secondary schools were derived from the National Policy on Education (2004). They include adequate laboratory and field skills in Biology, meaningful and relevant knowledge in Biology, Reasonable and functional scientific attitudes and ability to apply scientific knowledge to everyday life in matters of personal and community health and Agriculture. Following the above objectives, it could be stated that Biology content places emphasis on: - field studies, guided discovery, laboratory techniques and skills, together with conceptual thinking. This curriculum then sets to provide modern Biology course to meet the needs of the society. According to Oyekan (1999) Biology is a subject of universal interest in human development, especially with regard to the usage of its knowledge in real life situations. It has actually permeated most aspects of our economic and public life. Biology embraces a variety of fields of study and is combined with other subjects to satisfy senior secondary school certificate examination (SSCE) requirements (Soyibo 1982). This has brought the dire need of Biology in the secondary schools science curricula.

The interdisciplinary nature of Biology makes it to appeal to a wider audience. Biology thus appears to be the centre point for Arts and Science subjects, because of this it is the only laboratory science subject that non science students embrace in secondary schools (Watson 1991). In spite of its interdisciplinary nature, coupled with the preferential selection for the SSCE, WAEC (2007, 2009) it was observed that some students still exhibit non-challant attitude in the learning of Biology which often manifest in poor performance. This fact is borne out of the fact that majority of the candidates would not offer it for advanced studies. Another reason for nonchalance is the candidates' assumption that even though Biology is a science subject and somehow compulsory, it is the least intellectually demanding of the three traditional science subjects-Physics, Chemistry and Biology (WAEC 2009), and could be offered and passed with minimal effort (Kareem 2003).

These types of erroneous beliefs usually make Biology class a mixture of students with a broad spectrum of abilities, interests and expectations. These in turn reflect the students' ignorance which sometimes makes them to postpone the study of Biology with respect to other school subjects. In this regard, majority of the students are likely to display inadequate aptitude/ability for the cognitive and affective demands of the enormous work in the current inquiry-based Biology curriculum. According to Oyekan (1993), "these students' weaknesses can significantly impede effective learning, understanding and retention of Biological concepts"

2.2.5 Human Blood Circulation and Excretion Mechanisms

2.2.5.1 The Structure of the Heart and Circulation of Blood

The center of the circulatory system is the **heart**, which is the main pumping mechanism. The heart is made of muscle, shaped something like a cone, with a pointed bottom and a round top. The heart is in the middle of the chest. It fits snugly between the two lungs. It is held in place by the blood vessels that carry the blood to and from its chambers. The heart is tipped somewhat so that there is a little more of it on the left side than on the right (TutorVista 2008).

The heart is divided into a left half and a right half by a muscular wall called septum. The septum is solid so that blood cannot flow back and forth between the left and right halves of the heart. Another wall separates the rounded top part of the heart from the cone-shaped bottom part. So there are actually four chambers (spaces) inside the heart. The top chambers are called auricles. The bottom chambers are called **ventricles**. The auricles are often referred to as holding chambers, while the ventricles are called pumping chambers.

Thus, each side of the heart forms its own separate system, a right heart and a left heart. Each half consists of an auricle and a ventricle, and blood can flow from the top chamber to the bottom chamber, or ventricle, but not between the two sides .Blood can flow from the auricles down into the ventricles because there are openings in the walls that separate them. These openings are called **valves (bicuspid and tricuspid valves)** which open in one direction to let the blood pass through then they close, so that the blood cannot flow backwards into the auricles. There are also valves at the bottom of the large arteries that carry blood away from the heart: the **aorta** and the **pulmonary artery**. These valves keep the blood from flowing backward into the heart once it has been pumped out. The heart is a pump whose walls are made of thick muscle that can squeeze (contract) to send blood rushing out. The blood when it leaves the heart flows smoothly in tubes called **blood vessels**. First, the blood flows into tubes called **arteries**. The arteries soon branch again and again to form smaller and smaller tubes called **capillaries**. These form a fine network of tiny vessels throughout the body.

The capillaries have extremely thin walls so that the blood that they carry can come into close contact with the body tissues to deliver the oxygen they carry to nearby cells. As the blood flows through the capillaries, it also collects carbon dioxide from the body cells. The capillaries containing carbon dioxide return this used blood to the heart through a different series of branching blood vessels -the veins which in turn unite with each other to form larger veins until the blood from the body is finally collected into the large veins that empty into the heart.

So the blood vessels of the body carry blood in a circle: moving away from the heart in arteries, traveling to various parts of the body in capillaries, and going back to the heart in veins. The heart is the pump that makes this happens.

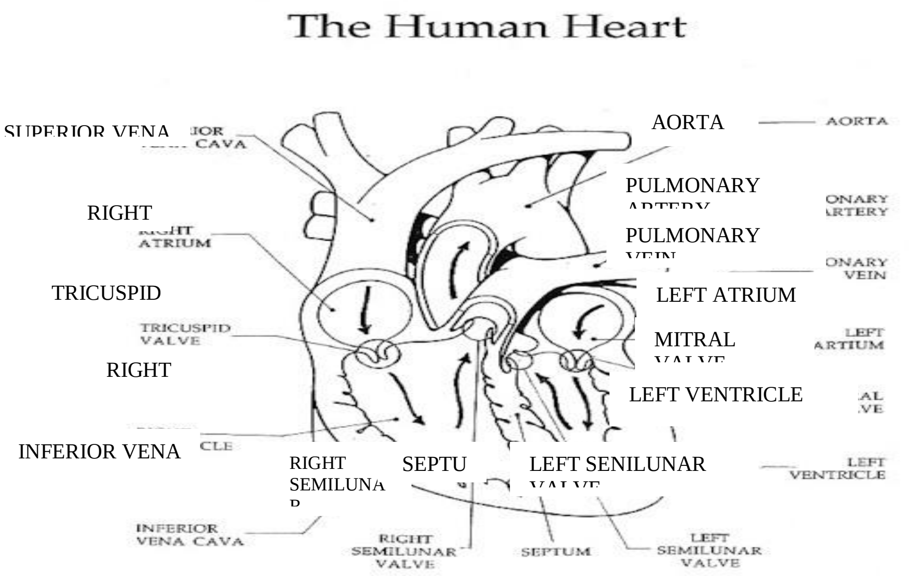


Fig 2.4 The Structure of Human Heart

The Circulation of Blood

The passage of blood throughout the body under the influence of the pressure exerted by the heart is called circulation. In mammals and birds the circulation is called double circulation. This is because the blood passes twice through the heart during one round of circulation. The other vertebrates have a single circulation.

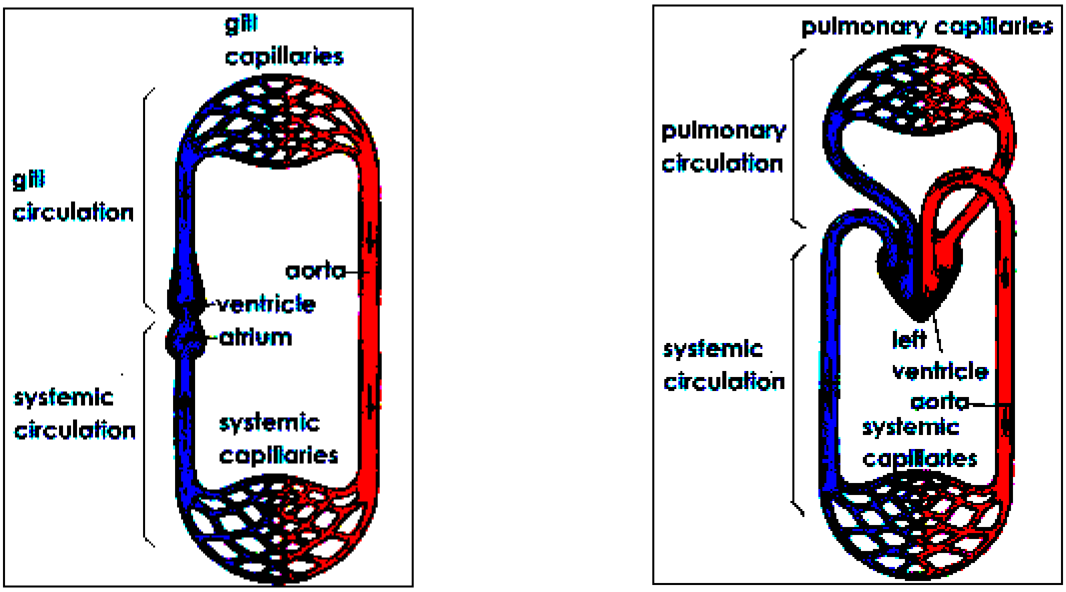


Fig 2.5. Single Circulation in Fish and Double Circulation in Mammals and Birds

Source: TutorVista (2008)

The human circulatory system is a two-part system whose purpose is to bring oxygen-bearing blood to all the tissues of the body. When the heart contracts it pushes the blood out into two major loops or cycles. In the systemic loop, the blood circulates into the body's systems, bringing oxygen to all its organs, structures and tissues and collecting carbon dioxide waste. In the pulmonary loop, the blood circulates to and from the lungs, to release the carbon dioxide and pick up new oxygen.

The systemic cycle is controlled by the left side of the heart, the pulmonary cycle by the right side of the heart. Let's look at what happens during each cycle in the circulatory system.

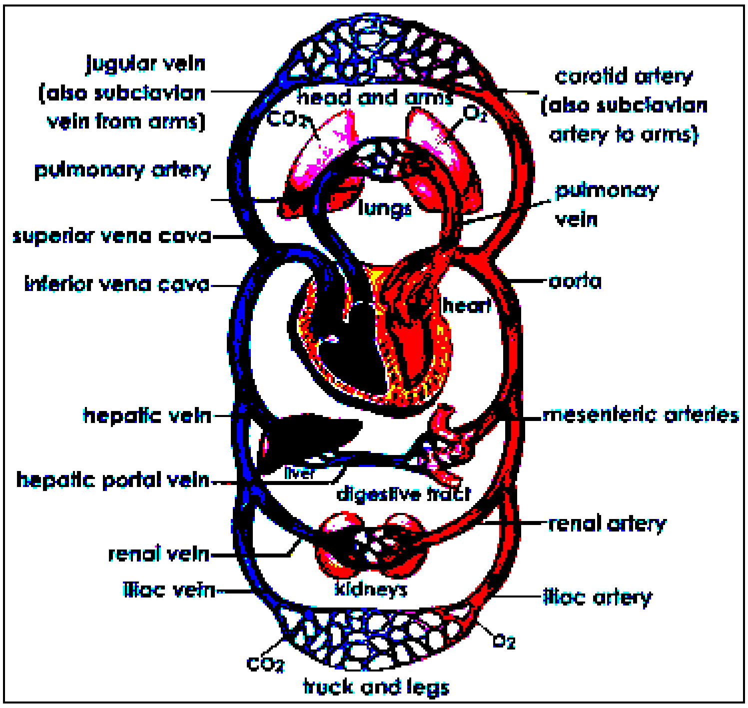


Fig. 2.6 Human Circulatory System

Source: TutorVista (2008)

The systemic loop begins when the oxygen-rich blood coming from the lungs enters the upper left chamber of the heart, the left atrium. As the chamber fills, it presses open the **mitral valve** and the blood flows down into the left ventricle. When the ventricles contract during a heartbeat, the blood on the left side is forced into the **aorta**. This largest artery of the body is an inch wide. The blood leaving the aorta brings oxygen to all the body's cells through the network of ever smaller arteries and capillaries.

The used blood from the body returns to the heart through the network of veins. All of the blood from the body is eventually collected into the two largest veins: the **superior vena cava**, which receives blood from the upper body, and the **inferior vena cava**, which receives blood from the lower body region. Both venae cavae empty the blood into the right atrium of the heart.

From here the blood begins its journey through the pulmonary cycle. From the right atrium the blood descends into the right ventricle through the **tricuspid valve**. When the ventricle contracts, blood is pushed into the pulmonary arteries to the lungs. The fresh, oxygen-rich blood then returns to the left atrium of the heart through the pulmonary veins.

Although the circulatory system is made up of two cycles, both happen at the same time. The contraction of the heart muscle starts in the two atria, which push the blood into the ventricles. Then the walls of the ventricles squeeze together and force the blood out into the arteries: the aorta to the body and the pulmonary artery to the lungs. Afterwards, the heart muscle relaxes, allowing blood to flow in from the veins and fill the atria again. In healthy people the normal (resting) heart rate is about 72 beats per minute, but it can go much higher during strenuous exercise. Scientists have estimated that it takes about 30 seconds for a given portion of the blood to complete the entire cycle: from lungs to heart to body, back to the heart and out to the lungs (TutorVista 2008).

2.2.5.2 Excretion in Man

When cells in the body break down proteins into forms they can utilize, they produce ammonia wastes that the liver turns into urea. When cells break down carbohydrates, they produce water and carbon dioxide as waste products. The body eliminates these wastes (and solid wastes, also) in a process known as excretion. The body system most responsible for waste excretion is the urinary system, which eliminates water, urea, and other waste products from the body in the form of urine. Because of this main function, it is often referred to as the excretory /urinary system (Fig 2.7).

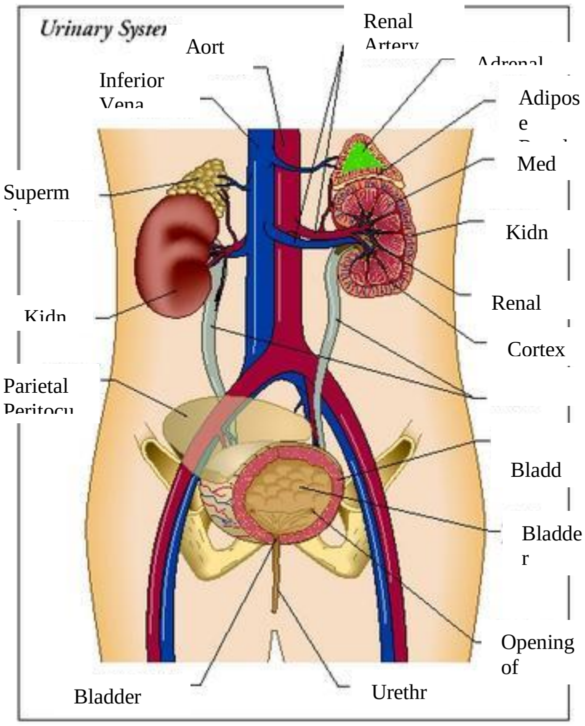


Fig. 2.7 The Excretory System

Source: Free Health Encyclopedia (2007)

The main organs of the urinary system are the kidneys, which form urine. The other parts of the system—the ureters, the urinary bladder, and the urethra—neither form urine nor change its composition. They are merely structures that transport urine from the kidneys to the outside of the body.

The Kidneys

The kidneys are bean-shaped organs located on either side of the vertebral column. The left kidney usually sits slightly higher than the right one. The size of an adult kidney is approximately 4 inches (10 centimeters) long, 2.5 inches (6 centimeters) wide, and 1 inch (2.5 centimeters) thick (Free Health Encyclopedia 2008). The upper portions of the purplish-brown kidneys rest on the lower surface of the diaphragm. The lower portion of the rib cage encloses and protects the kidneys. The kidneys are held in place by the abdominal lining and supporting connective tissue.

On the side of each kidney facing the vertebral column is an indentation called the hilus. Through the hilus the renal artery enters and the renal vein and ureter exit. The renal artery brings blood to the kidneys from the abdominal aorta. The renal vein returns blood to the inferior vena cava. Both the renal artery and renal vein have a right and left branch, each connected to a corresponding kidney. Each kidney is covered with a thin yet tough capsule of fibrous connective tissue which gives it a glistening appearance. Inside, a kidney can be divided into three layers. The outer layer, light in color, is called the renal cortex. The next layer, a darker reddish-brown, is called the renal medulla. It contains six to eighteen pie-shaped structures called renal pyramids, the tips of which face toward the center of a kidney.

Attached to the tips of the renal pyramids are cup-shaped tubes called calyces (singular: calyx), which collect urine from structures in the renal pyramids. The smaller calyces unite to form larger calyces, which in turn unite to form the renal pelvis, a cavity at the innermost part of a kidney. The renal pelvis collects urine from the calyces and funnels it to the ureter, to which it is attached. There are approximately 1.25 million nephrons (The urine-forming structures) in each kidney. Almost 0.5 inch (1.2 centimeters) in length, each nephron begins in the lower portion of the renal cortex, then twists and coils down into a renal pyramid in the renal medulla. A nephron has two major portions: a renal corpuscle and a renal tubule (FreeHealth Encyclopedia 2007).

The renal corpuscle is a knotted network of fine capillaries surrounded by a cup-shaped chamber. The knot of capillaries is called a glomerulus (plural: glomeruli). The cup-shaped chamber is called the Bowman's capsule, and it is filled with fluid and has an inner and outer wall. The inner wall encloses the glomerulus and has many pores that make it permeable or able to allow fluids or material to pass easily through it. Its outer wall has no pores and is, thus, not permeable.

The renal tubule consists of a: **Proximal convoluted tubule**. Coiled and lined with cells carpeted with microvilli and stuffed with mitochondria. **Loop of Henle**. It makes a hairpin turn and returns to the **distal convoluted tubule**, which is also highly coiled and surrounded by capillaries. **Collecting**

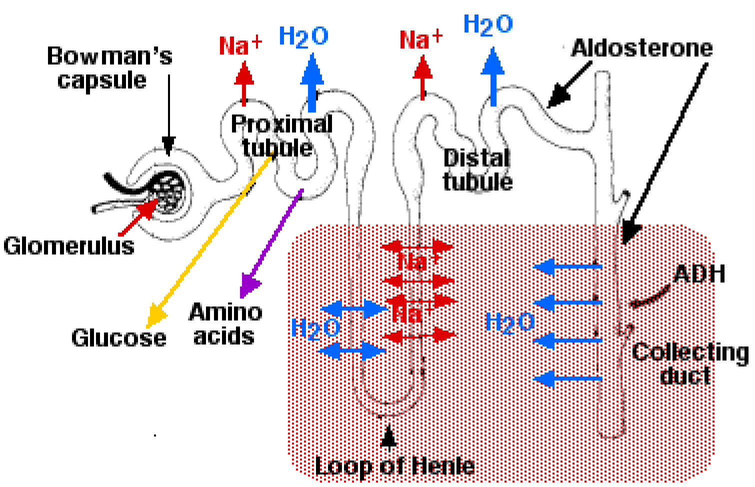


Fig. 2.8: The

duct. It leads to the pelvis of the kidney from where **urine** flows to the bladder and, periodically, on to the outside world.

Formation of Urine

The nephron makes urine by filtering the blood of its small molecules and ions and then reclaiming the needed amounts of useful materials. Surplus or waste molecules and ions are left to flow out as urine. In 24 hours the kidneys reclaim 1,300 g of NaCl, 400 g of NaHCO3, 180 g of glucose and almost all of the 180 liters of water that entered the tubules. According to Free Health Encyclopedia (2008); the steps involve in urine formation include the following:

- Blood enters the glomerulus under pressure.
- This causes water, small molecules (but not macromolecules like proteins) and ions to filter through the capillary walls into the **Bowman's capsule**. This fluid is called **nephric filtrate**. Nephric filtrate collects within the Bowman's capsule and then flows into the **proximal tubule**.
- Here all of the **glucose**, and **amino acids**, >90% of the uric acid, and ~60% of inorganic **salts** are reabsorbed by active transport.
  - The active transport of Na^+ out of the **proximal tubule** is controlled by angiotensin II.
  - The active transport of phosphate (PO_4^{3-}) is regulated (suppressed by) the parathyroid hormone.
- As these solutes are removed from the nephric filtrate, a large volume of the water follows them by osmosis (80–85% of the 180 liters deposited in the Bowman's capsules in 24 hours).

- As the fluid flows into the descending segment of the **loop of Henle**, water continues to leave by osmosis because the interstitial fluid is very hypertonic. This is caused by the active transport of Na^+ out of the tubular fluid as it moves up the ascending segment of the loop of Henle.
- In the **distal tubules**, more sodium is reclaimed by active transport, and still more water follows by osmosis. Final adjustment of the sodium and water content of the body occurs in the **collecting ducts**

2.3 Influence of Ability Levels and Gender on Students' Academic Performance in Science.

2.3.1 Ability Levels and Students' Academic Performance.

The issue of achievement level and or ability grouping on academic performance is among the oldest and most controversial issue in elementary and secondary schools in Nigeria and elsewhere. It is a common practice in most schools in Nigeria to find all sorts of children lumped together to be given the same treatment as if they have everything in common. This is why Foin (2001) pointed out that within a given classroom there are differences in the quality of work produced. Part of this variation in performance may be due to mixed ability among students (high, medium and low). This situation in the school system had led researchers into various studies.

Hollifield (1987) carried out a study on the effects of ability grouping in elementary school students' performance. He investigated the effects of the following grouping plans on performance:

- Ability grouped class assignment
- Regrouping for reading and mathematics
- Joplin plan
- Non-graded plan

- Within-class ability groups

Findings of this study revealed the following:

- Ability group class assignment which placed students in one self-contained class on the basis of ability level did not enhance students performance
- Regrouping for reading and mathematics which assign students to heterogeneous home room classroom which was later regrouped according to achievement level for one or more subjects improved performance. However Slavin stressed that the level and pace of instruction must be adapted to achievement level. Also, the students must not be regrouped for more than one or two subjects.
- Joplin plan which assigned students to heterogeneous classes for most of the day but regrouped across reading instruction increased reading performance.
- Within-class ability grouping which assigned students within their classes to a small number of groups based on ability level, did not improve reading performance but was very effective in mathematics performance.

Hollifield (1987) concluded that ability grouping increases students' performance. The assumption is that ability grouping enabled teachers to increase the pace and raise the level of instruction for high achievers, and to provide more individual attention for low achievers. The higher achievers benefit from having to compete with one another, and the low achievers benefit for not having to compete with their more able peers. The study recommended that schools and teachers should use the grouping plans which proved more effective such as within-class ability grouping and Joplin plan. One of the main arguments against ability grouping is that the practice creates classes or groups of low achievers who are deprived of example and stimulation provided by high achievers. Labeling students according to ability and assigning them to low achievers also communicate self-fulfilling low expectation. Further groups with low performance often receive a low quality of instruction. Ability grouping creates academic elites, a practice which is not democratically ideal.

Another study was carried out by Aiyedun (1995) on the influence of academic ability of students on achievement. In his study, he used five hundred senior secondary one (SS1) students drawn from fifteen schools in Kwara State. 1991 junior secondary school certificate examination scores in mathematics were used as basis for the ability level. The study revealed that academic ability influenced mathematics achievement. The regression equation obtained showed that increase in academic ability is associated with increase in achievement in mathematics.

Inyang and Ekpeyong (2000) conducted a pre-test, post-test study on the influence of ability and gender groupings on senior secondary two (SS1) chemistry students' achievement on the concept of redox reactions. One hundred and sixty chemistry students drawn from two schools in Itu local government area of Akwa Ibom State formed the sample for the study. They were assigned to experimental class of fifty mixed ability group and control class of one hundred and ten homogeneous groups. Both groups were exposed to activities on redox reactions as pre-test and post-test. T-test statistical analysis of the data revealed significant difference between the mean post-test and pre-test scores among the students of different ability levels in the performance on the concept of redox reactions.

In another study conducted by Manrique, (1998), on the effects of display type and spatial ability on performance during a virtual reality simulation, 76 Air force reserve officer training corps cadets with high and low spatial ability level were used. The study examined the effects of display type, spatial ability, and number of trials on simulation performance and performance strategy. Results indicated that subjects with high spatial ability performed significantly better on the simulation than subjects with low spatial ability. Performance results revealed a significant interaction between spatial ability level and trial. Separate analyses for each spatial ability group showed that the performance of high spatial ability subjects improved significantly from trial to trial. The performance of low spatial ability subjects did not significantly improve over time. Results for performance strategy suggested that high spatial ability subjects used more effective strategies during the simulation than low spatial ability subjects. Finally, he noted that high spatial ability subjects benefited significantly more from practice than low spatial ability subjects.

Lagoke, Oyebanmiji and Jegede (1999) investigated the efficacy of enriching biology teaching with analogy on the performance of students of different achievement level. One hundred and twenty six SS II students (75) below average and fifty one above were used for the study. Each of the groups were stratified into experimental and control groups. Both were given pre-test and then post-test after treatment was administered to the experimental group. The data from the study was analyzed using analysis of variance (ANOVA), it was revealed that experimental group taught with the inclusion of analogy as a strategy for teaching biology performed better than the control group. The analysis also revealed that the inclusion of analogy as a strategy was helpful to learners below and above average with the low achievers gaining slightly more than the high achievers. However, the result on interaction showed no significant effect.

In a similar study carried out by Okobi (1994) on the effects of audio taped enrichment in teaching the structure of English on students' performance, he assumed that the ability level of students would always affect their academic performance irrespective of the instructional material or strategy used in instruction. The study was a pre-test, post-test control group type in which two hundred part one students of College of Education formed the sample. The data obtained from the study was analyzed using analysis of variance; the results showed that an audio taped enrichment bridges the gap in understanding of English structure and the consequent disparity in performance of students in high, medium and low ability level.

The present study investigated the influence of ability level on performance of students when taught biology concept of circulation and excretion using improvised model and video DVD instructional package.

2.3.2 Gender and Student's Academic Performance

The concept "gender" has attracted the attention of many researchers, biologists, psychologists; as a result a lot of literature exists on different aspects such as gender and social role, gender and work role. In this study the differential gender achievement in science was reviewed. The term "gender" was defined by Oakley (1993) as the amount of masculinity and feminity found in a person and obviously while there are mixtures of both in most human beings, the normal male has a preponderance of masculinity and the normal female has a preponderance of feminity. Many researchers have carried out studiess on the influence of gender on students' achievement in science. This aspect of educational research has generated a lot of conflicting and non conclusive findings. Some findings indicated that significant differences existed between the performance of male and female students while other findings showed that gender factor had no impact on students performance. Such studies include that of Obe (1989), Ibitoye (1998), Jimoh (1992) Adebayo (1997), Awoniyi (2000) Balogun (2000), and Mohammed (2000).

Obe (1989) carried out a research on Nigerian Secondary School Students' conceptions of living things; she made use of six hundred (600) students, two hundred (200) each from J.S.S. 1, J.S.S. III and form V, which were randomly selected from five (5) secondary schools in Kwara State. She used twenty (20) pictures of living objects and non-living for classification with reasons. The result showed significant difference between the scores obtained by boys and girls in J.S.S. 1 on the classification test but there was no statistically significant difference between the scores obtained by boys and girls in J.S.S. III and form V. In characteristic test carried out, no statistically significant difference existed between the scores of boys and girls in all levels. The researcher then concluded that the significant difference observed in boys and girls in J.S.S. 1 could have happened by chance. She also remarks that it was not sex that affected the students' performance but their attitude to work and level of intelligence.

Ibitoye (1998) conducted a survey study on performance evaluation of Agricultural Science Education in some selected secondary schools in Kwara State. The researcher selected two hundred and ten (210) students and twenty two (22) Agricultural Science teachers randomly from five local government areas in Kwara State. He used a 14-items questionnaire administered to agricultural science teachers and 10-items questionnaire to the students. The determination of the students' achievements was based on the West African School Certificate (WASC) examinations' results of the selected schools in agricultural science. He used means, percentage and ANOVA statistical procedures in analyzing the data collected. The result of the research showed that there was no significant difference in the single sex (boys), single sex (girls) and co-educational schools.

Jimoh (1992) carried out a research work on the influence of teacher, school variables and gender on students' achievements in chemistry in Nigerian Secondary Schools. He used one hundred and ninety (190) final year chemistry students and forty-four (44) chemistry teachers randomly selected from twenty-four (24) Secondary Schools in five (5) local government areas of Kwara State. He used a 19-item questionnaire administered to the chemistry teachers while 30-items Chemistry Achievement Test

(CAT) were given to the sampled students. The statistical procedures used were mean, frequency, chi-square and t-test in analyzing the data collected, the result revealed that:

i. Laboratory facilities, teachers' qualification, school location, teaching experience had significant influence on students' level of Achievement.
ii. Nature of the school and gender had no appreciable influence on student's level of achievement in chemistry.

Adebayo (1997) carried out a research work on "gender, environment and co-education as factors of performance in the raven's standard progression matrices". He used a non-verbal figures test of reasoning called the raven's standard progressive matrices. The test was administered to a total of four hundred and eighty (480) students comprising of two hundred and forty (240) boys and two hundred and thirty six (236) girls all of Mean age of 14.5 years. They were selected from eight (8) secondary schools in Lagos State, Nigeria. The schools were single sex and co-educational and were also located both in rural and urban areas. The results obtained were analyzed with respect to gender environment and type of school. The findings showed that:

i. The boys performed significantly better than the girls.
ii. Students from Urban areas had high mean scores than those from rural areas although the difference was not statistically significant.
iii. Students from single-sex schools had higher mean scores than those from mixed schools with the difference being statistically significant. The result in Nigeria is comparable to the one from Britain. This is because geographical location and environment do not have effects on raven's standard progression matrices test.

Awoniyi (2000) carried out a study to investigate the relationship of gender to academic achievements. Data were collected on six courses offered at college of

Education Technical, Lafiagi using 1997/98 NCE III students. Proportional stratified systematic sampling techniques were used and the data collected were analyzed using mean score statistical method. The result revealed that there was a significant difference between the academic performances of male and female students. Balogun (2000) carried out a research work to determine whether gender has positive effects on performance in the productive and receptive skill among the secretariat students. He used proportionate satisfied random sampling method to select a total of sixty-two (62) students comprising forty-nine (49) female and thirteen male of first year secretariat students of Auchi Polytechnics, Auchi, University of Ibadan Modified Needs Analysis Questionnaire (UIMNAQ) was used to collect relevant data. Mean and standard deviation were used to analyze research question while the t-test statistics was used to test the level of significance. The result revealed that gender does not have positive effect on the performance of the skills.

Mohammed (2000) in his study titled "assessment of female students' performances in selected science courses" carried out a pilot study using selected female students offering Statistics and Science Laboratory studies. In his research, he compared the performance of both sexes in the courses. Statistical chart like multiple – bar chart was used for the presentation while test of significance of correlation, regression and time series were used. The result shows that there was a significant difference between male and female performance. In continued concern for influence of gender on students' performance, Okeke (2001) observed that in Nigeria and many other countries, women are grossly underrepresented in the scientific and technological fields. Odunusi (2001) observed that from 1993 to 1997, the enrolment rate of boys and girls increased in primary schools with the increase rates for boys and girls being 10% and 80% respectively. However, at the post primary school level, there was a sharp drop in enrolment for both boys and girls from 1992 to 1994 and the drop was sharper for females than for males. This trend continues up to university level especially for science subjects.

In trying to find explanations for low participation of women in science, Okeke (2001) attributed the trend to the following factors: biological factors, environmental inputs, such as childrearing practices, societal expectations, and instructional strategies. To add to this fact, Erinosho (1998), pointed out that girls usually start with positive attitude and enthusiasm towards the sciences, but their interest diminishes as they proceed in the programme. This occurrence led many researchers to examine the possible factors that deter girls' interest in science. Erinosho went further to state that girls do not experience science activities and skills in the classroom to the extent boys do. Oakes (1990) remarked that girls are treated differently from boys by teachers in their instructional strategies and expectations. Teachers are harder on boys than on girls and so boys learn better and faster. Also another factor is the use of sex–biased text- books that girls read, with more examples and illustrations focused on males in science careers and females on stereo typed roles with the use of generic nouns or pronouns. This is commonly seen in books illustrating engineers and technicians with "male pictures and using the pronoun "He" and a clerk or typist with a picture of a female and using the pronoun "She". These, brain – wash the girls, making them believe that science related courses are not for them. Odunusi (2001) observed that the role models provided are more of male science teachers and professionals, than females. They observed that the males receive more attention from teachers and dominate classroom activities more than the females and most importantly, there is every inequalities occurring inside and outside the classroom. These include denying girls' access to some subjects and also subtle differences in treatment which may also have cultural undertone or backing.

Balogun (1994) proposed three models as theoretical frameworks for the observed sex differences viz genetic deficit, cultural deficit and bicultural models. According to him, the genetic deficits centred on the biological components of the females as the causative factors. However, despite these biological components, and the accompanying physiological changes, various research findings have revealed that females are not deficient in abilities in science (Ibitoye 1998). However, since girls generally under-estimate their ability and have less confidence in their competence in science the need arises for appropriate modifications of the cultural and environmental factors to rectify this anomaly. Other researchers have also supported this assertion and established that lacks of interest in physical sciences among girls are more of the product of social and psychological factors than inherited abilities (Erinosho 1998). Hence the science teachers need to adopt some psychological techniques and appropriate motivational strategies to assist the females to get over their shyness and sensitivity in order to boost their ego/image in responding adequately to science activities.

The cultural deficit model has to do with the societal structures and practices, the pattern of domination (dominance) and subordination (submission) between males and females in our societies and how these limit the ability of the females to achieve scientific culture thus leading to unequal participation in science. The need for career counseling, for both female students and their parents or guardians is further made clear in the bicultural model which suggests the effect of traditional stereotyped roles and expectations on female choice of careers. All these constraints and misconceptions need to be removed and corrected respectively in a learning situation in order to improve on female participation and achievement in science, technology and mathematics.

2.4 Theoretical framework on Instructional Media in teaching and Learning Process.

Learning is a construct which is not directly observable but only inferred from the behavior or activities of the learner. Learning can be defined as a relatively permanent change in behavior that results from experience in the environment and is manifested in performance (Mallum and Haggai 2000). Therefore, many psychologists have formulated theories meant to explain the processes of learning. Learning theory is a tested model that explains the process of learning in animals and human beings. These theories may be broadly divided into two among others, namely:

- Cognitive/Gestalt theories of learning
- Behaviorism/S-R theories of learning

The proposition for the use of media in instructional process took its root from Cognitive/Gestalt theory of learning (Adewoyin 1991). The theory postulates that learning comes as a result of insight and perceptual organization or re-organization. Perception is the process by which an individual gains awareness and understanding of the events or objects in his environment. The theory thus explained that better and clearer perception and insight occur in the teaching and learning of any task when all the senses- the eye, the nose the mouth and the nerve endings are involved. The Gestalts thus reiterated that-

- Perception is the foundation of learning; it precedes communication which is the key to learning.
- The clearer the perception of an object, topic or concept, the better it can be understood and remembered.
- Clear perception facilitates learning while misinterpretation impedes learning.

- Where it is desirable to substitute for firsthand experience via the use of media, it is important that their substitute represent reality (three dimensional) from a perception point of view.

All these notions are summarized by a general principle which the Gestalts called "pragnanz" (Nwachukwu 1989). The word connotes meaningful, completeness, relative simplicity and good pattern. It implies that this principle will characterize any teaching-learning process which is enriched with instructional media materials.

The use of media in instruction also has some bearing from behaviorism theories. Behaviorism refers to stimulus – Response learning theories (S- R theories). These theories are also called connectionist theories, Associationist theories or the theories of contiguity. All the theories explain an association or a connection between the stimulus (S) and the response (R). A stimulus refers to anything that appeals to or excites the sense organs – eye, nose, tongue, skin and ear. Therefore stimulus refers to all sights, smell, sound or any other influence on our senses from the environment. Response is the individual's reaction to the stimulus. In this study, the models and videotape serve as the stimulus and the student's reaction to them is the response.

A Russian Psychologist, lvan Pavlov, (1849-1936) a Behaviourist put forward the theory of classical conditioning as explanation of how learning takes place. The major contribution of the theory is that the external environment is important in learning. Therefore, the theory emphasized on the provision of a stimulating environment in schools for efficient learning. Secondly, the theory also pointed out that practice and exercise are essential in learning since they strengthen the S-R bond. Invariably, the interaction of the students with the instructional media will strengthen the bond. Another behaviourist, Thorndike (1874-1949) agreed with this and stated that all learning is the formation of bonds or connections between stimulus and response (SR), and this depends on factors which operate in the organism. He experimented with cats in a puzzle box and afterwards came up with three laws of learning:

(1) The law of effect; this is the maintaining or strengthening of the S-R bond as a result of satisfaction. According to Thorndike, in classroom teaching, the law of effect can be applied by making classroom experiences satisfying, pleasant, meaningful and understandable to students and providing learning materials to the learner so that meaningfulness and understanding can be enhanced. In the present study, by using models it will make the Biology concepts real meaningful understandable and exciting. This gives the learner satisfaction at end of the lesson.

(2)The Law of Exercise; this law means practice or rehearsal. It is the law of use and discuss. When the S-R bond has been made, the connection becomes stronger when it is more frequently used, but weakened when the S-R bond is not used over a period of time. Thorndike added that in classroom learning, the law of exercise can be applied by giving students more opportunities to use what they have learnt. In the present study, the models and video DVD will always be available for students to practice with even after the lesson. By re-playing the DVD often the learners master the concept and it gives them opportunity to re- hearse on their own. When they do, that learning becomes permanent thereby giving them the opportunity to apply what they learnt in school in real life (Practice makes perfect).

(3) The law of Readiness; readiness refers to the preparedness of the child to learn a task. The readiness comes with age and the nature of learning task. Thorndike said that the S-R bond is established faster when the maturational and motivational level of the learner are adequate. According to Thorndike, the law of readiness can be applied in the classroom if teachers can promote readiness by giving students stimulating or motivating

experiences that enhances readiness. Models and video tape stand to serve these purposes as portrayed by Thorndike's laws.

A close look at the nature of instructional media and the roles they play in teaching learning process reveal that the media stand to satisfy the demands of behaviorism and Gestalt's theories of learning for efficient learning outcome. The psychological implication of the above views of both Gestalt and behaviorism theories is that science subjects especially biology cannot be properly taught without the use of appropriate instructional materials to facilitate better understanding of scientific concepts and underlying principle and theories. The uses of instructional media function to enable students acquire knowledge and skills that they could apply to their social and cognitive problems (Nwachukwu 1989).

Mazur (1990) remarked that to achieve the above stated conditions, learning has to be enjoyable so that students remember and share what they have learnt. He added that enjoyable learning happens when the learning environment offers rich and stimulating experiences. The present study on the improvisation and effects of instructional models and video instructional package focuses on the learner and how learning can be made easier, more meaningful and much more permanent. Myriads of researches into theory of learning have proved that any instructional process which evokes the involvement of as many human organs as possible tends to facilitate or ease learning.

2.5 Empirical Framework on Instructional Media in teaching and Learning Process.

Several researchers (Adebimpe, 1997; Inyang, 1997; Ezeudu, 2000; Ogunleye 2000; and Olagunju, 2000) had suggested many local materials that could be used in instructional process. Olagunju (2000) made a list of local materials that could be used in the teaching of biology. In his words, scalar and functional models of different organs and systems could be improvised using plasticine, moldable clay soil or paper mesh. Chromosome DNA models could be improvised with maize grains glued with plasticine. In ecological studies, an aquarium can be made from any moderate size wide-mouthed glass containers.

Insect nets can be constructed from a circular stiff wire to which a mosquito netting is attached at one end, and held by a small wooden pole, animal cages for keeping a few living animals in the laboratory can be made from empty boxes or a stiff wire made into a box. The conventional specimen bottle can be substituted with the cheaper, larger, and wide mouthed bottle. Important animal skeletons and bones such as those of guinea pigs or rabbits can be provided by local preparation by the teacher. Collections of specimens such as worms from abattoirs, local hospitals or veterinary clinic can also serve s improvisation where the original specimens are not available or are difficult to come by.

Onygegbu (2001) conducted a study on the effect of electronic instructional media for improved performance. He used 545 ss1 students from four schools. Results from the mean, Scheffe test and analysis of covariance (ANCOVA) showed that the video tape instruction was more effective than the convectional/ traditional instruction.

A similar study conducted by Obodozie (2002) on the effects of improvised television on the learning of Social Studies among primary school pupils in Niger State revealed that there was significant difference in the mean scores of pupils taught with an improvised television (experimental group) and those taught without it(control group). The study also showed significant difference in the mean scores of males and females in the experimental group.

Agommuoh and Nzewi (2003) conducted a study on the effect of video tape instruction on secondary school students' achievement in physics. The sample was 398 ss1 students from 2 co- educational schools. Data generated were analyzed using Analysis of covariance (ANCOVA). The result indicated that the achievement of students in physics greatly improved with the use of video tape instruction. Also that students gender had no significant effect in their achievement in physics.

Mohammed (2004) investigated the effect of improvised radio transmitter on the learning of physical education among primary school pupils in Niger State. A pre test-post test experimental design was adopted. The study sample was sixty (60) primary school pupils across public schools assigned to control group and experimental group. The experimented group was taught with improvised radio while the control group was taught without it. The mean standard deviation and t-test statistics were used to test for the significant difference between the mean scores at 0.05 levels. The result of the analysis showed that there was significant difference in the physical education mean achievement scores of primary school pupils taught with an improvised radio transmitter and those taught without it. The study also revealed that there was significant difference in mean scores of male and female primary school pupils in the experimental group.

Nwadibia (2005) investigated the effects of biological models on learning nervous system in senior secondary schools in Minna, Niger State. A pretest posttest control group design was adopted. The study used two hundred (200) students from four secondary schools assigned to experimental and control groups. The hypotheses were tested with t-test statistics, the result of the analyses showed that there was significant difference in the posttest mean achievement of the experimental and control group at 0.05 levels. Also there was no significant difference in the mean achievement of males and females taught with biological models.

Olumba (2007) carried out a study on the effects of Audiotape and Videotape instructional packages on the teaching of phonetics in senior secondary schools in Minna. The study adopted a pretest posttest control group design and used sixty (60) students as sample. One way ANOVA and t-test statistics were used to test the hypotheses at 0.05 levels. The results of the analysis showed that there was significant difference between the performance of students taught with videotape and the students taught with lecture method. Also the study revealed that there was no significant difference in the mean scores of males and females taught with videotape.

2.6 Summary of Reviewed Literature

A lot of literatures have been reviewed in this study. The literature reviewed provided the conceptual base for the study. It examined the concept of instructional media, improvisation, Education Technology and biology concepts of circulation and excretion. Ogunrati (1984), Akanbi (1993), Abimbade (1997), Adewoyin (1999), Gusen (2001), Adeniran (2002), Hahm (2003), and others, gave explanation to the concept of instructional media. Their various views imply that media are channels through which messages, information, ideas and knowledge are conveyed. Media are tools or instruments through which stimuli can be passed or obtained. In continuation, these researchers described instructional media as a part of educational technology which is a go-between, a carrier of messages from one person to the other in instructional process. Adewoyin (1991), Obianwu and Azubike (1994), Essien (2001) and Adeniran (2002) among others pointed out the importance, principles of selection, production and utilization of instructional media.

Literature was also reviewed on various aspect of improvisation. Akinmoyewa (1992), Akusobo (1997), Iwuozor (2000) and Wasagu (2000) just to mention a few all gave various explanations to the concept of improvisation. However, the most widely accepted definition of improvisation is that it is an act of using alternative materials obtainable from the local environment or designed and constructed by the teacher with the help of local personnel (carpenter, artist, and carver) to facilitate instruction. Mohammed (1997), Akinrorohum (2000), Eyetsemitan (2004) all gave clarifications on the rationale for improvisation while Boateng (1986), Yoloye (1989), Maduabum (1990) and Akinsola (2000) pointed out the constraints on improvisation.

Empirically, a number of studies on improvisation and media used in instruction were reviewed. Mohammed (2000) improvised and validated improvised radio transmitter, Orisabiyi (2002) improvised human skin for biology instruction, Ibrahim (2004) improvised aquarium tank. Okobi (1994) compared the effects of video tape and slide tape instruction on students' performance in social studies. Okoro and Etukudo (2001) compared the effect of computer Aided instruction and Extrinsic Motivation Traditional method on students' performance in chemistry. On these empirical work reviewed, none was found to dwell specifically on video DVD as in the present study. The literature reviewed also provides the theoretical framework.

Behaviourism and Gestalt theories of learning were then found to be the foundation upon which the use of instructional media in the classroom is built. The behaviourists (Thorndike, Ivan Pavlov) pointed out that external environments as well as motivating or stimulating experiences of the learner are essential for meaningful and lasting learning. The Gestalts postulated that learning comes as a result of insight and perceptual organization. They maintained that better and clearer perception and insight occur in instructional process when as many sense organs as possible are involved. The present work which employed Instructional media (models and video DVD) stands to fill this gap. This is because the media materials will allow the involvement of as many sense organs as possible thereby providing insight and perceptional re-organization needed for meaningful and lasting learning.

The works reviewed on gender differences as they effect achievement of students give diverse opinion. Obe (1989), Ibitoye (1996), Awoniyi (2000), Balogun (2000) and others, found out that gender does not have any influence on academic achievement of student. While Jimoh (1992), Adebayo (1997), Mohammed (2000) are of the view that gender difference has influence on the academic achievement. Yet others indicated that there is no significant difference in students' performance. This shows that more work on gender differences and academic achievement is still needed. Gender is a variable in this study.

When the issue of ability group was reviewed, Aiyedun (1995) and Inyang and Ekpeyong (2000) revealed that ability group influence students' performance. A study by Lagoke et al (1999) showed that low ability students gained slightly more than the higher ability. This pointed out that the treatment given to the low ability group enhanced their performance. However, Slavin (1986) cited in Hollifield (1987) revealed that ability grouped assignment which placed students in one self-contained class on the basis of ability level did not enhance students performance, but regrouping of students for reading and mathematics which assigned students to heterogeneous classroom and later regrouped according to achievement level improved performance.

Generally all the literature reviewed are relevant to this study in one way or the other but none was found to dwell specifically on the same premise as the present study.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Introduction

This chapter presents the procedures that were used to collect and analyze relevant data for this study. The procedures are discussed under the following sub-headings: Research design, Sample and Sampling Techniques, Research Instruments, Validation of instruments, Procedure for data collection and Data analysis technique.

3.2 Research Design

The study adopted a pretest-posttest control group factorial design. A three by three by two (3 x 3 x 2) factorial design were employed to test the seven hypotheses in this study. This design represents three levels of treatment, three ability levels (high, average, low,); and two levels of gender (male and female). As noted by Kareem (2003), factorial design allows the concurrent manipulation of two or more independent variables in order to assess the effects of their interaction on the dependent variable. Besides, this design is efficient as every observation in the design supplies information about factors that are included in the experiment. Table 3.1a shows the design layout.

Table 3.1 Pattern of Research Design

Groups	Pretest	Treatment	Post Test
Experimental group 1	O_1	X_1	O_2
Experimental group 2	O_1	X_1	O_2
Control group	O_1		O_2

Key:

O_1 represents pretests observations on Structured Biology Achievement Test of experimental groups 1, 2 and control group

O_2 represents posttests observations on Structured Biology Achievement Test of experimental groups 1, 2 and control group

X_1 represents treatment for Experimental groups.

Table 3.1 shows that two experimental groups and one control group were involved in the study. Subjects in the three groups were pretested before the treatment started. After the treatment, experimental groups 1and 2 and control group were posttested. The independent variables for this study are: instructional modes (3 levels), ability (3 levels) and gender (2 levels). The dependent variable is academic achievement on selected biology concepts. The moderating variables in this study, which are student ability level and gender are expected to determine the levels at which the dependent variables will be analysed.

3.3 Population of the Study

The population for the study were students from all the one hundred and fourty six (146) co-educational and other senior secondary schools in Niger state. (see Appendix C) The target population are eight thousand two hundred and fifty three (8253) senior secondary two (SS2) students,the choice of SS2 students is based on these considerations:

(i) they must have acquired basic pre-requisite of biology concept at SS1 level,

(ii) the concepts to be treated in this study(blood circulation and excretion in man) are stipulated to be treated in SS2 curriculum,

(iii) most of the school authorities do not allow their final year class to be used for resarch so as not to disrupt the schedules for examination preparation.

3.4 Sample and Sampling Technique

The research sample was selected from co-educational senior secondary schools so as to take care of gender variables. Nine (9) co-educational senior secondary schools were randomly selected using a hat-draw method from seventy seven (77) co- educational schools distributed within the three educational zones(A,B and C) in Niger State. The choice of nine (9) schools from the seventy seven (77) schools is purposive, since the 9 schools would not be a fair representation of the 77 schools. Purposive sampling allows researcher to conveniently select sample for a study (Kerlinger,1973; Mukherjee,2002). However, simple random sampling was adopted to select the actual nine (9) schools. According to Daramola (1995), a simple random sampling technique is a sampling procedure in which each element in the population has an equal chance of being selected or rejected in a desired sample. The nine secondary schools constituted six experimental and three control groups.

A total of thirty (30) (fifteen (15) male and fifteen (15)) female students were selected from each school for the purpose of treatment, analysis and discussion. This made the total sample to be two hundred and seventy (270). The technique adopted for the selection of the thirty students for the study was stratified random sampling technique. Kerlinger (1978) commended this approach and remarked that stratified random sampling reduces sampling error and ensures that differences among subjects are distributed evenly. The students were first stratified into three ability levels (high, average and low) based on their pretest. This technique was used because the conventional measure of mental ability (Intelligent Quotient (IQ)) and Verbal Quotient (VQ) among others are not available for many Nigerian Secondary Schools Students and adoption of foreign one may not be suitable for Nigerian subjects (Yusuf 1997). According to this study, a high ability level student is one whose average score in the last terminal biology examination falls within the upper 25%.The average ability level student is the one whose average score falls within the middle 50%, while the low ability level falls within the lower 25% (see table 3.2).

Table 3.2 Range of Scores forming Ability Levels

S/N	Range of Students' Scores	Ability levels
1.	Scores within the upper 25%	High ability level
2.	Scores within the middle 50%	Average ability level
3.	Scores within the lower 25%	Low ability level

Within the strata, the students were further stratified along gender (male and female).From each stratum, 10 students (5 male and 5 female) were selected using the hat draw method in which five papers were written "Yes" and others "No" separately for boys and girls. Those who pick "Yes" were selected, while those who pick "No" were dropped. This gave a sample size of 30 students (15 male and 15 female) from each school and a total sample size of two hundred and seventy (270) students (135 males and 135 females).

3.5 Research Instruments

The following research instruments were constructed by the researcher and used to gather data for the study. They include:

1. Treatment Instruments-

   a) Developed models of the circulatory system, internal structure of the heart, excretory system, and kidney nephron.

   b) Video DVD instructional package and

2. Test Instrument- Structured Biology Achievement Test (SBAT)

1(a) Procedure for Design and Production of the developed models

The materials needed for the production of the models were obtained from the immediate environment. They include: Madobia wood (timber) 122cm x 62cm, 75cm x 62cm and half inch ply wood (2sheets). The wood was obtained in timber market along Bosso Road, Minna. Paint, bulb of different coloure, sand-paper, body filler, solignum, cement, white wood glue, nail, wire, rope, battery, main circuit and others, were obtained from Minna central market. Other materials needed were saw, scrapper, pliers, Chisel of different shapes and sizes (Curved, chisel-shaped, Gorge Chisel and others).

Four different pieces of wood (Madobia and ply wood) were cut, each for a model. That is, two pieces 122cm x 62cm for blood circulatory system and urinary tubule respectively and two pieces 75cm x 62cm respectively for the structures of heart and excretory system. These pieces of wood were planned to make the surfaces smooth for designing / drawing, they were treated with solignum to prevent them from being eaten by wood worm. The choice of Madobia wood was based on the fact that it is strong, compact and highly resistant to heat or sunlight. In other words, it cannot bend, expand or shrink when dry or subjected to harsh weather. On each of the pieces of wood which have already been planed, the design or sketched outline of the features to be molded were drawn and carved or molded afterwards (see Appendix D for (1a) The internal structure of the heart, (2a) human blood circulatory system,(3a) Urinary system, and (4a) Kidney tubule/nephron)

The internal structure of the heart consists of the following, pulmonary arteries and veins, left and right auricle, left and right ventricle, septum, bicuspid valve and tricuspid valve, anterior and posterior vena cava, while, human blood circulatory system consists of the heart, pulmonary veins and arteries, carotid artery, jugular vein, sub- clavian artery and vein, hepatic artery and vein, hepatic portal vein, mesenteric artery, renal arteries and veins , gonadial arteries and veins , segmental and iliac arteries and veins, capillaries. Urinary system consists of two kidneys, two ureters, bladder, urethra, renal artery and renal vein. In addition; Kidney tubule/nephron consists of these features; Bowman's capsule, glomerulus's, convoluted tubule, Henley's loop, main collecting tubule, renal capillaries, and renal veins. All the features were shown in the models.

The method used in the production of the structures were carving and molding. Molding is the process by which materials (wood, metal, plastic) are shaped into three dimensions that looks exactly like the prototype. The model can be scaled down, scaled up, or same size as the original type depending on the set objectives, targeted audience and cost implications. To model the structures, the design or sketch drawing of each of the models were made on a planed wood and sawed to the shape of the drawing. The features - heart structure and circulatory system were carved out using chisel of different shapes and sizes, while excretory system and kidney nephron were molded using a mixture of top bond, body filler and cement. Scrapper was used to scrape off neatly the galloping of the chisel and to make room for sand-papering.

Each of the models was sand-papered with hard or rough sand-paper in order to remove different marks on the work, and then smooth sand-paper was used for the final smoothing of the surface. This was followed by modeling of the whole work with body filler mixed with top bond. This was done so as to fashion out the correct shape and fill up all the small holes to avoid any form of porosity in the process of final painting and to further protect the wood from being eaten by wood worm.

Painting, illumination and Mounting the models

In each model, the features were painted with different colors. This is to arouse and sustain the interest of the students and enable them differentiate the structures. To further motivate the student and aid their understanding of the trend in blood circulation, the structures of the heart and blood circulatory system were illuminated with different colour bulbs (White, Blue, and Red). For the Illumination mechnism (see Appendix E). The models produced were each mounted on a piece of ply wood with the aid of araldite or super-glue to fasten it to the wood. Mounting is the process of displaying the finished work to properly bring out its features. (See Appendix F for 1b, 2b, 3b, and 4b)

Labeling and Casing the models

The models were well annotated and a key made available beneath each model. They were finally cased using aluminum frame and plastic glass. Casing is the process of putting the finished work in a glass case. This enables the models stand conspicuously in the laboratory without being covered with dust. It also lowers the risk of damage, enhances easy handling and movement from one place to another (see Appendix G for 1c, 2c, 3c, and 4c).

1 (b) Procedure for developing the Video DVD Instructional Package

The DVD instructional package was developed and produced by the researcher based on the concepts taught to the students in the study, namely blood circulation (structure of human heart, blood circulation) and excretion (excretory system, excretory mechanism). See Appendix H for the photograph of the disc. The DVD package contains the video recordings of the produced models to suit narration on the concepts as detailed in the script write up (Appendix I). An expert in the video recording did the recording and editing. The researcher did the narration. The cost analyses for both models and video DVD package is shown in Appendix J.

2. Development of the Structured Biology Achievement Test (SBAT)

The biology concepts used for this study were selected from the senior secondary two scheme of work. The textbooks used were the Modern Biology for Secondary Schools, New Biology for Senior Secondary Schools and past questions for senior school certificate examination. These materials were used for the purpose of teaching and as a guide for the instrument designed.

The Structured Biology Achievement Test (SBAT) was a 40-item multiple-choice objective test with five options (A-E) as possible answers to each item. For each item only one of the five options was the correct answer. The items were constructed to reflect the concepts treated and in reference to the objective of the lessons on which instruction was based. The test instrument had two sections - A and B, Section A elicited information on students' class, school, age and sex, while section B elicited information on the achievement of the students in the chosen concepts. The students were required to answer all the questions by ticking the correct option out of the five options (A-E) provided. On the scoring of the items, a score of two and half was awarded for a correct answer and zero for wrong answer. Thus, the test instrument was scored over one hundred (100).

3.6 Validation of Research Instruments

(a) The Models.

The developed models were made to pass through the following: the supervisors of this work, two senior lecturers who are experts in the field of educational technology in the Department of Science Education, Federal University of Technology (FUT), Minna, two specialists in biology in the Department of biology, F.U.T. Minna, two biology teachers, each from Hill Top Model School Minna and Day Secondary School

Minna. They were used for face and content validity. Specifically, their comments and opinions were solicited as regards the suitability of the models for the concepts and level of students for the study, clarity and appropriateness of the features of the model. Based on their comments, modifications were made. The validations certified that the models appealed to the content of biology concepts selected for the study and therefore valid.

(**b). Video DVD Instructional Package**.

The DVD instructional package was validated by experts in educational technology, including the supervisor of this work and two senior staff from Audio Visual Department of F.U.T. Minna. The experts critically examined and assessed the package with reference to:

(i) the sharpness, clarity and suitability of the video recording for teaching the selected biology concepts,

(ii) the audibility, clarity and appropriateness of the narration,

(iii) subject matter coverage, accuracy and presentation and

(iv) general criticisms and / or suggestions for the improvement of the package

The DVD package was edited based on the suggestions from the experts.

These instruments were then pilot tested.

3.7 Procedures for the Pilot Test

The pilot test was conducted to test the reliability of the test instrument and the construct validity of the treatment instruments. It was also to test the efficacy of the research design and the procedures for the main study so as to identify and correct possible methodological flaws. The study involved three secondary schools randomly selected through a hat draw method from the schools not chosen for the main study. The school authorities were contacted to use their schools, and approval obtained. The schools were randomly assigned to the two experimental groups and one control group using the balloting system. Students in the first school were assigned to experimental group one taught with the developed models, while their counterparts in the second school were assigned to experimental group two taught with DVD instructional package. Students in the third school however, were assigned to the control group to be taught with lecture method.

Intact class approach was used for teaching of the concepts of circulation and excretion, however only ninety (90) randomly selected Students (thirty (30) in each school selected for the study) constitute the sample for the study. The study lasted seven weeks. During the first week of study; pretest was administered to the students in the three schools with the intention of knowing the entry behavior of the students. Instruction commenced in all the groups after the pretest for four weeks. Double periods of eighty minutes per week in each of the schools were utilized. The last two weeks out of the seven weeks were used for revision and posttest administration. In all, students were exposed to a total of five hours twenty minutes of instruction in each school. The construct validity of the developed models and DVD package was ascertained by subjecting the data collected to correlation analysis using SPSS statistical package. A correlation coefficient of 0.71 was obtained from the analyses on both instruments. This value was high enough for the instruments to be considered as having good construct validities.

3.8 Reliability of the Structured Biology Achievement Test (SBAT)

The data obtained from the pilot study were used to assess the reliability of the test instrument (SBAT). It was also used for item analysis, that is to obtain the facility and discrimination indices of the instrument. Reliability of a test is the consistency with which the test measures what it is intended to measure. According to Odama (1982) Indices of reliability give an indication of the extent to which a particular measurement is consistent and reproducible. The data obtained were subjected to correlational analysis using Pearson Product Moment Reliability Coefficient formulae. A reliability index of 0.83 was obtained for the test. This value was considered an adequate reliability measure for the test instrument.

3.7.1 Item Analysis: Facility and Discrimination Indices

(a) Facility Index

The facility index of an item in a test is referred to as the percentage of the entire respondents that got an item correct (Wood, 1990). According to Mukherjee (2002), facility index is the average of higher group percentage and the lower group percentage, that is:

$$FI = \frac{Rh + RI}{2}$$

Where F1 =Facility index

Rh =Percentage correct in the top or higher 1/3

RI=Percentage correct in the bottom lower 1/3

As clarified by Wood (1990), test items with facility indices within the range of 30 – 70% are usually recommended for use.

(b) Discrimination Index

The discrimination index of a test is its ability to discriminate between high and low achievers in a test as a whole. The discrimination index of a test item can be calculated from the difference of the two percentages, one for the higher group, and the other for the lower group. Discrimination index is given by the formula:

DI =RH - RI

Where **DI** - is the discrimination index,

Rh – Number among upper 25% who scored **an item correctly.**

Rl - Number among lower 25% who scored **an item correctly.**

As pointed out by Abdussalami (2008), discrimination indices ranging from 30 to 49% are described as moderately positive. Those from 59 to 70% are highly positive while those between 30 percent and below are low positive values. Mukherjee (2002) made it clear that the ideal range of facility and discrimination indices are taken to be between 30 and 70%. The forty item questions were able to meet the criteria above and thus selected. For the forty item questions (SBAT) and the marking scheme, See Appendix K.

3.9 Method of Data Collection

Two weeks before the experiment the researcher visited the selected schools to seek for official permission from the school authority. During these visits, the sample frame was determined and teachers that acted as research assistant trained. The entire study covered a period of seven (7) weeks. Intact class approach was adopted; however only thirty (30) students from each secondary school sampled was used for analyses and discussion. During the first week of experiment, pretest was given to all the groups before treatment to determine the equivalence of the control and the experimental groups. Instruction commenced in all the groups in the second week of the experiment. Two experimental groups were taught with two different treatments. Experimental group 1 was taught with improvised models, experimental group two was taught with video instructional package, while the third group, control group was taught with lecture method alone. Appropriate lesson plans were developed for experimental 1, 2 and control groups. (See appendix L).

For four (4) weeks, lessons on the content areas were presented to the students. Double period of 80 minutes per week was utilized; this gives a total of five hours twenty minutes per school. After a period of four weeks, there was one week of revision, and the Structured Biology Achievement Test (SBAT) was administered to the three groups as posttest. The interval between the administration of pretest and posttest was 5 weeks, in line with Mukherjee's (2002) suggestion that a minimum of 3 weeks should be allowed between the time interval of pretest and posttest. The scores of the experimental and control groups on pretest and protest were computed and used for data analysis. The arrangement is summarized as follows:

1st-week: Pretest administration of SBAT

2nd – 5th week: Treatment- teaching the selected concepts to the experimental group 1 (models), the experimental group 2 (video DVD instructional package) and the control group (lecture method).

6th –7th week: Revision and Posttest administration of (SBAT) to the three groups.

3.10 Method of Data Analysis

Analysis of variance (ANOVA) statistic was used to analyze the data. Where certain factors were found to have significant effect on the achievement of biology concepts, Scheffe's post hoc Multiple Test was further computed. This is a posteriori test to determine whether specific differences between means and their combinations are significant. It does multiple comparisons using all possible pairs. Graphical representation was also drawn to indicate the difference in the mean scores of the experimental and control groups. A level of 0.05 probabilities was adopted for all analyses and the criterion for significance. SPSS statistical package was used for the analyses.

CHAPTER FOUR

RESULTS

4.1 Introduction

The chapter presents the analyses of data and the results obtained. The hypotheses were tested using the analysis of variance (ANOVA) statistic. A follow-up Scheffe's post hoc test was used to identify the actual mean scores that were significantly different from one another. All the results are presented in tabular form.

4.2 Pretest Performance of Experimental and Control Groups

The purpose of pretest which was given to the experimental groups (1 and 2) and the control group was to establish the equivalence of the three groups before the study started. To analyze the pretest data, the mean scores and standard deviations of the experimental and control groups were computed and compared using ANOVA statistic. The results of the analyses are presented in Tables 4.1A and 4.1B.

Table 4.1A: Means and Standard Deviations of the Pretest Mean Achievement Scores of Experimental and the Control Groups

Variable	No in Sample (N)	Mean (μ)	SD
Control Group	90	23.99	5.14
Experimental Group 1	90	23.02	4.85
Experimental Group 2	90	23.32	5.53

Table 4.1A shows the mean and standard deviations of the experimental groups 1, 2 and the control group. From table 4.1A, the means of experimental group 1 and 2 are 23.02 and 23.32 respectively and that of the control group is 23.99. To find out if the mean differences between the three groups are statistically significant, ANOVA comparison was carried out as shown in Table 4.1B.

Table 4.1B: ANOVA Comparison of the Pretest Mean Achievement Scores of Experimental and the Control Groups

Sources of Variation	S S	Df	MS	F_{-cal}	F_{-tab}	Sign.
Between Groups	44.067	2	22.033	$.820^{ns}$	3.07	0.441
Within Groups	7172.600	267	26.864			
Total	7216.667	269				

ns = Not significant at 0.05 level

Table 4.1B shows the result of the ANOVA comparison of the pretest mean scores of the experimental groups 1, and 2 and the control group. From Table 4.1B, the calculated F-ratio is less than the critical F-ratio ($F_{-cal.}$ 0.820 < F_{-tab}. 3.07; df 2, 267; p > 0.05). This indicates that there is no significant difference in the mean achievement scores of the three groups (experimental groups 1, 2 and the control group) at 0.05 level of significance. This result shows that the students were comparable (i.e. equivalent in terms of previous knowledge of the subject matter) before the teaching started.

4.3 Posttest Results for the Experimental and Control Groups

4.3.1 Posttest Result for Experimental Group 1and Control Group

Hypothesis one ($H0_1$)

The hypothesis tested here states that there is no significant difference in the mean achievement of students taught with developed models and those taught with lecture method.

To test this hypothesis, the students' posttest mean scores and standard deviation were computed and compared through ANOVA statistic and the results are shown in Tables 4.2A and 4.2B

Table 4.2A: Means and Standard Deviations of the Posttest Mean Achievement Scores of Experimental Group 1 and the Control Group

Variable	No in sample (N)	Mean (μ)	SD
Experimental Group 1	90	42.82	9.24
Control Group	90	32.57	5.34

Table 4.2A shows the mean and standard deviations of experimental group 1 and the control group as 42.82 and 9.24; 32.57 and 5.34 respectively. The difference in the mean of the two groups is 10.25. The result in Table 4.2A is made clearer with a graphical representation as shown in appendix M, 4a.

To find out if the difference between the two means is statistically significant, ANOVA comparison was carried out as shown in Table 4.2B

Table 4.2B: ANOVA Comparison of the Posttest Mean Achievement Scores of Experimental Group 1 and the Control Group

Sources of variable	SS	df	MS	f_{-cal}	F_{-tab}	Sign
Between Groups	4732.939	1	4732.939			
Within Groups	10135.256	178	56.940	82.12*	3.92	0.000
Total	14868.194	179				

***= significant at 0.05 level of significance**

Table 4.2B above reveals that the calculated F-ratio is greater than the critical F-ratio at 0.05 level of significance (F_{-cal} 83.12 > F_{-tab} 3.92; df 1, 178 $p < 0.05$). This indicates that there is statistically significant difference between the mean achievement of the experimental group 1 (42.82) and the control group (32.57) at 0.05 level of significance. Therefore, hypothesis one was rejected.

4.3.2. Posttest Result for Gender of Experimental Group 1 and Control Group

Hypothesis Two ($H0_2$)

There is no significant difference in the mean achievement of students taught with developed models and those taught with lecture method irrespective of gender.

Table 4.3A: Means and Standard Deviations of the Posttest Mean Achievement Scores of Experimental Group 1 and the Control Group Irrespective of Gender

Variable	No in sample (N)	Mean (μ)	SD
Experimental Group 1 male	45	41.40	9.8174
Experimental Group 1 female	45	44.09	8.5409
Control group male	45	32.82	5.5033
Control group female	45	32.31	5.2259

Table 4.3A presents the mean and standard deviation of the male and female of both experimental group 1 and the control group. From the Table above, the following differences could be observed between the mean scores of the four groups - between experimental group 1 male (41.40) and control group male (32.82) and female (32.31) the mean differences are 8.58 and 9.09 respectively, between experimental group 1 female (44.09) and control group male (32.82) and female (32.31) the mean differences are 11.27 and 11.78 respectively. The result in Table 4.3A is further explained graphically as shown in appendix M, 4b

Table 4.3B: ANOVA Comparison of the Posttest Mean Achievement Scores of Experimental Group 1 and the Control Group Irrespective of Gender

Sources of variation	SS	Df	MS	F_{-cal}	F_{-tab}	Sign
Between Groups	4829.98	3	1609.99			

Within Groups	9984.67	176	56.73	28.379*	2.68	0.0001
Total	14814.64	179				

***significant at 0.05 level**

From Table 4.3B, the calculated F-ratio is greater than the critical F-ratio at 0.05 level of significance (F_{-cal} 28.38 > F_{-tab} 2.68 df; 3, 176; $p < 0.05$). This indicates that there is statistically, significant difference among the groups at 0.05 levels. Therefore, hypothesis two was rejected.

Since the ANOVA has indicated generally that there is significant difference among the groups, a follow up Scheffe's post hoc multiple comparison test was carried out to find out where the significant differences occur. Table 4.3C below shows the result of Scheffs's post hoc tests on the mean scores of the four groups.

Table 4.3C: Summary of Scheffe's Post Hoc Multiple Comparisons Table for Experimental Group 1 and the Control Group on the Posttest Irrespective of Gender

Variable (i)	Variable (j)	Mean diff	Sign level	Remarks
Expt 1 male	Expt 1 female	-2.69	0.45	Not Significant
Expt 1 male	Control group male	8.58	0.0001	Significant
Expt 1 male	Control group female	9.09	0.0001	Significant
Expt 1 female	Control group male	11.27	0.0001	Significant
Expt 1 female	Control group female	11.78	0.0001	Significant
Control gp male	Control group female	0.51	0.991	Not Significant

Key: mean of variable (i) minus mean of variable (j) equals to the mean diff.

From the summary of the Scheffe's post hoc test above on achievement of male and female students in both the experimental group 1 and the control group, it could be noted that there is statistically significant difference between the mean achievement of experimental group 1 male (Expt. 1 male) and control group male in favour of experimental group 1 male. Also there is significant difference between the mean achievement of experimental group 1 male and control group female in favour of experimental group 1 male. The test also indicates that there is significant difference between the mean achievement of experimental group 1 female (Expt. 1 Female) and control group male in favour of experimental group 1 female. Also that significant difference exists between the mean achievement of Experimental group 1 female and control group female in favour of Experimental group 1 female. Finally the test indicates that there is no significant difference between the mean achievement of male and female in the control group as well as between male and female in the experimental group 1.

4.3.3 Posttest Result for Ability Levels of Experimental Group 1 and Control Group

Hypothesis three (HO_3)

There is no significant difference in the mean achievement of students' base on their ability levels taught using developed models and those taught with lecture method.

Table 4.4A: Means and Standard Deviations of the Posttest Mean Achievement Scores of Experimental Group 1 and the Control Group based on their Ability Levels

Variable	No in sample (N)	Mean (μ)	SD
High Ability Expt Group 1	30	46.00	9.23
Average ability Expt Group 1	30	42.20	9.23
Low ability Expt Group 1	30	40.27	8.60

High ability control group	30	33.30	5.93
Average ability control group	30	32.00	4.73
Low ability control group	30	32.40	5.39

Table 4.4A presents the mean and standard deviation of the high, average and low ability level students of both experimental group 1 and the control group. From the Table above, mean differences could be observed between the mean scores of the high (46.00), average (42.20) and low (40.27) ability level students in experimental group 1 and their counterparts, the high (33.30), average (32.00) and low (32.40) ability levels in the control group. Between the high ability experimental group 1 and the high, average and low ability control group the mean differences are 12.70, 14.00 and 13.60 respectively. Between the average ability experimental group 1 and the high, average and low ability control group the mean differences are 8.90, 10.20 and 9.80, while

between the low ability experimental group 1 and the high, average and low ability control group the mean differences are 6.97, 8.27 and 7.87. This result is further explained graphically as shown in Appendix M, 4c.

Table 4.4B: ANOVA Comparison of the Posttest Mean Achievement Scores of Experimental Group1 and the Control Group based on their Ability Levels

Source of variation	S S	df	M S	F_{-cal}	F_{-tab}	Sign. Level
Between Groups	5270.028	5	1054.006			
Within Groups	9598.67	174	55.162	19.107*	2.29	0.0001

Total	14868.194	179

***= significant at 0.05 level**

The values in Table 4.4B shows that the calculated F-ratio is greater than the critical F-ratio at 0.05 level of significance (F_{-cal}19.11 > F_{-tab} 2.29; df 5,174; $p < 0.05$). This implies that based on the ability levels, there is significant difference between the mean achievement scores of students taught using developed models (experimental group 1) and those taught with lecture method (control group) at 0.05 levels. Therefore hypothesis three was rejected.

The Scheffe's post hoc multiples comparison test was conducted to locate the direction of this significant difference among the ability levels of experimental group 1 and control group. The result is shown in Table 4.4C. Table 4.4C shows that there is significant difference between the mean achievement scores of high ability level students in experimental group 1 (High ability Expt. 1) and all the three ability levels (high, average & low) students in control group (control gp.) in favour of the High ability Experimental group 1. Also there is significant difference between the mean achievement scores of average ability students in experimental group 1 (Average ability Expt. 1) and all the three ability levels (high, average and low ability) students in the control group in favour of Average ability experimental 1. Similarly, there is significant difference between the mean achievement score of low ability level students

Table 4.4C: Summary of Scheffe's Post Hoc Multiple Comparisons Table for Experimental Group 1 and the Control Group on the Post Test Based on their Ability Levels

Variable (i)	Variable (j)	Mean diff.	Sig. level	Remarks
High ability Expt.1	Average ability Expt.1	3.80	0.562	Ns
High ability Expt.1	Low ability Expt.1	5.73	0.118	Ns
High ability Expt.1	High ability control group	12.70	0.0001	Significant
High ability Expt.1	Low ability control group	13.60	0.000	Significant
Average ability Expt.1	Low ability Expt.1	1.93	0.961	Ns
Average ability Expt.1	High ability control group	8.90	0.0001	Significant
Average ability Expt.1	Average ability control gp	10.20	0.0001	Significant
Average ability Expt.1	Low ability control group	9.80	0.0001	Significant
Low ability Expt.1	High ability control group	6.97	0.025	Significant.
Low ability Expt.1	Average ability control gp	8.27	0.003	Significant.
Low ability Expt.1	Low ability control group	7.87	0.000	Significant.
High ability control gp	Average ability control gp	1.30	0.993	Ns
High ability control gp	Low ability control group	0.90	0.999	Ns
Average ability control gp.	Low ability control group	-0.40	1.00	Ns

Key: mean of variable (i) minus mean of variable (j) equals to the mean diff.

in experimental group 1 (Low ability Expt. 1) and all the three ability levels (high, average and low) students in the control group in favour of the Low ability experimental group 1. However, there is no significant difference between the mean achievement of students in the three ability levels in both experimental group 1 and control group.

4.3.4. Posttest Result for Experimental Group 2 and Control Group

Hypothesis four (HO_4)

There is no significant difference in the mean achievement of students taught using developed video DVD instructional package and those taught with lecture method.

Table 4.5A: Means and Standard Deviations of the Posttest Mean Achievement Scores of Experimental group 2 and the Control Group

Variable	No in sample (N)	Mean (μ)	SD
Experimental group 2	90	43.58	8.30
Control group	90	32.57	5.34

Table 4.5A shows the mean and standard deviations of the experimental group 2 and the control group. From the table above, a difference of 11.01 is observed between the mean scores of experimental group 2 (43.58) and the control group (32.57). The result in Table 4.5A is further explained clearly with graphical representation as in Appendix M 4d.

To find out if the difference between the two means is statistically significant, ANOVA comparison was carried out as shown in Table 4.5B.

Table 4.5B: ANOVA Comparison of the Posttest Mean Achievement Scores of Experimental Group 2 and the Control Group

Sources of variation	S S	Df	M S	F_{-cal}	F_{-tab}	Sign. Level
Between Groups	5456.006	1	54 56.006			
Within Groups	8664.056	178	48.674	112.09*	3.92	0.0001
Total	14120.061	179				

***significant at 0.05 levels of significance**

Table 4.5B indicates that the calculated F-ratio is greater than the critical F-ratio at 0.05 level of significance (F_{-cal} 112.09 > F_{-tab} 3.92; df 1,178; $p < 0.05$). This implies that there is significant difference between the mean achievement of students in the experimental group 2 and those in the control group at 0.05 levels of significance. Therefore, hypothesis four was rejected.

4.3.5. Posttest Result for Gender of Experimental Group 2 and Control Group

Hypothesis five (HO_5)

There is no significant difference in the mean achievement of students taught using developed video DVD instructional package and those taught with lecture method irrespective of gender.

Table 4.6A: Means and Standard Deviations of the Posttest mean Achievement Scores of Experimental Group 2 and the Control Group Irrespective of Gender

Variable	No in sample (N)	Mean (μ)	SD
Experimental Group 2 male	45	46.80	6.84
Experimental group 2 female	45	40.36	8.44
Control group male	45	32.82	5.50
Control group female	45	38.07	5.22

Table 4.6A presents the mean and standard deviation of the male and female of both experimental group 2 and the control group. From the table above, Mean differences could be observed between the mean scores of the experimental group 2 male (46.80) and female (40.36) and their counterparts in the control group, male (32.82) and female (38.07). Between experimental group 2 male and control group male and female the mean difference are 13.98 and 8.73 respectively, between experimental group 2 female and control group male and female the mean difference are 7.54 and 2.29. The above explanation is further illustrated graphically in Appendix M 4e.

To find out if the difference in the mean scores is statistically significant ANOVA comparison was carried out. The result is presented in Table 4.6B.

Table 4.6B: ANOVA Comparison of Mean Achievement Scores of Experimental Group 2 and the Control Group Irrespective of Gender

Sources of variable	SS	df	MS	F_{-cal}	F_{-tab}	Sign
Between Groups	6396.328	3	2132.109			
Within Groups	7723.733	176	43.885	48.58*	2.68	0.0001
Total	14120.061	179				

***=Significant at 0.05 level**

From Table 4.6B, the calculated F-ratio is greater than the critical F-ratio at 0.05 level of significance (F_{-cal} 48.58 > F_{-tab} 2.68; df 3, 176; $p < 0.05$ level). This shows that there is statistically significant difference in the mean achievement scores between male and female experimental group 2 and their counterpart in the control group at 0.05 level of significant. Therefore, hypothesis five was rejected.

A follow up Scheffe's post hoc multiple comparison test was conducted to locate the direction of the significant differences among the four treatment's mean achievement scores of the experimental group 2 and control group. The result is presented in Table 4.6C

Table 4.6C: Summary of the Scheffe's Post Hoc Multiple Comparisons of the Posttest Mean Achievement Scores of Experimental group 2 and the Control Group Irrespective of Gender

Variable (i)	Variable (j)	Mean diff.	Sign level	Remarks
Male Expt 2	Female Expt 2	6.44	0.0001	Sig.
Male Expt 2	Male control group	13.98	0.0001	Sig.
Male Expt 2	Female control Group	14.49	0.0001	Sig.
Female Expt 2	Male control Group	7.53	0.0001	Sig.
Female Expt 2	Female control Group	8.04	0.0001	Sig.
Male control Group	Female control Group	0.51	0.987	Ns

Key: mean of variable (i) minus mean of variable (j) equals to the mean diff.

Table 4.6C indicates that there is statistically significant difference in the post- test mean achievement scores of male and female in the experimental group 2 (Expt 2) that were taught with video DVD instructional package in favour of the male. Similarly, there is significant difference in the mean achievement scores of male Expt 2 and male control group in favour of male Expt 2. Also there is significant difference in the mean achievement scores of male Expt 2 and female control group in favour of male Expt 2. In the same vein, there is significant difference in the mean achievement scores of female Expt 2 and both male and female control groups in favour of female Expt 2.

4.3.6. Posttest Result for Ability Levels of Experimental Group 2 and Control Group

Hypothesis six (H_{O6})

There is no significant difference in the mean achievement of students' base on their ability levels taught using developed video DVD instructional package and those taught with lecture method.

Table 4:7A: Means and Standard Deviations of the Posttest Mean Achievement Scores of Experimental Group 2 and the Control Group based on their ability levels

Variable	No in sample (N)	Mean (μ)	SD
High ability expt group 2	30	44.37	7.97
Average ability expt Group 2	30	43.90	7.62
Low ability expt Group 2	30	42.47	9.36
High ability control Group	30	33.30	5.93
Average ability control group	30	32.00	4.73
Low ability control group	30	32.40	5.39

Table 4.7A presents the means and standard deviations of the high, average and low ability level students of both experimental group 2 and the control group. From the above Table, mean differences could be observed between the mean achievement score of the high, average and low ability levels in experimental group 2 (44.37, 43.90 and 42.47 respectively) and their counterparts in the control group (33.30, 32.00 and 32.40 respectively). Between the high ability experimental group 2 and the high, average and low ability control group the mean differences are 11.07, 12.37 and 11.97 respectively. Between the average ability experimental group 2 and the high, average and low ability control group the mean differences are 10.60, 11.90 and 11.50 respectively, while between the low ability experimental group 2 and the high, average and low ability control group the mean differences are 9.17, 10.47 and 10.07 respectively. This result is further explained graphically as shown in Appendix M, 4f.

To find out if the difference in the mean scores is statistically significant ANOVA comparison was carried out. The result is presented in Table 4.7B.

Table 4.7B: ANOVA Comparison of the Posttest Mean Achievement Scores of Experimental Group 2 and the Control Group based on their Ability Levels

Source of variation	SS	df	MS	F_{-cal}	F_{-tab}	Sig. Level
Between Groups	5541.428	5	1108.286			
Within Groups	8578.633	174	49.302	22.479*	2.29	0.0001
Total	14120.061	179				

***significant at 0.05 level**

Table 4.7B shows that the calculated F- ratio is greater than the critical F- ratio at 0.05 levels of significance (F_{-cal} 22.48 > F_{-tab} 2.29; df 5,174; $p < 0.05$). This indicates that based on the ability levels; there is significant difference between the mean achievement scores of experimental Group 2 and control group at 0.05 levels. Therefore hypothesis six was rejected.

A follow up Scheffe's post hoc multiple comparison Test in Table 4.7C was conducted to find the direction of the significant differences existing among the six treatment mean achievement scores of the experimental group 2 and control group. Table 4.7C reveals that there is significance difference between the mean achievement score of high ability experimental group 2 and the three ability levels (high, average and low) in the control group in favour of high ability Experimental group 2. That is, the high ability experimental group 2 students have greater mean achievement scores than any of the other three ability levels in the control group.

Similarly, there is significant difference between the mean achievement score of average ability experimental group 2 and the control group at the three ability levels (high, average and low) in favour of average ability experimental group 2. Furthermore, there is

Table 4.7C: Summary of Scheffe's Post Hoc Multiple Comparisons of the Posttest Mean Achievement Score of Experimental Group 2 and the Control Group based on their ability levels

VARIABLE (I)	VARIABLE (J)	MEAN DIFF	SIGN LEVEL	REMARKS
High Ability Expt gp 2	Average ability Exp gp 2	0.47	1.001	ns
High Ability Expt gp 2	Low ability Expt. Gp 2	1.90	0.954	ns
High Ability Expt gp 2	High ability Control gp	11.07	0.0001	Sig.
High Ability Expt gp 2	Average ability Control gp.	12.37	0.0001	Sig.
High Ability Expt gp 2	Low ability Control gp	11.97	0.0001	Sig.
Average ability Exp. gp 2	High Ability Control gp	10.60	0.0001	Sig.
Average ability Exp. gp 2	Average Ability control. Gp	11.90	0.0001	Sig.
Average ability Expt. gp 2	Low ability Control gp	11.50	0.0001	Sig.
Low ability Expt gp 2	High ability Control gp	9.17	0.0001	Sig.
Low ability Expt gp 2	Average ability control. Gp	10.47	0.0001	Sig.
Low Ability Expt gp 2	Low ability Control Group	10.07	0.0001	Sig.
High ability Control gp	Average ability control. Gp	1.30	0.991	ns
High ability Control gp	Low ability Control gp	0.90	0.999	ns
Average ability Control gp	Low ability Control gp	0.40	1.000	ns

Key: mean of variable (i) minus mean of variable (j) equals to the mean diff.

significant difference between the mean achievement score of low ability experimental group 2 and the three ability levels in the control group in favour of low ability experimental group 2.

4.3.7. Posttest Result for Achievement level of Experimental Group 1 and Experimental Group 2

Hypothesis Seven ($H0_7$)

There is no significant difference in the mean achievement of students taught using developed models and those taught with video DVD Instructional package.

Table 4.8A Means and Standard Deviations of the Posttest Mean Achievement Scores of Experimental Group 1 and the Experimental Group 2

Variable	No in Sample (N)	Mean (X)	SD
Experimental Group 1	90	42.82	9.24
Experimental Group 2	90	43.58	8.30

Table 4.8A shows the means and standard deviations of the students taught using models (experimental group 1) and those taught with video DVD instructional package (experimental group 2). The mean of the two groups are 42.82 and 43.58 respectively and their mean difference is 0.76. The result in Table 4.8A is further explained graphically in Appendix M 4g.

To find out if the difference between the mean achievement scores of experimental groups 1 and 2 is significant, ANOVA comparison was conducted as shown in Table 4.8B.

Table 4.8B: ANOVA Comparison of the Posttest Mean Achievement Scores of Experimental Group 1 and the Experimental Group 2

Sources of Variation	S S	Df	MS	F_{-cal}	F_{-tab}	Sign. level
Between Groups	25.689	1	25.689	0.33ns	3.92	0.564
Within Groups	13719.111	178	77.074			
Total	13744.800	179				

ns= Not Significant at 0.05level

From Table 4.8B the calculated F-ratio is less than the critical F-ratio at 0.05 level of significant (F_{-cal} 0.33 < F_{-tab} 3.92; df 1,179, P > 0.05). This implies that there is no significant difference in the Mean achievement of students taught with developed models and those taught with Video DVD instructional package at 0.05 levels. Therefore hypotheses seven was not rejected.

4.4 Summary of Findings of the Study

The findings of this study are summarized as follows:-

1. There was statistically significant difference in the mean achievement between the students taught selected biology concepts using the developed models and those taught using lecture method. The students taught using developed models achieved significantly better than their counterpart taught using lecture method.
2. There was statistically significant difference in the mean achievement between the male and female students taught using developed models and those taught using lecture method. The male students taught using models achieved significantly better than both male and female students taught using lecture method. In the same vein, the female

students taught using developed models achieved sufficiently better than their male and female counterparts taught using lecture method.

3. There was statistically significant difference between the mean achievement of students taught using developed models and those taught with lecture method based on their ability levels. High, average and low ability level students taught using developed models achieved significantly better than their counterparts taught with lecture method.

4. There was statistically significant difference in the mean achievement between the students taught the selected biology concepts using developed video DVD instructional package and those taught with lecture method. The students taught using Video DVD package achieved significantly better than their counterpart taught using lecture method.

5. There was statistically significant difference in the mean achievement between the male and female students taught using video DVD instructional package and their counterpart taught with lecture method. Male students taught using video DVD instructional package achieved significantly better than both male and female taught using lecture. Also the female students taught using video DVD instructional package achieved significantly better than both the female and male students taught with lecture method.

6. There was statistically significant difference between the mean achievement of students taught using developed video DVD instructional package and those taught with lecture method based on their ability levels. Students in the three categories of ability levels taught using video DVD package achieved significantly better than all the students in the three ability levels taught with lecture method.

7. There was statistically no significant difference in the mean achievement between the students taught the selected biology concepts using developed models and those taught using developed video DVD instructional package.

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATION

5.1 Introduction

The purpose of this study was to investigate the effects of improvised instructional media on secondary school students' achievement in biology concepts in Niger State. This chapter presents discussions, conclusion, recommendations and suggestions for further study.

5.2 Discussion of Results

In this section, the discussion of the results obtained from the data analysis is presented. The discussion is based on the research questions and the corresponding hypotheses. The result of the data analyzed showed that the experimental group 1 students taught with developed models with mean achievement of (42.82) achieved higher than the control group taught with lecture method with mean achievement of (32.57). This implies that there was a difference in the mean achievement of students taught using developed models and those taught with lecture method. This fact is manifested in table 4.2A and is relevant to research question 1. The outcome of testing the corresponding hypothesis 1 as presented in Table 4.2B further revealed that the difference between the mean achievements of the experimental group 1 and the control group was statistically significant. Thus hypothesis 1 was rejected. This means that the developed models have an enhancing effect on the teaching and learning of biology than lecture method.

The significant achievement of the students taught with the developed models over those taught with lecture method could be explained by the fact that Learning through visual resources is the key to acquisition of knowledge. When a student is instructed verbally there is the tendency to forget. Knowledge that is visualized aids remembrance. Media materials

(Models) have the potentials to evoke the involvement of as many sense organs as possible in the teaching and learning process. This stimulates the learners to receive and process all the necessary information thereby enhancing achievement. Also the use of the models introduces variety into the learning process and enables the teacher to convey meaningful information to the learners. Variety is the spice of life. Seeing and doing the same thing over and over again may lead to boredom. This can be true of teaching and learning, the interest of students in learning may diminish resulting in low achievement as in the case of the control group if instruction is only by "chalking and talking". The students' interest is stimulated, aroused and sustained for meaningful learning to take place when teaching is enriched with instructional materials such as models.

This result agrees with the previous findings of Umeoduagu (2000) Obodozie (2002), and Mohammed (2004). They found that the use of models in teaching enhanced students' academic achievement in Science and non science subjects. Kareem (2003) asserted that all teaching and learning is greatly improved by the use of visual media because they can make the learning experience memorable. He added that when models are intelligently used, they promote the most effective kind of learning in adults as well as children. It can therefore be emphatically said here that the use of improvised models enhanced the teaching and learning of biology in secondary schools resulting in higher achievement by the learners.

The findings on the effects of developed models on students' mean achievement irrespective of gender as sought by research question two indicated that male and female students taught with developed models had higher mean achievements (41.40 and 44.04 respectively) than their counterparts taught with lecture method (32.82 and 32.31 respectively), see Table 4.3A. This implies that there was a difference between the mean achievements of students taught using developed models and those taught with lecture method irrespective of gender. The result of testing hypothesis two as contained in ANOVA Table

4.3B proved that there was significant difference between the mean achievements of students taught using developed models and those taught with lecture method irrespective of gender. Hypothesis two was therefore rejected. Scheffe's post hoc multiple comparison tests in table 4.3C made it clear that the male students taught using developed models achieved significantly higher than both the male and female students taught with lecture method. Also the female students taught using developed models achieved significantly higher than both male and female students taught with lecture methods. It could be noted also from the Scheffe's test that although the male and female students taught using developed models have different mean achievements, the difference was statistically not significant. These findings indicated that the developed models have an enhancing effect on the teaching and learning of biology concepts of circulation and execration and were gender friendly.

The enhancing effects of the developed models on the mean achievement of experimental group 1 students over the control group irrespective of gender could be explained from psychological point of view. According to the Gestalt psychologists, perception is the foundation of learning irrespective of gender, age or race. Thus learning comes as a result of insight and perceptual organization. In the teaching and learning of any concept, better and clearer perception and insight occur when the instructional process is enriched with instructional media. This implies that the clearer the perception of an object, topic or concept, the better it can be understood and remembered by both sexes. An assessment of the nature and the roles the developed models played in teaching and learning of the selected biology concepts reveals that the models stand to satisfy the demands of Gestalt's theories of learning for enhanced learning outcome. The models provided the insight and better perception of the concepts taught irrespective of gender. The psychological implications of the above view is that science subjects especially biology cannot be properly taught without the use of instructional media.

The findings of the study agreed with the earlier findings of Essien (2001), Obodozie (2002), and Abdullahi (2003). They opined that models promote the learners perception, understanding, transfer and retention of learnt materials in male and female better than conventional method. However the finding is in disparity with the findings of Mohammed (2004) who came out with the findings that there was significant difference in the performance of male and female students taught physical Education with improvised radio (Model).

The findings on the effects of developed models on students' mean achievement based on their ability level as sought by research question three indicated that high, average and low ability students taught with developed models (experimental group 1) had higher mean achievements (46.00, 42.20 and 40.27) respectively than their counterparts taught with lecture method (control group) with mean achievement (33.30, 32.00 and 32.40) respectively. See Table 4.4A. Based on their ability level, this implies that there was a difference in the mean achievements of students taught using developed models and those taught with lecture method. The result of testing hypothesis three as contained in ANOVA Table 4.4B proved that there was significant difference between the mean achievements of three ability level students in the experimental and control groups. Hypothesis three was therefore rejected. Scheffe's post hoc multiple comparison tests in table 4.4c revealed further that each of the three ability-level students (high, average and low) taught with the developed models achieved significantly higher than the high, average and low ability students taught with lecture method. The Scheffe post hoc tests also indicates that there was no significant difference in the mean achievement of high, average and low ability students taught with developed models.

From these results, it could be deduced that the developed models enhanced the academic achievement of students more than the lecture method irrespective of the ability levels. This finding could be explained based on the view of the Gestalt psychologists that meaningfulness; completeness, relative simplicity and good pattern usually characterize any teaching and learning process which is enriched with instructional media materials. Thus the use of the developed models provided a favourable learning atmosphere for the learners irrespective of ability levels. The models are effective owing to their ability to bridge the gap in understanding of concepts and the consequent disparity in achievement of students in high, average and low ability levels. These findings are in line with the earlier findings of Okobi (1994) and Lagoke et al (1999). They maintained that inclusion of improved strategy for teaching biology was helpful to all ability levels of students than lecture method. However, the finding of this study is in disagreement with the findings of Aiyedun (1995), Inyang and Ekpeyong (2000). They found significant difference in the mean posttest scores among the students of different ability levels.

The result of data analysis with reference to research question 4 as shown in Table 4.5A indicated that the students taught using developed video DVD instructional package (experimental group 2) with mean achievement of (43.58) achieved higher than those taught with lecture method (control group) with mean achievement of (32.57). This implies that there was a difference in the mean achievement of experimental group 2 students and the control group. The outcome of testing the corresponding hypothesis 4 as presented in ANOVA comparison Table 4.5B further revealed that the difference between the mean achievements of the experimental group 2 and the control group was statistically significant. Thus hypothesis 2 was rejected. From this result, it could be inferred that video DVD instructional package has an enhancing effect on the teaching and learning of biology than lecture method.

The significant achievement of the students taught with the developed video DVD instructional package over those taught with lecture method could be explained by the fact that experimental group 2 participated in the lesson by making use of their senses. They listened to the teacher's voice as she spoke with them; they used their eyes to watch the video and they touched the video materials by way of participation in the lesson. In this way, video instruction stimulates thinking, summarizes, demonstrates and concretizes knowledge that could otherwise only be talked about in abstract terms, thereby culminating in enhanced academic achievements. The significant difference supports the fact that learning through audiovisuals such as video DVD used in this study is a vital key to assimilation of knowledge. When instructions are heard and visualized, they seek to arouse interest, clarify concepts, modify attitude and possess the capacity to enhance quality learning. Finally the knowledge is easily registered in the individual memory bank.

The above result is in agreement with previous findings of Ajayi and Salami (1999), Ayagu (2000), Nneji (2000), Amamize (2001) and Adekunle (2005). They found that the use of video package in teaching and learning makes learning interesting and motivating to students.

The findings on the effects of developed video DVD instructional package on the mean achievement of students taught with developed video DVD instructional package and those taught with lecture method irrespective of gender as sought by research question 5 indicated that male and female students taught with developed video DVD instructional package (experimental group 2) had higher mean achievements (46.80 and 40.36 respectively) than their counterparts taught with lecture method (control group) (32.82 and 38.07 respectively) see Table 4.6A. This implies that there was a difference in their mean achievements. The result of testing the corresponding hypothesis 5 as contained in ANOVA Table 4.6B proved that there was significant difference between the mean achievements of male and female students in experimental group 2 and their counterparts in the control group. Hypothesis 5 was therefore rejected. Scheffe's post hoc multiple comparison tests in table 4.6C made it clear that the male students taught using developed video DVD instructional package achieved significantly higher than both the male and female students taught with lecture method. Also the female students taught using developed models achieved significantly higher than both male and female students taught with lecture methods.

From these results, it could be inferred that using instructional video DVD package has an enhancing effect on the teaching and learning of the selected biology concepts irrespective of gender. This point is made clear from the fact that video DVD instructional packages have the potentials to concretize learning through a playback mechanism. It could be played, rewound, fast-forwarded and replayed by the learner for discussions and questions on difficult concepts. Also where audiovisual medium like video DVD package is used, learning environment is highly stimulating and the students motivated to take a greater interest in learning. This applies to students of all sexes and accounts for why male and female experimental group 2 students achieved significantly higher than their counterparts in the control group.

The result also revealed that male experimental group 2 students achieved significantly higher than their female counterpart. These observations could be explained from the fact that male students have the natural inclination to watch several programs (football, films and others) with understanding and interest on the television than the females. These tendencies might have equipped them with the ability to concentrate, follow trend and understand the scripts with ease. While the female counterpart will need to go through the scripts several times in order to meet up with their male counterpart. This implies that it was not sex that affected the students achievement but their attitude to the use of electronics.

The findings above support the findings of Nneji (2000) and Amamize (2001). They clarified that video instruction serves as a spring board for further learning and that the flexibility of video package makes it an effective learning tool. The result of this study is also in agreement with the previous research findings of Mohammed (2000), Awoniyi (2000), Mohammed (2004) and Olumba (2007). They came out with the finding that the use of electronic media enhanced the performance of male students' more than females. They found that gender does not have positive affect on the performance of students.

The findings on the effects of developed video DVD instructional package on students' mean achievement based on their ability level as sought by research question 6 indicated that high, average and low ability students taught with developed video DVD instructional package (experimental group 2) had higher mean achievements (44.37, 42.20 and 40.27 respectively) than their counterparts taught with lecture method (control group) with mean achievements (33.30, 32.00 and 32.40 respectively) see Table 4.7A. This implies that there was a difference between the mean achievements of the three ability level students in the experimental group 2 and their counterparts in the control group. The result of testing corresponding hypothesis 6 as contained in ANOVA Table 4.7B indicated that there was significant difference between the mean achievements of students based on their ability levels taught with video DVD instructional package and those taught with lecture method. Hypothesis 6 was therefore rejected. Scheffe's post hoc multiple comparison tests in table 4.7C revealed further that each of the three ability levels students (high, average and low) taught with the developed video DVD instructional package achieved significantly higher than their counterparts taught with lecture method. Scheffe's test also indicates that there was no significant difference in the mean achievement of high, average and low ability students taught with developed video DVD instructional package.

The enhancing effects of video DVD package on students' achievement could be explained from the fact that optimum performance in the teaching and learning of any task would occur only when instructional media such as video package is employed in teaching. The use of this media would have motivated, stimulated, captured the interest of the students irrespective of ability levels and spurred curiosity and eagerness among them to learn and remember what is learnt. This culminated in enhanced performance.

The above result is in agreement with pervious findings of Ajayi and Salami (1999), Nneji (2000) and Adekunle (2005). They found that the use of video package in teaching science subjects enhanced students' academic achievement irrespective of ability levels. They also affirmed that video package is effective owning to its ability to captivate and hold attention.

The result of data analysis with reference to research question 7 as shown in Table 4.8A indicated that the students taught using developed models (experimental group 1) with mean achievement of (42.82) achieved slightly lower than those taught with developed video DVD instructional package (experimental group 2) with mean achievement of (43.58). The outcome of testing the corresponding hypothesis 7 as presented in ANOVA comparison Table 4.8B revealed that the difference between the mean achievements of experimental group 1 and experimental group 2 was statistically not significant. Thus hypothesis 7 was not rejected.

Thus far, it seems logical to infer that both the developed models and video DV instructional package were equally effective in enhancing the teaching and learning of the selected biology concepts. The effectiveness of these media materials lies on the fact that instructional media reduce abstractions in the class lesson, reduce boredom among students and teachers, and restructure the learning environment. In addition, they make learning interesting and motivating to students, thereby promoting students' participation in the lesson. Most instructional media evoke the involvement of as many sense organs as possible which stimulate students to receive and process all the necessary information for the development of cognitive, affective and psychomotor skills.

The findings of the study confirmed the stand of Adewoyin (1991), Ayogu (2000), Umeoduagu (2000) and Amamize (2001). They pointed out that instructional media (models, video package and others) as an integral part of the instructional process enhance the delivery of educational information very quickly, widely and effectively. They added that instructional media enables the teacher to process instruction, enhance its presentation, supervision and management. These and many other views may account for why the developed model and video DVD instructional package both enhanced academic achievement of students equally.

5.3 Contributions to Knowledge

This study has contributed to knowledge in the following ways:-

1. The successful improvisation and use of the models and video DVD instructional package is a major contribution of this study to knowledge. Most teachers in secondary schools still teach without instructional media whenever there is lack or absence of instructional media. The result of this study will go a long way in reawakening the consciousness of such teachers to the fact that they could successfully improvise needed instructional media for improved achievement.
2. The instructional media, that is, models and video DVD instructional package improvised and used by the researcher in this study could be used by any biology teacher or student anywhere to teach or learn biology concepts of circulation and excretion.
3. The study has contributed to the existing scholarly literature and provided additional knowledge and information on how to produce models and video DVD instructional package. Any teacher, anywhere can follow the trend in these productions and produce other relevant instructional media.
4. The models and video DVD instructional package improvised and used have contributed in addressing the problematic issues of gender and ability levels' effects on students' academic. They bridged the gap in the achievement of students in respect of ability levels completely and gender partially.

5.4 Implications of the Findings to Science and Technology Education

The results of this study revealed that the use of models and video DVD package to teach biology concepts of circulation and excretion had not only enhanced students' achievement but also bridged the gender and ability gap among them.

1. This implies that the use of instructional media should be encouraged in the science classroom for biology instruction specifically and other science subjects in general. To achieve this, efforts should be geared towards equipping teachers with necessary improvisation skills so that they could design instructional materials using local materials or resources from the local environment to facilitate instruction whenever there is a lack or shortage. In the absence of this, the problem of poor performance will continue to pervade the educational system.

2 Either models or video DVD package can be used by the teachers since both of them are equally effective in enhancing academic achievement of students irrespective of gender and ability levels. This implies that disparity in gender and ability levels is minimized with instructional media.

3 The low performance of the control group is an indication that if nothing is done to improve the teaching and learning process in schools the poor performance which is a national problem will remain and continue to be part of the system.

5.5 Limitation of the Study

The limitation to this study includes:

1 Many schools in the rural area are not connected by the Power Holding Company of Nigeria (PHCN) and so the use of alternate current for the video DVD was not possible. This implied that generator was carried from one school to another and distractions from the noise of generator during the research experiment may have had effects on the

motivation and interest of the students and consequently the research results to some negligible extent.

5.6 Conclusion

Based on the findings of this research, the following conclusions are drawn.

1. The use of improvised models and video DVD package had great positive impact on students' academic achievement irrespective of gender and ability levels. Thus the use of instructional media should be seen as a 'sine qua non' in the teaching and learning of science particularly Biology subject in schools.

2. Improvised biological models and video DVD package have been put to test and proved to be effective. Consequently, it is concluded that all the stake holders in education should embrace the act of improvisation of instructional media in Nigeria schools as a way forward towards solving the problems of inadequate or lack of instructional materials in schools.
3. The use of lecture method in teaching should be greatly minimized in the teaching and learning process especially in the sciences. This is because the students' achievement scores when taught with lecture method were very low as compared to that of others taught with media materials.

5.7 Recommendation

The following are the recommendations made based on the findings of this study.

1. The use of improvised instructional media should be encouraged in the absence of imported prototypes. It is recommended that mass improvisation of instructional media be embarked upon by the Government and private enterprises. Teachers also at their own level should not fail to improvise as much as they could. This is because

the economics of education is generally economics of scarcity. Therefore, no matter how generous and rich the government might be, they are generally not in position to provide the schools with all the instructional media they need.

2. A Library of video package in different subject areas should be kept in schools so that both teachers and students can borrow them for use as and when needed to do their work.

3. Qualified teachers who are already in the field and are not knowledgeable in the act of production and use of various instructional media should be re-trained through seminars, workshops, conferences and in-service programmes. The teachers who are still on training in various teacher training institutions should be exposed to educational technology courses to equip them with skills needed to face the challenges of inadequate or lack of instructional media prevalent in Nigerian schools.

4. Improvised models or video packages should be used by teachers in biology instruction since both of them are equally effective in enhancing academic achievement of students irrespective of gender and ability levels.

5. The school management should in collaboration with Parent-Teachers Associations of their school endeavour to provide (since there is no other choice) an alternate power supply, which is the generator. This is necessitated by the epileptic nature of the PHCN and to provide enabling environment for the smooth use of electronic media in the teaching and learning process.

6 The use of lecture method alone in teaching biology should completely be minimized and if possible discouraged in schools.

5.8 Suggestions for further Research

1. This study should be replicated in other states or locations to find out if the same or similar results could be obtained for better generalization of findings.
2. The sample of this study was taken from only government owned schools. Similar studies may compare private schools to find out if the result will be the same irrespective of school type.
3. Researchers in educational media and related fields should conduct similar studies in the primary and tertiary levels of education using other concepts in biology.
4. Research could be conducted using models with animation and sound application software in order to develop a new method of instructional delivery for effective teaching of biology subject in schools.

REFERENCES

Abdullahi, M.H. (2003). Factors affecting the use of instructional materials in Technical Schools in Niger State. An unpublished M.Tech. Education Thesis Of Federal University of Technology (F U T) Minna.

Abdullahi, N .Y. (2001). *Introduction to Educational Technology: A Handbook.* Minna: College of Education Publication.

Abdussalami, A. S. (2008). *Research Methods in Education.* Ibadan: Stirling-Horden Publishers (Nig) Ltd.

Abilu, R. A. (2005). Factors Militating against Students with Visual Impairment Participation and Success in Science Education. Unpublished M.Ed Thesis. University of Ibadan.

Abimbade A. (1997). *Principles and Practice of Educational Technology*. Ibadan: International Publishers.

Adebayo, O. A. (1997). Gender Environment and Co-education as factor of Performance in the Ravens standard progression matrices. *Gombe Technical Education Journal (GOTEJ)*. 1(1),12-15.

Adebimpe, A. O. (1997). Improvisation of Science Teaching Resources. In A. O. Olarewaju, (Ed.) 43rd STAN Proceedings of Ajumojobia Memorial Conference, 51 – 66.

Adebiyi, T.U. (1998). Construction of Models of Monocot and Dycot stem for Biology Instruction in Secondary Schools. B.Tech Education project. F.U.T. Minna.

Adebute, E. O. (1991). The Effects of the use of Videotape Recorder on Students' Performance in Selected Skills in Technical Education. An unpublished PhD Thesis, Faculty of Education University of Ilorin, Ilorin

Adekola, Y.A. (1997). The role of improvisation as a means of improving Teacher Education and Technology Education in Nigeria 40th Anniversary Conference Proceeding of STAN, Kana. 153-154.

Adekunle, O. (2005). *Information and Communication Media in Education and Health sciences.* Lagos: Divine Media and Communications.

Adelakun, S. A .(2003). Issues in Science Education for the Visually Impaired. In W. O. Fatokun, O. A., Adebimpe, OK Omoniyi, T. Ajoblene (Eds). *Science and Technology in Special Education.* Oyo: Tobistic Printing and Publishing Ventures.

Adelu, A.F. (1984). Communication Technology for Education in Nigeria: Problems and Prospect. A Seminar presented on march, 15 at the Osun State College of Education, Ilesha, in March.

Adeniran, A.A. (2002). New Trend in Access to Information Communication Technology. Its implication to the Content of Africa. STAN Proceedings and inaugural conference of CASTME Africa. 89-94.

Adewoyin, J. A. (1991). *Introduction to Educational Technology.* Lagos: Jon – lad Publishers Ltd.

Adewunmi, J.A. (1992). *Key to success in Nigeria Public Examinations*. Ilorin: All Publishers.

AECT (1999). *Educational Technology*: A glossary of terms, Washington D.C.

Agommuoh P. C. and Nzewi U. M. (2003). Effects of Videotape Instruction on Secondary School students Achievement in Physics. Journal of STAN. 38 (1&2), 88-93.

Aguele, L.J. (2000). Improvisation and effective teaching of Mathematics in a recessing economy. 40th anniversary conference proceedings of STAN. Kano. 231-233.

Agun, I. and Imogie I. (1988). Educational Technology. An overview. In I.Agun and Imogie (Eds). *Fundamentals of Educational Technology.* Ibadan. Y Books. 13.

Aiyedun, J. O. (1995). Influence of Academic Ability of Students on Achievement in Secondary school Mathematics. *Ilorin journal of Education.* 1(5), 93-102.

Ajayi, D. O. (1998). Community Science: Implication for Science Teachers. STAN 39th Annual Conference Proceeding. 110-115.

Ajayi-D. Y. and Talabi, J. K. (1985). Effects of Videotape Recording on micro Teaching Training Technique for Education Students. Journal of Educational Television. 2(3), 207-210.

Ajelabi, J.T. (2000). *Production and Utilization of Educational media.* Lagos: Raytel Communication.

Akanbi, K. (1988). “Systems Approach in Educational Technology” Proceedings of National Symposium on Problems and Prospects of Educational Technology In Nigeria. H. E. B. Nigeria Ltd. 60-68.

Akanbi, K. (1993). Educational Technology in Teaching Practice. In K. Akanbi, B. Adekomi and L. Adeyanju (Eds.). *Educational Technology in Methodology of Teaching Humanities*. Ondo: Ife Oluwa Press. (14-31).

Akinmoyewa, J.O. (1992). Improvisation and the effective teaching of Technology. A paper presented at the 6th Annual Conference of Technology writers Association of Nigeria at Ibadan.

Akinmoyewa, J.O. and Delu, A.F. (1994). *Instructional Technology for Teachers.* Ilesha: Olayode Press.

Akinrorohum, O.F. (2000). Assessing the Use of Improvisation in Introductory Technology Teaching At Junior Secondary Schools in Ekiti State. 41st Annual Conference Proceeding of STAN. 399-401.

Akinsola, A.T. (2000). An Investigation into the Science Teachers self conceived ability to improvise materials for the teaching of primary science. *Ilorin Journal of Science Education*. 2 (1), 8-12.

Akudolu, L. R. (2002). Information and Communication Technology (ICT) Centered Education: A necessity for national development. *Nigeria Journal of Computer Literacy (NJCL)*. 3(1), 12-15.

Amamize, B.N. (2001). Nigeria Education Review. *Journal of the School of Education, Adeniran Ogunsanya College of Education.* 6(1), 197-199.

Ameh, C. O. and Gunstone, H. (1996). The understanding of selected concepts among Nigerian secondary school science Teachers. *Journal of STAN*. 27(2), 30-36.

Araromi, M. A. (1998). Effects of Visual Imagery Instruction on Achieving in Language with Particular Reference to French in Nigeria. *Nigeria Journal of Curriculum Studies.* 74(21), 110-115.

Awoniyi, A.S. (2000). Sex difference in an academic performance. *Nigeria Journal of Gender and Development. 1(82), 18.*

Ayogu, Z.U. (2000). Enriching Science, Technology and Mathematics Education: The Role of New Media. *Journal of Science Teachers Association of Nigeria.* 10(5), 18-20.

Balogun, F. (2000). Gender and Performance in Productive and Receptive skills of first year secretarial students at Auchi Polytechnic, Auchi Edo State. *Nigeria journal of Gender and Development.* 1(1&2), 78-80.

Balogun ,T.A. (1980). Educational Technology and Behavior Change. In Ogunranti, A. (Ed). *Problems and prospect of Educational Technology in Nigeria*. Ibadan: Heinemann Educational Books Nigeria Ltd.

Balogun, T.A. (1994). Gender Issues in the teaching of Science, Technology and Mathematics. In S. Y. Erinosho (Ed). *Perspective on Women in Science and Technology in Nigeria.* Ibadan: Sam Bookman Education and Communication Services.

Bassey, M. P. (2002). Availability of resources for the Teaching of Science Subject in Public Secondary School. A Case Study of some selected Secondary School in Alimosho Local Government Area of Lagos State.

Unpublished M.Ed Project. University of Lagos.

Best, J. W. and Kahn, J. V. (1992). *Research in Education.* New Jessy: Prentice Hall International Inc.

Boateng, B.L. (1986). Low organized Games. Zaria: PHE Department ABU.

Chapin, J.R. and Messiele, R.G. (1992). *Elementary Social Studies: A practical guide*. New York; Longman Publishers.

Clark, R.F. (1983). Considering Research on learning from media. *Review of Educational Research*. 53(4), 445-459.

Cobb, T.C. (1997). Cognitive Efficiency: Towards the Revised Theory of Media. *Educational Technology, Research and Development*. 45(4), 117-120.

Dada, S. A. (1984). The National Education Technology Center, Kaduna and the Development of Educational Technology in Nigeria.Nigeria Audiovisual Journal. 1 (3) 208-222.

Danjuma, I. M, Abdullahi, A. L, and Gero, M. S. (1997). A Study of some Factors Affecting Chemistry Teachers' Attitude towards Improvisation in Chemistry Teaching. 40th anniversary conference proceeding of STAN 164-168.

Daramola, S. O. (1995). Statistics in Research. In S. A Jimoh (Ed.), Research Methodology in Education: An Interdisplinary Approach. Ilorin: Library and Publication Committee.

Dareng, M.K and Timku, L. (1997). Improvisation in Mathematics. Proceedings of Ajumogobia Memorial Conference of STAN 234-237.

Debes, J. (1978). Cultural Symbolism, visual literacy and intellectual equality. *Educational Media International* (Emi) 1, 3-4.

Davies, I. (1978). Prologue: Educational Technology. Architypes, Paradigms and Models. In Herley, J. & Davies, I. (Eds.) *Contributions to an Educational Technology.* London, Kogan Press.

Dike, H. I. (1999). *A book of Educational Technology.* Port Harcourt: Cap 11 C. Publishers.

Dopemu, Y.A. (1988). Production of instructional Media. In I. Agun, and I. Imogu (Eds.) *Fundamentals of Educational Technology*. Ibadan; Y-Books Press.

Encyclopedia of Education (1969). Macmillan and Free Press. 9, 230-235

Erinosho, S.Y. (1998). Gender discrimination in Science Education in Nigeria: which way forward. Proceeding of Seminar supported by FAWE Nairobi, Kenya. November, 10th.

Essien, E. (2001). Dynamics of International Technology and Management. A paper presented at NAEMT 23rd Annual Conference Proceeding 125-128.

Ewusie, A. (1980). *Biology for O' level and Senior Certificate*. Lagos: Africa University Press.

Eyetsemitan P.E. (2004). Improvisation in the teaching of primary science. 41st Annual Conference Proceedings of STAN. 342-344.

Ezekannaya, G. N. and Ikeagu, C. N. (2004). Constraints on STM Research Effectiveness in Nigeria.Proceedings of the 45th Annual Conference Of STAN. 85-88.

Ezeudu, F. O. (2000). The use of Local Material in the Teaching of Chemistry. 41st Annual Conference Proceeding of STAN. 163 – 165.

Federal Republic of Nigeria (2004). National Policy on Education (4th Edition). Lagos: NERDC Press.

Foin, W. (2001). The Effect of Class size on Student's Academic Achievement in Secondary School Mathematics. *International Journal of research in Science Education.* 1(1), 31 – 34.

Fajola, O.O. (1992). Improvisation of material for Science Education in Nigerian Schools. A paper presented at the workshop on improvisation at Science equipment center, Lagos. November, 8th.

Franzer, B.J. Okebukola, P.A, and Jegede, O.J. (1992). Assessment of the learning environment of Nigerian Science Laboratory Classes. *Journal of Science Teachers' Association of Nigeria*. 27(2), 98-101.

FreeHealth Encyclopedia (2007). Excretory System. Retrieved June 16th, 2009, from http://www.doe.k12.ms.us/biology/anatomy/urinary.html

Gana, E.N. (2006). The use of instructional videotape in the learning of some geographical concepts (Map Reading) in Senior Secondary Schools in Minna. Unpublished M. Tech Education Thesis, Federal University of Technoligy, Minna.

Gbodi, E.B. (1998). The Relative Effectiveness of three levels of Visual Mnenaonics on SSS students' achievement and attitude in practical Geography. An unpublished PhD thesis, Faculty of Education University of Ibadan, Ibadan.

Guilford, T. P. (1967). *The nature of Human Intelligence*. New York; McGraw Hill.

Gusen, J. (2001). The information and Educational Technology in Nigeria. A Challenge for the Classroom Teacher. Paper Presented at the Maiden National Conference of College of Education Academic Staff Union, Federal College of Education, Pankshin. June, 11th.

Hahm, M. (2003). Media Skills of School Librarian to the New Subject Information and Media in Schools and the Implications to all Librarians. Instrument as a Positive Reference Service 64th IFCA General Conference.

Hoban, C.F. (1965). From theory to Policy decision. Audio Visual Communication. *Review*. 13 (2), 50-54.

Hollifield, J. (1987). Ability grouping in Elementary schools. Eric Digest. (073) http://ericae. Net/edo/ED 2905542.htm. Retrieved, 2/17/2004.

Hornby, A.S. and Cowie, A.P (Eds) (1985). *Oxford Advanced Learner's Dictionary* of *current English*, London: Oxford Press.

Ibe, E. (2004). Effects of Guided- Inquiry and Demonstration on Science Process Skills Acquisition among Biology Secondary school Students. Unpublished M. ED. Thesis University of Nigeria, Nsukka.

Ibitoye, S.J. (1998). Gender Differences and Achievement in Secondary School Agricultural Science in Kwara State. *The Nigeria Teacher Today*. 6 (1), 52-56.

Ibrahim, M. (2004). The Design and construction of Aquarium Tank for teaching of Biology in Secondary Schools B.Tech Education project. F.U.T. Minna.

Inyang, N.E.U (1997). Local Materials in Science, Technology and Mathematics (STM) Teaching. Identification and Utilization. 40th Annual Conference Proceeding of STAN 163-165.

Inyang, N.E.U. and Ekpeyong, H.E. (2000). Influence of ability and gender grouping in Senior Secondary School Chemistry Student's achievement on the concept of redox reaction. *Journal of STAN*. 35 (1&2), 30-40.

Iwuozor, C. (2000). Enriching Science Education through improvisation. 41st Annual Conference Proceeding of STAN, 45.

Jimoh, A.T. (1992). Influence of Teachers and School variables on students' level of Achievement in O-level chemistry. An Unpublished M.ED thesis; University of Ilorin. Nigeria

Kareem, L. O. (2003). Effects of audio – graphic self instructional packages on Senior secondary school students' performance in biology in Ilorin, Nigeria. Unpublished Ph.D Thesis, Faculty of Educatin, University of Ilorin, Ilorin.

Kerlinger, F. N. (1973). *Foundations of Behavioural Research*. London: Rinchart And Winston.

Kutigi, A. U. (2006). Relative effectiveness of Audio tape and computer Instructional package on the teaching of oral English at Senior Schools in

Minna. Unpublished M.Tech Education Thesis. Federal University of Technology, Minna.

Lagoke, B. A. ,Oyebanmiji, P. K. and Jegede, O. I. (1999). The efficacy of enriching Biology teaching with analogy on the performance of students of different achievements level. *The Nigeria Today.* 7(1), 39-40

Lumsdaine, A.A. (1964). Educational Technology; programmed learning and instructional Science. In Hilgard (Ed.). *Theories of learning and instruction* (20-24), Chicago; National Society for the study of Education.

Madu, B. C. (2004). Effects of a constructivist- Based Instructional Model on Students' Conceptual change and Retention in Physics. Unpublished Ph.D Dissertation, Faculty of Education, University of Nigeria. Nsukka.

Maduabum, M.A. (1983). Declining in structive students' enrolment in basic science in our institution of higher learning: problem and prospects. Annual April publication by the Science Education Students, UNN.

Maduabum, M.A. (1989). *Teaching Integrated Science effectively*. Onitsha. Space Matric Publishers.

Maduabum, M. A. (1990). Effective Science teaching through the use of local Materials: A way out. A Paper Presented at the International Symposium on improvisation held at ABU Zaria 1990.

Maduabum, M.A. (1996). Improvisation and sourcing of Local materials for effective STM Teaching and Evaluation in contemporary Nigeria. Onitsha: Kmensuo Educational Publishers.

Mallum, J.O. and Haggai, M.P. (2000). *Educational Psychology: Classroom Practice.* Jos: Deka Publications.

Manrique, F. (1998). The Effects of Display Type and Spatial Ability on Performance Duying a Virtual Reality Simulation. http:// handle.dtic.mil/100.2/ADA348364.

Martins, O. O. and Oyebanji, P. K. (2000). The Effects of Inquiry and Lecture Method On the Cognitive Achievement of integrated Science Students. *Journal of STAN.* 35(1&2), 31-35.

Mazur, J.E. (1990). *Learning and Behaviour*. London: Meuthen Publishers.

Mohammed, D.M (1991). Improvisation as a veritable Tool for Achieving integrated Science goal *Azara Journal of Education.* 1 (1), 20-27.

Mohammed, N. (1997). Improvement: A Resort in Teaching Science in a Depressed Economy. 40th Annual Conference Proceedings of STAN Kano. 70 – 73.

Mohammed, S.A. (2000). Assessment of Female Students' performance in selected

Science courses. A case study of Federal Polytechnics Bida. *Nigeria Journal of Gender and Development.* 1 (1&2), 61-64.

Mohammed, H. A. (2004). Development and Use of An Improvised Radio for Teaching and Learning of Physical Education in Primary School in Minna, Niger State. Unpublished M.Tech. Thesis, Federal University of Technology, Minna.

Momoh, G. D. (1997). Individualised Instruction in Industrial Education. Journal of Applied Science and Education. 1 (1), 10-14.

Momoh, G. D. (1997). Technology of Education: An Aid for the Communication Needs of the Handicapped persons. Journal of Applied Science and Education. 1 (1), 22-26.

Momoh, G. D. (2004). Improvisation of Teaching Materials. A paper presented at a Seminar organized for the Teaching Staff of the Federal Science and Technical Shiroro held in Kuta in November.

Mukherjee, A. (2002). *Educational Psychology for Teachers, students and Parents*, Benin City: K. P. Basu Publishing Co.

Nateinyin, I. (1995). Diagnosis of Students' Weakness in Biology. Unpublished M.Ed Project University of Ibadan, Ibadan, Oyo State.

National Teachers' Institute (NTI), (1990). Educational Cycle 3, Module 10-12. Kaduna: Al-Rissiah printing and publishing Co Nigeria Ltd.

Nneji, L. (2000). Videos film as a Science tool, *Junior Integrated Science panel.* 1 (19), 134-145.

Nsofor, C.C. (1991). A study of prior knowledge and New Knowledge of SS II Biology Students in Relation to inheritance. Unpublished M.ED Theses University of Jos, Jos Nigeria.

Nsofor, C. C. (2001). Cultural Impediments on Women in Science, Technology and Mathematics Education. 42nd Annual Conference Proceeding of STAN Ilorin. 154-160.

Nsofor,C. C. (2007). Assessing the Effects of Designed Instructional Media on Students' performance in science (Biology). *Journal of Science, Education and Technology. 1(1), 105-111*.

Nwachukwu, V.C. (1989). Theories of learning. In G.C. Unachukwu, (Ed.) *Educational Psychology: theory and practice*. Owerri: Totan Publishers Ltd.

Nwadibia, J. I. (2005). The Effects of Biological Models on the Teaching and Learning of Nervous System in Secondary Schools in Minna, Niger State. Unpublished M.Tech Thesis of Federal University of Technology Minna.

Nwaizugbe, P. N. (1991). The impact of a practical Based Improvisation Course on Expressed Difficulties faced by Science Teachers. *Journal of STAN.* 27(1), 89-93.

Nwankoby, F.U. (1988). *Product, Design and Development of Local Educational Mateirals: problems.* Ibadan: Heinemann Education Books.

Nwosu, E.C. (2000). Resource Utilization in Science Education (Chemistry) classroom. Implication for teachers. 41st Annual Conference proceedings of STAN. 166-168.

Oakes, J. (1990). Opportunities, Achievement and Choice: Women and Minority Students in science and Mathematics. In B. Cazden, (ED.) *Review of Research in Education.* Washington DC: American Education Research ssociation Publication.

Oakley, A. (1993). *Sex Gender and Society.* London: Red Wood Books Ltd.

Obaba, I. A. (2003). The Design and Construction of Hibiscus Flower Model for Biology Instruction in senior secondary schools. B.Tech Education project F. U. T. Minna.

Obe, C.O. (1989). A study of Nigerian Secondary School Students' conception of living things. Unpublished M.Ed Thesis University of Ilorin.

Obianwu, C.A. and Azubike, N (1994). *Educational Technology Media: Characteristics and Utilization:* Abba: Nuel Centi Nigeria Publishers.

Obodozie, G. N. (2002). Development and Use of an Improvised Television For Teaching and Learning of Social Studies in Primary Schools in Minna, Niger State. M. Tech. Thesis, Federal University of Technology Minna.

Odama, J. S. (1982). *Glossary of Statistical Terms and Formulae.* Benin City: Koda Publishers Ltd.

Odunusi, J.O. (2001). Women in STM education – an alternative strategy. 42nd STAN annual conference proceeding. 72-75.

Ogunmilade, C.A. (1984). *Media in Educational*. Ile Ife: University of Ife Press.

Ogunmilade, C.A. (1993). *Media in Education*. Ile-ife: Obafemi Awolowo University Press.

Ogunranti, A. (1982). *Educational Technology ACE Publication Series*; Ibadan: Heinemann Publishers.

Ogunranti, A. (1984). *Educational Technology*. Ibadan: Heinemann Publishers.

Ojiaku, F. C. (2003). The Effects of Combining Advance Organizer, video package and lecture method on students achievement in integrated science in Oshodi Local Government Area of Lagos State. M.Tech Education Thesis, F. U. T. .Minna

Okafor, E.N. (2000). *Educational Technology theory, a practice for tertiary institution.* Awka: Educational Research and Publishers.

Okeke, C. (1998). Gender issues in teaching and learning in Higher Education. A paper presented at the National workshop on teaching and learning in Higher Education. University of Ibadan.

Okeke, E.A.C. (2001). Women in STM Education in Nigeria. Key note address at 42nd STAN Annual Conference at Ilorin.

Okeke, J.N. (1997). Evaluating the use of instructional Technologies and their implications for Adult Literacy programme. A paper presented at the 10th National Convention of Nigeria Association for Educational Media and Technology. University of Ibadan, Ibadan.

Okobi, P. (1994). Effects of Audio Taped Environment Segment in Teaching the Structure of English on Students' Performance. *The Nigeria Teacher Today*. 3(1), 90 – 96.

Okoro, C.A. and Etukudo, U.E. (2001). Computer assisted instruction versus extrinsic motivation based traditional method; its effects on female gender performance in chemistry. 42nd STAN Annual Conference proceeding. 98-103

Okwo, F. A., Amaka, C. ,Okoye, B. N., Ugwu and Onyeka, J. O. (2008). Effects of Three modes of Diagram Presentation on the performance of students in Animal Excretion. *Journal of STAN.* 43(1&2), 87-94.

Olagunju, A.M. (1998). Improvisation of resources for effective communication In elementary science education. 4th National Annual Conference of National Association of Curriculum Theorist. Owerri. 112-118.

Olagunju, A.M. (2000). An Investigation into Teachers attitude towards and extent of improvisation of resources for effective teaching of biology. 41st Annual conference. Proceedings of STAN. 120-125.

Olumba, R. N. (2007). Effects of Audiotape and Videotape Instructional Package on the teaching and learning of Phonetics in Senior Secondary schools in Minna. M. Tech. Thesis of Federal University of Technology Minna.

Olusola, S. (1982). *Telescope: some notes on 20 years of television in Africa*. Ibadan: Ariya Production.

Onasanya, S. A. (2004). Selection and Utilization of Instructional Media for effective

Practice teaching. *Institute Journal of Studies in Education (IJSE)*. 2(1), 127-133

Onasanya, S. A. and Adegbija, M. V. (2007). *Practical Hand book on Instuctional Media*. Ilorin: Graphcom Publishers.

Onyebunwa, S.E. (1999). *Educational Technology; An instruction.* Owerri: Cape Publishers International Ltd.

Onyegegbu, N. (2001). Use of Electronic Instructional Media for improved Understanding of Disease Control and Health promotion in rural Nigeria. *Journal of STAN.* 36(1&2), 81-86.

Orisabiyi, O.O. (2002). The design and construction of a model of Human skin for teaching biology in Secondary Schools B.Tech Education Project F.U.T Minna.

Osisioma, I. (2005). Active Learning Strategies for the senior classroom (workshop). Proceeding of the 46th Annual Conference of STAN, 74-79.

Otegbayo, C.O. (2005). Effect of Audiotape and film package on the Teaching and learning of phonetics in Junior Secondary Schools in Niger State. An M.Tech Education Thesis. Federal University of Technology Minna.

Owolabi, T. (2000). A Diagnosis of simple faults resulting in malfunctioning of physics laboratory apparatus. 41st STAN Annual Conference Proceeding. 334-338.

Oyekan, S.O. (1993). Diagnosis of Student's weakness. A conceptual Framework remediation of under-achievement in Science. *Journal of STAN.* 28 (1&2), 59-69.

Oyekan, S.O. (1999). Social, Economic and Political Dimensions of Schooling. In Ipaye, B. (Ed.) *Research on schooling in Nigeria.* Lagos: Chayabi Printers and Publishers.

Rahman, L. (2002). Strengthening Information Archeology infrastruction in Bangladesh. Paper presented at STAN 43rd Annual Conference, Abuja, Abuja.

Richman, V. (2001). The Gale Encyclopedia of Science (2nd Edition). Gale group. Farmington Hills.

Salawu, A. and Taiwo (2001). *Essentials of Educational Technology*. Oyo; Kay Blessing Ventures.

Soyibo, K. (1993). An investigation into the use of improvisation in Biology Teaching in some Lagos Secondary School. *Journal of STAN*. 22 (1), 120-128.

Tauheed, M. D. (2002). The Design and construction of kidney nephron model for Teaching Biology in Secondary Schools. B.Tech Education project F. U. T. Minna.

Thomas, M. (2004). An Investigation into the availability of Biology Instructional materials at the secondary schools in Niger State B.Tech Education project F.U.T. Minna

TutorVista (2008). Circulation. Retrieved June 16th2009, from http: www. Tutorvista. com

Umeoduagu, J.N. (2000). Resource utilization for effective Teaching of Science, Technology and Mathematics in the New Millennium. STAN Conference Proceeding. 38-41.

Wasagu, M.A. (2000). Improvisation as a good source of enriching science

lesson. In N.G. Akale, (Ed) STAN 41st Annual Conference Proceeding. 54- 57

Watson, F.G. (1991). Science Curriculum in Schools. Delighton, L.C (Ed). *Encyclopedia of Education* 14 (1),38-43.

.

West African Examination Council (2007).Annual Report.

West African Examination Council (2008).Annual Report.

West African Examination Council (2009).Annual Report.

Wood, R. (1990). *An introduction to philosophy of education*. London: Cambridge University Press.

Yoloye, E.A. (1989). Resources for Science, Mathematics and Technical Education in Nigeria Secondary Schools. A National Survey.

Yusuf, M.O. (1997). Effects of videotape and slide tape instruction on student's performance in Social Studies in some Junior Secondary Schools. Unpublished doctorate thesis. Faculty of Education University of Ilorin

APPENDIX A

Statistics of Entries and Results in Biology, Chemistry and Physics for May/June WASSCE 2000-2007 in Nigeria

SUBJECT	YEAR	TOTAL SAT	CREDIT PASS and ABOVE	PASS	FAILURE	MEAN % FAILURE
BIOLOGY	**2000**	**620291**	**119769(19.30)**	**184603 (29.76)**	**315919(50.93)**	
	2001	**995345**	**231475(23.25)**	**295654 (29.70)**	**·468216 (47.04)**	
	2002	**882 I 19**	**278122(31.52)**	**270301 (30.64)**	**333696 (37.82)**	
	2003	**1005553**	**424636 (42.22)**	**271058 (26.95)**	**266222 (26.47)**	**41.82**
	2004	**1005894**	**298555(29.68)**	**326092 (32.41)**	**348890 (34.68)**	
	2005	**1051557**	**375850(35.74)**	**313827 (29.84)**	**338491 (32.18)**	
	2006	**1137131**	**559854(49.23)**	**292317 (25.70)**	**284960 (72.96)**	
	2007	**1238163**	**413211 (33.27)**	**397353 (32.09)**	**402148 (32.47)**	
CHEM	**2000**	**195810**	**62442(31.88)**	**52303 (26.71)**	**81065 (41.39)**	
	2001	**301740**	**109397(36.25)**	**81679 (27.06)**	**110664 (36.67)**	
	2002	**262824**	**90488 (34.42)**	**77480 (29.47)**	**94856 (36.09)**	
	2003	**313332**	**154914(49.44)**	**73385 (23.42)**	**67412 (21.51)**	**31.52**
	2004	**327503**	**124009(37.86)**	**83571 (25.51)**	**107318 (32.76)**	
	2005	**349936**	**178274(50.94)**	**65499 (18.71)**	**95495 (27.28)**	
	2006	**380104**	**170670 (44.90)**	**86423 (22.73)**	**114475 (30.11)**	
	2007	**422681**	**194284 (45.96)**	**104680 (24.76)**	**111322 (26.33)**	
PHYSICS	**2000**	**NA**	**NA**	**NA**	**NA**	
	2001	**132768**	**16929(12.06)**	**40392 (30.04)**	**75446 (56.08)**	
	2002	**254188**	**120768(47.51)**	**81814 (32.18)**	**51606 (20.30)**	**25.56**
	2003	**275369**	**130982(47.56)**	**84413. (30.65)**	**53079 (19.27)**	
	2004	**265262**	**135359(51.02)**	**77590 (29.25)**	**52313 (19.72)**	
	2005	**344411**	**142943(41.50)**	**102036 (29.62)**	**89150 (25.88)**	
	2006	**375824**	**218199 (58.05)**	**87025 (23.15)**	**62119 (16.52)**	
	2007	**418593**	**180797 (43.19)**	**140172 (33.48)**	**88480 (21.13)**	

Source: WAEC, Office of the controller, Minna, Niger State. Note: Percentages are in parentheses

APPENDIX B

Statistics of Entries and Results in Biology, Chemistry and Physics for May/June WASSCE 2000 – 2008 in Niger State

SUBJECT	YEAR	TOTAL ENTRY	CREDIT PASS AND ABOVE	PASS	FAILURE	MEAN % FAILURE
BIOLOGY	**2000**	**6298**	**458 (7.27)**	**979(15.54)**	**4861 (77.18)**	
	2001	**6385**	**698 (10.93)**	**1092(17.10)**	**4595 (71.97)**	
	2002	**7779**	**1086 (13.96)**	**1639(21.07)**	**5054 (64.97)**	
	2003	**5755**	**819 (14.23)**	**1308(22.73)**	**3628 (63.04)**	
	2004	**6252**	**1075 (17.19)**	**1274(20.36)**	**3903 (62.43)**	**65.29**
	2005	**6000**	**856 (14.27)**	**1793(29.66)**	**3351 (55.85)**	
	2006	**6640**	**1190(17.92)**	**1563(23.54)**	**3887 (58.54)**	
	2007	**NA**	**NA**	**NA**	**NA**	
	2008	**13773**	**1152 (8.36)**	**2386 (17.32)**	**9413 (68.32)**	
CHEMISTRY	**2000**	**1378**	**190 (13.79)**	**259 (16.60)**	**929 (67.42)**	
	2001	**1420**	**217 (15.26)**	**337 (23.73)**	**866 (60.99)**	
	2002	**1759**	**295 (16.77)**	**520 (29.56)**	**944 (53.67)**	
	2003	**1285**	**378 (29.42)**	**375 (29.16)**	**532 (41.40)**	
	2004	**1325**	**239 (16.04)**	**380 (26.68)**	**706 (53.28)**	
	2005	**1515**	**305 (20.13)**	**507 (33.47)**	**703 (46.40)**	**53.9.1**
	2006	**1715**	**361 (21.05)**	**484 (26.22)**	**870 (50.73)**	
	2007	**NA**	**NA**	**NA**	**NA**	
	2008	**3140**	**514 (16.37)**	**818 (26.05)**	**1802 (57.39)**	
PHYSICS	**2000**	**1374**	**242 (17.61)**	**452 932.89)**	**680 (49.49)**	
	2001	**1404**	**316 (22.51)**	**416(29.63)**	**672 (47.86)**	
	2002	**1818**	**552 (30.36)**	**637(35.04)**	**629 (34.60)**	
	2003	**1283**	**264 (20.56)**	**339(26.42)**	**680 (53)**	**45.58**
	2004	**1404**	**288 (20.53)**	**410(29.22)**	**705 (50.25)**	
	2005	**1503**	**492 (32.73)**	**415(27.61)**	**596 (39.65)**	
	2006	**1677**	**615 (36.67)**	**536(31.96)**	**526 (31.37)**	
	2007	**NA**	**NA**	**NA**	**NA**	
	2008	**3171**	**801 (25.26)**	**696 (21.95)**	**1853 (58.44)**	

Source: Niger State Ministry of Education {2007}
Note: Percentages are in parentheses

APPENDIX C

Niger State Senior Secondary Schools and Their Zones and Local Government Areas

Zone A

AGAIE/KINTAKO LGA

1	1	GGSS AGAIE (S)
2	2	DENDO SNR. SEC. SCH. AGAIE (CO)
3	3	DSS BARO (S)
4	4	DSS ETSUGAIE (CO)
5	5	DSS KUTIRIKO (CO)

BIDA LGA

6	1	GGDSS BIDA (S)
7	2	DSS NDAYAKO BIDA (S)
8	3	DSS EYAGI –BIDA (CO)
9	4	GGSS BIDA (S)
10	5	GSS BIDA (BTC) (S)
11	6	WADATA DSS BIDA (S)
12	7	GGDSS BIDA (B) (S)
13	8	DSS EYAGI-BIDA (B) (CO)
14	9	GSS BIDA (BTC) (B) (S)

EDATI LGA

15.	1	DSS ENAGI (CO)
16	2	DSS SAKPE (CO)

GBAKO/EDOZHIGI LGA

17	1	GSS LEMU (CO)
18	2	DSS EDOZHIGI (CO)
19	3	GGSSS LEMU (S)
20	4	GSS WUYA-KEDE (CO)

LAPAI/AZZA LGA

21	1	MKSS LAPAI (CO)
22	2	GGDSS LAPAI (S)
23	3	DSS EBBO (S)

24	4	DSS GULU (CO)
25	5	DSS MUYE (CO)
26	6	DSS EVUTI (CO)
27	7	DSS (MKSS) LAPAI (B) (CO)

KATCHA/BADEGGI

28	1	DSS KATCHA (S)
29	2	DSS KATAEREGI (CO)
30	3	DSS BADEGGI (CO)
31	4	DSS CHECHE (B) (S)

LAVUN/DOKO LGA

32	1	GSS DOKO (S)
33	2	ADSS BIDA (CO)
34	3	DSS GABA (CO)
35	4	DSS DABBAN (CO)
36	5	DSS KUTIGI (S)
37	6	DSS JIMA (S)
38	7	DSS BATATI (S)
39	8	WDC KUTIGI (CO)
40	9	ADSS BIDA (CO)
41	10	DSS KUTIGI (S)

MOKWA /KEDE LGA

42	1	DSS KUDU (S)
43	2	GSS MOKWA (CO)
44	3	GSS BOKANI (CO)
45	4	GSS KPAKI (CO)
46	5	DSS KPEGE-MOKWA (CO)
47	6	GSS GBARA (CO)
48	7	GSS MOKWA (CO)
49	8	DSS WUYA-KEDE (B)

ZONE B

BOSSO L.G.A

50	1	DSS MAIKUNLELE (CO)

52	2	DSS MAITUMBI (CO)
53.	3	ADSS MINNA (CO)
54	4	DSS BOSSO MINNA (CO)
55	5	DSS CHANCHAGA (CO)
56	6	DSS BEJI (CO)
57	7	DSS MAITUMBI (CO)
58	8	ADSS MINNA (B) (CO)
59.	9	DSS CHANCHAG (B) (CO)
60.	10	DSS BOSSO MINNA (B) (CO)
CHANCHAGA/MX WEST/MX EAST LGA		
61	1	ABSS MINNA (S)
62	2	GGSS MINNA (S)
63	3	GSS MINNA (S)
64	4	WDC MINNA (S)
65	5	DSS MINNA (CO)
66	6	DSS TUNGA MINNA (CO)
67	7	GSS MINNA (B) (S)
68	8	DSS MINNA (B) (CO)
69	9	DSS TUNGA MINNA (B) (CO)
PAIKORO/KAFFI		
70	1	ADSS PAIKO (CO)
71	2	GGSS KAFFIN/KORO (S)
72	3	DSS KAFFIN/KORO (CO)
73	4	DSS ADUNU (CO)
74	5	DSS ISHAU (S)
75	6	DSS KWAKUTI (S)
76	7	MSGSS PAIKO (CO)
77.	8	ADSS PAIKO (B) (CO)
GURARA LGA		
78	1	DSS GAWU BABANGIDA (S)
79	2	DSS DIKO (CO)
79	3	DSS KABO (S)
80	4	DSS G/BABANGIDA (S)

SHIRORO/LAKPMA LGA

81	1	GSS KUTA (CO)
82	2	DSS GWADA (CO)
83	3	GGDSS KUTA (S)
84	4	DSS ERENA (B)
85	5	DSS TUM-TUM (CO)
86	6	GSS ALLAWA (S)
87	7	DSS SHIRORO (NEPA) (CO)
88	8	DSS GURMANA (S)
89.	9	DSS GUSORO (S)
90	10	DSS SHAKWATU (CO)
91	11	DSS MANTA (S)
92	12	WDC KUTA (S)

SULEJA/ABUKWAKA

93	1	GSS SULEJA (CO)
94	2	CSS (DSS) SULEJA (CO)
95	3	GGDSS SULEJA (S)
96	4	WDC SULEJA (S)
97	5	GSS SULEJA (B) (CO)
98	6	CSS SULEJA (B) (CO)
99	7	GGDSS SULEJA (B) (S)

TAFA LGA

100	1	GGSS SABON WUSE (S)
101	2	DSS GARAMA (CO)
102	3	DSS IJA GWARI (CO)

ZONE C

AGWARA LGA

103	1	GSS AGWAA (CO)

BORGU/SHAGUNU/BABANNA LGA

104	1	GSS NEW BUSSA (CO)
105	2	DSS KARABONDE (CO)
106	3	DSS WAWA (S)
107	4	ADSS WAWA (CO)

108	5	DSS BABANNA (S)
109	6	DSS SHAGUNU (CO)
110	7	GSS NEW BUSSA (B) (CO)

KONTAGORA LGA

111	1	GSS KONTAGORA (CO)
112	2	MICSS KONTAGORA (CO)
113	3	DSS KONTAGORA (S)
114	4	GGDSS KONTAGORA (S)
115	5	DSS UNGUWAN TUKURA (S)
116	6	GSS KONTAGORA (CO)
117	7	MICSS KONTAGORA (CO)
118	8	DSS KONTAGORA (S)
119	9	GGDSS KONTAGORA (S)

MAGAMA/AUNA

120	1	GSS N/KAINJI (CO)
121	2	CSS IBETO 9S)
122	3	GSS NASKO (CO)
123	4	DSS SALKA (S)
124	5	DSS AUNA (S)
125	6	DSS SALKA (B) (S)

MARIGA/KOTONKORO LGA

126	1	DSS MARIGA (CO)
127	2	GSS KOTONKORO (CO)
128	3	DSS BANGI (CO)
129	4	DSS BOBI (S)
130	5	DSS GULBINBOKA (CO)

MASHEGU/ZUGURMA LGA

131	1	EMERATE SEC. SCH. MASHEGU (CO)
132	2	GSS SAHORAMI (S)
133	3	DSS KABOJI (CO)
134	4	DSS IBBI (CO)
135	5	DSS MASHEGU (CO)

MUNYA LGA

136	1	DSS GUNI (S)

137	2	DSS SARKIN PAWA (CO)

RAFI/KUSHERIKI LGA

138	1	AASS KAGARA (CO)
139	2	GSS TEGINA (CO)
140	3	GSS PANDOGARI (CO)

RIJAU/DARANGI LGA

141	1	DSS DUKKU (S)
142	2	GSS RIJAU (CO)
143	3	GGSS TUNGA MAGAJIYA (S)

WUSHISHI LGA

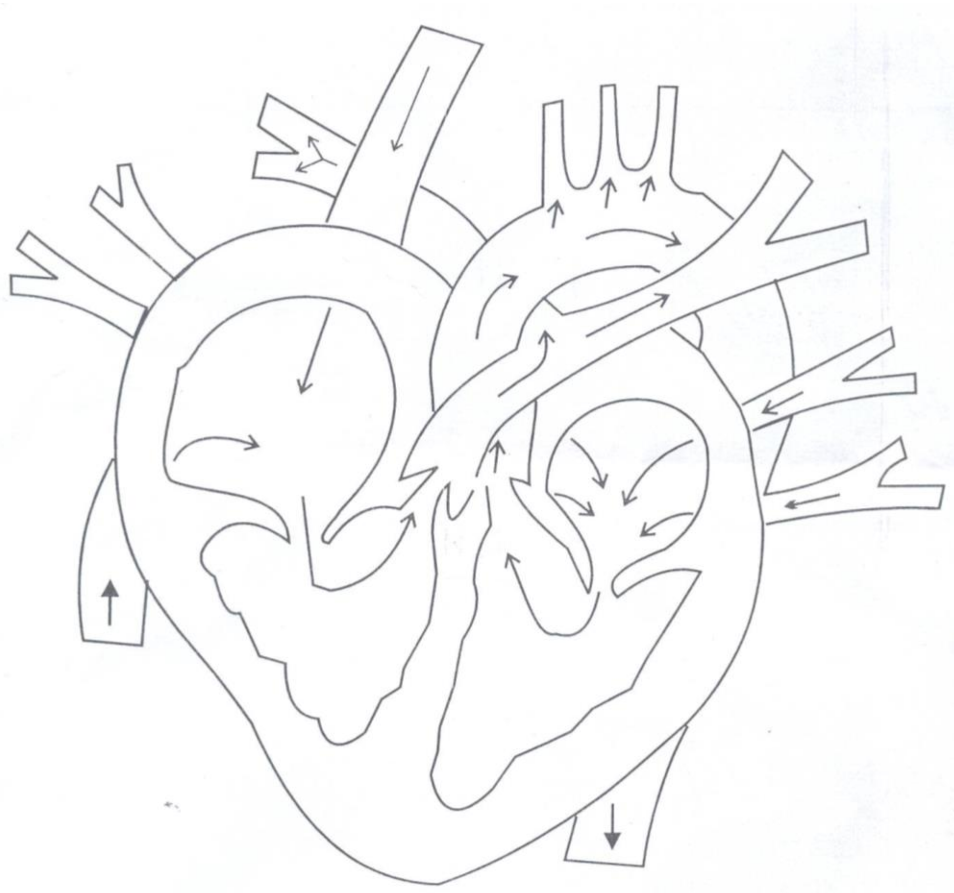
144	1	GSS WUSHISHI (S)
145	2	DSS ZUNGERU (CO)
146	3	GSS WUSHISHI (B) (S)

Selected Schools, Zones and Local Government Area (L.G. A)

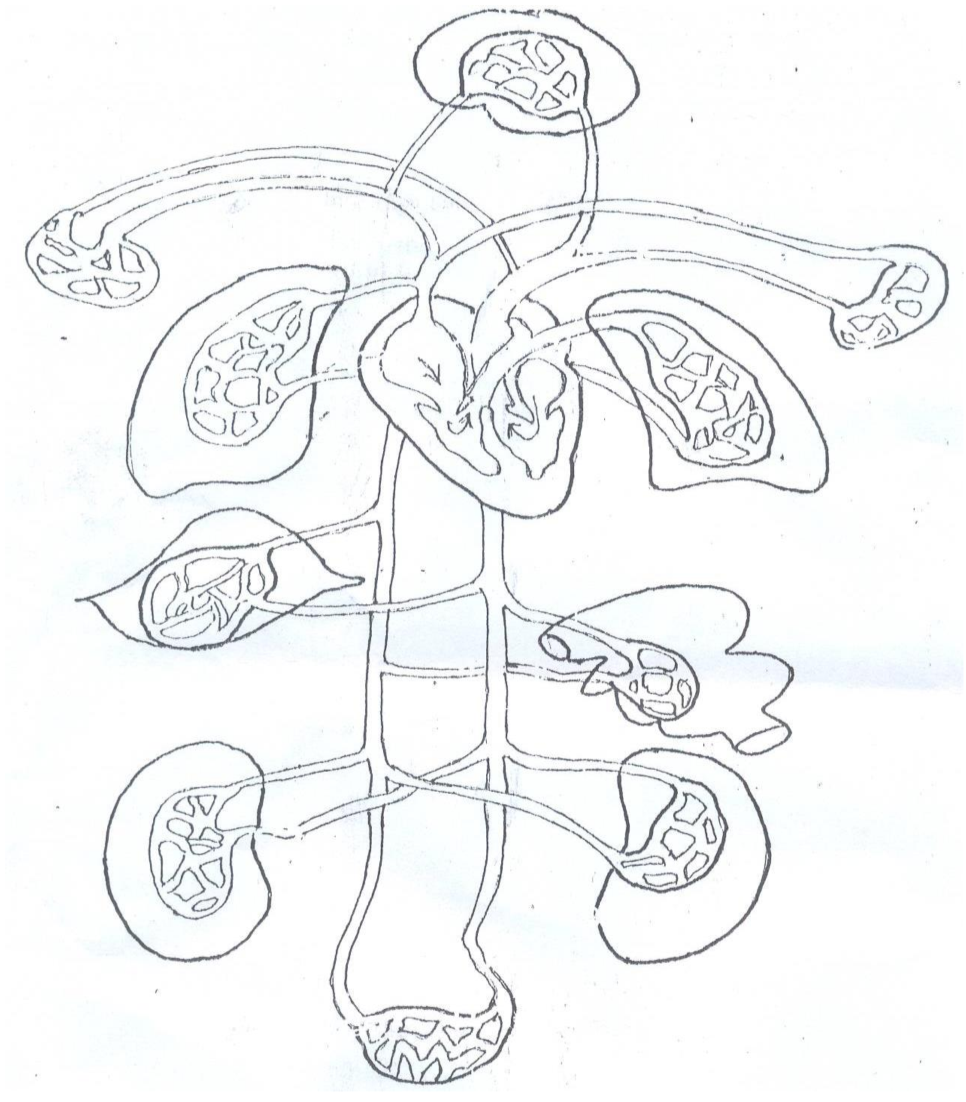
S/N	School	Zone	L. G. A
1	Day Secondary school Gaba	A	Lavun/Diko
2	Government Secondary school Mokwa	A	Mokwa/Kede
3	Day Secondary School Enagi	A	Edati
4	Day Secondary Maikunkele	B	Bosso
5	Day Secondary school Tunga Minna	B	Chanchaga
6	ADSS Paiko	B	Paikoro/kaffi
7	Day Secondary School Sarkin Pawa	C	Munya
8	Government Secondary School Agwara	C	Agwara
9	Government Secondary School Nasko	C	Magama/Auna

APPENDIX D

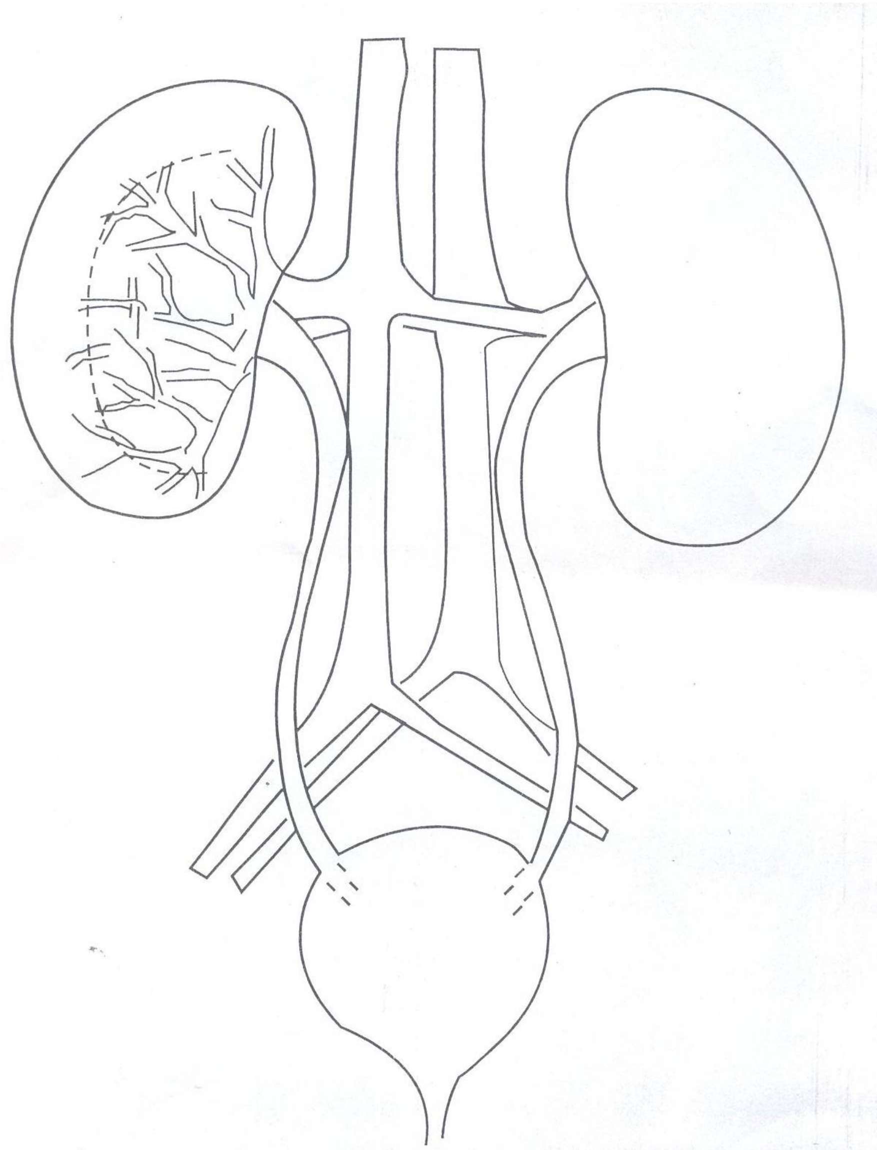
Sketched Models of (1a) The Internal Structure of the Heart, (2a) Human Blood Circulatory System, (3a) Excretory System, and (4a) Kidney Tubule/Nephron.



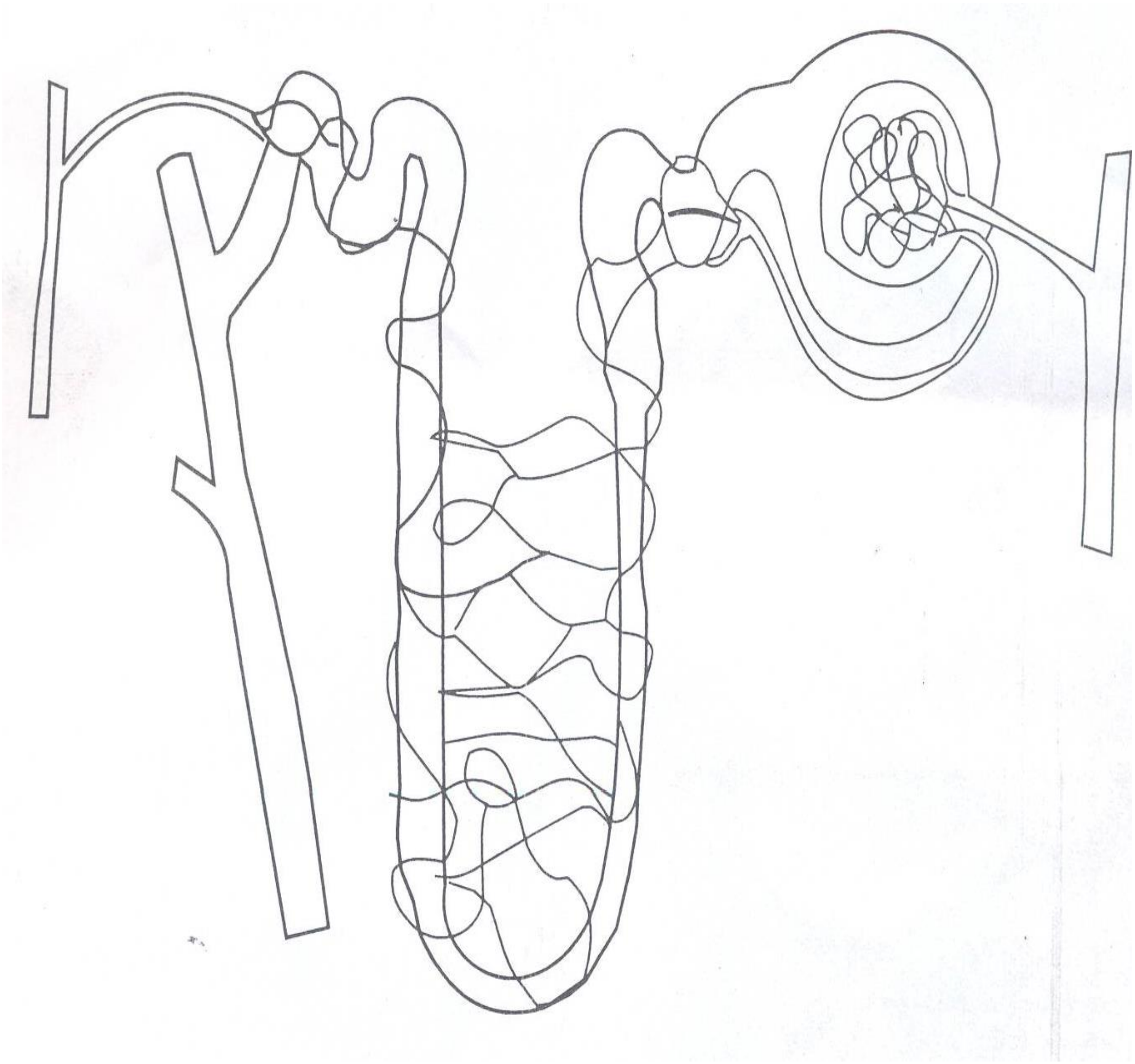
1a: The Internal Structure of the Heart



2a: Human Blood Circulatory system



3a: Excretory System



4a: Kidney Tubule/Nephron

APPENDIX E

Illumination Mechanism for the Developed Models of the Heart and the Circulatory System

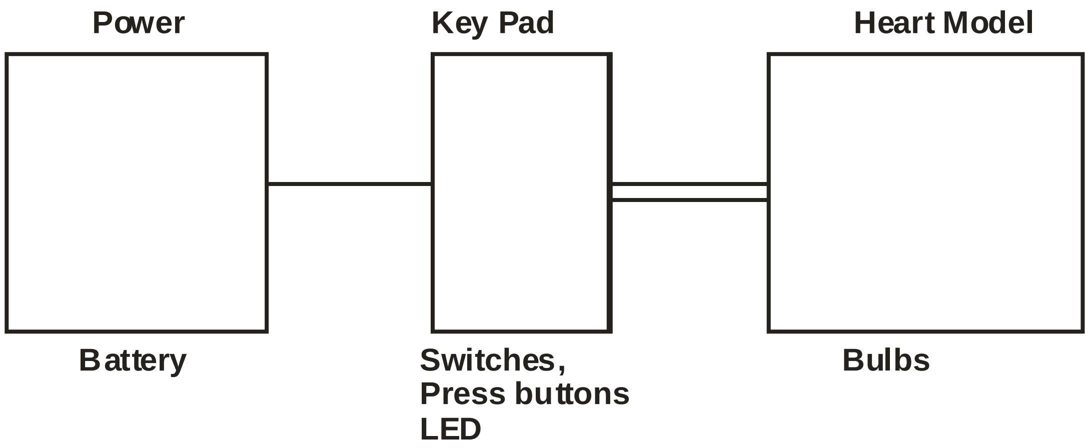
(a) The internal structure of heart's circuit.

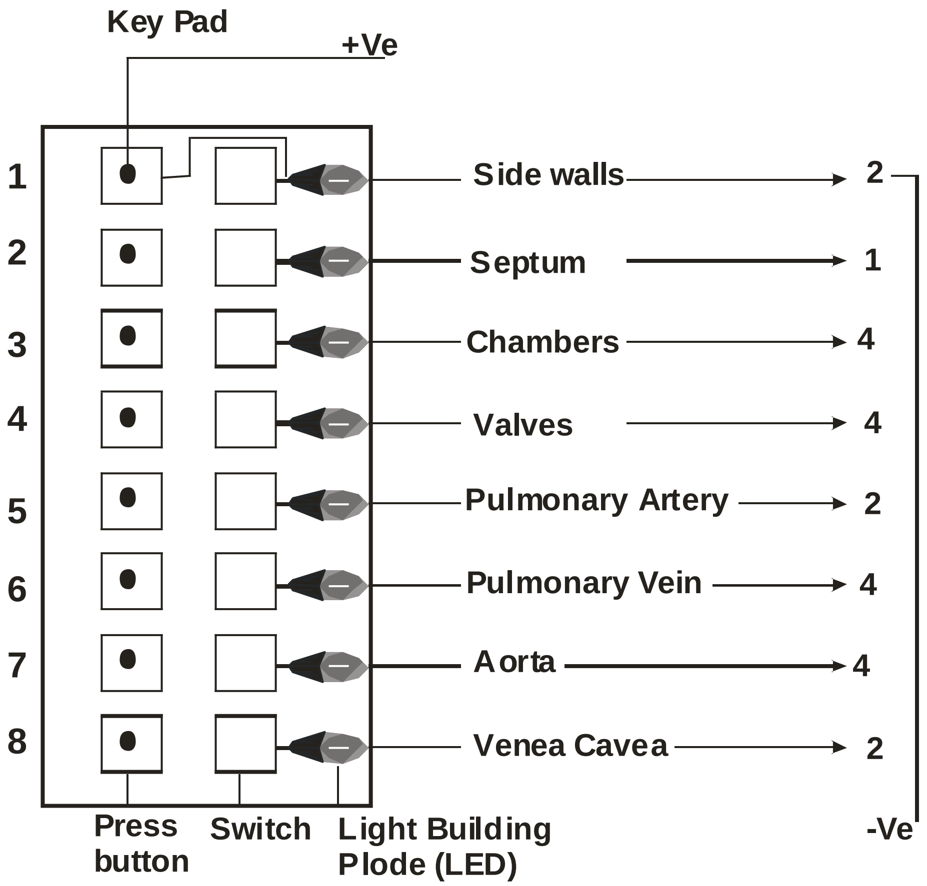
There are eight (8) identified parts of the heart, each distinguished by electric bulb(s). These parts are as follows:

S/No	Key Pad	Parts	No of Bulb highlighted
1		Side walls	2 bulbs
2		Septum	1 bulb
3		Chambers	4bulbs
4		Valves	4 bulbs
5		Pulmonary Arteries	2 bulbs
6		Pulmonary Veins	4 bulbs
7		Aorta	4 bulbs
8		Venea Cavea	2 bulbs

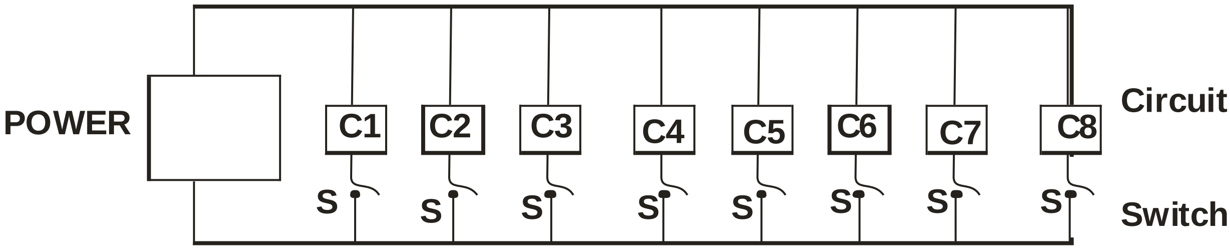
Each bulb or group representing a part has a press button and a switch on a keypad. To highlight a part, its press button is pressed and released. For further explanation on the highlighted part, its switch is pressed on. This makes the light to steadily be on as long as you want it. To explain another part, the former switch is switched off and the process of pressing the new button begins. To be sure of the switch or press button in use, each set of press button and switch has a light emitting Diode (L.E.D) that comes on. The heart structure model circuit is developed to use Direct Current (DC) i.e. rechargeable battery only.

BLOCK DIAGRAM





The connection is a parallel connection, thus each circuit has access to the power supply and the voltage is the same across such. If one circuit or appliance fails to function, it does not affect others.

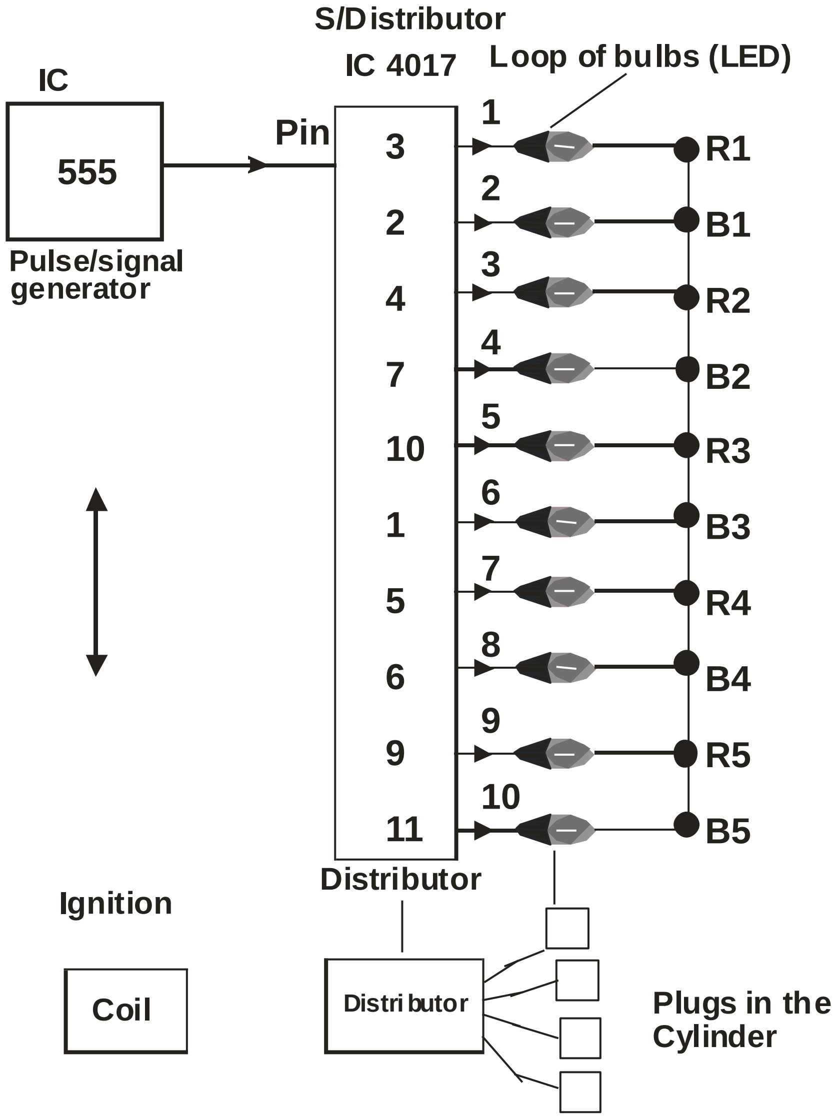


The keypad has a long cable and a control switch. This enables the teacher to freely move about.

(b). The Circulatory System Circuit

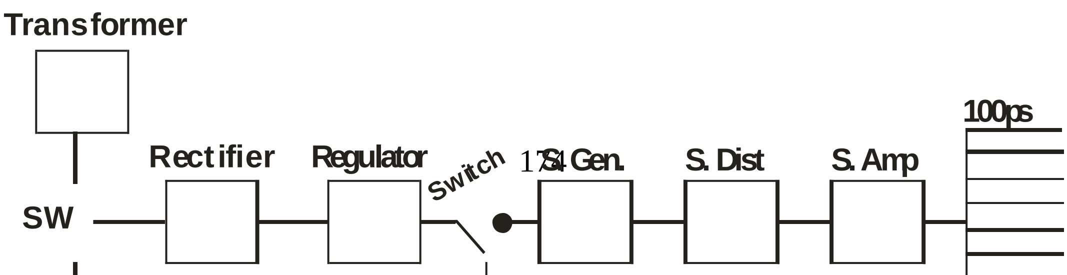
From the main circuilt, which has parallel connection, signals are generated to switch on the bulbs in sequence. There are two sources of power (1) Battery (2) Means via transformer. Thert are switches for any choice to be made.

The pulse generator is IC 555 called Multi-vibrator. The distributor is IC 4017 called decade counter. IC 4017 works like the distributor in a car, it can send signals to a maximum of 10 outlets. It can be programmed to send too less and recycle or halt. For this project, it is to recycle.



There are ten loops of which five (5) are for oxygenated blood and five (5) for de-oxygenated blood. In a loop, there are between ten (10) to twelve (12) bulbs. Oxygenated blood is illustrated by red bulbs while de-oxygenated by blue bulbs. From the heart de-oxygenated blood flows to the lungs and oxygenated blood flows to the heart. From the heart, the oxygenated blood flows to the body and deoxygenated blood flows back to the heart. The process is repeated. Note that the reverse is the movement of blood between heart and lungs and heart and body. The blood flows in the opposite direction.

A transistorized stable circuit is used to show the heart beat by bulbs flashing. A side signal is fed to power a 5551C, which operates at a variable audio frequency.

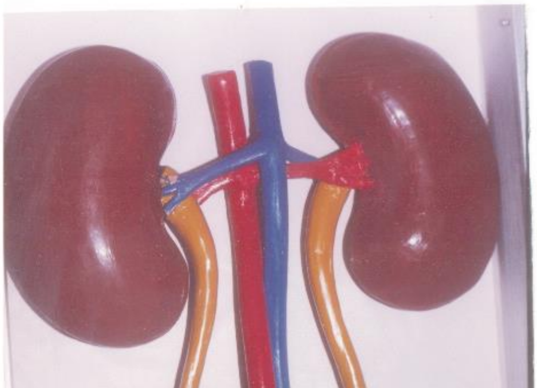


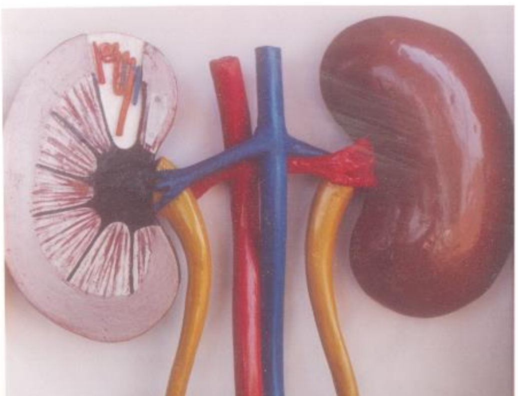
The circulatory system is illuminated to use Direct current (DC) and alternate current (AC). Therefore in the absent of AC, user can switch to DC (rechargeable battery).

APPENDIX F

Researcher Developed Models Of (1b) The Structure Of The Heart (2b) Human Blood Circulatory System (3b) Excretory System (4b) Kidney Tubule/Nephron

1b





APPENDIX

APPENDIX F

APPENDIX G

The Casing of the Developed Models of (1c) the Structure of the Heart (2c) Human Blood Circulatory Syste Excretory System (4c) Kidney Tubule/Nephron

THE INTERNAL STRUCTURE OF THE HEART

KEY TO THE HEART
STRUCTURE

A. Septum
B. Left Auricle
C. Bicuspid valve
D. Left Ventricle
E. Right Auricle
F. Tricuspid valve
G. Right ventricle
H. Walls of left and right Auricle
I. Anterior/Superior Vena Cava
J. Posterior/Interior Vena Cava
K. Semi lunar valve of pulmonary

1c


THE EXCRETORY SYSTEM
C
D

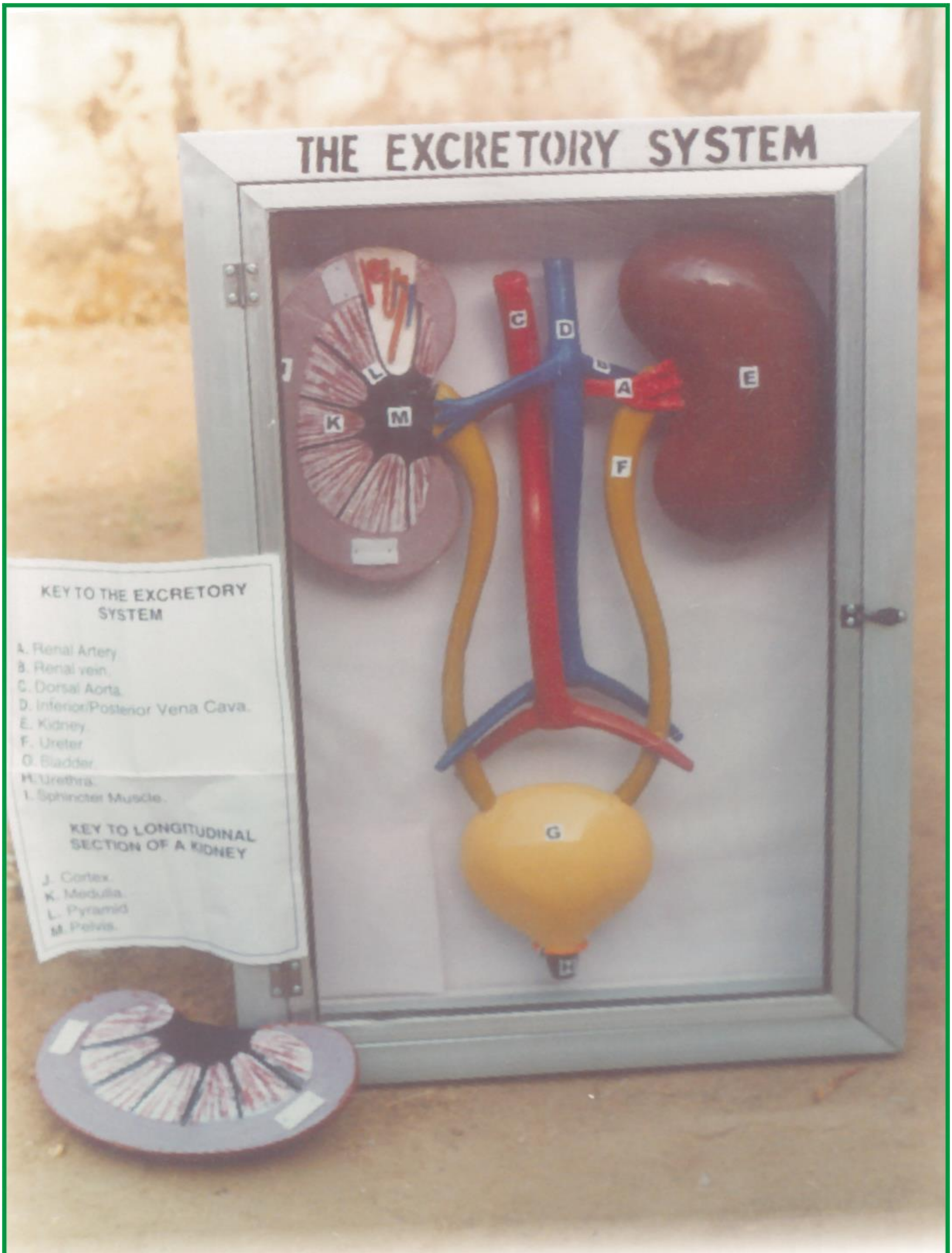
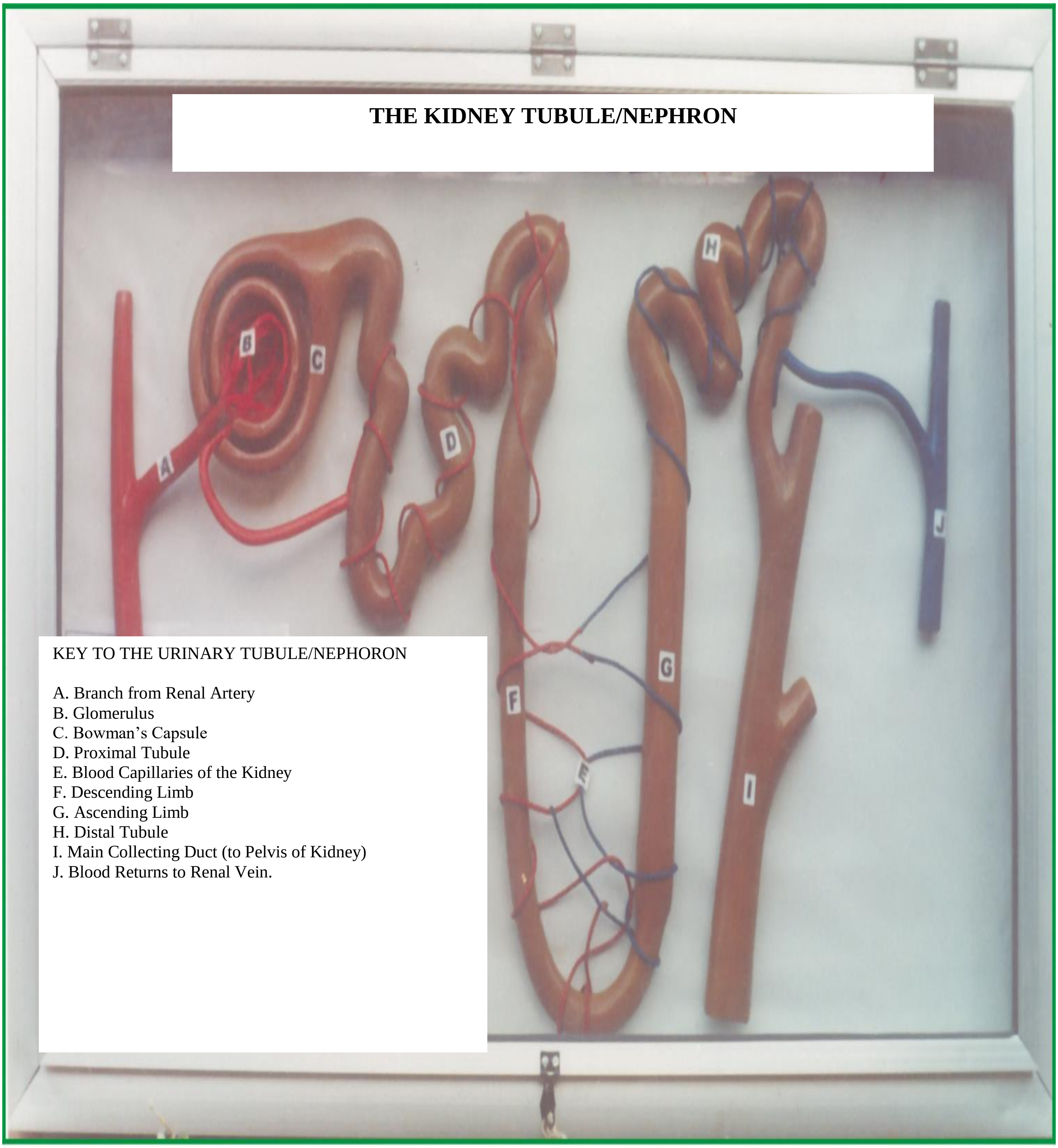

THE EXCRETORY SYSTEM
KEY TO THE EXCRETORY SYSTEM
A. Renal Artery.
B. Renal vein.
C. Dorsal Aorta.
D. Inferior/Posterior Vena Cava.
E. Kidney.
F. Ureter.
G. Bladder.
H. Urethra.
I. Sphincter Muscle.
KEY TO LONGITUDINAL SECTION OF A KIDNEY
J. Cortex.
K. Medulla.
L. Pyramid
M. Pelvis.
C
D
B
A
E
F
J
L
K
M
G

Fig. 3.4c

THE KIDNEY TUBULE/NEPHRON



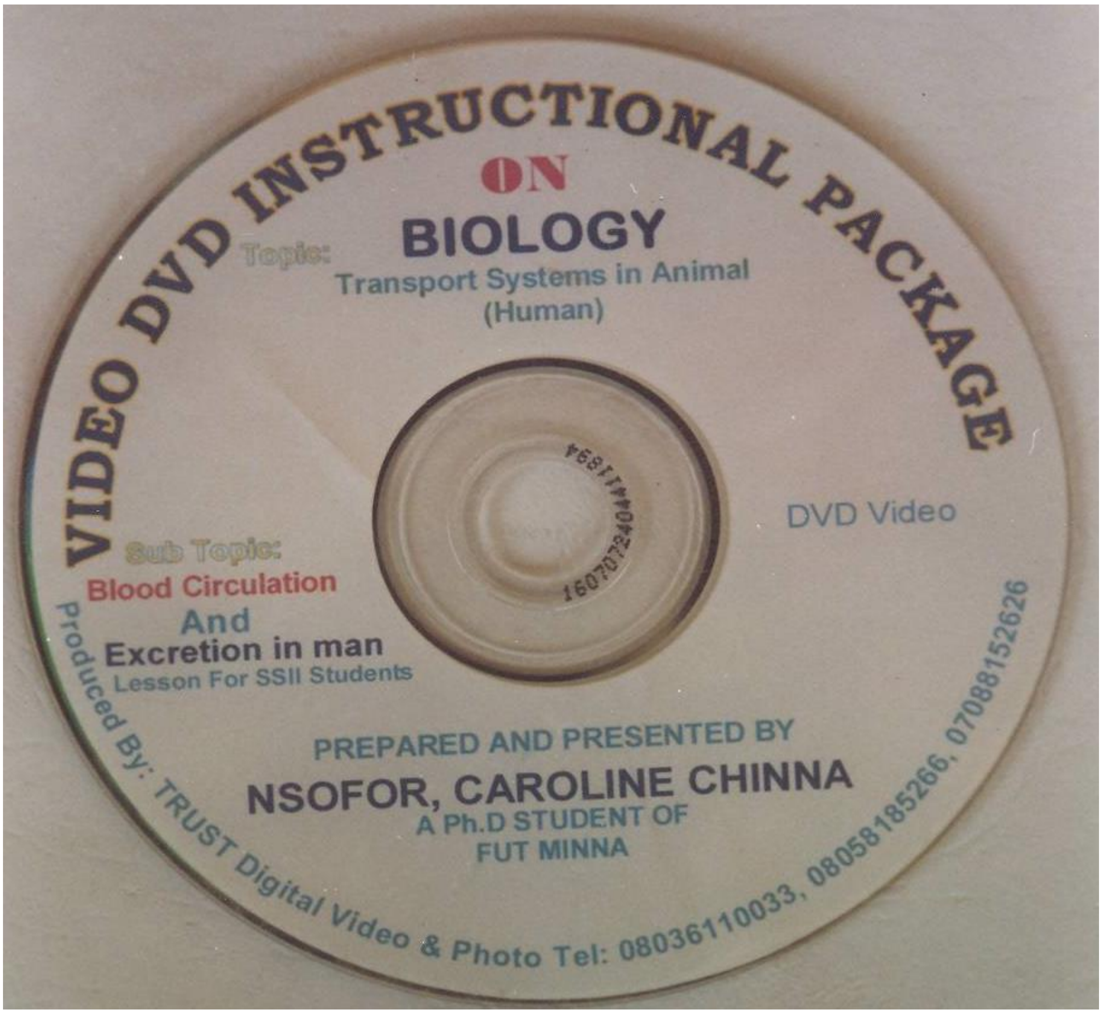
KEY TO THE URINARY TUBULE/NEPHORON

A. Branch from Renal Artery
B. Glomerulus
C. Bowman's Capsule
D. Proximal Tubule
E. Blood Capillaries of the Kidney
F. Descending Limb
G. Ascending Limb
H. Distal Tubule
I. Main Collecting Duct (to Pelvis of Kidney)
J. Blood Returns to Renal Vein.

4c

APPENDIX H

Photograph of the Researcher Developed Video DVD Disc



APPENDIX I

SAMPLE OF SCRIPT WRITINGS FOR THE DEVELOPED VIDEO DVD INSTRUCTIONAL PACKAGE

SCRIPT 1

HUMAN BLOOD CIRCULATORY SYSTEM

DURATION 80MINS

STEPS	VISUAL	AUDIO	TIME
Step 1	Opening Graphics	Signature tune	2mins
Step 2 Introduction	Narrator on Focus	Hello students you are welcome to this class. The subject for today is Biology. We will be looking at the topic, transport system in animals and 2 sub-topics blood circulation and excretion. Today we shall start with blood circulation, but for a better understanding we shall first look at the circulatory system.	3mins
Step 3 Objectives	At the end of the lesson students should be able to 1. Explain what transport system in animal mean.	Before we commence the lesson, we shall look at the instructional objectives. They are the expectations from you at the end of the lesson. They include the following:	5mins

	2. State what circulating system is. 3. Mention the two major components of circulatory system. 4. Name any four features of the heart and their function. 5. Describe briefly the diastolic and systolic phases of the heartbeat.		
Step 4 Objective I (transport system in animals)		This is the system through which food and other materials needed by cells of animals are supplied and waste products formed gotten rid of promptly. In man the system through which food and other materials are supplied to the cells is called circulatory system while the system through which waste products are removed is	10mins

		called excretory system. The whole system is filled with a liquid transport medium, the blood.	
Step 5 Blood circulatory system	Narrator and illuminated model of circulating system on focus	Blood circulatory system is the network through which blood circulates continuously through the heart and blood vessels round the body. In man, circulatory system consists essentially of a single hollow pumping structure (heart) connected to cylindrical branching tubes (blood vessels) (arteries, arterioles, veins, venules and capillaries).	10mins
Step 6 Structure of the heart & functions	illuminated model of the heart, structure and functions on focus	The heart of all mammals is cone shaped, made up of a special muscle known as cardiac muscle and enveloped in a thin pericardium. The heart has four chambers (left auricle, left ventricle, right auricle and right ventricle) and four valves (bicuspid	20mins

		valve, tricuspid and two semi lunar valves). Every part of the heart has their roles to play.	
Step 7 Working of the heart (diastole & systole phases)	Narrator and model of heart structure on focus	The heart is the most powerful organ in the circulatory system. It pumps incessantly like a muscular pump and keeps the blood in continuous circulation. The pumping action of the heart is known as heart beat. The heart beat occurs in two stages – diastole and systole. At the Diastole stage, the two auricles contract, creating a high pressure in the blood contained in them. This pressure causes the bicuspid and tricuspid valves to open so allowing blood to flow from auricles into the ventricles. When the ventricles are filled up, the cuspid valves close up. At the systole stage, the two ventricles contract force opens the semi-lunar valves and forces the blood into the two trunks	20mins

		of the main arteries and out of the heart. While this is happening, blood from the body is filling up the auricles again and the cycle repeats itself. Music 1min	
Step 8 Summary Evaluation		This brings us to the end of the lesson. In this lesson, we laid the foundation for the next lesson which will be on blood circulation procedures. Now answer these questions in your book. 1. Explain transport system in animals. 2. What is circulating system? 3. What are the two major components of circulatory system? 4. State any four features of the heart and their functions 5. Describe the diastolic and systolic phases of the heartbeat	10mins

SCRIPT 2

HUMAN BLOOD CIRCULATION

DURATION 80mins

STEPS	VISUAL	AUDIO	TIME
Step 1	Opening Graphics	Signature tune	2mins
Step 2 Introduction	Narrator on Focus	Hello students you are welcome to our biology class we are going to continue with the topic blood circulation. In the first lesson we looked at the circulatory system. (1) Mention the two major components of circulatory system. (2) state any three features of the heart and their functions	3mins
Step 3 Objectives	At the end of the lesson students should be able to 1. Discuss procedures in the blood flow through the circulatory system. 2.Differentiate between pulmonary and systemic circulation 3. Explain close and double circulation 4. State at least two blood vessels of pulmonary and	Usually we have objectives of the lesson before we start so that you have focus. These objectives include:	5mins

	five of systemic circulation		
Step 4 Objective I	Illuminated model of circulatory system illustrating the procedures in blood circulation	Oxygen poor blood (deoxygenated blood) is returned from the body through venae cavae to the right auricle, after passing from right auricle to the right ventricle, deoxygenated blood blood is pumped into the pulmonary artery .This artery divides into two, each carry deoxygenated blood to the left and right lungs. In the lung capillaries, carbon dioxide in the blood is given off, and oxygen is picked up (oxygenation). Blood, now rich in oxygen (oxygenated blood) flows from each lung through the pulmonary vein to the left auricle (Pulmonary Circulation). From the left auricle blood then passes to the left ventricle. The left ventricle pumps the blood into the aorta, which distributes the blood through its branches to all parts of the body. In the body cells, oxygen is given off and carbon dioxide is picked up by the blood. (Deoxygenation). This blood is collected by veins into the venae cavae which return them to the	30mins

		right auricle (systemic circulation). This completes the circulation and the procedure starts all over.	
Step 5	Model on focus. Narration on pulmonary and systemic circulation and their blood vessels continues.	The pulmonary circulation is the circulation of blood between the heart and the lungs while systematic circulation is between the heart and all parts of the body beside the lungs. Blood vessels of the pulmonary circulation are blood vessels (arteries and veins) that carry blood from the right ventricle of the heart to the lungs and back to the left auricle. These include: Pulmonary arteries and Pulmonary Veins. While blood vessels of the pulmonary circulation are blood vessels (arteries and veins) that carry blood from the left ventricle of the heart to the tissues of the body and back to	15mins

		the right auricle. They include: Aorta, Carotid Artery, Jugular Veins, Subclavian Artery , Subclarian Vein, Hepatic Artery, Hepatic Vein, Mesentric Artery, Hepatic Portal Vein, Renal Artery, Renal Vein, Iliac Artery, Iliac Vein, Superior/Anterior Vena Cava, Inferior/Posterior Vena Cava. They stransport blood to different parts of the body-	
Step 6	Narrator on focus explaining double circulation	Mammals (man) are said to have double circulation. This implies that for one complete circulation, blood has to pass through the heart twice, each time going through a separate path way. The two path ways are referred to as the pulmonary circulation and the systemic circulation. The sequence involved in double circulation is that blood from any part of the body enters the heart for the first time, is then sent to the	15mins

		lungs for oxygenation and from here is brought back to the heart for the second time before it can be redistributed to all parts of the body.	
Step 7 Evaluation	Narrator on focus 1. Briefly Discuss the procedure of blood circulation in the body. 2. Explain the following terms – double circulation, pulmonary circulation and systemic circulation 3. State two blood vessels associated with pulmonary circulation 4. State five blood vessels associated with systemic circulation	We have come to the end of lesson two and the end of the lesson on blood circulation. In the next lesson we will start with excretion. Answer these questions to evaluate ourselves on how far we understood the lesson.	10mins

SCRIPT 3

EXCRETION IN MAMMALS (MAN)

DURATION 80MINS

STEPS	VISUAL	AUDIO	TIME
Step 1	Opening Graphics	Signature tune	2mins
Step 2 Introduction	Narrator on Focus	Hello students you are welcome to Biology class. In the last lesson we concluded our study on blood circulation. In this lesson, we are starting with the second sub-topic which is excretion.	3mins
Step 3 Objectives	At the end of the lesson students should be able to 1. Explain what excretion is. 2. Mention three excretory products in man and their sites of excretion. 3. List at least three components of excretory system. 4. mention three parts as seen in the longitudinal section through a kidney. 5. List four components of a nephron. 6. Explain briefly the mechanism	At the end of this lesson, there are expectations from you, the things you should be able to do. They are the objectives, which include the following:	5mins

	of excretion (urine production)		
Step 4 Objective I & 2	Narrator on focus	Excretion is the removal of waste products from the body of a living organism. The principal products excreted by mammals are carbon dioxide, water and Nitrogenous waste. Carbon dioxide is excreted from the lungs as an animal exhales; water is excreted from the lungs, skin and kidney, while Nitrogenous wastes are excreted from the Kidneys to form part of the urine. The excretion by the kidney is done in a system called excretory system/urinary system.	10mins

Step 5 Structure of excretory system	Narrator and model of excretory system on focus	Excretory system consists of two kidneys, two ureters, the bladder and the urethra. At the concave edge of the kidney lies a depression, the helium, from which the ureters arise. At this point also the renal artery from the dorsal aorta enters the kidney bringing blood containing excretory products while the renal vein drains filtered blood from the kidney to the posterior vena cava. All these structures especially kidney, works together for effective removal of waste.	10mins
Step 6	Narrator and the model of L/S of kidney on focus	The longitudinal section (L/S) of the kidney shows that it consists of two distinct regions, an outer cortex and the inner medulla. The medulla extends as	10mins

		projections called pyramid into the pelvis. The pelvis is the widened end of the ureter, in contact with the kidney. Each kidney consists of over one million of a system of tubules or nephron and an extensive network of blood capillaries in close contact with the nephrons. The nephron is the functional unit of the Kidney	
Step 7 Structure of nephron and mechanism of excretion(urine production)ss	Model of Nephron on focus	Each nephron has the following parts: (**i**). An enlarged ending called Bowman's capsule in which sits a knot of blood capillaries called glomerulus, (**ii)** The proximal tubule (**iii).** U-shaped loop of Henle having descending limb and ascending limb and (**IV).** The distal tubule	30mins

		which empties into a collecting tubule. All along its course, the tubule is closely associated with several networks of blood capillaries. As blood brought to the kidney by the renal artery flows through the glomerulus, high pressure is built majorly because the blood vessel leading from the glomerulus is narrower than the vessel leading to it. Consequently, substances in the blood such as nitrogenous waste, water mineral salts, and glucose and plasma solutes are filtered into the Bowman's capsule by a process known as ultra-filtration to become glomerular filtrate. Other materials like blood corpuscles and plasma protein which cannot filter through	

		remain in the blood streams. As the filtrate passes through the tubule many of the solutes and water which are useful to the body are reabsorbed back into the blood capillaries by a process known as selective re-absorption. Specifically, as the filtrate passes through the proximal tubule, about 65% (solute & water) of the filtrate volume is reabsorbed. In the descending limb of Henle's loop 15% of the filtrate volume is reabsorbed. In the distal tubule and collecting duct, 19% of the filtrate volume is re-absorbed. This implies that as the filtrate passes from proximal tubule to the collecting duct, about 99% of the original filtrate volume is reabsorbed.	

		These materials flow through the renal veins to enter the general circulation. Only 1% of the original filtrate volume remains as urine. Urine is mostly water and contains organic waste products such as urea, uric acid and creatinine as well as excess ions. The urine so formed trickles down the ureter and collects in the bladder which stretches to accommodate it. When the bladder is full, the urethral sphincter relaxes allowing the urine to pass out of the body through the urethra.	
Step 8 Evaluation	Narrator and model on focus 1. What is Excretion? 2. Mention three excretory products in the body and state their site of removal. 3. State any three	This has brought us to the end of the lesson on excretion. At the beginning of the lesson we had objective. At the end of this lesson we shall evaluate ourselves through these questions.	10mins

	components of the excretory system. 4. Describe the longitudinal section (L/S) of a kidney. 5. Describe briefly the mechanism of excretion in the kidney (urine production).		

APPENDIX J

COST ANALYSIS FOR THE DEVELOPED MODELS AND VIDEO DVD PACKAGE

The cost of producing the biology models (Internal Structure of the Heart, Circulatory System, Excretory System and Kidney Nephron) and Video DVD instructional package was based on the prevailing market value and in some cases discretional estimates. While some components could be quantified on their market values, certain other items would best be described as scraps or recycled materials, had monetary values ascribed to them by the discretion of the researcher.

The table below presents the cost of the materials used in this research as obtained in Minna as at the time of this study.

MATERIAL COST FOR THE DEVELOPED INSTRUCTIONAL MEDIA

S/NO.	LIST OF MATERIALS	QUANTITY	TOTAL COST
1	Madobia Wood	122cm by 62cm (1) 75cm by 62cm (1)	1200 1000
2	Sand Papers (rough & smooth)	4 Pieces	200
3	Poly Guard	½ Liter	200
4	Salignum	½ Liter	200
5	Auto Paints	Assorted Colour	900
6	Body Filler	14kg	1000

7	½ inch Plywood (4ft * 8ft)	2 Sheets	1200
8	General Purpose white glue (top bond)	4 Small Cans	800
9	Cement	2kg	75
10	Rope	3 Yards	60
11	¾’’ Particle board (2ft * 4ft)	1 Sheet	300
12	Nails		170
13	Aluminum Frame	4	5,500
14	Plastic glass	4	5,000
15	Door Handle and Hinges	8	520
16	Rechargeable Battery (12V)	1	1700
17	Bulbs (red, blue, white)		1000
18	Main Circuit	1	1000
19	Wires		1000
20	Scrabs		500
21	Master Tape	1	1000
22	DVD Plates	4	2,000
	TOTAL		**26,525.00**

OVERHEAD COST

This includes miscellaneous expenses other than the cost of materials or labor cost. Overhead cost is calculated as 15% of the material cost, that is -

Overhead cost = 15

100 x Material cost = **N3,978.75**

LABOUR COST

This includes the expenses incurred from consultations, use of facilities and the work done. Labour cost is calculated as 30% of the material cost, that is-

Labour Cost = 30

100 x Material Cost =**N7,957.50**

The total cost (T) is given by

T = M + O + L

Where M = Material Cost.

O = Overhead Cost.

L = Labour Cost.

Therefore T = 26,525.00 + N3,978.75 + N7,957.50= **N38,461.25**

The total cost of developing the models and Video (DVD) instructional package is Thirty Eight thousand four hundred and sixty one naira twenty five kobo only (N38,461.25) Comparing the cost of these locally developed instructional media with the imported prototype shows that it is cost effective and affordable.

APPENDIX K

STRUCTURED BIOLOGY ACHIEVEMENT TEST (SBAT) AND THE MARKING SCHEME

Dear Students, these questions are designed to carry out academic research on the Evaluation of the Effects of Improvised Instructional Media on Niger State Secondary School Student's achievement in selected Biology concepts. All information provided remains confidential, so we solicit for your co-operation towards the success of the research.

STRUCTURED BIOLOGY ACHIEVEMENT TEST (SBAT)

SECTION A

PERSONAL DATA

INSTRUCTIONS

(a) Respond by filling or ticking the appropriate answer to the questions.

1 Name of the student

2. Name of the School:

3. Class:

4. Gender: Male ☐ female ☐

4. Age: 10-15 ☐ 1 16-20 ☐ 21-25 ☐

SECTION B

MUITIPLE CHOICE OBJECTIVE TEST ITEMS (SBAT)

INSTRUCTIONS:

a. Please, read the questions carefully, each question is followed by five options lettered A-E. Find out the correct option and circle it with pencil on the question paper.

b. Give only one answer to each item/question.

c. Erase any incorrect answers properly before choosing another option.

d. you are free to ask question for clearance in respect of any item on which you need further explanations.

e. Answer all the questions

f. Time allowed is 40 minutes

1. The wall of the heart is made up of a thick muscle known as:-

   A. Cardial Muscle.

   B. Cardiac Muscle

   C. Cardium Muscle

   D. Carditis Muscle

   E. Carditinum Muscle.

2. The left side of the heart forces blood to flow to all other tissues of the body and back to the right side of the heart through vessels. This circulation is known as:-

   A. Capillaric circulation.

   B. Systemic circulation

   C. Pulmonary circulation

   D. Veinary circulation.

   E. Arternary circulation

3. The bicuspid valve is located between the

   A. left auricle and left ventricle

   B. aorta and left auricle

   C. superior vena cava and inferior vana cava

   D. right auricle and superior vana cava

E. right auricle and right ventricle.

4. The pulmonary artery carries

A. oxygenated blood from the lungs to the right auricle

B. oxygenated blood from the right ventricle to the lungs

C. oxygenated blood from the left ventricle to the right auricle

D. deoxygenated blood from the left ventricle to the lungs

E. deoxygenated blood from the right ventricle to the lungs

5. Which of the following blood vessels carry oxygenated blood into the heart?

A. Pulmonary artery

B. Aorta

C. Pulmonary vein

D. Anterior vena cava

E. Posterior vena cava

6. Which of these blood vessels transport blood from the small intestine to the liver?

A. Hepatic portal vein

B. Renal artery

C. Aorta

D. Subclavian artery

E. Anterior vena cava

7. The heart is divided into the right and left halves by the

A. Tricuspid valve

B. Bicuspid valve

C. Septum

D. Semilunar valve

E. Chordea tendinae

8. Mammals posses a close circulatory system which implies that

A In the circulation of blood, all blood are mixed up in the heart

B. In the circulation of blood, all blood are enclosed in vessels

C. In the circulation of blood, there is no mixing of oxygenated and deoxygenated blood in the heart

D. In the circulation of blood, there is no mixing of oxygenated and deoxygenated blood in the lungs

E. In the circulation of blood, there is no mixing of oxygenated and deoxygenated blood in the body.

9. The heart is an organ found in the ____________system of the body

A. Circulatory

B. Digestive

C. Excretory

D. reproductive

E. respiratory

10. Which of the following statements about the circulation of blood is NOT correct?

A. Deoxygenated blood flows in to the heart through the vena cava

D. Blood is pumped out of the heart through the aorta to the rest of the body.

C. Oxygenated blood from the lungs is carried to the left auricle

D. Deoxygenated blood enters the lungs through the pulmonary vein

E. Left ventricles contract to pump blood into the aorta

11. Two anterior venae cavae and posterior vena cava carry deoxygenated blood froms all parts of the body except____________to the heart.

A. head

B. lungs

C. limbs

D. intestine

E. liver

The figure below is a longitudinal section of mammalian heart. Use it to answer question 12-22

12. Which of the labelled structures stand for bicuspid valve?

A. V

B. ii

C. vi

D. i

E. iv

13 Which of the labelled structures carry oxygenated blood into the heart?

A. III

B. I

C. II

D. III

E. VII

14 Which of the structures labelled carry deoxygenated blood to the lungs?

A. IV

B. II

C. VII

D. III

E. VII

15. The posterior/inferior vena cava is represented by.

A. VIII

B. VII

C. IX

D. I

E. III

16. The flow of blood from the right auricle to the right ventricle is allowed by the structures labelled.

A. II

B. IV

C. I

D. VI

E. V

17. The blood vessel that carries oxygenate blood to the liver is called.

A. hepatic artery

B. renal artery

C. iliac artery

D. iliac Veins

E. hepatic vein

18. Jugular veins carry deoxygenated blood away from ____________________part of the body

A. Intestine

B. Head

C. Genital organs

D. Liver

E. Stomach

19. Filtered/ deoxygenated blood from the Kidney is carried back to the circulatory system through the

A. hepatic portal vein

B. renal artery

C. renal vein

D. pulmonary vein

E. vena cava

The figure below is a cross section of the human kidney; use it to answers question 20-22

20. In which of the following labelled structures will the glomerulus be found?

A. I

B. II

C. III

D. IV

E. VI

21. Which of the following labeled structures represent the pelvis?

A. I

B. IV

C. V

D. VI

E. II

22. Which of the following labeled structures represent the ureter?

A. II

B. III

C. IV

D. V1

E. V

23. The functional unit of the kidney is called

A. nephron

B. cortex

C. medulla

D. pelvis

E. ureter

24. The following parts of a nephron (urinary tubule) are found in the cortex of the kidney except

A. Bowman's capsule

B. Glomerulus,

C. The proximal tubule

D. Loop of Henle

E. Distal tubule.

25. The urinary system consists of

A. Two kidneys, two ureters, the urinary bladder and the urethra.

B. Two kidneys, a ureter, two urinary bladders and the urethra

C. A kidney, two ureters, two urinary bladders and the urethra

D. Two kidneys, a ureter, urinary bladder and the urethra

E. A kidney, a ureter, renal vein, pelvis

26. The cup-shaped part of the Bowman's capsule contains the

A. nephridium

B. glomerulus

C. Ioop of Henle

D. nephron

E. Convoluted tubule

27. The outer edge of the kidney is convex while the inner edge is concave, at the concave edge of the kidney lies a depression called

A. capsule

B. ureter

C. renal artery

D. hilum

E. renal vein

28. The blood vessels in the cavity of the Bowman's capsule are collectively known as:-

A. renal vein

B. renal arteries

C. glomerulus

D. renal capillaries

E. vena cava

29. Ultra filtration in the kidney takes place in the

A. Bowman's capsule

B. Loop of Henle

C. pelvis

D. renal vein

E. pyramid

30. The kidney is connected to the urinary bladder by the

A. urethra

B. pelvic

C. renal artery

D. renal vein

E. ureter

31. All vertebrates have

A. A kidney

B. A pair of kidney

C. Two pairs of kidney

D. Three pairs of kidney

E. Four pairs of kidney.

32. The mechanism by which useful materials in the glomerular filtrate are taken back into the blood is known as

A. filtration

B. selective reabsorption

C. heterolysis

D. osmosis

E. dialysis

33. Pulmonary circulation is the circulation

A. between the heart and the lungs

B. between the heart and the head

C. between the lungs and the head.

D. between the lungs and the liver

E. between pulmonary artery and the lungs

34. The kidney in mammals is located at

A. chest cavity and attached to the dorsal wall

B. cauvdal cavity and attached to the dorsal wall

C. abdominal cavity and attached to the dorsal wall

D. hip cavity and attached to the ventral wall

E. clavian cavity and attached to the dorsal wall.

35. Mammals are said to display a pattern of double circulation. This implies that

A. for one complete circulation, blood has to pass through the heart twice, each time going through the same pathway.

b. for one complete circulation, blood has to pass through the heart twice, each time going through a separate pathways.

C. for one complete circulation, blood has to pass through the heart many times through separate pathways.

D. for one complete circulation blood has to pass through the heart once through the same pathway.

E. for one complete circulation, blood has to pass through the heart once through separate pathways.

36. During ultra filtration, these materials are filtered into Bowman's capsule EXCEPT

A. Water

B. Urea

C. Plasma protein

D. Mineral salts

E. Sugar

37. The following are adaptations of the mammalian heart to its functions EXCEPT.

A. It is divided unto four chambers

B. The chambers are separated by valves

C. Its walls are thick and muscular

D. The auricles have thin wall while ventricles have thicker walls.

E. The heart is dark colour and oval in shape.

38. The heart of an adult human at rest beats about__________ time's per-minute

A. 50-70

B. 70-75

C. 75-80

D. 80-95

E. 35-50

39. Which of the following statements is NOT true of the systole phase of heart beat?

A. The ventricles contract

B. The Ventricles force blood along aorta and pulmonary artery.

C. The auricles relax

D. The auricles contract

E. The auricles begin to fill up with blood

40. In an average man, the urge to urinate usually arises when about ________cm^3 of urine have collected in the bladder

A. 100-200

B. 200-300

C. 50-100

D. 300-400

E. 100-150

MARKING SCHEME FOR SBAT

1. B
2. B
3. A
4. E
5. C
6. A
7. C
8. C

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

APPENDIX L

SAMPLE LESSON PLANS FOR EXPERIMENTAL AND CONTROL GROUPS

LESSON ONE FOR EXPERIMENTAL GROUP 1

Subject: Biology

Topic: Transport system

Sub- Topic: Blood Circulation

Class: SS II

Time: 80 Minutes (Double period)

Average age of students: 15years.

Behavioral Objectives: At the end of the lesson, the students should be able to;

1 Explain what transport system is.

2 Explain human blood circulation and circulatory system.

3 Mention the components of circulatory system.

4 Differentiate between open and close circulation.

5 Briefly describe the internal structure of the heart.

6 Differentiate between systolic and diastolic phases of heartbeat.

Instructional Materials: Developed models (heart structure and circulatory System)

Previous Knowledge: The students have learnt about blood groups. They also know that they have blood and heart in their body. Specific questions that can reveal what the students know and arouse their interest will be asked thus:-

(i) Hold the centre portion of your chest and explain what you feel

(ii) al portion of your chest and explain what you feel

(iii) Hold your wrist tightly and explain your observations.

(iv) Mention the types of blood corpuscles.

Introduction: An overview of what to be learnt in terms of knowledge and skills objective of the lesson will be given.

Presentation

Step I: Transport system in animals is to be discussed and explained. Thus, transport system in animals is the system through which food and energy needed by cells of animals are supplied and waste products formed in the cells are gotten rid of promptly. In man, transport system consists essentially of a single hollow pumping structure (heart) connected to cylindrical branching tubes (blood vessels) making up a system called circulatory system. The whole system is filled with a liquid transport medium, the blood.

Step II: The concepts of blood circulation and circulatory system and blood vessels are to be discussed and explained. Thus, blood is the medium for transporting materials in complex organisms like man. It is the fluid, red in colour due to presence of oxy-haemoglobin in the red blood cells. The blood moves/circulates materials continuously round the body of animals. The continuous movement of blood round the body is called blood circulation and the system through which this movement occurs is called circulatory system. This system thus, is the network through which blood circulates continuously through the heart and blood vessels (arteries, arterioles, veins, venules and capillaries). Arteries and Arterioles transport blood away from the heart to the different parts of the body. While veins and venules transport blood from the body back to the heart. Capillaries connect arterioles and the venules within the body parts. The components of circulatory system thus are the heart and the blood vessels. The model of circulatory system will be presented with emphasis on the heart and blood vessels as the two major components. Names of various parts of the circulatory system and their functions will be made clear from the model.

Step III: The teacher explains open and close circulatory systems as follows- Close circulatory system is the system where the blood vessels branch many times into smaller units but eventually join up with other vessels connected to the heart. In this system, blood is always confined within the cavities and never in direct contact with cells of the body. In open circulatory system, the blood vessels lead out of the heart and end in blood spaces within the blood cavity. Here the blood comes into direct contact with the cells after which it is returned to the heart.

Step IV: Using the illuminated model of the heart, the structure of the heart as the engine house (pumping action) in the circulatory system will be discussed. The parts of the heart and their functions will be explained with emphasis on the model as follows:

(a) Cardiac muscles – enables the heart to go on pumping continuously.

(b) Septum – divides the heart into a right and left half with no connection between the two.

(c) Left auricle and left ventricle – contain blood with oxygen (oxygenated blood).

(d) Right auricle and right ventricle – contain blood without oxygen (deoxygenated blood).

(e) Bicuspid valve – ensures that blood flows in one direction from left auricle to left ventricle.

(f) Tricuspid valve – ensures that blood flows in one direction from right auricle to right ventricle.

(g) Semi-lunar valves – ensures that blood flows in one direction from left ventricle to aorta and from right ventricle to pulmonary artery.

(h) Aorta – Carries oxygenated blood to all parts of the body except the lungs.

(i) Vena cava (posterior and interior) – return deoxygenated blood to the heart from all parts of body except the lungs.

(j) Pulmonary artery – carries deoxygenated blood from the heart to the lungs

(k) Pulmonary vein-returns oxygenated blood from the lungs to the heart.

With the aid of the models, the students learn by identifying, naming and stating the functions of the heart and the blood vessels. This exercise continues until mastery is shown.

Step V: Using the model, the pumping action of the heart (diastolic and systolic phase) will be explained

The teacher entertains questions from the students and clarifies areas of difficulty if any.

Evaluation: The teacher asks the students the following questions.

1. Explain transport system in animals
2. Differentiate between blood circulation and circulatory system.
3. Mention the two major components of the circulatory system.
4. Briefly describe the structure of human heart.
5. Describe systolic phase of heartbeat

Conclusion: The teacher summarizes the lesson with emphasis on identified areas of difficulty.

LESSON TWO FOR EXPERIMENTAL GROUP 1

Subject: Biology

Topic: Blood Circulation

Class: SS II

Time: 80 MINUTES (Double period)

Average age of students: 15years.

Behavioral Objectives: At the end of the lesson, the students should be able to;

1 Explain blood circulation.

2 Discuss the procedure in the blood flow through circulatory system.

3 Explain double circulation and differentiate between pulmonary and systemic circulation.

4 Explain the concept "closed circulation".

5 State two blood vessels of pulmonary circulation, five bloods Vessels of systemic circulation and their areas of operation structional

Materials: Developed models (heart structure and circulatory system) and lecture method

Previous Knowledge: The students have learnt about circulatory system. They also have learnt the structure and functioning of the heart. Specific questions that can reveal what the students know will be asked thus:-

1 Mention the components of circulatory system.

2 Mention the names of the four chambers of the heart.

Introduction: An overview of what to be learnt in terms of knowledge and skills objective of the lesson will be given.

Presentation

Step I: The concept of blood circulation and blood vessels will be clarified. The continuous movement of blood round the body is called blood circulation. The illuminated model of circulatory system will be used to explain the procedure in the blood flow through the circulatory system.

Step II: The teacher explains the processes of close, open, double, systemic and pulmonary circulations. Close circulation implies that there is no mixing of oxygenated and deoxygenated blood in the heart. Oxygenated blood is confined to the left side of the heart while deoxygenated blood is confined to the right side. Double circulation implies that for one complete circulation, blood has to pass through the heart twice, each time going through a separate path way. The two path ways are referred to as the pulmonary circulation and the systemic circulation. The sequence involved in double circulation is that blood from any part of the body enters the heart for the first time, is then sent to the lungs for oxygenation and from here is brought back to the heart for the second time before it can be redistributed to all parts of the body. The pulmonary circulation is between the heart and the lungs while systematic circulation is between the heart and all parts of the body beside the lungs.

Step III: With the aid of the models, the teacher emphasizes on the blood vessels of the systemic and pulmonary circulation and their areas of operation. Thus:

BLOOD VESSELS OF THE PULMONARY CIRCULATION

BLOOD VESSELS	DESIGNATION
Pulmonary arteries	Carry deoxygenated blood from the right ventricle of the heart to the lungs.
Pulmonary Veins	Carry oxygenated blood from lungs to the left auricle of the heart.

BLOOD VESSELS OF THE SYSTEMIC CIRCULATION

BLOOD VESSELS	DESIGNATION
Aorta	Carries blood from the heart and distributes to specific arteries.
Carotid Artery	To head and neck.
Jugular Veins	From head and neck to vena cava
Subclavian Artery	To fore limbs
Subclarian Vein	From fore limbs to vena cava
Hepatic Artery	To liver
Hepatic Vein	From liver to vena cava.
Mesentric Artery	To stomach and intestine
Hepatic Portal Vein	From stomach and intestine to Vena Cava
Renal Arteries	To kidney
Renal Veins	From kidney to vena cava
Iliac Arteries	To hind limbs
Iliac Veins	From hind limbs to vena cava

Superior/anterior Vena Cava	From head & fore limbs to the heart
Interior/Posterior Venae Cava	From the rest of the body beside the head, fore limbs & lungs to the heart.

Step IV: The teacher asks and answers questions from the students.

Evaluation: These questions will be written on the board for

Students to answer.

1. Briefly discuss the procedure of blood circulation in the body.
2. Explain the following terms- double circulation pulmonary circulation and systemic circulation
3. State two blood vessels associated with pulmonary circulation
4. State five blood vessels associated with systemic circulation.
5. Differentiate between systemic and pulmonary circulation.

Conclusion:

The teacher summarizes the lesson with emphasis on identified areas of difficulty. They will be given notes to copy inside their note books.

LESSON THREE FOR EXPERIMENTAL GROUP 1

Subject: Biology

Topic: Excretion in man

Class: SS II

Time: 80 MINUTES (Double period)

Average age of students: 15years.

Behavioral Objectives: At the end of the lesson, the students should be able to;

1 Explain what excretion is.

2 Mention three excretory products in man and site of excretion.

3 List the components of excretory system.

4 Mention the parts as seen in longitudinal section through a kidney.

5 List the components of a nephron.

2 Explain the mechanism of excretion by the kidney (Urine Production).

Instructional Materials:. Developed models (Excretory system and kidney nephron) and lecture method.

Previous Knowledge: The students have learnt about circulation of blood. They also have learnt the structure and functioning of the heart. Specific questions that can reveal what the students know will be asked thus:-

1 Differentiate between systemic and pulmonary circulation.

2 State two blood vessels associated with pulmonary Circulation

3 State five blood vessels associated with systemic. Circulation

Introduction: An overview of what to be learnt in terms of knowledge and skills objective of the lesson will be given.

Presentation

Step I: The concept of excretion, excretory products and their site of removal are to be discussed and explained. Excretion is the removal of waste products from the body of a living organism. The principal products excreted by mammals are carbon dioxide, water and Nitrogenous waste. Carbon dioxide is excreted from the lungs as an animal exhales; water is excreted from the lungs, skin and kidney, while Nitrogenous wastes are excreted from the Kidneys to form part of the urine. The excretion by the kidney is done in a system called excretory system/urinary system.

Step II: Using the model of excretory system, the teacher explains its various parts with emphasis on the kidney as the key part of the system. The system consists of two kidneys, two ureters, the bladder and the urethra. At the concave edge of the kidney lies a depression, the helium, from which the ureters arise. At this point also the renal artery from the dorsal aorta enters the kidney bringing blood containing excretory products while the renal vein drains filtered blood from the kidney to the posterior vena cava. All these structures especially kidney, works together for effective removal of waste.

Step III: The teacher shows the internal structure of the kidney and explains the parts with emphasis on its functional unit – the nephron.

The longitudinal section (L/S) of the kidney shows that it consists of two distinct regions, an outer cortex and the inner medulla. The medulla extends as projections into the pelvis called pyramids. The pelvis is the widened end of the ureter, in contact with the kidney. Each kidney consists of over one million of a system of tubules or nephron and an extensive network of blood capillaries in close contact with the nephrons. The nephron is the functional unit of the Kidney.

Step IV: Using the model of the nephron, the structure is explained. Each nephron has the following parts: **(i)**. An enlarged ending called Bowman's capsule in which sits a knot of blood capillaries called glomerulus, (**ii)** The proximal tubule (**iii).** U-shaped loop of Henle having descending limb and ascending limb and (**IV).** The distal tubule which empties into a collecting tubule. All along its course, the tubule is closely associated with several networks of blood capillaries.

Step v: With reference to the structure of the nephron the mechanism of excretion will be discussed as follows: As blood brought to the kidney by the renal artery flows through the glomerulus, high pressure is built majorly because the blood vessel leading from the glomerulus is narrower than the vessel leading to it. Consequently, substances in the blood such as nitrogenous waste, water mineral salts, and glucose and plasma solutes are filtered into the Bowman's capsule by a process known as ultra-filtration to become glomerular filtrate. Other materials like blood corpuscles and plasma protein which cannot filter through remain in the blood streams. As the filtrate passes through the tubule many of the solutes and water which are useful to the body are reabsorbed back into the blood capillaries by a process known as selective re-absorption.

Specifically, as the filtrate passes through the proximal tubule, about 65% (solute & water) of the filtrate volume is reabsorbed. In the descending limb of Henle's loop 15% of the filtrate volume is reabsorbed. In the distal tubule and collecting duct, 19% of the filtrate volume is re-absorbed. This implies that as the filtrate passes from proximal tubule to the collecting duct, about 99% of the original filtrate volume is reabsorbed. These materials flow through the renal veins to enter the general circulation.

Only 1% of the original filtrate volume remains as urine. Urine is mostly water and contains organic waste products such as urea, uric acid and creatinine as well as excess ions. The urine so formed trickles down the ureter and collects in the bladder which stretches to accommodate it. When the bladder is full, the urethral sphincter relaxes allowing the urine to pass out of the body through the urethra.

Evaluation: The teacher answers questions from students and in turn asks them the following questions.

1. What is excretion?
2. Mention three excretory products in the body and state their site of removal
3. State any three components of excretory system.
4. Briefly describe the structure of the kidney as seen in its L/S.

Conclusion: The teacher summaries the lesson with emphasis on identified areas of difficulties.

LESSON ONE FOR EXPERIMENTAL GROUP 2

Subject: Biology

Topic: Transport system

Sub- Topic: Blood Circulation

Class: SS II

Time: 80 Minutes (Double period)

Average age of students: 15years.

Behavioral Objectives: At the end of the lesson, the students should be able to;

1 Explain what transport system is.

2 Explain human blood circulation and circulatory system.

3 Mention the components of circulatory system.

4 Differentiate between open and close circulation.

5 Briefly describe the internal structure of the heart.

7 Differentiate between systolic and diastolic phases of heartbeat.

Instructional Materials: Video DVD instructional package

Previous Knowledge: The students have learnt about blood groups. They also know that they have blood and heart in their body.

Introduction: An overview of what to be learnt in terms of knowledge and skills objective of the lesson will be given. The lesson is introduced in a way as to arouse the interest of the students.

Presentation

Step I: The video DVD instructional package will display the narrations on transport systems in animals as it is linked to human blood circulation and excretion and as it is different from other means of transport. The teacher views the instructional package along with the students as the narration goes on in this way- transport system in animals is the system through which food and energy needed by cells of animals are supplied and waste products formed in the cells are gotten rid of promptly. In man, transport system consists essentially of a single hollow pumping structure (heart) connected to cylindrical branching tubes (blood vessels) making up a system called circulatory system. The whole system is filled with a liquid transport medium, the blood.

Step II: It will be made clear to the viewers (students) that the lesson will mostly be focused on circulatory system for a better understanding of blood circulation in the next lesson. The package continues with narrations on the concepts of blood, blood circulation, circulatory system and blood vessels. This procedure is to make students see the link between them, thus, blood is the medium for transporting materials in complex organisms like man while blood circulation is the continuous movement of blood in the circulatory system round the body. Circulatory system thus, is the network through which blood circulates needed materials continuously to the different parts of the body. The components of circulatory system are the heart and the blood vessels (arteries, arterioles, veins, venules and capillaries). Differences between arteries, veins, close and open circulation will be pointed out.

Step III. The model of illuminated circulatory system will be displayed on the screen with the narration emphasizing on the heart and blood vessels. Names of various parts of the circulatory system and their functions will be made clear from the model. The teacher pauses and rewinds the tape at intervals to allow for clarification and mastery on the parts of the student and for emphasis if any by the teacher.

Step IV: With the model of the illuminated heart on the screen,the narration on the structures of the heart and their functions will continue like this;- The heart of all mammals is cone shaped, made up of special muscles known as cardiac muscles and enveloped in a thin pericardium. Using the illumination procedure, the structure is explained as follows-

The heart is divided into two halves (right and left half) by a central wall called septum. Each half has two chambers, upper chambers, the auricles and lower chambers, the ventricles. This gives rise to four chambers known as the left auricle, the left ventricle, the right auricle and right ventricle. Between the left auricle and left ventricle is a valve known as bicuspid valve and between right auricle and right ventricle is the tricuspid valve. From left ventricle originates the aorta and from right ventricle originates pulmonary artery. On the inner walls of the aorta and pulmonary artery are the semi lunar valves. Entering the left auricle are the pulmonary veins and entering the right auricle are the venea cavea. The functions of the features in the heart will be clarified.

(a) Cardiac muscles – enables the heart to go on pumping continuously.

(b) Septum – divides the heart into a right and left half with no connection between the two.

(c) Left auricle and left ventricle – contain blood with oxygen (oxygenated blood).

(d) Right auricle and right ventricle – contain blood without oxygen (deoxygenated blood).

(e) Bicuspid valve – ensures that blood flows in one direction from left auricle to left ventricle.

(f) Tricuspid valve – ensures that blood flows in one direction from right auricle to right ventricle.

(g) Semi-lunar valves – ensures that blood flows in one direction from left ventricle to aorta and from right ventricle to pulmonary artery.

(h) Aorta – Carries oxygenated blood to all parts of the body except the lungs.

(i) Vena cava (posterior and interior) – return deoxygenated blood to the heart from all parts of body except the lungs.

(j) Pulmonary artery – carries deoxygenated blood from the heart to the lungs

(k) Pulmonary vein-returns oxygenated blood from the lungs to the heart.

Step V: The narration on the functioning of the heart (diastolic and systolic phases) continues thus - At the Diastole stage, the two auricles contract, creating a high pressure in the blood contained in them. This pressure causes the bicuspid and tricuspid valves to open so allowing blood to flow from auricles into the ventricles. Thus, deoxygenated blood enters the right ventricle and oxygenated blood enters the left ventricle. When the ventricles are filled up, the cuspid valves close up.

At the systole stage, the two ventricles contract, force open the Semi-lunar valves and the blood flows into the two trunks of the main arteries (pulmonary artery and the aorta). While this is happening, blood from the body is filling up the auricles again. The first stage (diastole) of the next heart beat then follows after a short lapse of time and the cycle repeats itself

Evaluation: The teacher entertains questions from the students and clarifies areas of difficulty by pausing, rewinding, and fast forward the DVD package for the student's mastering of the lesson and for further clarifications by the teacher.

These questions will be displayed on the screen for students to answer.

1 Explain transport system in animals

2 Differentiate between blood circulation and circulatory system.

3 Mention any five components of the circulatory system.

4 Briefly describe the structure of human heart.

5 Describe systolic phase of heartbeat

6 State the names of any three arteries and corresponding veins that enter and leave any three named parts of the body.

7 Differentiate between systemic and pulmonary circulation.

Conclusion: The teacher clarifies any identified difficulties in the DVD instructional package.

LESSON TWO FOR EXPERIMENTAL GROUP 2

Subject: Biology

Topic: Blood Circulation

Class: SS II

Time: 80 MINUTES (Double period)

Average age of students: 15years.

Behavioral Objectives: At the end of the lesson, the students should be able to;

1 Explain what blood circulation is.

2 Discuss the procedure in the blood flow through circulatory system.

3 Explain double circulation and differentiate between pulmonary and systemic circulation.

4 Explain the concept "closed circulation".

5 State two blood vessels of pulmonary circulation, five blood Vessels of systemic circulation and their areas of operation

Instructional Materials: Video DVD instructional package

Previous Knowledge: The students have learnt about circulatory system. They also have learnt the structure and functioning of the heart. Specific questions that can reveal what the students know will be asked thus:-

1 Mention the components of circulatory system.

2 Mention the names of the four chambers of the heart.

Introduction: An overview of what to be learnt in terms of knowledge and skills objective of the lesson will be given.

Presentation

Step I: The video DVD instructional package on the concept blood circulation will be played. The narration on the procedure in the blood flow through the circulatory system goes on. The illuminated model of circulatory system will be displayed on the screen and be used to explain the procedure in the blood flow.

Step II: The narration continues, explaining the concepts of pulmonary and systemic circulations and their associated blood vessels. The pulmonary circulation is between the heart and the lungs while systematic circulation is between the heart and all parts of the body beside the lungs.

BLOOD VESSELS OF THE PULMONARY CIRCULATION

BLOOD VESSELS	**DESIGNATION**
Pulmonary arteries	Carry deoxygenated blood from the right ventricle of the heart to the lungs.
Pulmonary Veins	Carry oxygenated blood from lungs to the left auricle of the heart.

BLOOD VESSELS OF THE SYSTEMIC CIRCULATION

BLOOD VESSELS	**DESIGNATION**
Aorta	Carries blood from the heart and distributes to specific arteries.

Carotid Artery	To head and neck.
Jugular Veins	From head and neck to vena cava
Subclavian Artery	To fore limbs
Subclarian Vein	From fore limbs to vena cava
Hepatic Artery	To liver
Hepatic Vein	From liver to vena cava.
Mesentric Artery	To stomach and intestine
Hepatic Portal Vein	From stomach and intestine to Vena Cava
Renal Arteries	To kidney
Renal Veins	From kidney to vena cava
Iliac Arteries	To hind limbs
Iliac Veins	From hind limbs to vena cava
Superior/anterior Vena Cava	From head & fore limbs to the heart
Interior/Posterior Venae Cava	From the rest of the body beside the head, fore limbs & lungs to the heart.

Step III: The teacher pauses, rewind, and fast forward the DVD package for better mastering of the subject matter.

Step IV: The package continues with the explanations on closed circulation and double circulation in this way- Closed circulation implies that there is no mixing of oxygenated and deoxygenated blood in the heart; oxygenated blood is confined to the left side of the heart while deoxygenated blood is confined to the right side. Double circulation implies that for one complete circulation, blood has to pass through the heart twice, each time going through a separate path way. The two path ways are referred to as the pulmonary circulation and the systemic circulation. The sequence involved in double circulation is that blood from any part of the body enters the heart for the first time; it is then sent to the lungs for oxygenation and from here is brought back to the heart for the second time before it can be redistributed to all parts of the body.

Step V: The narration will be paused for questions from the students on the areas of difficulty. The teacher rewinds or fast forwards the package for clarification

Evaluation: These questions will be displayed on the screen for students to answer.

6. Briefly discuss the procedure of blood circulation in the body.
7. Explain the following terms- double circulation pulmonary circulation and systemic circulation
8. State two blood vessels associated with pulmonary circulation
9. State five blood vessels associated with systemic circulation.
10. Differentiate between systemic and pulmonary circulation.

Conclusion:

The lesson will be summarized with emphasis on identified areas of difficulty.

LESSON THREE FOR EXPERIMENTAL GROUP 2

Subject: Biology

Topic: Excretion in man

Class: SS II

Time: 80 MINUTES (Double period)

Average age of students: 15years.

Behavioural Objectives: At the end of the lesson, the students should be able to;

1 Explain what excretion is.

2 Mention three excretory products in man and site of excretion.

3 List the components of excretory system.

4 Mention the parts as seen in longitudinal section through a kidney.

5 List the components of a nephron.

3 Explain the mechanism of excretion by the kidney (Urine Production).

Instructional Materials: Video DVD instructional package

Previous Knowledge: The students have learnt about circulation of blood. They also have learnt the structure and functioning of the heart. Specific questions that can reveal what the students know will be asked thus:-

1 Differentiate between systemic and pulmonary circulation.

2 State two blood vessels associated with pulmonary circulation

3 State five blood vessels associated with systemic circulation.

Introduction: An overview of what to be learnt in terms of knowledge and skills objective of the lesson will be given.

Presentation

Step I: The video DVD instructional narration on excretion, excretory products and their sites of removal will be on this way; excretion is the removal of waste products from the body of a living organism. The principal products excreted by mammals are carbon dioxide, water and Nitrogenous waste. Carbon dioxide is excreted from the lungs as an animal exhales; water is excreted from the lungs, skin and kidney, while Nitrogenous wastes are excreted from the Kidneys to form part of the urine. The excretion by the kidney is done in a system called excretory system/urinary system.

Step II: Displaying the model of excretory system on the screen, the narration on its various parts will continue with emphasis on the kidney as the key part of the system. The system consists of two kidneys, two ureters, the bladder and the urethra. At the concave edge of the kidney lies a depression, the helium, from which the ureters arise. At this point also the renal artery from the dorsal aorta enters the kidney bringing blood containing excretory products while the renal vein drains filtered blood from the kidney to the posterior vena cava. All these structures especially kidney, works together for effective removal of waste.

Step III: The narration continues on the explanations of the internal structure of the kidney with emphasis on its functional unit – the nephron. Thus - The longitudinal section (L/S) of the kidney shows that it consists of two distinct regions, an outer cortex and the inner medulla. The medulla extends as projections into the pelvis called pyramids. The pelvis is the widened end of the ureter, in contact with the kidney. Each kidney consists of over one million of a system of tubules or nephron and an extensive network of blood capillaries in close contact with the nephrons. The nephron is the functional unit of the Kidney. The model of the nephron, will be displayed as the narration on its structure continues thus: Each nephron has the following parts: (**i**). An enlarged ending called Bowman's capsule in which sits a knot of blood capillaries called glomerulus, (**ii)** The proximal tubule (**iii).** U-shaped loop of Henle having descending limb and ascending limb and (**IV).** The distal tubule which empties into a collecting tubule leading to the pelvis. All along its course, the tubule is closely associated with several networks of blood capillaries.

Step IV : With reference to the structure of the nephron, narration on the mechanism of excretion will follow in this way - as blood brought to the kidney by the renal artery flows through the glomerulus, high pressure is built majorly because the blood vessel leading from the glomerulus is narrower than the vessel leading to it. Consequently, substances in the blood such as nitrogenous waste, water mineral salts, and glucose and plasma solutes are filtered into the Bowman's capsule by a process known as ultra-filtration to become glomerular filtrate. Other materials like blood corpuscles and plasma protein which cannot filter through remain in the blood streams. As the filtrate passes through the tubule many of the solutes and water which are useful to the body are reabsorbed back into the blood capillaries by a process known as selective re-absorption.

Specifically, as the filtrate passes through the proximal tubule, about 65% (solute & water) of the filtrate volume is reabsorbed. In the descending limb of Henle's loop 15% of the filtrate volume is reabsorbed. In the distal tubule and collecting duct, 19% of the filtrate volume is re-absorbed. This implies that as the filtrate passes from proximal tubule to the collecting duct, about 99% of the original filtrate volume is reabsorbed. These materials flow through the renal veins to enter the general circulation.

Only 1% of the original filtrate volume remains as urine. Urine is mostly water and contains organic waste products such as urea, uric acid and creatinine as well as excess ions. The urine so formed trickles down the ureter and collects in the bladder which stretches to accommodate it. When the bladder is full, the urethral sphincter relaxes allowing the urine to pass out of the body through the urethra.

Evaluation: Questions will be entertained from the students and then the following questions will be displayed on the screen for students to answer.

5. What is excretion?
6. Mention three excretory products in the body and state their site of removal
7. State any three components of excretory system.
8. Briefly describe the structure of the kidney as seen in its L/S.

Conclusion: The teacher rewinds, fast forward, and pauses as required by the students.

LESSON ONE FOR CONTROL GROUP

Subject: Biology

Topic: Transport system

Sub- Topic: Blood Circulation

Class: SS II

Time: 80 Minutes (Double period)

Average age of students: 15years.

Behavioral Objectives: At the end of the lesson, the students should be able to;

1 Explain what transport system is.

2 Explain human blood circulation and circulatory system.

3 Mention the components of circulatory system.

4 Differentiate between open and close circulation.

5 Briefly describe the internal structure of the heart.

8 Differentiate between systolic and diastolic phases of heartbeat.

Instructional Materials: Modern Biology, Introduction to Biology and lecture method.

Previous Knowledge: The students have learnt about blood groups. They also know that they have blood and heart in their body. Specific questions that can reveal what the students know and arouse their interest will be asked thus:-

(v) Hold the central portion of your chest and explain what you feel

(vi) Hold your wrist tightly and explain your observations.

(vii) Mention the types of blood corpuscles.

Introduction: An overview of what to be learnt in terms of knowledge and skills objective of the lesson will be given.

Presentation

Step I: Transport system in animals is to be discussed and explained. Thus, transport system in animals is the system through which food and energy needed by cells of animals are supplied and waste products formed in the cells are gotten rid of promptly. In man, transport system consists essentially of a single hollow pumping structure (heart) connected to cylindrical branching tubes (blood vessels) making up a system called circulatory system. The whole system is filled with a liquid transport medium, the blood.

Step II: The concepts of blood, blood circulation, circulatory system and blood vessels are to be explained. Thus, blood is the medium for transporting materials in complex organisms like man. It is the fluid, red in colour due to presence of oxy-haemoglobin in the red blood cells. The blood moves/circulates materials continuously round the body of animals. The continuous movement of blood round the body is called blood circulation and the system through which this movement occurs is called circulatory system. This system thus, is the network through which blood circulates continuously through the heart and blood vessels (arteries, arterioles, veins, venules and capillaries). Arteries and Arterioles transport blood away from the heart to the different parts of the body. While veins and venules transport blood from the body back to the heart. Capillaries connect arterioles and the venules within the body parts. The components of circulatory system thus are the heart and the blood vessels. The model of circulatory system will be presented with emphasis on the heart and blood vessels as the two major components. Names of various parts of the circulatory system and their functions will be made clear from the model.

Step III: The teacher explains open and close circulatory systems as follows- Close circulatory system is the system where the blood vessels branch many times into smaller units but eventually join up with other vessels connected to the heart. In this system, blood is always confined within the cavities and never in direct contact with cells of the body. In open circulatory system, the blood vessels lead out of the heart and end in blood spaces within the blood cavity. Here the blood comes into direct contact with the cells after which it is returned to the heart.

Step IV: Using diagram of the heart, the structure of the heart as the engine house (pumping action) in the circulatory system will be discussed. The parts of the heart and their functions will be explained with emphasis on the model as follows:

(l) Cardiac muscles – enables the heart to go on pumping continuously.

(m) Septum – divides the heart into a right and left half with no connection between the two.

(n) Left auricle and left ventricle – contain blood with oxygen (oxygenated blood).

(o) Right auricle and right ventricle – contain blood without oxygen (deoxygenated blood).

(p) Bicuspid valve – ensures that blood flows in one direction from left auricle to left ventricle.

(q) Tricuspid valve – ensures that blood flows in one direction from right auricle to right ventricle.

(r) Semi-lunar valves – ensures that blood flows in one direction from left ventricle to aorta and from right ventricle to pulmonary artery.

(s) Aorta – Carries oxygenated blood to all parts of the body except the lungs.

(t) Vena cava (posterior and interior) – return deoxygenated blood to the heart from all parts of body except the lungs.

(u) Pulmonary artery – carries deoxygenated blood from the heart to the lungs

(v) Pulmonary vein-returns oxygenated blood from the lungs to the heart.

With the aid of the models, the students learn by identifying, naming and stating the functions of the heart and the blood vessels. This exercise continues until mastery is shown.

Step V: Using the diagram, the pumping action of the heart (diastolic and systolic phase) will be explained

The teacher entertains questions from the students and clarifies areas of difficulty if any.

Evaluation: The teacher asks the students the following questions.

6. Explain transport system in animals
7. Differentiate between blood circulation and circulatory system.
8. Mention the two major components of the circulatory system.
9. Briefly describe the structure of human heart.
10. Describe systolic phase of heartbeat

Conclusion: The teacher summarizes the lesson with emphasis on identified areas of difficulty.

LESSON TWO FOR CONTROL GROUP

Subject: Biology

Topic: Blood Circulation

Class: SS II

Time: 80 MINUTES (Double period)

Average age of students: 15years.

Behavioural Objectives: At the end of the lesson, the students should be able to;

1 Explain what blood circulation is.

2 Discuss the procedure in the blood flow through circulatory system.

3 Explain double circulation and differentiate between pulmonary and systemic circulation.

4 Explain the concept "closed circulation".

5 State two blood vessels of pulmonary circulation, five blood Vessels of systemic circulation and their areas of operation

Instructional Materials: Modern Biology, introduction to biology and lecture method.

Previous Knowledge: The students have learnt about blood groups. They also know that they have blood and heart in their body. Specific questions that can reveal what the students know will be asked thus:-

1. Mention the components of circulatory system.

2 Mention the names of the four chambers of the heart.

Introduction: An overview of what to be learnt in terms of knowledge and skills objective of the lesson will be given.

Presentation

Step I: The concept of blood circulation and blood vessels will be clarified. The continuous movement of blood round the body is called blood circulation. The diagram of circulatory system will be used to explain the procedure in the blood flow through the circulatory system.

Step II: The teacher explains the processes of close, open, double, systemic and pulmonary circulations. Close circulation implies that there is no mixing of oxygenated and deoxygenated blood in the heart. Oxygenated blood is confined to the left side of the heart while deoxygenated blood is confined to the right side. Double circulation implies that for one complete circulation, blood has to pass through the heart twice, each time going through a separate path way. The two path ways are referred to as the pulmonary circulation and the systemic circulation. The sequence involved in double circulation is that blood from any part of the body enters the heart for the first time, is then sent to the lungs for oxygenation and from here is brought back to the heart for the second time before it can be redistributed to all parts of the body. The pulmonary circulation is between the heart and the lungs while systematic circulation is between the heart and all parts of the body beside the lungs.

Step III: With the aid of the diagram, the teacher emphasizes on the blood vessels of the systemic and pulmonary circulation and their areas of operation. Thus:

BLOOD VESSELS OF THE PULMONARY CIRCULATION

BLOOD VESSELS	DESIGNATION
Pulmonary arteries	Carry deoxygenated blood from the right ventricle of the heart to the lungs.
Pulmonary Veins	Carry oxygenated blood from lungs to the left auricle of the heart.

BLOOD VESSELS OF THE SYSTEMIC CIRCULATION

BLOOD VESSELS	DESIGNATION
Aorta	Carries blood from the heart and distributes to specific arteries.
Carotid Artery	To head and neck.
Jugular Veins	From head and neck to vena cava
Subclavian Artery	To fore limbs
Subclarian Vein	From fore limbs to vena cava
Hepatic Artery	To liver
Hepatic Vein	From liver to vena cava.
Mesentric Artery	To stomach and intestine
Hepatic Portal Vein	From stomach and intestine to Vena Cava
Renal Arteries	To kidney

Renal Veins	From kidney to vena cava
Iliac Arteries	To hind limbs
Iliac Veins	From hind limbs to vena cava
Superior/anterior Vena Cava	From head & fore limbs to the heart
Interior/Posterior Venae Cava	From the rest of the body beside the head, fore limbs & lungs to the heart.

Step IV: The teacher asks and answers questions from the students.

Evaluation: These questions will be written on the board for Students.

1 Briefly discuss the procedure of blood circulation in the body.

2 Explain the following terms- double circulation pulmonary circulation and systemic circulation

3 State two blood vessels associated with pulmonary circulation

4 State five blood vessels associated with systemic circulation.

5 Differentiate between systemic and pulmonary circulation.

Conclusion:

The teacher summarizes the lesson with emphasis on identified areas of difficulty. They will be given notes to copy inside their note books.

LESSON THREE FOR CONTROL GROUP

Subject: Biology

Topic: Excretion in man

Class: SS II

Time: 80 MINUTES (Double period)

Average age of students: 15years.

Behavioral Objectives: At the end of the lesson, the students should be able to;

1 Explain what excretion is.

2 Mention three excretory products in man and site of excretion from the body.

3 List the components of excretory system.

4 Mention the parts as seen in longitudinal section through a kidney.

5 List the components of a nephron.

6 Explain the mechanism of excretion by the kidney (Urine Production).

Instructional Materials:. Developed models (Excretory system and kidney nephron) and lecture method.

Previous Knowledge: The students have learnt about circulation of blood. They also have learnt the structure and functioning of the heart. Specific questions that can reveal what the students know will be asked thus:-

8 Differentiate between systemic and pulmonary circulation.

2 State two blood vessels associated with pulmonary

circulation

3 State five blood vessels associated with systemic .

circulation

Introduction: An overview of what to be learnt in terms of knowledge and skills objective of the lesson will be given.

Presentation

Step I: The concept of excretion, excretory products and site of removal are to be discussed and explained. Excretion is the removal of waste products from the body of a living organism. The principal products excreted by mammals are carbon dioxide, water and Nitrogenous waste. Carbon dioxide is excreted from the lungs as an animal exhales; water is excreted from the lungs, skin and kidney, while Nitrogenous wastes are excreted from the Kidneys to form part of the urine. The excretion by the kidney is done in a system called excretory system/urinary system.

Step II: Using diagram of excretory system, the teacher explains its various parts with emphasis on the kidney as the key part of the system. The system consists of two kidneys, two ureters, the bladder and the urethra. At the concave edge of the kidney lies a depression, the helium, from which the ureters arise. At this point also the renal artery from the dorsal aorta enters the kidney bringing blood containing excretory products while the renal vein drains filtered blood from the kidney to the posterior vena cava. All these structures especially kidney, works together for effective removal of waste.

Step III: The teacher draws the longitudinal section (L/S) of the kidney and explains the parts with emphasis on its functional unit – the nephron. The (L/S) of the kidney shows that it consists of two distinct regions, an outer cortex and the inner medulla. The medulla extends as projections into the pelvis called pyramids. The pelvis is the widened end of the ureter, in contact with the kidney. Each kidney consists of over one million of a system of tubules or nephron and an extensive network of blood capillaries in close contact with the nephrons. The nephron is the functional unit of the Kidney.

Step 1v : Using the diagram of the nephron, the structure is explained. Each nephron has the following parts: (**i**). An enlarged ending called Bowman's capsule in which sits a knot of blood capillaries called glomerulus, (**ii)** The proximal tubule (**iii).** U-shaped loop of Henle having descending limb and ascending limb and (**IV).** The distal tubule which empties into a collecting tubule leading to the pelvis. All along its course, the tubule is closely associated with several networks of blood capillaries.

Step v: With reference to the structure of the nephron the mechanism of excretion will be discussed as follows: As blood brought to the kidney by the renal artery flows through the glomerulus, high pressure is built majorly because the blood vessel leading from the glomerulus is narrower than the vessel leading to it. Consequently, substances in the blood such as nitrogenous waste, water mineral salts, and glucose and plasma solutes are filtered into the Bowman's capsule by a process known as ultra-filtration to become glomerular filtrate. Other materials like blood corpuscles and plasma protein which cannot filter through remain in the blood streams. As the filtrate passes through the tubule many of the solutes and water which are useful to the body are reabsorbed back into the blood capillaries by a process known as selective re-absorption.

Specifically, as the filtrate passes through the proximal tubule, about 65% (solute & water) of the filtrate volume is reabsorbed. In the descending limb of Henle's loop 15% of the filtrate volume is reabsorbed. In the distal tubule and collecting duct, 19% of the filtrate volume is re-absorbed. This implies that as the filtrate passes from proximal tubule to the collecting duct, about 99% of the original filtrate volume is reabsorbed. These materials flow through the renal veins to enter the general circulation.

Only 1% of the original filtrate volume remains as urine. Urine is mostly water and contains organic waste products such as urea, uric acid and creatinine as well as excess ions. The urine so formed trickles down the ureter and collects in the bladder which stretches to accommodate it. When the bladder is full, the urethral sphincter relaxes allowing the urine to pass out of the body through the urethra.

Evaluation: The teacher answers questions from students and in turn asks them the following questions.

1 What is excretion?

2 Mention three excretory products in the body and state their site of removal

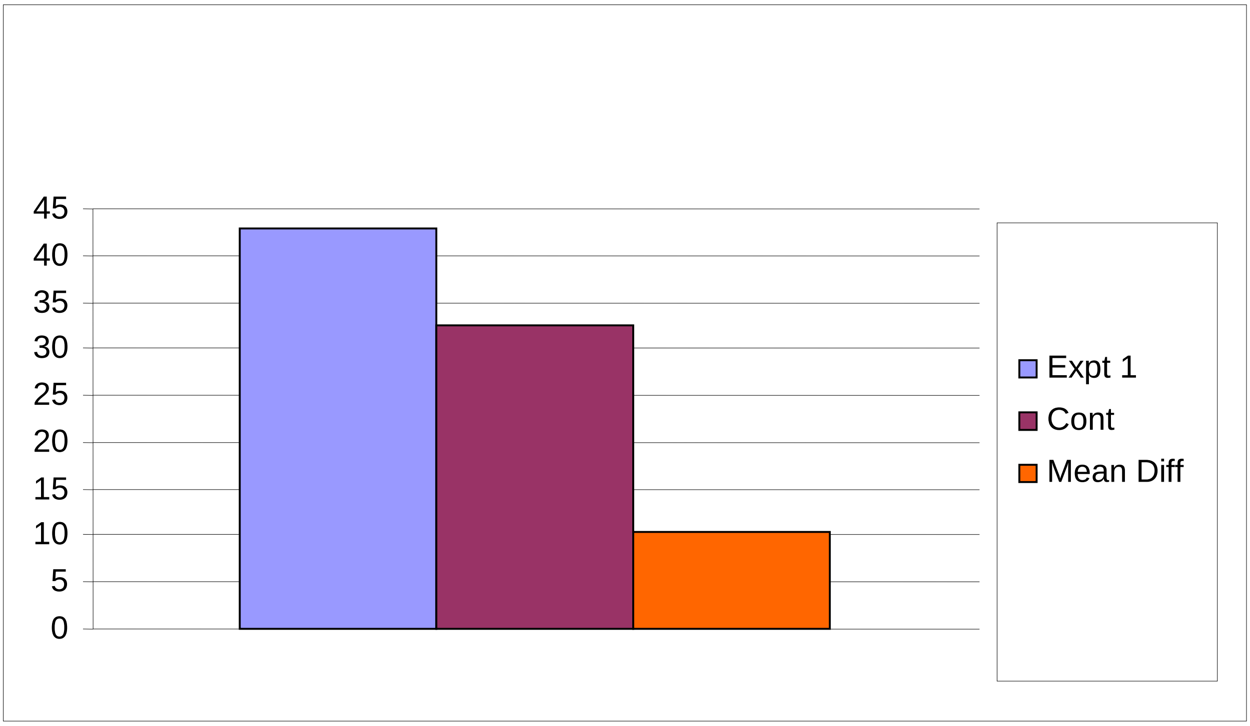
3 State any three components of excretory system.

4 Briefly describe the structure of the kidney as seen in its L/S.

Conclusion: The teacher summaries the lesson with emphasis on identified areas of difficulties.

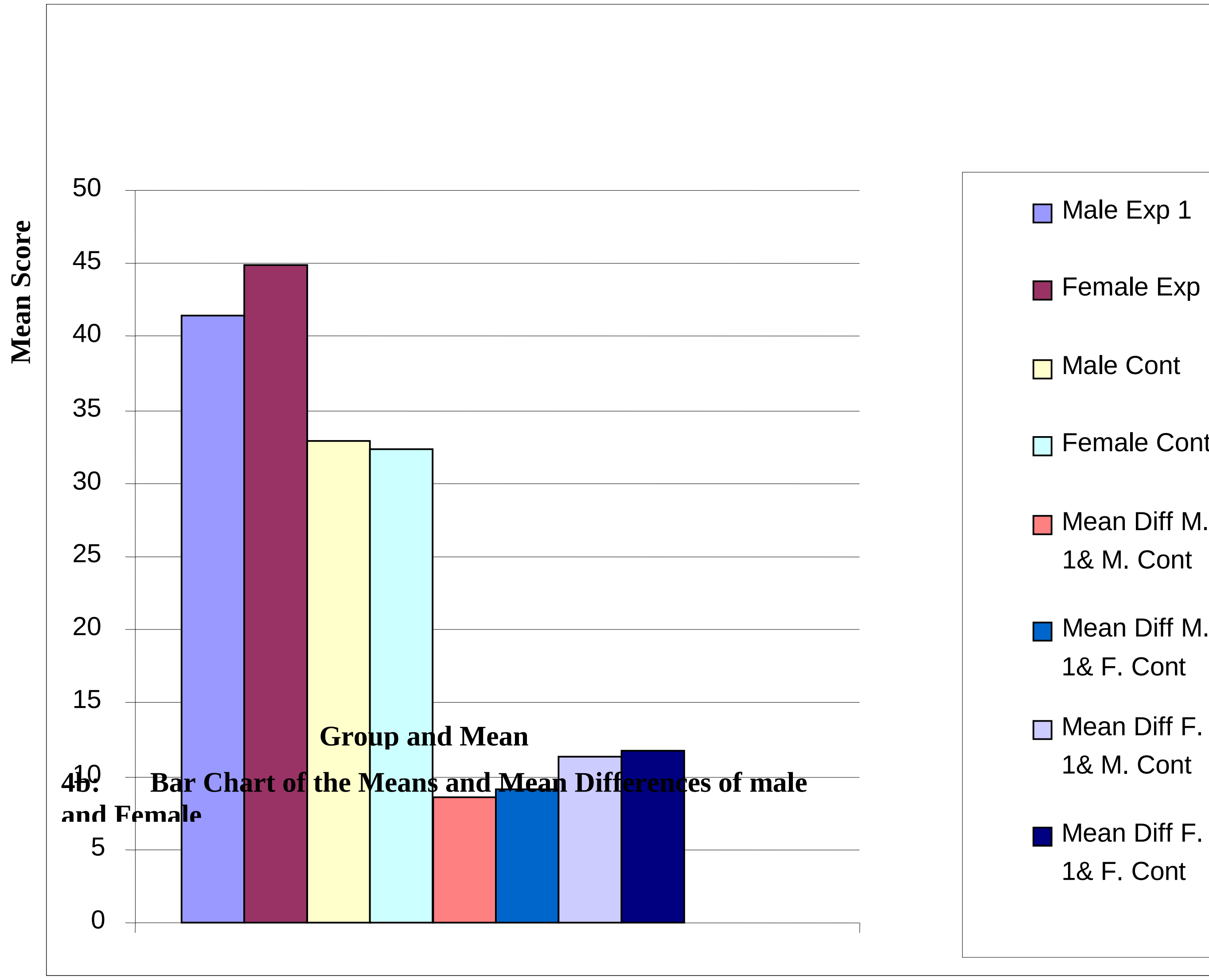
APPENDIX M

Bar Charts of the Means and Mean Differences of Experimental and Control Groups

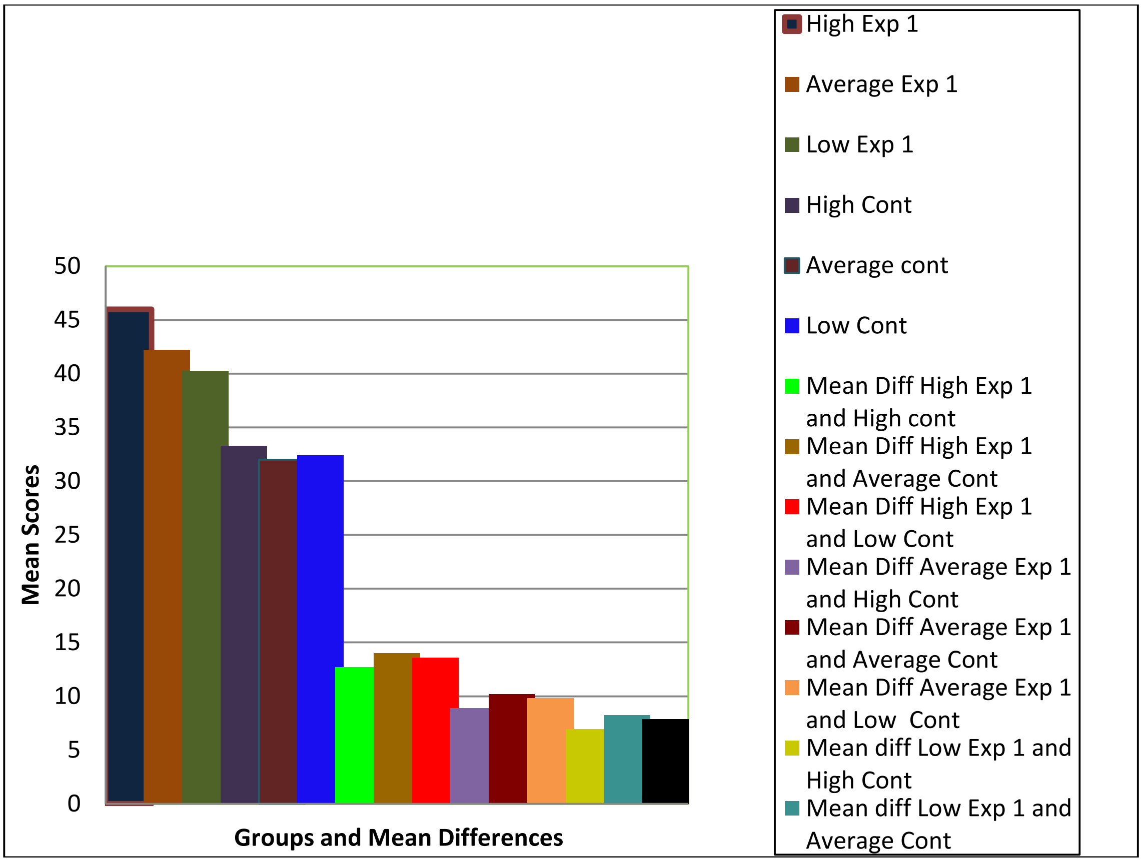


Groups and Mean Difference

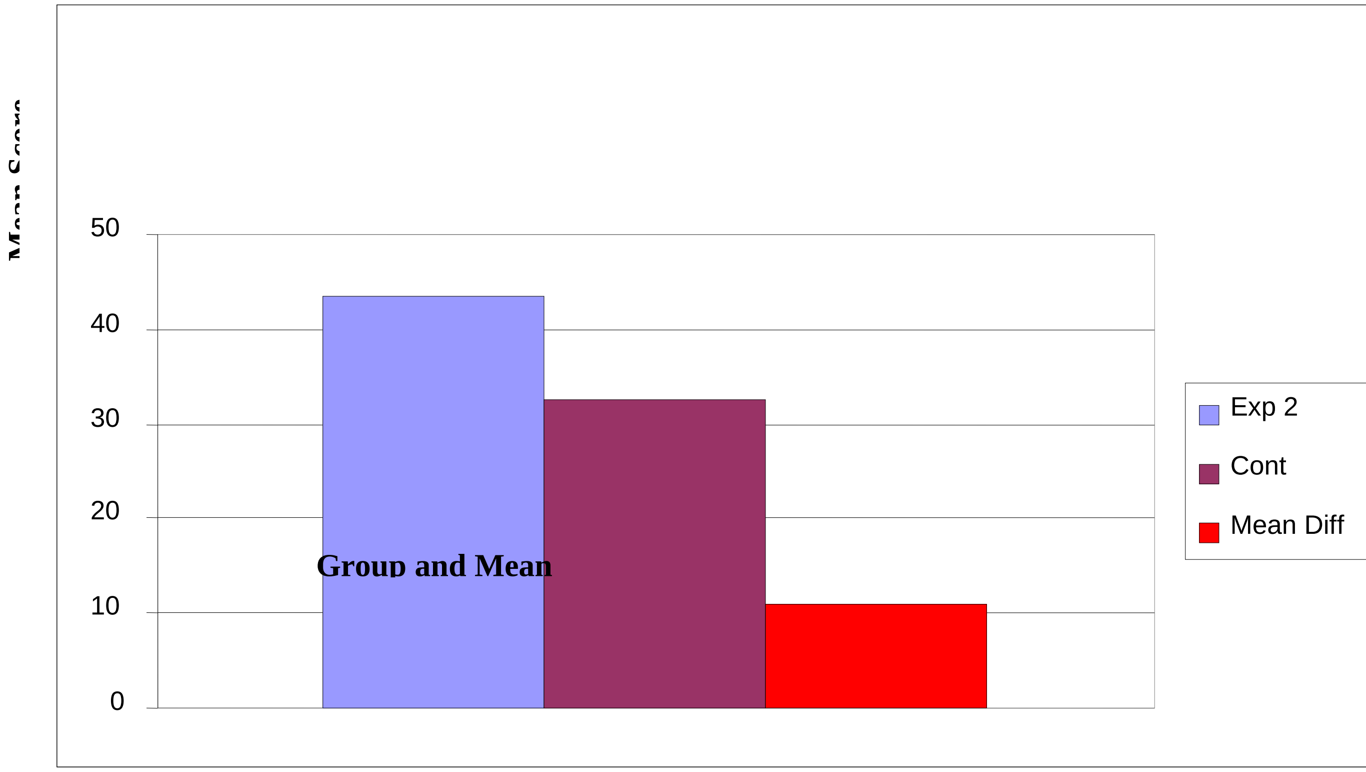
4a: Bar Chart of the Means and Mean Difference of Experimental 1 and Control groups at Posttest



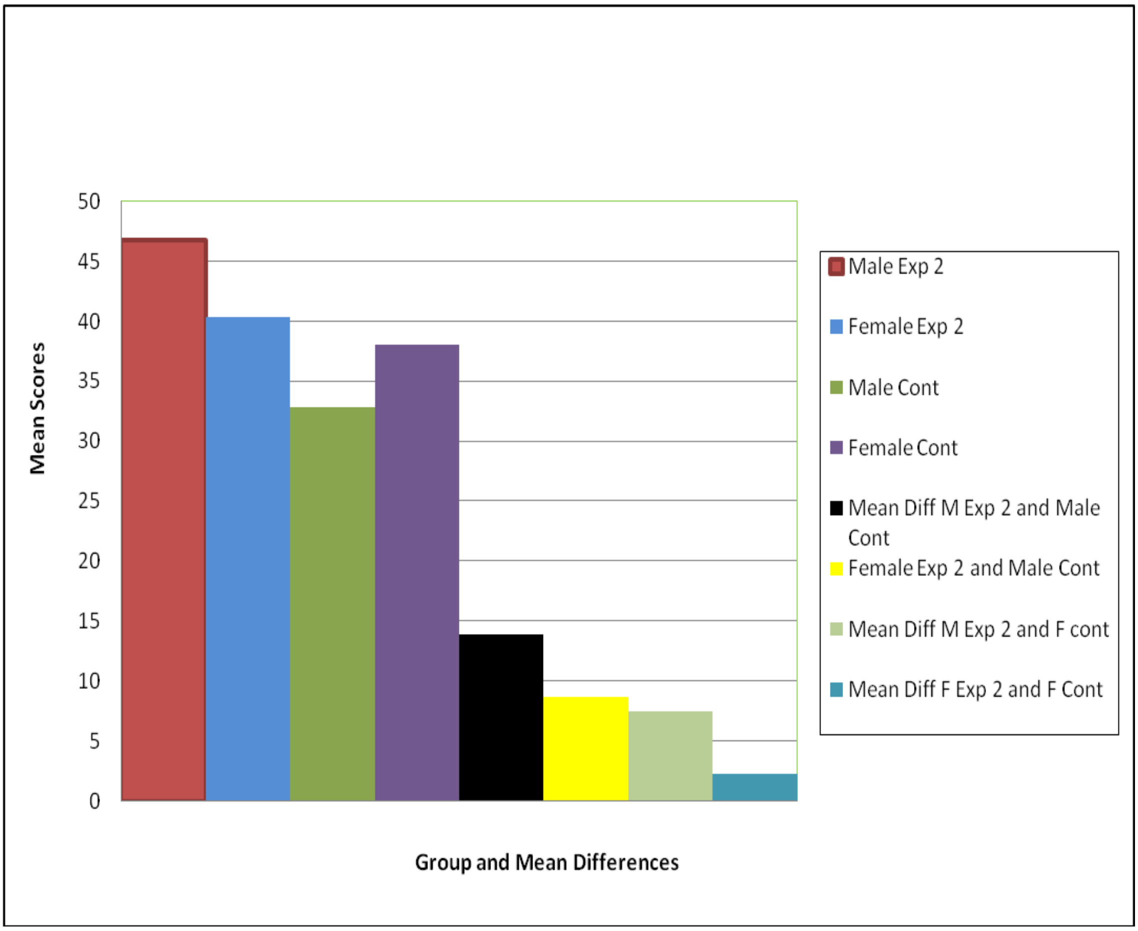
4b: Bar Chart of the Means and Mean Differences of male and Female



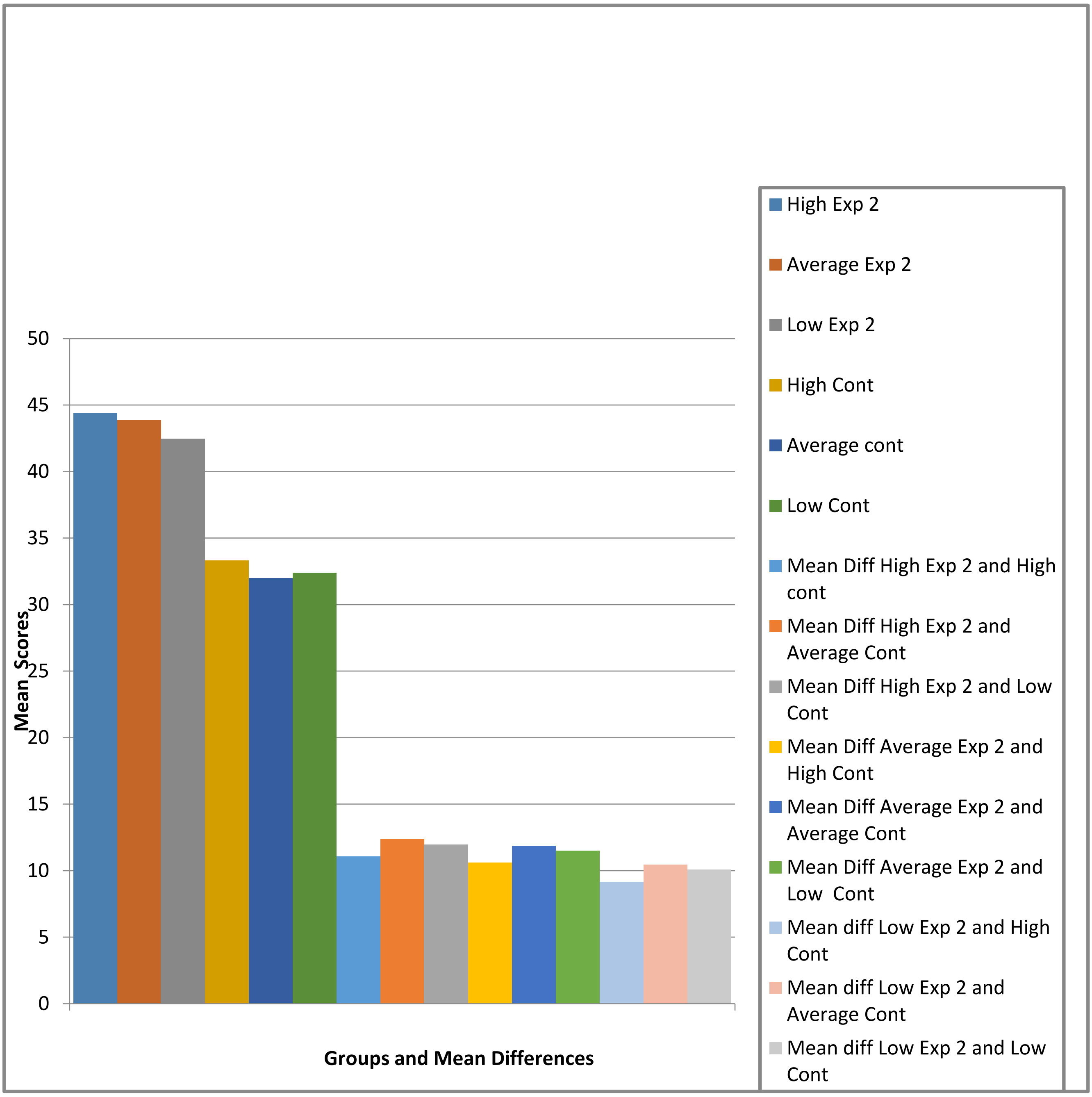
4c: Bar Chart of the Means and Mean Differences of the Ability Levels in Experimental 1 and Control Groups at Posttest



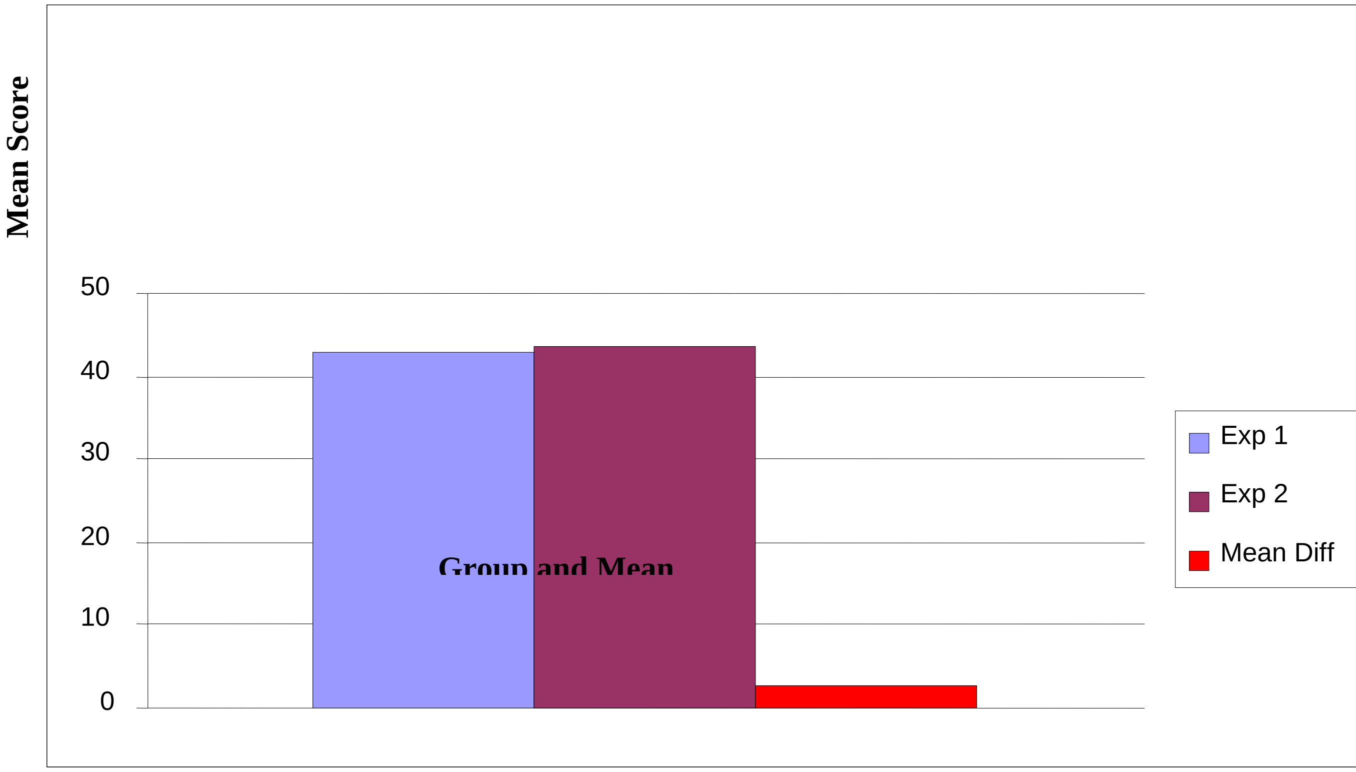
4d: Bar Chart of the Means and Mean Difference of Experimental 2 and Control Groups at Posttest



4e: Bar Chart of the Means and Mean Differences of Male and Female Experimental 2 and Control Groups at Posttest



4f: Bar Chart of the Means and Mean Differences of Ability Levels in Experimental 2 and Control Groups at Posttest



4g: Bar Chart of the Means and Mean Difference of Experimental 1 and Experimental 2 Groups at Posttest