EVALUATION OF THE INTEGRATED SCIENCE AND INTRODUCTORY TECHNOLOGY PROGRAMMES IN SECONDARY SCHOOLS IN BENUE STATE.

BY

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JUNE, 2006.

CERTIFICATION

This is to certify that this research work and the subsequent preparation of this thesis by MUSA JAMES ADEJOH (PGED/UJ/10725/99) were carried out under my supervision.

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(Head of Department)	**(Supervisor)**

DECLARATION

I hereby declare that this thesis is a record of my original research work and to the best of my knowledge, no part of it has been presented to any other institution for the award of higher degree.

MUSA JAMES ADEJOH

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DEDICATION

This work is dedicated to my dear wife Mrs. Gloria Otini Adejoh and children: Victor Ugbedeojo Adejoh and Dominion Ojochonu Adejoh.

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ABSTRACT

This study evaluated the Integrated Science and Introductory Technology curricula contents as well as their implementation in secondary schools in Benue State. Twelve research questions were answered and six hypotheses tested in this study. The study employed a survey design and six instruments were used to collect data from 50 secondary schools selected from 246 schools in the State using the Probability Proportionate to Size (PPS) sampling technique, 10 experts each in the fields of Integrated Science and Introductory Technology using the purposive sampling technique and all the Integrated Science and Introductory Technology teachers in the selected schools. The instruments were Classroom Observation Schedule (COS), Programme Evaluation Instrument for Teachers (PEIT), Introductory Technology Resource Assessment Checklist (ITRAC), Integrated Science Resources Assessment Checklist (ISRAC), Integrated Science Curriculum Contents Evaluation Instrument (ISCCEI) and Introductory Technology Curriculum Contents Evaluation Instrument (ITCCEI). Descriptive Statistics like frequency counts and simple percentages were used to answer the research questions while t-test for independent samples was used in testing the hypotheses.

The study established that the Integrated Science and Introductory Technology curricula had a number of defects such as irrelevance of some topics in the curricula to students range of experience and ability, low level of integration of the different disciplines that compose the programmes, little or no attention to new developments and current issues in the fields of science and technology, defective balance in the contents of the disciplines that compose the programmes. The programmes were also confronted with such problems as inadequate provision of resources, dearth of qualified manpower and ineffective teaching strategies among others. The study offered no evidence to establish a significant difference in the mean scores of Integrated Science and Introductory Technology as well as in the provision of Integrated Science and Introductory Technology resources between urban and rural schools. There was evidence to establish a significance difference in the mean scores of male and female students in the programme. The study further recommends that for these programmes to have their impact on the student and the society at large the Integrated Science and Introductory Technology curricula have to be reviewed with a view to removing these defects and urgent steps need to be taken by all stakeholders in the education sector towards finding lasting solutions to the problems confronting the effective implementation of these programmes.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

The importance of science and technology to national development in the life of any country cannot be over-emphasized. This is because knowledge and skills in science and technology are very vital in the development of any society. Mulemwa (2002) points out that, the fast changing applications of science and technology and the global reliance on its processes and products in all areas of human endeavour have made them invaluable that any society or country without them risks being alienated from the global village.

Science and technology have become such critical factors of economic and social development that life without them can no longer be contemplated. In addition to the fact that, through science and technology, a nation develops its manpower in such critical areas as agriculture, engineering, architecture, medicine and other science based professions and technologies, the benefits of science and technology have transversed every conceivable sphere of human life. For example, man's ability to produce high quality goods and services has improved tremendously. New drugs, vaccines, sophisticated equipment and tools have been produced which are helping in the diagnosis and treatment of various diseases thereby enhancing longevity. High-yielding varieties of crops and animals as well as disease-resistant varieties have been developed. Through science and technology, transportation and communication have improved remarkably, sophisticated buildings that provide comfortable accommodation for people have also been constructed. As a result of these benefits that accrue from the pursuit of science and technology, many countries have been making frantic efforts towards their development so as to keep pace with the rest of the world.

In Nigeria, the system of education that was inherited from the colonial masters was inadequate and, to a large extent, irrelevant to the developmental needs of the society (Afe, 1992). This is because the secondary schools were mainly of the grammar type aimed at training boys and girls for clerical and white-collar jobs. Though there were attempts to introduce students to the rudiments of science (Bajah, 1983) and technology subjects like blacksmithing, carpentry, bricklaying (Fafunwa, 1991), the voluntary agencies that pioneered western education were unable to increase and popularize science and technology education on the same scale as literary education because of the cost of equipment, dearth of manpower, among others. The effect of public opinion caused plans to be made for a series of national curriculum conference to redirect the course of Nigerian education in the face of the new felt needs and aspirations of the people. In 1977, a document tagged the National Policy on Education was released by the federal government which was revised in 1981, 1998 and 2004. In the document, efforts were made to put in place certain measures and policies aimed at enhancing the development of science and technology in Nigeria, for example, the general objectives of all levels of education emphasize science and technology. The National Policy on Education also had the 6-3-3-4 education plan embodied in it. The 6-3-3-4 system of education operates a curriculum with comprehensive opportunities for all candidates having varying talents and abilities to acquire different and relevant skills through technical, commercial and vocational subjects. The prevailing system of education in the country also lays great emphasis on the teaching of science and technology at all levels of the 6-3-3-4 education structure. With the adoption of the National Policy on Education, the Integrated Science and Introductory Technology programmes were introduced as core subjects at the junior secondary school level to introduce students to the world of science and technology and to prepare them for higher education in science and technology.

In accordance with the National Policy on Education, a study of Integrated Science and Introductory Technology should fulfill the following:

i. preparation for useful living within the society;

ii. preparation for higher education.

The aims and objectives of the Integrated Science course according to the Federal Ministry of Education (2002, p.1) are:

i. To stress the fundamental unity of science;

ii. to foster in the students scientific attitudes and ways of solving problems;

iii. to help the students live effectively in our rapidly changing age of science and technology;

iv. to acquaint students with some of the basic principles and theories of science and ensure proper foundation for future scientific education;

v. to enable students appreciate science-related social problems and proffer solutions to them e.g. food, environmental degradation, population explosion, conservation and health;

vi. to enable students and teachers implement the National Curriculum on Integrated Science effectively.

The Introductory Technology course is a broad based field of study in which subjects like metal work, woodwork, electronics, etc. have been integrated to provide a wholistic view of technology to students. The course has been carefully structured into a teaching sequence which largely consists of clear explanations and descriptions of how results are to be obtained with tools and equipment. It is a skill development study aimed at providing technical literacy for everyday living for students. The objectives of the Introductory Technology curriculum according to the federal core curriculum (Federal Ministry of Education, 1985) are:

i. To provide prevocational orientation for further training in technology;

ii. to provide basic technological literacy for everyday living;

iii. to stimulate creativity.

The need to evaluate the implementation of the Integrated Science and the Introductory Technology programmes after almost three decades of implementation has been stressed by Jegede (1982), Ibole (1999) and Afe, (1992), Awotunde (1992) and Okeke (1997) respectively. Evaluation of a programme is an attempt to determine whether the programme is being run in line with the objectives setting it up and whether the programme is achieving the desired effects. Specifically, evaluation has been defined by Okoro (1991, p.1) as: the appraisal of the worth or value of a thing or action and the making of appropriate decisions on the basis of such appraisal. Generally, when a programme is evaluated some data related to the programme are collected, analyzed and interpreted so that decisions regarding the programme can be made. These decisions may lead to programme improvement, programme re-planning and personnel improvement among others.

Attempts have been made by various researchers to evaluate the implementation of the Integrated Science programme (Maduabum, 1990; Akale, 1992; Oloruntegbe, 1996; Apea, 1997; Ibole, 1999) and the Introductory Technology programme (NERDC, 1992; Awotunde, 1992; Utulu 1998). It is doubtful from the evidence provided by these research reports if these programmes are yielding the desired results.

Development in science and technology according to Akpan (1992), starts with the education of the people in science and technology. The extent and pace of the development according to him will depend on how well the curriculum in science and technology has been planned, organized and implemented. The curriculum content is, therefore, an important factor to consider if there must be any meaningful development in science and technology in the country.

The Integrated Science and Introductory Technology programmes were introduced by the federal government as core courses into the Junior secondary school curriculum to enable students acquire basic scientific and technological literacy for everyday living. This implies that the junior secondary school science and technology education is assumed to be sufficient for those who may not proceed further to lead useful lives in later years. However, Akpan (1996) observes that, the science and technology curricula at present appears to be overloaded with contents which have little relevance to the societal needs. As a result of this, many students leave the junior secondary school without having the capability to join vocations, talkless of being scientifically literate enough to take rational decisions in adulthood.

Jebe and Ortyoyande (2001) also observe that, Nigerian secondary school curricular provisions are ambiguously broad and vague in many areas including the specifications on skills in science and technology. Mulemwa (2002) on this same issue also points out that, the existing STM curricula in many African countries have well conceived goals and objectives, the challenge that still exists, is in the development of appropriate curricula that would achieve the stated objectives in terms of both content and methodology.

Over the past few years, the interest and need for curriculum integration according to Jacobs (1989) have intensified throughout the country because of the need to provide a more relevant, less fragmented and stimulating experience for students. In view of this development, the Integrated Science and

Introductory Technology courses were introduced to give students a unified and wholistic view of science and technology. In view of this, the subjects that make up the Integrated Science course (i.e. Biology, Chemistry, Physics, etc) and Introductory Technology course (i.e. Metalwork, Woodwork, Electricity, etc) ought to be integrated in such a way that the boundaries between the traditional subjects are almost removed and connections are emphasized through the use of important conceptual themes. Omoifo (1996) points out that, in the case of the NCCE Integrated Science Curriculum, the boundaries between the different disciplines are very distinct due to low level of integration. Whether this applies to the Integrated Science and Introductory Technology curricula at the Junior Secondary School level is a matter for serious consideration.

In an integrated curriculum such as that of Integrated Science and Introductory Technology, the issue of sequence and balance of the curriculum contents are issues that cannot be taken lightly. While balance implies giving appropriate and or adequate proportionate considerations to the essential elements in terms of coverage and depth of understanding, sequence on the other hand connotes logical order, levels of difficulty or differences in ability of all the details of the elements of the curriculum (Adegoke, 1987). The need for sequence and balance of the curriculum contents of Integrated Science and Introductory Technology cannot be overemphasized. This is because, this will ensure that the contents of the disciplines are not under-represented and there will be a wide coverage to ensure smooth transition from the junior secondary school to the types of science and technology subjects taught at the senior secondary school level.

Researchers like Jegede (1982), Olarewaju (1987), Maduabum (1990) and Akale (1992) report that Integrated Science teaching was being handled by incompetent teachers. The same also holds for the teaching of Introductory Technology as pointed out by NERDC (1992) and Awotunde (1992). In order to resolve the crisis affecting the teaching of Integrated Science and Introductory Technology in Nigerian schools due to inadequate background of the existing teachers of Integrated Science and Introductory Technology, the National Commission for Colleges of Education (NCCE) prescribed minimum standards that must be met by Colleges of Education engaged in the preparation of Integrated Science and Introductory Technology teachers so as to ensure specialization. It is expected that the stipulation of these minimum standards by NCCE would strengthen the preparation of Integrated Science and Introductory Technology teachers and be a panacea to the dearth of suitable teachers for these subjects at the secondary school level. After almost fifteen years of the establishment of the NCCE by the federal government, it is doubtful if the quality of teachers for these programmes has improved.

The Integrated Science curriculum is child-centred and emphasis is laid more on learning science as a process rather than as a body of knowledge. For this purpose the following methods were specifically recommended for the subject: Discovery teaching tactics, problem solving activities, and the involvement of students in open-ended field or laboratory exercises (Olarewaju, 1994). For the Introductory Technology programme, the National Core Curriculum (Federal Ministry of Education, 1985), specifically states that the course cannot be taught without equipment because it is essentially practical. The theory is minimal and largely consists of simple explanations on descriptions of how simple results can be obtained with tools and equipment. The Integrated Science and Introductory Technology curricula, therefore, demands a high level of competence in teaching strategies on the part of the teachers. The teaching strategies employed by teachers in teaching these subjects must be consistent with their nature and philosophy if they are to be effective. Researchers like Akinmade (1985), Olarewaju (1987) and Nwosu (1991) show that, many teachers lack the quality and competence for providing students the opportunity to engage in creative scientific inquiry.

The teaching and learning of science and technology, no doubt, require well-equipped laboratories, workshops, tools and equipment if relevant skills are to be acquired by students. However, Awotunde (1992) also points out that, most secondary schools in Nigeria have no workshops for vocational or trade subjects like woodwork, metal work, electronics, among others. Added to the problem of workshops according to him, is the inadequacy of recurrent items (materials and consumables) for practical training in most secondary schools and technical colleges. The result of this is that, learning of theory is emphasized to the neglect of practical skills acquisition in vocational subjects. The much desired technology culture as well as a pool of skilled industrial workers cannot be developed under the type of situation obtaining now in the nation's secondary schools and technical colleges he remarked. For Integrated Science programme, the situation is not different either as researches like those of Odubumi (1991), Ozoji (1998) and Ibole (1999) all point to the gross inadequacy of laboratory equipment for the teaching of Integrated Science. Researchers like James (1998) and Equabor (2000) observe that, many of the personnels and equipment for the teaching of Integrated Science and Introductory Technology are simple, inexpensive and can be obtained from our local environment by students and teachers. Since our environment is richly blessed with varieties of human and material resources, success in the teaching of science and indeed technology is more as a result of the skill and resourcefulness of the teachers. Unfortunately, researchers like James (1998) and Akinrotohun (2000) all point to the fact that, the exposure of teachers of Integrated Science and Introductory Technology to the use of human resources and the concept of improvisation are generally very poor.

Researchers like Jebe (1997) and Okeke (1997) identify large class size as one of the factors affecting the teaching and learning of science and technology. This bulging enrolment figures according to Denga (1991) outstrip the existing learning space in today's classrooms. With the student-teacher ratio of about 60:1, it becomes almost impossible for the teacher to give individual attention to the children needing it.

Majority of countries in Africa according to Mulemwa (2002), experience a serious problem of the rural –urban divide due to the drastic difference between the facilities and opportunities available in the rural and urban areas. As a result of this development, the quality of education tends to be poorer in the rural areas due to lack of resources and well qualified teachers.

Evidence is accumulating too, that students are under-achieving in science and technology related subjects. An example, according to Maduabum (1995), can be seen in the result of the Second International Science Study (Rossier, 1990). The result shows that, of the different countries that participated in the study, Nigerian pupils came last in primary science with Japanese primary school kids coming first. Nigeria also came second to the last in ranking in secondary science. The poor performance of students in STM and particularly, the Junior Secondary School Certificate Examination (JSSCE) results in Integrated Science and Introductory Technology has also been lamented by Jegede (1992) and Nwoji (2000). There is evidence to also show that girls' access to education in general and to Science Technology and Mathematics Education (STME) in particular as well as performance are very poor relative to boys (STAN, 1992; Mulenwa, 2002).

It is no wonder that surveys of students' attitudes towards Science, Technology and Mathematics conducted by Akpan (1986) and Otuka (1987) provide evidence of students' poor attitudes towards STM while researches by Akpan (1986a, 1986b and 1991) point to the fact that, enrolments into science and technology-based subjects have been very poor – a trend which may not be unconnected with the poor implementation of the Integrated Science and Introductory Technology programmes in the schools. This dwindling number of youths willing to study science and technology-based courses, however, may lead to shortage of personnel in science and technology related jobs and professions.

The need for the constant monitoring of such programmes as the Integrated Science and Introductory Technology programmes in secondary schools cannot be over emphasized if science and technology are to develop appropriately. The implications of an unmonitored programme no doubt are numerous. The implementation of the programmes, for example, will be haphazard, the quality of the products from these programmes definitely cannot be guaranteed and it will be difficult for the administrators to be informed of the problems confronting such programmes. Consequently plans for tackling these problems will not be properly put in place. It is in view of these that this study intends to investigate how the Integrated Science and Introductory Technology programmes are being implemented in secondary schools in Benue State.

1.2 STATEMENT OF THE PROBLEM

The implementation of the Integrated Science and the Introductory Technology programmes in secondary schools in Nigeria, has been a matter of serious concern to educators. This is because, these subjects taught as core courses at the junior secondary school level occupy unique positions in the school curriculum. Besides the fact that they equip students with the necessary introductory scientific and technological knowledge and skills necessary to build a progressive society, they form bedrocks on which further science and technology studies rest. In view of the fact that, a good number of students may not go beyond junior secondary education and many others who go beyond this level may offer courses other than science and technology subjects, Aba (2003) observes that, Integrated Science and Introductory Technology may be the highest form of science and technology education many Nigerians may be exposed to in formal education. This situation places greater responsibility on the schools, teachers, administrators, curriculum planners, developers, and the government with regards to the implementation of these programmes to ensure that by the end of junior secondary school, students should have been exposed to the basic science and technology education to enable them to live and function meaningfully in the world dominated by science and technology.

Evidence from research findings however, point to the fact that the Integrated Science and Introductory Technology programmes are not properly implemented in the schools. Research reports Oloruntegbe (1996) and Apea, (1997) point to the dearth of well trained Integrated Science teachers while NERDC (1992) and Okeke (1997) have identified lack of equipment and facilities as problems facing the effective implementation of these programmes. Teachers too, have been reported to make use of ineffective teaching strategies in the teaching of Integrated Science and Introductory Technology (Nwosu, 1991; Awotunde, 1992; Adeyegbe, 1993).

Research reports (Orukotan, 1997; Salim, 1998) have indicated that in Nigeria, students enrolment into science and technology subjects have dwindled from year to year, a trend which may not be unconnected with the poor implementation of the science and technology programmes in schools. Students, from available JSSCE, WAEC results and research findings, have been performing poorly (Jegede, 1992; Maduabum, 1995; Nwoji, 2000). Researchers like Awotunde (1992), Omoifo (1996) and Akpan (1996) report that, the junior secondary school science and technology curricular contents are not adequate for students who go through them to lead useful lives in later years. This is because the curricula are over loaded with contents that are of little relevance to societal needs. These and many more are serious problems confronting the implementation of the Integrated Science and Introductory Technology programmes in the country. For a country like Nigeria that is in dire need of development, this state of affairs is quite unsatisfactory. What could be responsible for this state of affairs? Could it be that the curricula contents are not adequate for the attainment of the programme objectives? Could it be that the inputs and the interactions in the system are defective? Could it be that the quality of the programmes has not improved as to enhance the quality and quantity of their products? As teachers who operate the curriculum, it is essential for us to become aware of the hindrances to students progress outside such factors as inadequate resources, dearth of qualified teachers, etc.

While most evaluative studies focus on external factors that affect the implementation of the Integrated Science and Introductory Technology programmes, much is yet to be done by way of research particularly, in the area of content analysis of the science and technology curricula at the junior secondary school level in terms of relevance and adequacy of contents, the level of integration between the different disciplines (e.g. Biology, Chemistry, Physics and Earth Science) in the case of Integrated Science and (Metalwork, Woodwork, Electricity, Technical Drawing, etc) for Introductory Technology as well as the relationship of the Integrated Science and Introductory Technology curricula with each other. This would seem necessary as the programmes have been designed to: (i) equip students to function effectively in the society, (ii) to ensure a smooth transition from junior secondary school to the senior secondary school science and technology subjects and (iii) to complement each other in our efforts to transform the country technologically. These factors necessitated the choice of the two subjects for this study.

The problem of this study, therefore, was to evaluate the Integrated Science and Introductory Technology curricula contents as well as their implementations in secondary schools in Benue State.

1.3 PURPOSE OF THE STUDY

This study was out to investigate how the different schools in Benue State are implementing the Integrated Science and Introductory Technology programmes. This was with the purpose of finding out the strengths and weaknesses in the implementation of these programmes and the curricula contents so as to put forward relevant recommendations to improve their quality in the schools.

The following were the specific objectives of the study:

1. To find out the nature of the Integrated Science and Introductory Technology curricula in terms of relevance to the attainment of programme objectives and students ability, adequacy of content and the relationship with each other.
2. To assess the availability and adequacy of basic infrastructures and resources (human and material) for the Integrated Science and Introductory Technology programmes.
3. To investigate the quality of teachers and instructions in each of the subjects.
4. To investigate the trends in the enrolment of students into science and technology programmes at the senior secondary school level in Benue State.
5. To assess the achievements of students in Integrated Science and Introductory Technology subjects in the various schools in Benue State for a period of five years.
6. To determine the level of community participation in the development of the Integrated Science and Introductory Technology programmes in Benue State.

1.4 RESEARCH QUESTIONS

In order to provide direction and sharpen the focus of the study, the following research questions were formulated:

1. How relevant are the contents of the curriculum of the Integrated Science and Introductory Technology to the attainment of the programme objectives?
2. How relevant are the Integrated Science and Introductory Technology curricula contents to the learners' range of experience and ability?
3. What new developments and current issues in the fields of science and technology need to be included in Integrated Science and Introductory Technology curricula?
4. How adequate are the Integrated Science and Introductory Technology programmes in motivating junior secondary school students to offer and progress in science and technology education subjects at the senior secondary school level?
5. What is the level of integration of the different disciplines that make up the Integrated Science and Introductory Technology curricula?
6. What relationship exists between the curriculum contents of Integrated Science and that of the Introductory Technology programmes?
7. Are the resources required for the implementation of the Integrated Science and Introductory Technology programmes available and adequate in the secondary schools in Benue State?

8. What is the staffing situation in terms of quality and quantity for the implementation of the Integrated Science and Introductory Technology programmes in Benue State secondary schools?
9. How relevant are the teaching strategies used by the teachers in teaching the Integrated Science and Introductory Technology?
10. What has been the trend in students' achievements in the Integrated Science and Introductory Technology programmes in Junior Secondary Schools in Benue State?
11. What has been the trend in students' enrolments into science and technology programmes at the senior secondary school level in Benue State?
12. What is the level of community participation in the development of the Integrated Science and Introductory Technology programmes in the State?

1.5 RESEARCH HYPOTHESES

The following hypotheses were formulated for this study:

1. There is no significant difference between the mean scores of Integrated Science students in urban and rural secondary schools in Benue State.
2. There is no significance difference between the mean scores of Introductory Technology students in urban and rural secondary schools in Benue State.

3. There is no significance difference between the mean scores of male and female students in Integrated Science in Benue State secondary schools.
4. There is no significant difference between the mean scores of male and female students in Introductory Technology in Benue State secondary schools.
5. There is no significant difference in the provision of resources for Integrated Science teaching in urban and rural secondary schools in Benue State.
6. There is no significant difference in the provision of resources for Introductory Technology teaching in urban and rural schools in Benue State.

1.6 THEORETICAL FRAMEWORK

In any Intellectual society all professional practices according to Tita (1991), are expected to hinge on vigorous intellectual framework aimed at advancing the attainment of programme goals and objectives. Attempts to arrive at information useful to others in considering the value of educational programmes require some framework in which to think about the valuing process (Cooley and Lohyness, 1976). It is in view of this, that the theory of valuation proposed by John Dewey in 1938 provides a convincing framework for this evaluation inquiry. The theory proposes that thinking about values is of great importance to educational practice because all educational practices have undertones of values that are expected at the end of instruction. The theory further contends that, facts have their bearing in the value of things and that value propositions should not be considered to be empirically un-testable or else it will be considered to be serving the interest of just a group, and when tested, it should be concluded to have worth to justify its continuous existence (Lere, 1996). Dewey (cited in Cooley and Lohness, 1976, p.13) in his theory of valuation states that the value of an object or process depends upon how well it satisfies some needs. This implies that any programme that fails to meet up the intended consequences should be considered valueless and, hence, should be thrown away. The theory further stresses that decision about curriculum worth can only be arrived at through investigation of its consequences and outcomes. Dewey (cited in Cooley and Lohness, 1976) believes, therefore, that evaluation is that type of deliberation which has its beginning in troubled activity and its conclusion in the choice of a course of action which straightens it out.

Another theory of learning and instruction which is also in consonance with the problem under investigation is the Humanist Theory propounded by John Locke and his co-workers (cited in Tita, 1991). According to the theorists, man at birth has no ideas but has capacity to receive ideas and know several truths. It is the contention of this theory that, since man's developmental potentialities are unlimited and environmental events determine human behaviour, if children are given appropriate educational content and procedures according to their capacity, they will acquire the desired knowledge, values and behaviour. It, therefore, follows that if curriculum planners and developers organize the instructional content and process of the Integrated Science and Introductory Technology programmes in accordance with the objectives and the programmes are implemented properly, students will acquire the desired values, knowledge and skills.

In addition to these theories, any evaluative inquiry of this nature also requires a model for organizing and analyzing the probable functional relationships among the different domains of relevant variables (Cooley and Lohness, 1976). Several models exist and these models are useful, mainly in providing suggestions to evaluator in solving their own designed problems. Unfortunately, however, each available model has been devised to meet the needs of a particular situation.

Stufflebeam's model is based on a definition which views evaluation as a process of delineating, obtaining and providing useful information for judging decisions alternatives (Stufflebeam, 1973, p.129). The model identifies four types of evaluation. These are:

1. Context evaluation
2. Input evaluation
3. Process evaluation
4. Product evaluation

These four types of evaluation correspond with four types of decisions. The four types of decisions are: planning decision, structuring decisions, implementing decisions and recycling decisions. Planning decisions determine the goals and objectives of the programmes, structuring decisions determine the procedures or the means to be adopted in attaining the desired objectives. Implementing decisions deals with the utilization and implementation of procedure, and recycling decisions reviews achievements and make decisions on modifying, terminating or continuing the programme. The main components and specific aspects of the CIPP model are discussed as follows:

1.6.1 Context evaluation

Context evaluation is concerned with the determination and validation of goals and objectives. This usually takes place when planning the programme. Context evaluation is useful in describing the relevant condition that surrounds the programmes. It refers to the operationalisation of the broad objectives of the government concerning the programmes and the objectives for which the science and technology education programmes were established.

1.6.2 Input evaluation

Input evaluation provides information on resources available and how resources may be used to achieve desired ends. This entail the assessment of staff, students, physical facilities, equipment, library resources, funds and other resources that will be involved in the educational programmes.

1.6.3 Process evaluation

Process evaluation provides periodic feedback on the quality of implementation and this is undertaken during the period of programme implementation. This type of evaluation is concerned with course offering, teaching methods and the various kinds of activities and interactions that take place in the classrooms.

1.6.4 Product evaluation

Product evaluation will determine the effectiveness of the programme in achieving the objectives and goals of the programmes. It also relates the programme outcomes to the overall objectives of the programme and the process component.

The CIPP evaluation model appears more appropriate and was employed in this evaluation study on Integrated Science and Introductory Technology programmes in secondary schools. The reason for the choice of this model is in agreement with Bello and Okafor (1999) who argued that the CIPP model appears more appropriate in evaluating science education programmes and the fact that the information needed to address the research questions and hypotheses in this study require data relating to the totality of the programmes being evaluated namely: the context, input, the process and the product components.

1.7 SIGNIFICANCE OF THE STUDY

Given the importance of science and technology to national development in the life of any nation, a research of this nature which aims at evaluating the curricula contents and the implementation of the Integrated Science and Introductory Technology programmes in our educational institution no doubt, is very needful at this stage of our development. If education has been adopted as an instrument of development, then educational objectives must be linked to national objectives and their attainments need to be monitored since public interest and funds are involved. The public, therefore, has the right to know what actions have been taken in the schools it supports and how effective these actions have been.

The Integrated Science and Introductory Technology programmes have been in operation for several years now and there is the need to check the direction of growth and development. If the challenges posed are to be properly addressed, the achievement or otherwise of the past need to be critically examined for unless we know where we are going we will not know when we get there.

This study identified the sources of problems in the effective implementation of the science and technology programmes at the junior secondary school level. This will keep the government informed on problems confronting the implementation of these programmes and will help her find lasting solutions to the problems.

The study also revealed the strengths and weaknesses in the curricula contents of the Integrated Science and Introductory Technology programmes.

The findings of this study will help in deciding what new developments and current issues in the fields of science and technology that need to be included in the Integrated Science and Introductory Technology curricula as well as those areas that need to be expunged from the curricula. The results will, therefore, benefit curriculum experts, developers and implementers. This is because the discoveries made will contribute in the planning of new programmes and in deciding whether to expand, modify or discontinue with the existing programmes or reformulate the programmes.

This study also revealed the background of teachers and exposed the methodologies in use for the teaching of these subjects. The results of the study will, therefore, have implications for teachers, administrators and the government. It is possible that the findings may require the teachers being made to sit up through the improvement of their teaching strategies, improvisation of teaching aids where they are lacking. The administrators and government will also through the findings of this study be sensitized to the need for providing relevant teaching facilities and equipment for the inculcation of science and technology.

The study further revealed relationships and gaps existing between the junior secondary school science and technology curricula and the science and technology subjects at the senior secondary school level. The findings of the study will, therefore, provide a basis for understanding the increasing failures in the science and technology subjects at the Senior Secondary School Certificate

Examinations. The results also revealed the relationships and gaps that exist between the Integrated Science and Introductory Technology curricula. This would seem necessary in view of the fact that these courses have been developed to compliment each other in our efforts to transform the country technologically.

This study no doubt will be helpful to students as the implementation of suggestions emanating from it will go a long way in promoting students mastery of the science and technology curricula contents and thereby reducing failure rates in examinations.

1.8 DELIMITATION OF STUDY

This study focussed on the implementation of the Integrated Science and Introductory Technology programmes in the selected secondary schools in Benue State. The investigation covered the nature of the curricula in terms of relevance to the attainment of programme objective and students ability, adequacy of content, level of integration of the different disciplines that make up the Integrated Science and Introductory Technology curricula, sequence and balance of curricula contents, teaching strategies in the various schools, the availability and adequacy of resources (human and material) for the implementation of the programmes. In addition the enrolment patterns of senior secondary class two (SS 2) students into the science and technology subjects was investigated to assess the effect of the programmes at the junior secondary school on the subsequent selection of the science and technology subjects.

Students' achievement in the Integrated Science and Introductory Technology subjects were also investigated to assess the effectiveness of the implementation of the programmes as well as the level of community participation in the development of the Integrated Science and Introductory Technology programmes in the state.

1.9 OPERATIONAL DEFINITION OF TERMS

1. **Evaluation:** This refers to the collection of information/data and using the data to judge the value or worth of the programmes and finally taking decisions about the programme on the basis of the data collected and the judgment made.
2. **Rural Schools:** These are secondary schools located in the rural areas (outside the State capital and local government headquarters).
3. **Urban Schools:** These are secondary schools located in the State capital and local government headquarters of the State.
4. **Teaching strategy:** This refers to a grand design directed towards the achievement of certain objectives. It is concerned with the "why" of instruction and in this study it consists of three aspects namely: choice of teaching methods, the structure of the lesson and the settings of instruction.
5. **Resources:** This refers to the skilled science and technology personnel (teachers, laboratory/workshop technicians and attendants) as well as secondary school science and technology facilities (laboratories, workshops, tools, equipment, apparatuses, consumables and materials).

CHAPTER TWO

REVIEW OF RELATED LITERATURE

This chapter deals with the review of related literature. This is to ensure that the present study was not carried out in isolation of the works of others. The review therefore, covered the following areas:

Science and technology education in Nigeria (historical perspective), Science and technology education in relation to the National policy on Education and the National policy on Science and Technology, Patterns of Curriculum Design: The Integrated Curriculum, Research reports on development of science and technology education in secondary schools, Programme evaluation in education, Evaluation models and Summary of review of literature.

2.1 SCIENCE AND TECHNOLOGY EDUCATION IN NIGERIA (HISTORICAL PERSPECTIVE)

Informal science and technology education have always been with us in Nigeria. They are indeed as old as man himself. This is because as Fafunwa (1991) points out, children were involved in practical farming, weaving, knitting, black-smithing, brass work, leather work, wood work and many others before the introduction of the western type of education.

These skills were being taught to children, however, their teachings were not institutionalized as they are the case today.

During the colonial era, science and technology according to Onweh (1991), were treated as relatively insignificant aspects of the country's educational system. The emphasis was on general education with no particular orientation towards training boys and girls for different vocations on leaving school. The secondary schools were mainly of the grammar type; the aim being to train boys and girls for clerical and white collar jobs. The Christian missionaries no doubt, brought formal science and technology education into Nigeria (Fafunwa, 1991). The men who were enrolled into the missionary schools were taught among other subjects, Hygiene and Nature Study (science), Carpentry, Bricklaying and Blacksmitting (technology). The men who excelled in their examinations were further trained to become sanitary inspectors (Health Officers) and road inspectors. As these officer gained more experience, they were given higher responsibilities for example, meat inspection or livestock inspection (veterinary officers)

Formal secondary school education has been reported to date back to 1842 (Taiwo, 1986). Most of the schools according to him were established by missionaries. The first secondary school established in Lagos was the CMS Grammar school, Lagos in 1859. However, science teaching in secondary schools came to existence almost twenty years after. Taiwo (1986) reports that, the first reference to science teaching in Nigeria was in the curriculum of the Wesleyan Methodist Boys High school, Lagos in 1878 as well as the sister school, the Methodist Girls' High School established in 1879 which also taught some science subjects. Olarewaju (1994) observes that, Nature Study which was being taught in these missionary schools at the time, failed to cater for the societal and economic realities of the period. By 1920, the enthusiasm for Nature Study began to decline as many teachers started expressing their dissatisfaction. This growing concern over the inadequacy of Nature Study led to the introduction of General Science. General Science, according to Olarewaju (1994), also failed to inculcate the process and the spirit of science to students. Teachers of General Science being specialized in their various subject areas were teaching the subject as either Biology, Chemistry or Physics depending on their area of specialization. In view of these deficiencies General Science, had to give way for other science programmes.

Technical education, on the hand, developed less quickly than other forms of education in Nigeria. This, according to Fafunwa (1991), was due to the fact that the voluntary agencies which pioneered western education in Nigeria were unable to popularize technical education on the same scale as literary education, since the former was much more expensive in terms of staff and equipment. Some of the mission schools introduced bricklaying, carpentry, etc as part of the curriculum. However, as Thakur and Ezenne (1980) observe, there was lack of enthusiasm on the part of the parents as these skills were not seriously regarded by parents as integral part of Western education. As a result, these practices virtually died except for the Blaize Memorial Industrial School in Abeokuta founded by some Nigerians and West Indians and the Hope Waddel Institute in

Calabar established by the Church of Scotland Mission (CSM). The establishment of courses in the various government departments such as the Nigerian railway, marine, public works between 1901 and 1938 according to Thakur and Ezenne (1980), marked the beginning of organized technical and vocational education in Nigeria. It was more of an in-service training but it brought along improvement in the skills of the people. These were later followed by the engineering courses at the Yaba Higher college in 1932. However, there was no formally organized technical or vocational education at the post primary school level. The first major recommendation for the introduction of technical and vocational education according to Fafunwa (1991), was in 1945, when the commission on higher education in West Africa proposed that the premises of the defunct Yaba Higher College should be converted into a territorial college for Nigeria with a view to meeting the needs of government and commercial firms at the post secondary school level. The Federal government, in 1949, appointed F.J. Harlow, principal of Chelsea Polytechnic, London and W. H. Thorp, Nigeria Deputy Director of Education to assess the need for establishing colleges of higher technical education. The report led to the establishment of the Nigerian College of Art, Science and Technology with branches in Ibadan, Enugu and Zaria. To ensure that certain professional courses taught at the three branches were acceptable to the professional bodies in the United Kingdom, Fafunwa (1991) points out that, the college entered into a relationship with London University in collaboration with University College, Ibadan, in running a degree programme in engineering. Other courses (mostly of three years duration) affiliated to recognized bodies in the United kingdom for diploma awards were secretaryship, surveying, teacher certificate, architecture, pharmacy and estate management. In addition to these professional courses, the colleges also offered regular higher school certificate courses in most academic fields particularly in Arts and the majority of the students were enrolled in these courses. In 1962, however, the colleges were closed down and their assets were taken over, Ife took over the Ibadan branch, Ahmadu Bello University, the Zaria branch, and University of Nigeria, Nsukka, the Enugu branch.

2.1.1 Curriculum Development Efforts in Science and Technology in Nigeria

Following the launching of the Russian "Sputnik" into space in 1957, the middle of the 20th century experienced a lot of curriculum innovations in the United States of America in an attempt to out-strip the Russian achievement. Curricular reform movements like Biological Science Curriculum study (BSCS), Chemstudy, Physical Science Study Committee (PSSC), etc were initiated. These programmes according to Olarewaju (1994), had significant effects on the science programmes in the developing countries of the world, including Nigeria.

The beginning of curricular movement in Nigeria however, can be traced to 1968 when a request was received by the Science Teachers' Association of Nigeria (STAN) from the West African Examinations Council (WAEC) to make recommendations to her for revision and improvement of the then West African School Certificate (WASC) science syllabuses (Oyewole, 1972). A revision of the syllabuses according to Bajah (1983) was felt to be necessary in the light of modern developments in science education and the need to bridge the gap between the then up dated high school certificate (HSC) science syllabuses and the West African School Certificate syllabuses. In response to the request Bajah (1983) also points out that the National Executive Committee of STAN constituted three curriculum development committees, one in each of Biology, Chemistry and Physics in May, 1968. The fourth Committee, the Mathematics Committee was later constituted. The terms of reference of the curriculum development committees were set out by the national executives as follows:

i. To review and revise the existing science and mathematics syllabuses.

ii. To prepare teachers and pupils' materials relevant to the revised syllabuses.

iii. To perform such other function connected with science curriculum development as the STAN executive may from time to time direct.

iv. To co-operate with any other science curriculum development groups to achieve these ends (Bajah, 1983, p. 20).

After reviewing the syllabuses in Biology, Chemistry, Physics and Mathematics, some members of STAN according to Odubumi (1991), thought that the already designed science programme – the Aiyetoro Basic Science programme could be modified and adapted for junior forms of the secondary school. This idea however, was not accepted. As a result, representatives from various subject committee were elected to serve on Integrated Science Curriculum Committee.

In January 1970, the Committee published the Curriculum Newletter No. 1 which specified the philosophy, methodology, content and evaluation of Integrated Science programme. Owing to financial constraints according to Odubunmi (1991), STAN could not proceed on the writing of text materials for schools immediately. However, with the collaboration of STAN and the Heinemann Educational Books International, pupils text, teachers guides and pupils' workbooks were produced in 1972.

With the adoption of the National policy on Education and the 6- 3 - 3 -4 system of education in 1979, science and technology were given more prominence in view of the need to transform the country into a technologically self reliant nation. The curricula at the Junior and the Senior Secondary School levels were diversified to cater for the varying talents and abilities of pupils. In view of this development, Integrated Science and Introductory Technology became core subjects to be taught at the Junior Secondary School level. This made it necessary for the two year Integrated Science programme to be revised in 1981. Some members of STAN were selected to work at producing the new edition of the Nigerian Integrated Science Project. In 1982, the new edition of the three years junior secondary school Nigerian Integrated Science Project ((NISP) was published.

Other subjects like Woodwork, Metalwork, Electronic, Electricity, Auto-mechanics and building construction were also introduced into the senior secondary school curriculum.

2.1.2 The Integrated Science and the Introductory Technology Programmes in Nigeria

The Federal Ministry of Education commissioned a group of Nigerian science educators to produced a draft curriculum in Integrated Science (Olarewale, 1987). The result from the workshop led to the publication of core curriculum for Integrated Science for the junior secondary school by the Ministry of Education, Science and Technology in 1984. According to the core curriculum for Integrated Science (Federal Ministry of Education, 1981), the essence of an Integrated Science course is to introduce scientific concepts to pupils at the early level of education. The integrating principles according to the document are therefore intended to produce a course which:

i. Is relevant to student needs and experiences
ii. Stresses the fundamental unity of science
iii. Lays adequate foundation for subsequent specialist study
iv. Adds a cultural dimension to science education.

A study of Integrated Science should, therefore, fulfil the following in accordance with the National Policy on Education:

i. Preparation for useful living within the society
ii. Preparation for higher education

In order to achieve the aims specified above it is expected that students who are exposed to integrated science course should acquire the following skills (Federal Ministry of Education Core Curriculum for Integrated Science, 1981):

i. Observing carefully and thoroughly
ii. Reporting completely and accurately what is observed
iii. Organizing information acquired
iv. Generalizing on the basis of acquired information
v. Predicting as a result of generalizations
vi. Designing experiments (including controls where necessary) to check predictions.
vii. Using models to explain phenomena where appropriate
viii. Continuing the process of inquiry when data do not conform to predictions.

Odubunmi (1991) points out that, the Science Teachers Association of Nigeria recognizes the importance of teaching Integrated Science according to its philosophy or nature. In view of this, the philosophy underlying the teaching of the subject was specified when the curriculum was being designed. According to Integrated Science Newsletter (1970), the Science Teachers Association of Nigeria specified the following as the strategies to be employed in teaching Integrated Science:

a. The use of the discovery method of teaching;

b. The inclusion of problem solving activities;

Technical education aims at providing trained manpower in the field of sciences. In technical education individuals are formally prepared for the world of work. The objectives of the Introductory Technology curriculum therefore are:

i. To provide prevocational orientation for further training in technology.

ii. To provide basic technological literacy for every day living.

iii. To stimulate creativity.

From the general point of view, Introductory Technology is a broad based skills development study in which practice oriented work is emphasized and technological literacy is provided through an integrated approach. Introductory Technology has such a complex combination of subject units. It is an integrated technology in which several specialized technical courses have been identified. Some of these include: Technical drawing, metalwork, woodwork, electrical/electronics, rubber, ceramic, plastic, building and food technology (National Curriculum for JSS Introductory Technology, 1985).

To achieve the listed objectives, Bazza (1992) observes that, Introductory Technology is expected to be carefully structured into a teaching sequence with minimum theory and largely consisting of clear explanations or descriptions of how results are to be obtained with tools and equipment. The main features of Introductory Technology as listed in Bazza (1992, p.38) are:

a. The development of a broad range of skills

b. Introductory Technology is essentially practical

c. Theory is kept to the minimum and used primarily on topics related to the practical work.

d. Introductory Technology is taught using an integrated approach that is, the various components of technology are not taught as individuals subjects (as was the case in the past) but as an integrated subject.

e. Whereas Introductory Technology provides technical literacy for every day living, skills to be developed are made relevant to the students' environment.

2.2 SCIENCE AND TECHNOLOGY EDUCATION IN RELATION TO THE NATIONAL POLICY ON EDUCATION AND THE NATIONAL POLICY ON SCIENCE AND TECHNOLOGY.

The extent to which the National Policy on Education and the National Policy on Science and Technology have emphasized science and technology are considered below looking at the two policy documents one after the other as follows:

2.2.1 Science and Technology Education in Relation to the National Policy on Education.

In Nigeria, the system of education that was inherited from Britain shortly after independence was found to be inadequate and incapable of producing the calibre of youths with the right orientation and attitudes to salvage the nation from the adverse economic effects of inadequate production of goods and services (Onweh, 1991). The effect of public opinion according to Okobia

(1986), caused plans to be made for series of national curriculum conference to re-direct the course of Nigeria education in the face of the new felt needs and aspirations of the public. In 1969, a national curriculum conference to which scholars were invited to present papers on the type of education wished for Nigeria was organized by the then Nigeria Educational Research council.

The conference according to Fafunwa (1991), was not only that of experts and professionals but also of the people. This is because organizations, religious bodies, teachers' association, other professional (medical, legal, engineering, etc.), university teachers and administrators ministry officials, youth club organizers, businessmen and representatives from the government of most of the then twelve states of Nigeria were all involved. The importance of the conference was better described by Cookey (cited in Adaralegbe, 1972, p.7).

> It was not a conference for educationist alone; it was necessary also to hear the views of the masses of people who are not directly engaged in teaching for they surely have a say in any decision to be taken about the structure and content of Nigerian education. This explains the wide coverage of participation. Furthermore, we were determined that the conference should be a purely Nigerian affairs; thus although we had participants from places as far away as Europe, the United States and other countries in Africa, They came in as observers and the main papers submitted for the conference were written by Nigerians.

In 1973, a national seminar of experts drawn from a wide range of interest groups within Nigeria was convened. The recommendations of the seminar after further deliberations and modifications by government became what we know today as the National policy on Education first published in 1977 (Okoli, 1991).

In Nigeria, policy makers have long realized the importance of science and technology to our economic development. In view of this, efforts were made to put in place certain measures and policies aimed at enhancing the development of science and technology in the National Policy on Education. For example the five national objectives as stated in the National Policy on Education (Federal Republic of Nigeria, 1991, paragraph 3) are the building of:

i. a free and democratic society;
ii. a just and egalitarian society;
iii. a united, strong and self-reliant nation;
iv. a great and dynamic economy;
v. a land full of bright opportunities for all citizens.

These objectives, according to Awotunde (1992), in part provide a guide towards the transformation of Nigeria from technological backwardness to a society that is technologically self-reliant.

According to the National policy on Education, the nation's education aims and objectives to which the philosophy of education are directed are:

a. The inculcation of national consciousness and national unity.
b. The inculcation of the right type of values and attitudes for the survival of the individual and the Nigerian society.
c. The training of the mind in the understanding of the world around;

d. The acquisition of appropriate skills, abilities and competencies both mental and physical as equipment for the individual to live in and contribute to the development of his society (Federal Republic of Nigeria, 1991, paragraph 7).

Section five of the National Policy on Education (Federal Republic of Nigeria, 1991, paragraph 39) also states, among other things, that:

> a greater proportion of education expenditures will be devoted to science and technology; universities and other levels will be required to pay greater attention to the development of scientific orientation… the ratio of science to liberal arts students in our universities has been fixed at 60:40

The general objectives of all levels of education as it relates to science and technology as highlighted by the Federal Republic of Nigeria (1991) are:

1. Pre-primary education is to inculcate in the child the spirit of inquiry and creativity through the exploration of nature and the local environment, playing with toys, artistic and musical activities etc
2. Primary education is to lay a sound basis for scientific and reflective thinking as well as provide basic tools for further educational advancement, including preparation for trades and crafts of the locality
3. Secondary education is to equip students to live effectively in our modern age of science and technology.
4. Higher education is aimed at the development of intellectual skills which will enable individual to develop into useful members of the community.

In addition to these policy statements, the 6-3-3-4 education plan also embodied in the policy gave prominence to the study of science and technology in our schools. The philosophy that informed the introduction of the 6-3-3-4 system of education has always been a very laudable one and it is quality and functional education for meaningful technological take off of the country. The junior secondary school and the senior secondary school level have the core subjects as well as the elective subjects. The core is compulsory for every student while for the elective, students are expected to select from the subjects. At the junior secondary school level, Integrated Science and Introductory Technology are among the core subjects which are compulsory for students. At the senior secondary school level the students too are expected to offer at least one of the sciences and a vocational subject.

The curriculum under 6-3-3-4 system has also been varied and diversified in such a way as to cater for all talents and abilities. Several technical and vocational subjects like wood-work, metal work, smithing, carpentry, have found their way into the school curriculum. It is expected, that by the time a child goes through this enriched curricula he would be able to imbibe the scientific and technological attitude, develop according to his own talent and ability as well as develop the spirit of self reliance, since the system encourages the dignity inherent in manual vocations.

There is no doubt, therefore, that the National Policy on Education if well implemented, will enable the nation attain parity with the leading nations of the world with regards to technological development as well promote the spirit of self-reliance in Nigerians.

2.2.2 Science and Technology Education in Relation to the National Policy on Science and Technology.

The Federal Government of Nigeria in 1979 created the Ministry of Science and Technology. The ministry was charged with the responsibilities of promoting and developing scientific and technological research in the country. Since the range of science and technology is so vast and its financing so costly, there is no doubt, that certain guidelines, criteria and priorities have to be adopted in pursuing them. The need for a policy on science and technology arose. The policy was to bear relevance to the economic and social aspirations of the people and was to lay out clearly the strategy for implementation. The Ministry formulated the science and technology policy and this was launched in July, 1987. The policy was a product of wide consultations in national conferences and specialized committee meetings with specific and technological community including ministry, polytechnics, research institutes, industrialists and bureaucrats. The National Policy on Science and Technology (1986, p.8) recognizes the fact that Nigeria is a technologically underdeveloped country by stating that:

> While many countries are in the second phase of the industrial revolution in which computers, robots, microelectronics biotechnology, nuclear technology etc. are common place, we are yet to grasp the fundamentals of the first phase of the industrial revolution which began in Europe in the eighteenth century…. The country is yet to create the necessary science culture in which the general public is made aware of the need to use scientific methods in their daily operations.

The National Policy on Science and Technology, therefore, is another major effort of government at correcting this situation, thereby, helping to transform Nigeria into a technological self – reliant nation.

The objectives of the science and technology policy as contained in the National Policy on Science and Technology (1986, pp. 11-12) are:

1. Increasing public awareness in science and technology and their vital roles in national development and well being.
2. Directing science and technology efforts along identified national goals
3. Promoting the translation of science and technology results to actual goods and services
4. Creating, increasing and maintaining an endogenous science and technology base through research and development
5. Motivating creative output in science and technology.
6. Increasing and strengthening theoretical and practical scientific base in the society, and
7. Increasing and strengthening the technological base of the nation.

One of the policy statements for science and technology for example, stresses that the educational system should emphasize science at all levels. The objective of this, according to the policy is to reorientate the entire society towards scientific thinking in order to develop new technologies and adapt existing ones to improve societal well-being and security. The different methods, stated in the National Policy on Science and Technology, for meeting this objective include the following:

i. Making it possible for the average child to have early contact with the concepts of, and materials related to science and technology even before attaining primary school age;

ii. Ensuring a sound science foundation during the first six years of the 6-3-3-4 structure;

iii. Orienting science and technology curricula in polytechnic and colleges of technology to be less theoretical and more practical base.

iv. Ensuring that adult education includes, in addition to learning how to read and write, learning how things around us work;

v. Encouraging and promoting the writing of mathematics and science books at all levels, and

vi. Enforcing strictly an absolute minimum of 60 : 40 ratio of science – base disciplines to humanities in student yearly enrolment into the nation's universities with the target ratio of 70:30 by the year 1988 which will correspond with the graduating year of the first set of the new 6-3-3-4 education system.

Another policy statement in the National Policy on Science and Technology states that there should be mass movement for science and technology development in the country. The objective of this according to the policy is to orientate the entire society towards science and technology within the framework of its customs and traditions. As stated in the policy, the strategies for meeting this objective also include:

i. Relating science and technology to formal and informal education processes and emphasizing their role in the socio-economic development of the society in general and in personal development in particular;

ii. Providing adequately equipped science laboratories and workshops in the secondary and tertiary educational system; and

iii. Ensuring appropriate and adequate industrial attachment programmes for all science based technical and professional courses at the tertiary level.

The policy on science and technology statements and objectives, apart from being in line with some of the provisions of the National policy on Education, attest to government's efforts at ensuring the proper development of science and technology in the country.

2.3 PATTERNS OF CURRICULUM DESIGN: THE INTEGRATED CURRICULUM

Curriculum design according to Adegoke (1987, P.1), is essentially a small-scale map for future development or an overall blueprint used in selecting, planning and implementing educational experiences in the school or any learning-teaching situation. The design of a curriculum lays down general principles or guidelines to be followed in its planning and implementation. It tries to ask and answer such questions relating to the nature of knowledge, worthwhile knowledge, the purpose of a school instructional strategy, techniques and processes of ascertaining or measuring effectiveness, etc. A good curriculum design should, therefore, define the elements of the curriculum and show the patterns of their relationship.

2.3.1 Defects of Curriculum Design

There are certain defects which can be found with some curriculum designs. Some of these defects as Adegoke (1987) points out, are as follows:

1. Many curriculum designs are defective because they eventuate in a package which is inappropriate, because it is based on an inadequate concept of the learning process or because a greater uniformity of learning than is warranted is assumed.
2. A curriculum design can also be defective if its theme elements are inadequately related to the central emphasis. If it pays little attention (without any rationale or justification) to the needs of society or if the perspective on these needs is derived from an inadequate analysis of the information in that society. This according to the source can result in objectives of parochial scope or objectives which are at variance with social realities.
3. It is also possible to have a defective curriculum design when such a design is without any rationale, based on analysis or the content of the disciplines, only little or no attention to the characteristics of the learner or of the learning process or the concept in which the design will be operationalised.

4. Some curriculum designs are also bad because they do not give the required attention to sequence and balance. Sequence and balance are two of the prime requisites of a good curriculum design. This is because they ensure longitudinal advance and lateral equilibrium. Balance according to Adegoke (1987) implies giving appropriate and or adequate proportional considerations to the essential elements in terms of coverage and depth of understanding. Sequence on the other hand connotes logical order, level of difficulty or differences in ability of all the details of the elements of the curriculum. A curriculum design may contain essential elements but may have them in defective balance mostly because these elements are poorly identified or have an inadequate theoretical rationale.

2.3.2 Types of Curriculum Design: The Integrated Curriculum

Several curriculum designs exist today like the subject-centred curriculum in which the basis for the organization of the curriculum is the traditional subject matter and each subject represents a specialized and homogenous body of knowledge. The activity curriculum on the other hand is the type in which emphasis is placed on the needs and interests of the learner. Other designs include the child-centred curriculum where attention is focussed upon children's interest and the core-curriculum design, which is used to describe a portion of the curriculum usually those courses prescribed for all.

As reaction against the criticisms of these patterns of organization of the curriculum increases, the integrated curriculum came into existence. The integrated curriculum is thus an imprecise term that covers a range of responses to the difficulties in a subject-based curriculum and other designs. This curriculum according to Brown, Oke and Brown (1992), is essentially designed to overcome the compartmentalization and atomization of the curriculum by combining specific subject areas into large fields. Under this form of organization, History, Geography, Civics, Government and Economics are combined into Social Studies. Biology, Chemistry, Physics, Earth Science are combined into Integrated Science. Woodwork, Metal Work, Mechanics, Electronics are combined to form Introductory Technology.

To Jacobs (1989), the integrated curriculum is a knowledge view of curriculum approach that consciously applies methodology and language from more than one discipline to examine a central theme, issue, problem, topic or experience. The curriculum does not stress delineations but linkages. It brings together broadfields of content areas, synthesizing the same into an integrated whole for the learner to see relationship between or among subject areas.

2.3.3 Modes of Integration

Different approaches to integration can be employed in the development of the integrated curriculum. Four common modes of integration are discussed below.

1. Complete Integration

This type of integration according to Wuyep (1997) is one which has the greatest scope. It is the wholistic view of knowledge as being essentially undivided. Scientists believe in the unity of science and as Bajah (1983) asserts, science must adopt a unified approach in the study of the universe, hence this mode of integration attempts to discover the unifying laws of nature without being restricted by any artificial disciplinary boundaries.

2. Thematic Approach

The thematic approach of integration identifies themes, topics or ideas to provide the integrating element within the curriculum (Urevbu, 1990). This approach was used in developing the Integrated Science and the Introductory Technology curricula. Agebi (1983, P.105) asserts that compared to other approaches, the thematic approach has more variability within and between content, concept and process skills. Teaching Integrated Science through thematic approach requires teachers with sound knowledge of content, concepts and processes of science as well as the interrelatedness in education.

The following example of a theme is taken from Bajah (1983).

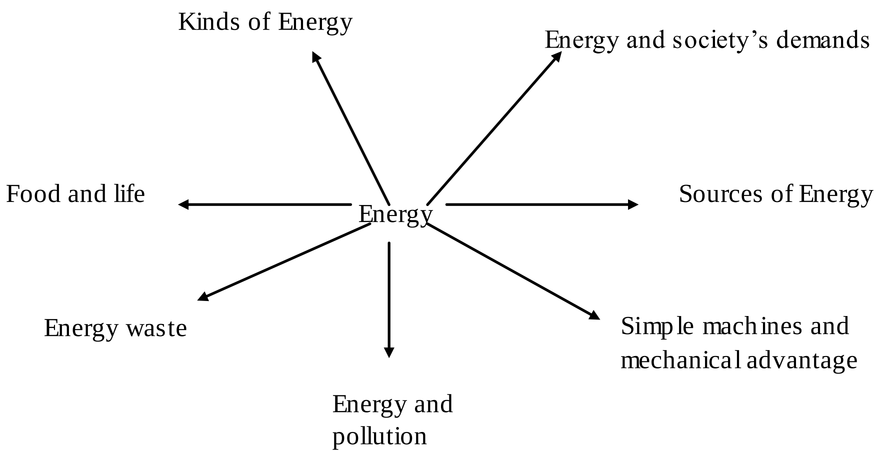

Fig. 1: Module on Energy adopted from Bajah (1983).

The unifying theme as shown in Fig. 1 is energy. Each sub-theme cannot be treated in isolation from the major (central) theme, energy.

3. Process Skills Form of Integration

The idea of integration of science on the basis of process skills arose from the fact that scientists irrespective of their areas of specialization do engage in activities as observation, measurement, classification, hypothesizing, prediction, communication, interpretation of data, experimentation, formulation of models among others. This form of integration emphasizes teaching of the process skills and through these efforts students will be exposed to scientific activities early enough and learn to behave like scientists.

4. Coordination Mode of Integration

Coordination is a form of integration where specialists teach their areas of specialization. In this form of integration, the children's horizon in different disciplines widens because of their contact with the different teachers.

Another type of integrated curriculum according to Urevbu (1990) may not involve the whole curriculum but only certain areas of practical thinking. For example, sex education, violence and war, building a democratic society may all be seen as a curriculum concern, yet the questions raised will not fit within any one traditional subject matter. In dealing with these areas, integration may not be explicitly sought, but the resolution of difficulties identified and inquiry into the pupil would demand personal integration on the basis of multi-disciplinary evidence and argument.

2.3.4 Advantages of the Integrated Curriculum

Over the past few years the interest and need for curriculum integration according to Jacobs (1989) has intensified throughout the country because of the following reasons:

1. Knowledge is growing at exponential proportion in all areas of study. In the sciences for example, there is remarkable degree of specialization that has resulted from research and practice. Each area of the curriculum has the blessing and burden of growth. As a result many subjects will be available to students for study without sufficient time. These add

pressure to the school schedules, since knowledge will not stop growing, integrated curriculum appears to be the only way out as it attempts to select the various areas of knowledge and integrate them thereby reducing the number of subjects available to students.

2. The integrated curriculum experiences also provide an opportunity for a more relevant, less fragmented and stimulating experience for students. When properly designed and when criteria for excellence are met, the students according to Jacobs (1989) breaks with the traditional view of knowledge and begin to actively foster a range of perspectives that will serve them in the larger world.

3. It is also difficult to train people in specialization and expect them to cope with the multifaceted nature of their works. This is because it is important that we draw from the range of fields to better serve our specific fields. These renewed trend in the schools towards interdisciplinary curriculum according to Jacobs (1989) will help students better integrate strategies from their studies into the larger world.

4. One major problem encountered by students in schools is the irrelevance of the course work in their lives out of school. There is the need to create learning experiences that periodically demonstrate the relationship of the disciplines

pointing out their relevance to the societal needs. Through these efforts students will come to understand how different subject areas influence their lives and it is critical that students see the strength of each discipline perspective in a connected way.

5. Other advantages of the integrated curriculum as pointed out by Onwuka (1981), Mkpa (1987) and Urevbu (1990) are that this pattern of curriculum organization also promotes transfer of knowledge or learning. Since in this pattern, the subject matter of the broadfields subject cut across various subject areas, the learner can utilize ideas obtained from one subject area to understand more clearly ideas in another area. When subject matter from some areas are integrated, the learner can then draw experiences from a wider range of subject matter which could be brought to bear on a number of day to day situations.

6. When the broadfields design integrates subject areas, only the most important concepts or elements of each composite subject are included. The advantage is that, the emergent subject is precise and devoid of excessive details.

7. For the learner, the integrated curriculum also offers breadth or coverage of content than the subject design. This is because while the one lesson period e.g. Biology may be used to discuss one topic, a similar period of Integrated Science will likely cut across a number of related subjects including aspects of biology.

2.3.5 Criticisms of the Integrated Curriculum

Despite the enormous benefits of the integrated curriculum, some of the criticisms levelled against it as pointed out by Onwuka (1991), Mkpa (1997) and Urevbu (1990) are as follows:

1. The unification of knowledge which it was believed would result from the integrated curriculum has not completely materialized (Brown, Oke & Brown, 1992). This is because, teachers trained under the university system or colleges of education tended to specialize in a particular subject and hence find it difficult to teach an integrated curriculum.
2. Secondly, universities still retain their subject-oriented curriculum and when candidates are considered for admission, they are expected to have specialized in their later years in secondary schools in particular subjects. Examination bodies like WAEC are also slow in drawing up examinations in integrated studies
3. The wide coverage that integrated curriculum is accepted to address also has its dangers. This is because students are in danger of acquiring a rather superficial knowledge of many topics and no deep understanding of anything. In view of this, there is the need for more studies in this area to see how the essential ideas of a field can be taught, provision being made for depth as well as breadth of understanding.
4. There is also the dearth of good textbooks in the integrated pattern of organization. This is because most authors are trained to produce

textbooks in the autonomous disciplines. As a result, when they attempt to write for subjects in the broadfields pattern of organization, their styles often fail to effect the desired integration adequately.

5. This pattern of organization sometimes fail to integrate many subject areas. It is selective in the extent to which it integrates content areas. To achieve a high level of integration depends on the degree of efforts invested towards effecting real synthesis of ideas, concepts or subjects. In view of this, care must be taken not to allow the broadfields subject become an incoherent patch-work of isolated ideas from different subjects. This task is a great challenge to both curriculum planners and textbook authors.

6. The resources for teaching integrated subjects may be difficult to procure. This is because if a topic in one broadfields subject cuts across about three subject areas, it may be difficult to obtain the necessary instructional resources. In this regard, efforts should be made to procure resources through direct involvement of learners where necessary.

7. The seventh criticism is that when ideas from several subject areas are integrated into a broadfield, it becomes impossible for the learner to appreciate the logical pattern of organization or the structure of the individual subjects. Each subject is believed to have its own structure (i.e. how the content is organized. The structure is necessary for a better understanding of that subject, however in the broadfield pattern of

organization, the structure of each subject is lost in the process of integration.

2.4 RESEARCH REPORTS ON THE DEVELOPMENT OF SCIENCE AND TECHNOLOGY EDUCATION IN SECONDARY SCHOOLS

Several research efforts have been made to evaluate the implementation of Science and technology education programmes in Nigerian schools (Ajewole, 1991; Awotunde, 1992; Olayiwole, 1993; Ayinde, 1995; Okebukola, 1997; Utulu, 1998). Evidence from these research reports seem to indicate that the implementation of these programmes are confronted with a number of problems.

Ukeje (1991) asserts that, teachers are the foundation of quality in the schools. It is their quality, efficiency and effectiveness that the future of organized education depend. It is the teacher who according to him, in the final analysis, translates principles, policies and ideals into action. The effective implementation of science and technology education programmes therefore, depend on the supply of adequate and well-qualified teachers as no system of education can rise above the quality of its teachers (Federal Republic of Nigeria, 1991). Unfortunately, however, many researchers (Ifejiaka, 1990; Akale, 1990) have reported that in Nigeria there is a dearth of qualified and well-trained science and technology teachers. Researches (Maduabum, 1990; Akale, 1992; Oloruntegbe, 1996; Apea, 1997) all point to the fact that Integrated Science teachers have not been properly prepared for the job because most of them were trained in separate disciplines and as a result were confronted with pedagogical difficulties in view of their professional backgrounds.

On this same issue of the quality of teachers Ibole (1999), conducted a study on the calibre of teachers teaching Integrated Science after 28 years of its inception. Qualifications of teachers were obtained from participants at the 1999 STAN Integrated Science National Workshop. The results of the study show that, out of the 69 teachers of the subject from 8 states that participated in the workshop, only 2 (3.8%) did Integrated Science at N.C.E. and the university level. Others were combinations of TC I, TC II, NCE, B. Ed, B. Sc., HND, OND, M.Ed., and Ph.D. in Health, Physical Education, Agricultural Science, Biology, Chemistry and Physics. Most of the higher degrees were through sandwich programmes. The study further concluded that qualified teachers for Integrated Science were grossly inadequate.

For Introductory Technology, the situation is not different either as researchers like Ugwu (1984), Onweh (1991), NERDC (1992) report that, there was scarcity of teachers for the Introductory Technology programme. In a nation wide survey on the teaching of Introductory Technology conducted by the NERDC (1992), more than 90% of the J.S.S. students registered for the subject but less than 60% of the teachers were qualified to teach the subject. Without the right calibre of teachers, the Integrated Science and Introductory Technology programmes and indeed the entire science and technology programmes no doubt will be in a precarious position.

Olarewaju (1987) also carried out a study on some problems identified in implementing the core curriculum for Integrated Science. The study aimed at finding out the calibre of teachers who teach Integrated Science, the topics they find difficult to teach, the topics they think should be included and those topics they feel should be expunged from the curriculum. An open-ended Integrated Science Teachers' Questionnaire (ISTQ) was used to collect data from forty-two teachers from twenty-three schools situated in seven LGA of Ondo and Oyo States.

The results of the study show that, most of the teachers were not adequately prepared to teach the contents of the curriculum and thus they encounter problems with the teaching of topics that are not related to their areas of specialization. School activities take up much of the time that most of the teachers cannot cover all the topics specified for each year. The study also reports that, teachers find such topics like electrical circuits, reproduction in mammals, forces, electricity, energy, pressure, mirage, tools for work and states of matter in JSS one difficult to teach. The topics in JSS two include laboratory preparation of gases, water, oxygen, hydrogen and topics in physics while topics teachers find difficult to teach in JSS three include, skeletal system, electrical energy and chemical reactions. The following topics were also identified as topics to be expunged from the curriculum, reproduction, circulatory system, human biology, man in space, digestive system. The reasons range from the difficulty level of the topics and students' inability to understand because of their age. The topics to be included in the curriculum include nutrition, personal cleanliness, environmental sanitation, vitamins and plants.

Other studies like Bomide (1983), Ogenyi (1988) and Agbo, (1991) also point to the fact that students find some aspects of the concepts and principles outlines in the Integrated Science and Introductory Technology curricula difficult to understand despite teachers efforts to explain and illustrate such units. The causes of these difficulties arise from a number of factors such as poor teaching and the abstract nature of the concepts. Akinmade (1992) and Awotunde (1992) further points out that, the syllabi for Introductory Technology are defective since they place little or no emphasis on traditional technologies of the student environment. These technologies, according to him, include construction, smiting and boat making among others. The efforts to transform the Nigerian society technologically according to him, must be based partly on the acquisition of skills and knowledge in the traditional technologies at the secondary school level. It is in view of this, that a review of the curricula in both secondary schools and the technical colleges is advocated.

Bazza (1992) conducted a study on the problems confronting the effective implementation of the Introductory Technology programme in Yola LGA of Adamawa State. Eight schools were randomly selected from the local government area of the state. The instruments used for data collection were face-to-face unstructured interview, questionnaires, reference books and participatory observation. Data collected were from seven principals, fifteen teachers out of 22 and 150 students out of 2020 students and these data were analyzed using frequency distribution and percentages.

The study revealed the major problems militating against the effective implementation of the Introductory Technology programme in the junior secondary school to include: lack of qualified teaching staff, lack of teaching aids, high cost of textbooks, lack of well equipped libraries, non payment of teacher's allowances and fringe benefits, mismanagement of funds by principal, nonchalant attitude by the government, lack of workshop, lack of adequate seats among others.

As insightful as this study is, the procedure for the validation of the instruments particularly the Principal's Questionnaire, Teacher's Questionnaire and student questionnaire were not mentioned. Since the reliability coefficients of the rating scales in these instruments were not stated, the reliability of the instruments are in doubt and hence findings are suspects. The study also depended mainly on sampling opinions of teachers, principals and students without actually getting to the roots of the matter by designing checklists to assess facilities and equipment on ground. It is also worthy of note that, the study focused only on external factors that affects the implementation of the Introductory Technology programme without examining factors emanating from the curriculum content. It is in view of this development that this study, in addition to sampling opinions will also get into the laboratories and workshops to assess the provision of resources and their usage, enter the classrooms to observe the teaching strategies and in addition also examine the curricular contents of the two subjects to point out the strengths and the weaknesses.

Ncharam (2000) undertook a study of students' perceived difficult concepts in J.S.S. III Nigerian Integrated Science Project (NISP) contents in Plateau State. The purpose of the study was to identify J.S.S. III students' problem areas in the Integrated Science course content, the reasons for such difficulty and suggest possible remedies for the identified problems. The Nigerian Integrated Science Learning Difficulty Questionnaire (NSLDQ) was designed and administered to the one hundred and forty JSS III students selected from four categories of schools (federal, state, voluntary and community schools) in Plateau State using systematic random sampling. The study was limited to three local government areas of the state based on stratified random sampling techniques by school location (urban and rural). Six schools were selected with at least one from each of the three local government areas.

The findings among others show that, students perceived ten of the sixteen topics (about 62.5%) to be difficult to learn. The study further revealed that nineteen (12%) of the total difficult sub-topics are from Biology. These topics include Nervous system, Feeding in plants and animals. Thirty-nine (24%) from Chemistry and these topics are writing chemical equations, atomic structure, acids bases and salts. Twenty-eight (17%) in Physics and the topics include kinetic theory of gases, energy transfer, man in space, work and energy and energy conversion. In science, technology and society related issues, one sub-topic (1%) was found to be difficult. This sub-topic is in the area of erosion and flooding. Some of the major reasons which account for students' perceived difficulty as revealed by the study include high cognitive demand of the concepts, language of instruction, poor attitude of students towards science subjects and non-availability of Integrated Science textbooks.

Mohammed (1992) conducted a study to ascertain the extent to which the NCE (Tech.) curriculum for the preparation of Introductory Technology teachers is relevant and adequate for producing Introductory Technology teachers capable of facilitating the attainment of the objectives of the Introductory Technology programme. Two hypotheses were postulated for the study and these are:

i. There is no significant difference in the mean responses of Introductory Technology teachers and final year NCE technical students on the relevance of NCE technical curriculum for preparing teachers of Introductory Technology; (ii) There is no significant difference in the mean responses of Introductory Technology teachers and final year NCE technical students on the adequacy of NCE technical curriculum for preparing teachers of Introductory Technology. The population for the study consisted of 78 NCE technical graduates teaching Introductory Technology in Yobe State secondary schools and all the 93 final year technical education students in the state. The instrument used was a questionnaire developed by researcher based on the research questions and the literature reviewed.

The findings revealed that: (i) the NCE technical curriculum is not relevant to food and water technology and (ii) the NCE technical curriculum does not adequately prepare its graduates to teach ceramics, maintenance and repairs, food and water technology areas of Introductory Technology syllabus. As revealing as this study is, there is the need to also examine the relevance and adequacy of the curricula contents of the JSS Introductory Technology and Integrated Science to the achievement of the objectives of these programmes. This study is therefore an effort to fill this gap.

Science and technology teachers have been criticized over the years with regard to the effectiveness and quality of their teaching. The Integrated Science and Introductory Technology curricula no doubt, demand a high level of competence in teaching strategies on the part of the teachers. Available evidence (Akinmade, 1985; Nwosu, 1991; Maduabum, 1995; Ozoji, 1998) show, however, that the teaching strategies employed for these subjects are not different from the conventional methods. Akinmade (1995) had earlier reported that, there was little or no progress in changing the orientation of the Nigerian science teacher from being a dominant, dogmatic and authoritative figure to being student-centred and a facilitator of learning. Studies like Okebukola (1985) and Nwosu (1991) have also confirmed poor quality teaching of science subjects including Integrated Science. Nwabueze and Ilemobode (1994) in their survey also confirmed that, there were virtually no teacher/pupil interactions which could result in the acquisition of practical skills and scientific attitudes, rather teachers emphasized more the information aspects of the subjects.

For Introductory Technology, Awotunde (1992) points out that, learning of theory is emphasized to the near neglect of practical skills acquisition. The practical work, if conducted Olayiwola (1999) observes that, the assessment by the teachers seem to be lop-sided in that it is product-oriented and not process-conscious. He asserts that, practical skills and traits are rarely assessed, as subjective marks are often awarded to learners by the over-worked teachers. There is no doubt that, it is indeed difficult to reap the much desired pool of skilled industrial workers under the type of situation obtainable in the classrooms; as success in science and indeed technology can only be achieved if the concepts and skills are imparted through activity-based learning (Wuyep, 1997).

The teaching and learning of Integrated Science and Introductory Technology no doubt, requires varieties of laboratory and workshop materials, equipment and tools. Many studies have shown that students learn better through a practical approach with the use of equipment (Akinmade, 1992; Akale and Usman, 1993;). Besides this, practical work also helps students to develop psychomotor skills thereby making the knowledge and skills gained to be meaningful and relevant to the students. The school laboratories and workshops must therefore, be adequately equipped to reflect the actual working environment.

Researches (Nneji, 1992; Utulu, 1998) observe that, the implementation of these programmes have suffered serious set backs due to lack of facilities.

Oriafo (1984) had earlier pointed out that there is no educational level in Nigeria where the range of resources available especially for the teaching of the science and technology courses can be described as being in any way adequate. In the same vein, Olatunji (1990) also remarks that, the intentions, objectives and strategies for the junior secondary school are commendable but she lamented that the actual implementation has lagged behind the intentions due to inadequate workshop and laboratory equipment to teach the subjects. Researchers (Frazer, Okebukola and Jegede, 1992; Soyibo, 1993; Wuyep, 1997) also confirm that materials for the teaching and learning of science and technology subjects are in short supply.

According to Okebukola (1997), the World Bank evaluation of the secondary education sector in Nigeria conducted in 1991 revealed that only laboratories in Federal government colleges were adequate. Researchers (Odubunmi, 1991; NERDC, 1992. Awotunde, 1992; Nwabueze and Ilemobode, 1992) also point to the gross inadequacy of teaching materials, laboratory facilities among others. The National Board of Technical Education after a critical look at Nigeria's technical colleges also identified lack of basic instructional equipment as their bane and further asserts that, the sad state of the colleges is directly responsible for the poor performance of their students in certificate examinations.

In a study conducted by Utulu (1998) titled Evaluation of the adequacy of laboratory and workshop equipment in secondary schools in Edo State, the study attempted to answer the following research questions: (i) How adequate is the provision of laboratory and workshop equipment in urban and rural secondary schools in Edo State? (ii) What are the differences in the provision of laboratory and workshop equipment in urban and rural secondary schools in Edo State? Stratified random samples of 58 schools out of 253 secondary schools in Edo State were selected. Two checklists, the Laboratory Equipment Evaluation Checklists (LEEC) and the Workshop Equipment Evaluation Checklists (WEEC) were employed in the collection of data. The checklists were prepared from the approved list of standard laboratory and workshop equipment requirement for secondary schools obtained from the Ministry of Education, Benin City. The LEEC was employed in gathering information on the quantity of equipment provided for practical teaching of Physics, Chemistry and Biology in secondary schools while the WEEC was used in collecting information on the quantity of equipment supplied to secondary schools for the teaching of Introductory Technology. Data obtained were analyzed using frequency counts and percentages.

The study revealed that laboratory and workshop equipment were inadequately provided in the schools. The results indicate that more than 60% of the schools with laboratory facilities had less than 50% of the equipment that was supposed to be supplied to this laboratories. Similarly, over 50% of the schools with introductory technology workshops had below 50% of the required workshop equipment. The study further revealed an imbalance in the allocation of the equipment between urban and rural schools in the area. Although both urban and rural schools recorded a shortage of laboratory and workshop equipment, the shortage was more pronounced in the rural schools than in the urban schools.

As revealing as this study appears to be, it assessed the provision of laboratory equipment for the teaching of the separate science disciplines of Biology, Chemistry, Physics as well as Introductory Technology without considering Integrated Science. The study also failed to assess the level of usage of these equipment. This would seem necessary in view of the fact that it is possible to have adequate supply of these facilities and equipment in the schools without putting them to use in teaching students. It is also possible to have these equipment in the right quantity and yet not functional. In view of this, this study will consider the level of usage of these resources and reasons for non-use. In addition to the standard list of the equipment and facilities approved by the Ministry of Education, attempt was also made to include human resources like laboratory assistant, technicians as well as library resources in order to make the list more comprehensive.

Today public and private secondary schools are growing in Nigeria at an alarming rate and the problem however, is that in view of this increase in the population of students, the demand for laboratory and workshop facilities and equipment will continue to increase. The owners of these schools no doubt, will find it difficult to provide adequate teaching facilities required for the effective teaching and learning in the areas of science and technology. One short-term solution to this problem according to Eguabor (2000) and Akinrotohun (2001) is improvisation. Several scholars have written on improvisation. Nwaizugbe,(1991), Balogun (1992) and Eguabor (2000) wrote separately on improvisation in Integrated Science while Okeke (1997) and Akinrotohun (2000) have written on improvisation in the teaching of Introductory Technology in the schools. Several researchers (Nwaizugbe, 1991; Eguabor, 1995; Ezeudu, 1997) have all stressed the benefits of improvisation of laboratory and workshop teaching equipment. Eguabor (2000) and Akinrotohun (2000) observe that, many of the equipment needed for Integrated Science and Introductory Technology are simple, inexpensive and can be obtained from our environment by the students and the teachers.

It is in view of this, that Effiom and Ntibi (2000) opine that, teachers complain of lack of science equipment is only an excuse for their failure to carry out basic experiments and laboratory demonstrations with what is available in the laboratories. Since our environment is richly blessed with varieties of resources and most laboratories stocked with basic equipment that are commonly adaptable to many purposes, success in the teaching of science and indeed technology is more as a result of the skill and resourcefulness of the teacher. Unfortunately, however the exposure of teacher of Introductory Technology and Integrated Science to the concept of improvisation is generally poor and most teachers lack adequate knowledge of improvisation (Akinrotohun, 2000).

Another alternative way of communicating science and technology in a not too expensive way according to James (1998) is the use of human resources, examples of which include the road side mechanics, carpenter, farmers, herbalists, medical doctors, electricians, fishermen, sanitary inspectors among others. Human resources are therefore, individual or groups of persons with a particular occupational or professional specialization, capability or ingenuity relevant to teach a particular concept or content area in science. Some of the advantages of using human resources personnel according to James (1998) include: They can make learning more interesting, enjoyable, meaningful and permanent, they can supplement laboratory lessons, they can also serve as compliment to the teacher since teachers cannot claim expertise in all fields. The use of human resources will also enable pupils to appreciate the use of scientific knowledge in several occupations. Despite the benefits of human resource he however pointed out some limitations which include that human resources cannot be used for some topics, the medium of communication may also be a problem, there may be the problem of organization and discipline of students especially when the lesson is to take place outside the classroom among others.

Many students lack the right kind of motivation for doing science and technology courses. Surveys of students' attitudes towards science and technology conducted by Akpan (1986), Otuka (1987), Umeoduagu (1990) provide evidence of students' poor attitudes towards science and technology subjects - a trend which Igwue (1990) argues, may not be unconnected with the drudgery, boredom and frustration which characterize science classrooms. Other researches like Olayiwola (1993) and Ayinde (1995) also point to poor attitude of students to work. Researchers (Umeoduagu, 1990; Akpan, 1991) point to the fact that enrolments into science and technology based subjects have been very poor. There is particularly low enrolment in the technology subjects relative to the science subjects. For example, in the 1991 West African Examination Councils technical examinations only a total of 2,051 candidates registered nation-wide for the available technical subjects as against 285,690 candidates for Biology and 96,742 for Physics (WAEC, 1991).

The performances of students in public examinations to some extent are reflections of how well the programmes have been effectively implemented and consequently the extent to which the students understand the concepts taught to them. Maduabum (1995) had earlier reported results of international science study in which different countries participated. Nigerian pupils ranked last in primary science and second to the last in secondary science. Students from available West African School Certificate Examination results have been performing poorly. Nwoji (2000) reports the poor performance of students in

Nsukka education zone in their JSSCE results in Introductory Technology for the 1997/98 where only 12% had credit while 80% had ordinary pass and 8% failed. Also in 1998/99 academic session only 13% had credit while 75% had ordinary pass and 12% failed.

Other problems confronting science and technology programmes as pointed out by Okunrotifa (1981), Ayinde (1995) and Okebukola (1997) include: inadequate provision of funds for the development of these programmes by the government, others include, lack of reward for excellence in science and technology teaching as well as non-commensurate remuneration packages for the teachers. Ajewole (1991), Olayiwole (1993) and Ayinde (1995) also identify over-crowded classrooms and heavy workload for teachers as other problems confronting science and technology programmes. The effect of large class size and the heavy workload it imposes on the teachers no doubt, is enormous. Besides making it difficult for teachers to judiciously use laboratory and workshop facilities effectively and efficiently, it also reduces drastically the teacher-student contact (Bajah, 1983 and Ayinde, 1995).

2.5 PROGRAMME EVALUATION IN EDUCATION

There have been several attempts by various authors to provide a clear definition of evaluation. Cangelosi (1991, p.3) defines evaluation as a judgement about the quality, value, effectiveness or impact of something (e.g. a product, process, person, organization or collection).

Evaluation, according to Okoro (1991, p.1), can simply be defined as the appraisal of the worth or value of a thing or action and the making of appropriate decision on the basis of such appraisal. To Bello and Okafor (1997), evaluation is seen as a process that attempts to determine as systematically and objectively as possible the relevance, effectiveness and impact of activities in the light of their objectives. Okoro (1991) indicates that, evaluation in education, therefore, involves the collection of data and the use of data to assess the effectiveness or quality of a programme or performance. Programmes in education, according to him, are established for some purposes and it is the function of programme evaluation to determine the extent to which the purposes of the programme are being achieved

A careful study of these definitions reveal that though areas of emphasis may differ they have much in common. Evaluation essentially involves the collection of information or data and using the data to judge the worth or value of the programme in question and finally taking decisions about the programmes on the basis of the data collected and the judgement made.

2.5.1 Purpose of Evaluation in Education

The purpose of programme evaluation in education are numerous. Bajah (1986) states that the basic rationale for evaluation is that it provides information for action while its primary justification is that it contributes to the rationalisation of decision making. To Okoro (1991), the main purpose of evaluation in education is to judge the worth, usefulness, effectiveness or value of something, be it an educational programme, curriculum, text book, students' performance or equipment. Other function of evaluation as put forward by some scholars are as discussed below:

1. Programme Improvement: Evaluation makes it possible for data and information relating to programmes and students to be collected. Such collected data according to Okoro (1991) are used in judging the effectiveness of the programme and in detecting deficiencies in the programme that need to be removed.

2. Accountability: Another reason commonly advanced for the evaluation of programmes is the need to justify expenditures of time, talent and money. These are expenditures which curriculum leaders are likely to be questioned at any time. Okoro (1991) points out that, vast sums of money are spent on education by the government. This money ought to produce good educational programmes for students; programmes that would serve the needs of the country and bring about the desired changes in the behaviour, character, skill level and social life of students who pass through the programmes. Evaluation therefore, ensures that all educational expenditures are justified by the improved learning or other favourable outcomes that might result from the expenditure.

3. Decision-Making: Decisions must be made with regards to all aspects of education and at all stages in the provision of education. Ofoegbu (1997) shows strong support for programme evaluation as a basis for presenting evidence for the sake of facilitating decision making in stages of curriculum development.

Such decisions according to him may lead to continuation, termination or modification of the educational programmes. Evaluation, therefore assists in decision making by providing the information on the basis of which wise decisions can be taken (Okoro, 1991).

4. Programme Planning: Evaluation also aids the planning of a new programme and in deciding whether to expand, modify or discontinue with the existing programmes. According to Okoro (1991), high quality education programmes can be provided for the citizen of any country only by careful planning. Planning ensures that any educational programme established will serve the needs of the country and the community. Proper planning according to him, involves the collection of information about objectives, needs of the community, students to be served, cost of programmes and availability of teachers. These information play an important role in effective planning in education.

5. Personnel Improvement: Evaluation also helps in ensuring that educational personnel are well trained and are carrying out the functions that they are best suited to carry out. According to Saylor and Alexander (1974), evaluation in schools helps to judge the merits of all the administrative and managerial arrangements and practices and the structures within which the school itself operates. The skill and ability of administrative and instructional personnel in educational institutions no doubt, determine to a large extent the quality of programmes offered. Staff according to Okoro (1991), should therefore, be

assisted to identify their strong and weak points and be encouraged to improve on their performance.

Other purposes commonly advanced for the need to evaluate programmes in education include the significance to participants of knowing what they have accomplished. This knowledge tends to improve their morale and supply guide posts by which they may plot further action.

2.6 EVALUATION MODELS

Several tactics and strategies have been adapted by evaluators in evaluating social action, programmes such as welfare, science, health and education. These tactics and strategies are called models. A model according to Bello and Okafor (1997), therefore, is a system or a working mechanism with which curriculum evaluation operates based on the purpose in which evaluation is focused. It shows the components and structures of evaluation and how these are interrelated in bringing about a specific intent. To Okoro (1991), an evaluation model may be regarded as a set of steps or a system of thinking which if followed or implemented will result in the generation of information which can be used by decision makers in the improvement of educational programmes. According to him, evaluation models are a great help to evaluators because they provide a general guide, which can be adopted or modified to suit specific programmes being evaluated. Examples of such models are as discussed as follows:

2.6.1 Ralph Tyler's Model or the Objectivist Model

The focus of Tyler's curriculum model according to Mezieobi (1993), is that evaluation should be based more than anything else on predetermined objectives which should form the rationale, for determining the effectiveness of the curriculum in terms of being relevant and functional as well as its appropriateness in realising the objectives of the programmes of curriculum and instruction. With specific reference to instructional evaluation, this school of thought aptly thinks that, since the ultimate objective is to produce desirable changes in the behaviour patterns of learners, the objectives have to be stated behaviourally in order to warrant proper evaluation of competence- based objectives if the strengths and pitfalls of the curriculum with regards to the extent of the actual achievement or performance of the learner would be ascertained. The ensuing feedback, according to him, would after synthesis be utilized for programme efficacy. From the foregoing, it can be clearly seen that there is an interdependence between objectives and evaluation such that evaluation makes it possible to determine from the demonstrated achieved objectives what has or has not been achieved from the intended outcomes as determined from the clearly defined objectives.

2.6.2 Robert Stake's Countenance Evaluation Model

Educational evaluation has its formal and informal sides. According to the Stakes model, informal evaluation is recognized by its dependence on casual observation, implicit goals, intuitive norms and subjective judgement. Perhaps, because these are also characteristic of day-to-day personal styles of living, informal evaluation results in styles of living while formal evaluation results in perspective which are seldom questioned.

Worthen and Sanders (1973) observe that, informal evaluation of education can sometimes be penetrating and insightful, sometimes superficial and distorted. Formal evaluation on the other hand is recognized by its dependence on checklists, structured visitation by peers, controlled comparison and standardized testing of students. The model, therefore utilize informal (i.e. opinion polls or survey) and formal (i.e. checklist, standardized tests) procedures to ascertain the perceived efficacy or otherwise of an existent curriculum (Mezieobi, 1993). Although this model does not emphasis the interrelationship between objectives and evaluation, yet we share the views of Mkpa (1986), that through the evaluation practice of this model, one can possibly obtain a broad picture of the curriculum in actuality, what a society thinks of an existing curriculum and their expectations which may be conflicting yet instructive, if the resulting data is used to make the curriculum functional.

Stake suggests that educators must abandon informal (subjective) evaluation procedures if rational judgements are to be made. He points out that the two major activities of formal evaluation studies are description and judgement of the programme being evaluated. The Stakes model according to Worthen and Sanders (1973), therefore, is a useful mnemonic device for planning an evaluation study. It is an evaluation recipe but it is an organizational framework which emphasis the two most important components of programme evaluation. In addition, operations which should be performed on the data (such as looking for contingencies and congruencies) are suggested as appropriate methods for analyzing the vast amount of data collected in many evaluation studies.

2.6.3 Robert Hammond's Evaluation model

This model, according to Worthen and Sanders (1973), concerns itself with the determination of how effective a curriculum (existing or innovated one) is in meeting local needs as embodied in expressed objectives. Like the Tyler's model, this model also proposes that the basis for effective evaluation is a set of predetermined, clearly defined behavioural objectives which are perhaps locally oriented in terms of reflecting the needs of the locality in which the curriculum is to operate.

2.6.4 Product Evaluation Model:

This school of thought, according to Mezieobi (1993), thinks that curriculum evaluation should focus on the products of the educational institutions who have been exposed via teaching to a planned or unplanned curriculum up till the terminal stage in their programme of study. In this evaluation model, he points out that evaluation focuses mainly on the cumulative academic achievement of learners or on their performance effectiveness as judged by their ability to translate skills, values, attitudes and competencies acquired in school into functional productive utility in real life situation after they had left the school.

2.6.5 Scriven's Goal Free Evaluation Model:

Scriven (1972), while recognizing the pitfalls of the goal- free evaluation, opines that evaluation should anchor not only on already intended goals but also on the evaluator identifying and collecting relevant data that would enable him appraise the total consequences of the evaluated curriculum without reference to any pre-set goals which may blur his objectivity. According to Scriven (1972), while evaluation can play many roles in education (such as in accountability studies, curriculum development or teacher education programmes) the evaluation process has only one functional goal, that of determining the worth or merit of something.

He made a distinction between formative evaluation (evaluation used to improve a programme while it is still fluid by providing feedback to the developer) and summative evaluation (evaluation of a completed product aimed at the potential consumer). To him, understanding the distinction between these two evaluation roles will help the evaluator to delineate the methods, which may be appropriately used in any evaluation study. It is most appropriate, as Scriven has suggested, to assign the formative evaluation task to a professional evaluator who is a regular part of the programme being evaluated, a person internal to the organization, someone who knows the details of the project. On the other hand, it is essential that a disinterested unbiased professional evaluator from outside the programme be brought in as the summative evaluator. The reason for using an external evaluator for summative evaluation studies is that consumers of the evaluation report must be assured that the evaluation was done by an independent person and that no " whitewash" or favourably biased report was written (Worthern and Sanders, 1973). Thus Scriven suggested credibility as a critical criterion in judging an evaluation report.

2.6.6 Context, Input, Process and Product (CIPP) Evaluation Model:

This evaluation model was developed by Stufflebeam (1973) and is widely used today in the evaluation of programmes especially science education programmes (Bello and Okafor, 1997). Four types of decisions were identified by Stufflebeam. These are planning decisions, structuring decisions, implementing decisions and recycling decisions. Planning decision determine goals and objectives to be served by the programme, structuring decisions determine procedure or the means to be adopted in attaining the desired objectives. Implementing decisions deals with the utilization and implementation of procedure, and recycling decisions reviews achievements and makes decisions on modifying, terminating or continuing the programme. Planning decisions and structuring decisions according to Okoro (1991), deals with intended ends and means while implementing decisions and recycling decisions deal with actual means and ends. The CIPP evaluation model identifies four types of evaluation. They are:-

1. Context evaluation

2. Input evaluation
3. Process evaluation
4. Product evaluation

These four types of evaluation support the four types of decisions mentioned. Planning decisions require context evaluation, structuring decisions require input evaluation, and implementing decisions require process evaluation while recycling decisions require product evaluation. The component and specific aspects of the CIPP model are as discussed as follows:

1. **Context Evaluation.**

This is the most basic kind of evaluation. Its purpose, according to Worthern and Sanders (1973), is to provide a rationale for the determination of objectives. Specifically, it defines the relevant environment, describes the desired and actual conditions pertaining to that environment, identifies unmet needs and unused opportunities and diagnoses the problems that prevent needs from being met and opportunities from being used. The diagnosis of problems, according to Worthern and Sanders (1973), provide an essential basis for developing objectives whose achievement will result in programme improvement. Context evaluation, therefore, is concerned with the determination and the validation of goals and objectives. In relation to science and technology education programmes, context evaluation refers to the relevant conditions that surrounds the programme, the operationalisation of the broad objectives of the government concerning the programmes and the objectives for which the programmes were established. The variables here, according to Bello and Okafor (1997), will include space provisions and location for the programme, adequacy of classrooms, laboratories, reading rooms among others.

2. **Input Evaluation:**

This provides information on resources available and how resources may be used to achieve desired ends (Okoro, 1991). Input evaluation to him may entail the assessment of staff, students, physical facilities, equipment, library resources and other resources that will be involved in the educational programmes. The purpose of input evaluation, according to Worthen and Sanders (1973), is to provide information for determining how to utilize resources to achieve project objectives. Bello and Okafor (1997) further point out that input evaluation refers to the various materials and finance available to the programme and these include course content, its organization, quantity and quality, material resources, availability and adequacy of instructional aids, laboratory equipment, finance and time. Essentially, input evaluation, therefore, provides information for deciding whether outside assistance should be sought for achieving objectives, the strategy to be employed for example the adoption of available solutions or the development of new areas and the design or procedural plan to be employed for implementing the selected strategy (Worthen and Sanders, 1973).

3**. Process Evaluation**

This is undertaken during the period of programme implementation and provides periodic feedback on the quality of implementation. This type of evaluation therefore is needed to provide periodic feedback to person responsible for implementing plans and procedures. The main purpose of process evaluation is to determine if there are defects in the implementation process. Process evaluation is concerned with course offerings, teaching methods and other processes for programme implementation and assesses the efficacy with which input components are being utilized. Process evaluation, according to Worthen and Sanders (1973), has three main objectives. The first is to detect or predict defects in the procedural design or its implementation during the implementation stages, the second is to provide information for programme decisions and the third is to maintain a record of the procedure as it occurs.

There are four essential features of process evaluation methodology. These are the provision for a full- time process evaluator, instruments for describing the process, regular feedback meetings between the process evaluator and project personnel, and frequent updating of the process evaluation design. In summary, therefore, Worthen and Sanders (1973), point out that, process evaluation provides project decision makers with information needed for anticipating and overcoming procedural difficulties for making pre-programmed decisions and for interpreting project outcomes.

4. **Product Evaluation**

This determines the effectiveness of the programme in achieving the objectives and goals of the programme. Okoro (1991) points out that product evaluation relates programme out comes to programme objectives and process components. The purpose of product evaluation therefore is to measure and interpret attainments not only at the end of a project cycle but as often as necessary during the project term. The general methods of product evaluation according to Worthen and Sanders (1973), include devising operational definitions of objectives of the activity, comparing these measurements with predetermined absolute or relative standards and making rational interpretations of the outcomes using the recorded context, input and process information.

The foregoing evaluation models are not exhaustive. No one model of evaluation is best for science and technology programmes. Science and technology evaluation utilizes a rational combination of a number of these models for better results.

2.7 SUMMARY OF THE REVIEW OF LITERATURE

Research evidence from this review of literature show that the implementation of the Integrated Science and Introductory Technology programmes in secondary schools are confronted by a number of problems. Several researches carried out on Integrated Science (Maduabum, 1990; Akale, 1990; Nwosu, 1991; Akinmade, 1992; Apea, 1997) and Introductory Technology (Ugwu, 1984; Awotunde, 1992; NERC, 1992; Bazza, 199; Utulu, 1998) have confirmed that the implementation problems range from lack of qualified personnel, inadequate provision of facilities and poor teaching strategies. Other areas as pointed out by (Maduabum, 1995; Ozoji, 1998; James, 1998; Nwoji, 2000; Akinrotohun 2000) include lack of exposure of teachers to the concept of improvisation, large class size, poor performances of students in external examinations and students' lack of interest in the subject. In addition to these external factors that affect the effective implementation of these programmes, the curriculum itself can be defective thereby constituting problems. These defects may arise from inadequate attention to sequence and balance of curriculum contents, irrelevance of the contents of the curriculum to learners and societal needs (Adegoke, 1987). This developments brings to focus the need for this research as these issues cannot be taken lightly.

The review also points out that, the interest and need for curriculum integration has intensified all over the world because of the need to provide a more relevant, less fragmented and stimulating experience for students (Mkpa, 1987; Jacobs, 1989 and Urevbu, 1990). Despite these benefits, there were a number of criticisms like dearth of qualified teachers, textbooks and resources. Other criticisms include: lack of integration of the different disciplines that make up these subjects, students acquiring superficial knowledge of many topics without deep understanding of any of them (Urevbu, 1990; Onwuka, 1991 and Mkpa, 1997).

The review also shows strong support for programme evaluation as an important tool for presenting evidence for the purpose of facilitating decision making in stages of curriculum development (Ofoegbu, 1997). Such decision making may lead to continuation, termination or modification of programmes. Other purposes of evaluation include programme planning, accountability, programme improvement, personnel improvement (Saylor and Alexander, 1974; Doll, 1978; Okoro 1991)

Though several evaluation models exist like the Tyler's, Stake's, Hammond's evaluation models cited in Worthen and Sanders (1973), Scriven's and a number of others. The review identifies the Stufflebeam's model of evaluation popularly called the Context, Imput, Process and Product (CIPP) evaluation model as appropriate for the evaluation of the Integrated Science and Introductory Technology programmes (Bello and Okafor, 1997) in view of its comprehensive approach to evaluation.

CHAPTER THREE

METHODS AND PROCEDURE

This section deals with the methods and procedure that was followed in carrying out the study. The section was, therefore, described under the following: research design, population and sample, sampling technique, the instruments, procedure for data collection and method of data analysis.

3.1 RESEARCH DESIGN

This study employed a survey design. In a survey design, a group of people or items are studied by collecting and analyzing data collected from a few people or items considered to be representative of the entire population. The study fits into the survey design in the sense that, it aimed at collecting data from a representative sample of schools, teachers and experts for the purpose of describing in a systematic manner the characteristics and facts about the implementation of the Integrated Science and Introductory Technology programmes as well as their curricula contents and generalizing the findings to these programmes in all the secondary schools in the State. In doing this a variety of instruments like questionnaires, checklists and observation schedules were employed.

3.2 POPULATIONS AND SAMPLES

The target population and sample that were used in this study are discussed below:

3.2.1 Populations

The units of analysis in this study were the Integrated Science and Introductory Technology programmes in the secondary schools in Benue State. Thus, the populations for this study were made up of the Integrated Science and Introductory Technology programmes in the secondary schools in Benue State. There were 246 schools having these programmes in the State. The schools were spread across three zones namely, zone A, Zone B and Zone C. Zone A, made up of seven local government areas, had 70 rural schools and 31 urban schools. Zone B, made up of seven local government areas, had 29 rural schools and 34 urban schools, while zone C, made up of nine local government areas, had 61 rural schools and 21 urban schools. There was also a total population of 257 Integrated Science and 244 Introductory Technology teachers in the State. The overall population of schools and the population of JSS III students in the three educational zones in Benue State at the end of the 2001/2002 session are presented in Table 1.

Table 1
Populations of schools and JSS III Students by Educational zones in Benue State 2001/2002.

	School Population [a]		JSS III Students' Population [b]	
Zone	Rural	Urban	Rural	Urban
A	70	31	10349	4873
B	29	34	3888	6611
C	61	21	6425	4135
Total	160	86	20662	15619

Note. a List of post primary institutions in Benue State, Benue State Teaching Service Board, Makurdi.

b List of registered students in the JSSCE 2002, Benue State Examination Board, Makurdi.

3.2.2 Samples

The observation units for this study were made up of the Integrated Science and Introductory Technology curricula, resources, teachers, experts and lessons in Benue State secondary schools. Thus, the samples from which information were collected were made up of:

1. Fifty schools selected from the population of 246 secondary schools in the State. The 246 schools were stratified into rural and urban schools, 32 schools were selected from the 160 rural schools while 18 schools were selected from the 86 urban schools.
2. All the Integrated Science and Introductory Technology teachers in the selected schools (61 Integrated Science and 48 Introductory Technology teachers).
3. A sample of ten experts each in the fields of Integrated Science and Introductory Technology.
4. A sample of two lessons per each subject (i.e. Introductory Technology and Integrated Science) in ten schools in the State.

3.2.3 Sampling

The fifty schools' programmes that were used for this study were selected using the probability proportionate to size (PPS) sampling technique. The use of the PPS gave the schools' programmes an equal probability for selection based on students population. The schools in each zone were first of all sorted into rural and urban schools. Rural schools were the schools located outside the state and local government headquarters, whereas urban schools were the schools located within the state and local government headquarters.

The total numbers of rural and urban schools in each of the zones were ascertained before sampling was done. In Zone A there was a total number of 70 rural schools and 31 urban schools. In zone B, there was a total of 63 secondary schools (29 rural and 34 urban schools) while in zone C, there was a total number of 61 rural schools and 21 urban schools. Twenty percent of the rural and urban schools in each of the zones were selected.

A list of the 70 rural schools in zone A and their population sizes were prepared from the list of post primary institutions in the State compiled by the Benue State Teaching Service Board. The cumulative totals and the ranges of the schools' populations were calculated. The sampling interval (S1) was worked out, and based on the sampling interval calculated, a random starting number between 1 and the sampling interval value was selected. The school whose population range falls within the random number chosen was the first school to be selected. The second school was selected by the addition of the sampling interval to the random starting number and selecting the school whose population range contained the sum. In order to select the third school, the sum used in selecting the second school became the starting number. The sampling interval (SI) was added to this number and the school whose population range contained the new sum was made the third school to be selected. This process was continued until the required number of schools were selected. The PPS sampling technique was applied using the sampling frames of rural and urban schools separately. The number of schools sampled for the study is as shown in Table 2.

Table 2
Number and Percentage of School Sampled for the Study.

Zone	No of Rural Schools	No of Rural Schools Selected	Percentage of Total Rural Schools Selected	No. of Urban Schools	No of Urban Schools Selected	Percentage of Total Urban Schools Selected
A	70	14	20%	31	6	20%
B	29	6	20%	34	7	20%
C	61	12	20%	21	5	20%
Total	**160**	**32**		**86**	**18**	

The purposive sampling technique was used in the selection of the experts (ten in each of the fields of Integrated Science and Introductory Technology). In selecting the schools for observing the Integrated Science and Introductory Technology lessons, the proportional stratified sampling techniques was used. The 50 schools selected were stratified into rural and urban schools, the sampling fraction was calculated and based on the value obtained, the number of schools were selected from the urban and rural schools based on their proportions. This procedure guaranteed proportional representation of each stratum based on the number of schools in each stratum. Awotunde, Ugodulunwa and Ozoji (1997) provide that, the Sampling Fraction (SF) be calculated as follows:

$$SF = \frac{\text{sample size}}{\text{Population size}}$$

$$= \frac{10}{50}$$

$$= 0.2$$

consequently, the product of the SF and the population from each stratum represents the number of schools from the stratum to be included in the final sample. Thus:

(i) From the rural school stratum were drawn 0.2x32 =6.4 =6 schools

(ii) From the urban school stratum were drawn 0.2x18 =3.6= 4 schools

These schools were randomly selected from each of the list of the rural and urban schools through the 'Hat and Draw Method'.

The number of schools selected from the rural and urban schools for the observation of the Integrated Science and Introductory Technology lessons are shown in Table 3.

Table 3

Number of Schools Selected for Observation of Integrated Science and Introductory Technology Lessons.

Location	Number of schools	Sampling proportion	Sample size
Rural	32	0.2	6
Urban	18	0.2	4

3.3 INSTRUMENTS FOR DATA COLLECTION

Six sets of instruments were developed and used for collection of data in this study. The instruments were:

1. Classroom Observation Schedule (COS) - Appendix A
2. Programme Evaluation Instrument for Teachers (PEIT)- Appendix B
3. Introductory Technology Resource Assessment Checklist (ITRAC)- Appendix C
4. Integrated Science Resource Assessment Checklist (ISRAC)-Appendix D
5. Integrated Science Curriculum Contents Evaluation Instrument (ISCCEI)- Appendix E
6. Introductory Technology Curriculum Contents Evaluation Instrument (ITCCEI) - Appendix F.

3.4 DEVELOPMENT AND VALIDATION OF INSTRUMENTS

The procedures for the development and validation of the instruments are as described below:

3.4.1 Development and validation of COS

The COS was developed by the researcher and was used to assess the teaching strategies of teachers in the Integrated Science and Introductory Technology classrooms in the respective schools sampled for the study.

In developing this instrument, copies of the National Curriculum for Junior Secondary Schools for Integrated Science and Introductory Technology were obtained and the methods of instruction recommended studied. Literature search was also conducted on the teaching strategies for the courses. The works of Olarewaju (1987), Oloruntegbe (1996), Abba (1999) were found very useful. The evaluation format used for assessing teaching practice students of the University of Agriculture, Makurdi was obtained from the Department of Agricultural and Science Education and the contents studied. The researcher in collaboration with experienced science and technology educators developed the instrument. The instrument had four sections namely: sections A, B, C and D. Section A dealt with planning of the lesson, section B assessed the teaching procedures, section C focussed on the student activities while section D dealt with classroom management and control. The four sections of COS were assigned marks. Section A designated "Planning of the lesson" carried 25 marks. Section B, "Teaching procedures" was assigned 50 marks. Section C, "Student Activities" carried 15 marks while Section D, "Classroom Management and Control" was assigned 10 marks. The researcher observed the teaching strategies of teachers in the Integrated Science and Introductory Technology classroom carefully and assigned the appropriate scores ranging from very poor (0) to Excellent (5). The maximum score obtainable by a teacher on this instrument is 100. The COS was given to four experienced science educators and four technology educators to ensure face and content validity of the instrument.

3.4.2 Development and validation of PEIT

The PEIT which was developed by the researcher was used to collect information from teachers with regards to the implementation of the Integrated

Science and Introductory Technology programmes in the respective schools. In developing this instrument, literature search was undertaken to identify the issues involved in the implementation of the Integrated Science and Introductory Technology programmes. The works of Olarewaju (1987), Oloruntegbe (1996), Akpan (1996) and Utulu (1998) were found to be very useful in this regard. The issues identified from these previous studies formed the basis on which the questionnaires were developed. A total of 30 items were initially drawn for each of the questionnaire and subjected to ranking pre-trials using four experienced science educators and technology educators each. These experts were requested to examine the relevance of each item in relation to the research questions and hypotheses posed. They were also required to rephrase the items to make them simple as well as delete those that were not relevant. A final version of the instrument was arrived at after a consideration of the entire rankings.

The instrument (PEIT) was made up of sections A, B and C. Section A solicited information about the teachers' qualifications, areas of specialization, years of teaching experience, the number of teaching periods per week, the teacher pupil ratio in the classes as well as the level of community participation in the development of science and technology. Section B, had 20 statements covering the aims and objectives of the programmes, the nature of the curriculum in terms of relevance and adequacy of content, the extent of coverage of topics in the syllabus, availability of resources for instructions and the teaching strategies employed by teachers. Section C solicited information from the teachers regarding students' performances in JSS examinations in integrated science and introductory technology for the period of five years as well as students' enrolments into science and technology courses at the senior secondary school level for the same period of years. The teachers were expected to rate each of the statements in section B on a five-point-scale ranging from strongly disagree (1) to strongly agree (5). The maximum score obtainable by a respondent was 100.

To establish the validity of this instrument, the researcher gave them to a panel of experts made up of four experienced science educators and technology educators each to ensure face and content validity. Thereafter, the instrument was piloted tested using smaller samples that possessed similar characteristics as the main study sample but did not participate in the main study. In order to establish the internal consistency of the rating scale in the instruments, the Cronbach's Coefficient Alpha Method was used. The formula is as shown below:

$$\propto = \frac{n}{n-1}\left(1 - \frac{\sum s^2_1}{s^2_x}\right)$$

Where n = number of items

S^2_1 = variance of a single item

S^2_X = variance of the total items

The reliability coefficients for PEIT for Integrated Science and Introductory Technology teachers were 0.90 and 0.78 respectively. (See Appendix J and I)

3.4.3 Development and validation of the ISRAC and ITRAC

The ISRAC and ITRAC which was developed by the researcher had all the resources for the teaching and learning of Integrated Science and Introductory Technology respectively. The checklists were used to assess the resources available for implementing each of the programmes in the respective schools sampled for the study.

In developing these checklists, the following procedures were followed: First a literature search on resources for teaching Integrated Science and Introductory Technology was made and both human and material resources recommended were identified. The works of Bajah (1983), Balogun (1983), Olarewaju (1987) were found to be very useful. Secondly, copies of the National core curriculum for Junior Secondary Schools for Integrated Science and Introductory Technology were obtained from the Federal Ministry of Education and examined critically and the resources recommended for the implementation of the Integrated Science and Introductory Technology programmes were isolated. Finally, the approved list of standard laboratory and workshop equipment requirement for junior secondary schools Integrated Science and Introductory Technology were obtained from the Federal Ministry of Education and the National Board for Technical Education respectively. The researcher in collaboration with experienced Integrated Science and Introductory Technology teachers developed a comprehensive list of all the resources (human and material) required for the teaching and learning of Integrated Science and

Introductory Technology. The checklists had eight columns namely: Serial number, Resources, Minimum number recommended, Number available, Adequate, Used, Not Used and Reasons for non use. The ISRAC had 166 items while ITRAC had 105 items. The researcher scored each of the resources Adequate (2), Available (1) or Not available (0) depending on the number of the resources available and in line with the minimum number of the resources specified by the Federal Ministry of Education and the National Board for Technical Education. The maximum score obtainable on the ISRAC and ITRAC were 332 and 210 respectively (i.e. if all the items listed on the checklists were adequate (2).

To ensure face and content validity of these instruments, the checklist were given to a panel of experts made up of four experienced Integrated Science and four Introductory Technology teachers to vet. The teachers made very useful suggestions that helped in regrouping some of the items and compressing some of the items thereby helping to prevent the list being unnecessarily lengthy.

3.4.4 Development and validation of ISCCEI and ITCCEI

The ISCCEI and ITCCEI were developed by the researcher and were used to determine the relevance or otherwise of the curricula contents of the Integrated Science and Introductory Technology to the learner range of experiences and ability. In addition, the instruments were also used to find out what new developments and current issues in the fields of science and technology that need to be included in the Integrated Science and Introductory Technology curricula. The instruments were also used to find out the extent to which the different disciplines (subjects) that make up the Integrated Science and Introductory Technology courses were well integrated.

In developing these instruments, copies of the National Core Curriculum for Integrated Science and Introductory Technology were obtained from the Federal Ministry of Education and the contents of the two curricula studied. The researcher in collaboration with experienced Integrated Science and Introductory Technology teachers developed these instruments. The ISCCEI and ITCCEI were made of two sections A and B. Section A of the instruments (ISCCEI and ITCCEI) contained all the topics in Integrated Science and Introductory Technology respectively recommended to be taught to students from JSS I to JSS 3 and the experts were to indicate by ticking in the appropriate columns the relevance or otherwise of these topics specified to the learners range of experience and ability. The experts were required to also give reasons where they feel the topics specified were not relevant to the learners experience and ability.

Section B of the instruments ISCCEI and ITCCEI solicited information from the experts on the extent to which the different disciplines that compose the Integrated Science and Introductory Technology courses were well integrated to provide a wholistic view of science and technology to students. Section B of the instruments sought to find out from experts what new developments and current issues in the fields of science and technology that need to be included in the Integrated Science and Introductory Technology curricula.

The instruments ISCCEI and ITCCEI were also given to a panel of four experts each in science and technology education to ensure face and content validity of the instruments.

3.5 DATA COLLECTION PROCEDURE

Permission was sought from the principals of the secondary schools for the use of the schools and the teachers. Each school was visited by the researcher and the questionnaire (PEIT) was personally administered to the teachers to obtain the necessary information with regards to the implementation of the Integrated Science and Introductory Technology programmes in the respective schools. The teachers were instructed on how to complete the questionnaires to ensure that mistakes were not made.

The Integrated Science and Introductory Technology teachers of the respective schools served as research assistants and helped the researcher to assess the resources put in place in the schools for implementing the Integrated Science and Introductory Technology programmes using the Integrated Science Resource Assessment Checklist (ISRAC) and the Introductory Technology Resource Assessment Checklist (ITRAC) respectively.

The Classroom Observation Schedule (COS) was used by the researcher to assess the teaching strategies as well as the interactions that go on between the teachers and the students in the classrooms. In using the COS for observing the teaching strategies used by teachers in the Integrated Science and Introductory Technology classrooms, the following procedures were followed: permission was sought from the principals and teachers teaching Integrated Science and Introductory Technology in the selected schools for the use of their schools and classes for observation respectively. The COS which had the key attributes and strategies to be observed specified in it, had a rating scale which was used in indicating the degree or extent to which these attributes were present.

The researcher personally entered the classrooms to observe these lessons using the instrument COS. The researcher tried as much as possible not to interfere with the setting in which the observation took place by entering the classrooms and sitting quietly at the back without distracting the students and the teachers. Two lessons each in Integrated Science and Introductory Technology were observed in ten schools selected from the 50 schools sampled for the study. The instrument COS was scored for each lesson observed and the score used in determining the appropriateness or otherwise of the teaching strategies employed by the teachers in teaching these subjects.

The Delphi technique was used in determining the relevance or otherwise of the Integrated Science and Introductory Technology curricula contents to the learners range of experience and ability as well as current issues and new developments in the fields of science and technology that need to be included in the Integrated Science and Introductory Technology curricula. Delphi Technique consists of series of interrogation of samples of individuals (experts) by means of questionnaires. The focus is on some curricula content areas in which each individual is knowledgeable. This technique enables these experts to speculate individually and then reach consensus collectively regarding the content of a particular course.

The instrument ISCCEI and ITCCEI were personally administered to ten experts each in the fields of Integrated Science and Introductory Technology by the researcher. The initial questionnaire requested for a list of content that each expert feels should be included in the curriculum and the ones that were not relevant to the students' range of experience and ability. This was followed by a second round with each participant receiving a list of all opinions. The listing is reviewed and then each item is rated in terms of importance to the curriculum. During the third round, participants were asked to review consensus ratings of items and based upon the results, the experts may possibly revise their opinions. The fourth round provides participants with a chance to review updated consensus ratings and make final revisions (if any) to their individual ratings. This technique is of much value when persons desire to reach consensus regarding the content of a particular curriculum. All too often, there is more content available than time to teach the material, this technique, therefore ensures that the most relevant content is included and the least relevant content is excluded. A maximum of six months will be set as a target period within which to get the data collected from the respective schools.

The Context, Input, Process and Product (CIPP) evaluation model that was used in the evaluation of the Integrated Science and Introductory Technology programmes considered the following components and specific aspects of the programmes: Context evaluation sought to find out the extent to which the subjects fulfill the programmes objectives as well as the nature of the Integrated Science and Introductory Technology curricula in terms of relevance, adequacy and relationship with each other.

Input evaluation assessed staff, students, physical facilities, equipment, library resources, funds and other resources needed for implementing these programmes. Process evaluation in this study was concerned with course offering, teaching strategies and the various kinds of activities and interactions that take place in the classrooms.

3.6 METHOD OF DATA ANALYSIS

A variety of statistical techniques were used to answer the research questions and test the hypotheses generated in section one. These are as discussed as follows:

3.6.1 Research Questions:

3.6.1.1 Research question one

This question was raised to find out the relevance of the Integrated Science and Introductory Technology curricula contents in achieving the objectives of the programme. Descriptive statistics were used to address this research question. Percentages was used to present the expressed opinions of teachers on this issue.

3.6.1.2 Research question two

This question was out to find out the relevance of the Integrated Science and Introductory Technology curricula contents to the learners range of experience and ability. Data obtained were analyzed using frequency counts and percentages.

3.6.1.3 Research question three

This question sought to find out new developments and current issues in the fields of science and technology that needed to be included in the Integrated Science and Introductory Technology curricula. Frequency counts and percentages were used to analyze the data.

3.6.1.4 Research question four

This question was concerned with the adequacy of the Integrated Science and Introductory Technology programmes in motivating JSS students to offer and progress in science and technology subjects at the SSS level. The data were analyzed using frequency counts and percentages.

3.6.1.5 Research question five

The question sought to find out the level of integration of the different disciplines that make up the Integrated Science and Introductory Technology curricula. Frequency counts and percentages were used to present the expressed opinions of experts on this issue.

3.6.1.6 Research question six

The question sought to find out the relationship that existed between the Integrated Science and Introductory Technology curricula contents. Frequency counts and percentages were used in analyzing the data.

3.6.1.7 Research question seven

This question sought to find out the availability and adequacy of resources for the implementation of the programmes. Data obtained were analyzed using frequency counts and percentages.

3.6.1.8 Research question eight.

This relates to the staffing situation of the schools in terms of quality and quantity. Frequency counts and percentages were used in analyzing the data.

3.6.1.9 Research question nine

The research question sought to find out the appropriateness of the teaching strategies employed by teachers in teaching the subjects. The total score of each teacher in percentages on the instrument (COS) was used in the determining whether the strategies adopted by the teacher were appropriate or not.

3.6.1.10 Research question ten

The research question sought to find out the trend in students' enrolments into science and technology programmes. Frequency counts and percentages were used in analyzing the data obtained.

3.6.1.11 Research question eleven

This relates to the achievements of students in the programmes. Percentages were used to address this research question.

3.6.1.12 Research question twelve

This relates to the level of community participation in the development of science and technology. Frequency counts and percentages were used to address this question.

3.6.2 Hypotheses

3.6.2.1 Hypotheses one and two

The mean difference in the achievements of students in the programmes (Integrated Science and Introductory Technology) between urban and rural secondary schools were tested for significance using t-test statistic for independent samples which is defined by the formula

$$t = \frac{X_1 - X_2}{\sqrt{\frac{S^2_1}{N_1} + \frac{S^2_2}{N_2}}}$$

Where X_1 = mean score of group I

X_2 = mean score of group II

S^2_1 = variance of group I

S^2_2 = variance of group II

(see Awotunde and Ugodulunwa, 1997, p.158)

The choice of t-test statistic for independent samples was considered appropriate in view of the fact that, the data collected were interval in nature, the samples were randomly selected and besides, the t-test is very sensitive in detecting any difference that exists between two different samples on a given dependent variable.

3.6.2.2 Hypotheses three and four

The mean difference in the achievements of students in the programmes between male and female students were tested for significance using the t-test for independent samples.

3.6.2.3 Hypotheses five and six

The difference in the provision of resources for the Integrated Science and Introductory Technology programmes between urban and rural schools were tested for significance using the t-test for independent samples.

3.7 THE PILOT STUDY

The pilot study was conducted to validate the design and instruments for the main study. The sample for the study consisted of 4 secondary schools selected from 210 secondary schools, all the Integrated Science and Introductory Technology teachers in the four selected schools numbering 8 each. In addition 2 lessons each for Integrated Science and Introductory Technology were observed in the 4 schools and 4 experts each in the fields of Integrated Science and Introductory Technology were also used in analyzing the contents of the curricula. These samples possessed similar characteristics as the sample for the main study but did not eventually participate in the main study.

The instruments were administered on the samples. The results of the pilot study showed that more than 75% of the teachers accept that the contents of the programmes were relevant to the attainment of the programme objectives. 43(67%) out of 64 topics in Integrated Science were found to be relevant whereas 39(78%) out of 50 topics in Introductory Technology were found to be relevant to students range of experience and ability. The study also identified new developments and current issues in the fields of science and technology that need to be incorporated into the curricula of these programmes. Other defects in the curricula of these programmes as revealed by the pilot study include defective balance in the contents of the disciplines that compose the two programmes, low level of integration between these disciplines and lack of relationship between the Integrated Science and Introductory Technology topics. The Pilot study also revealed implementation problems like inadequate distribution of resources for the two programmes, dearth of qualified manpower for the programmes and the use of ineffective teaching strategies. In addition achievements of students in the two programmes were very impressive while enrolments into science and technology subjects apart from Biology were very poor.

The study also revealed that there was a significant difference in the achievements of students in Integrated Science and Introductory Technology between urban and rural schools. This is because the calculated t-values of 2.5806 and 2.2553 for the Integrated Science and Introductory Technology programmes were greater than the critical t-values of 2.101 and 2.131 for the Integrated Science and Introductory Technology programmes respectively.

The study also established a significant difference in the achievements of male and female students in Integrated Science and Introductory Technology. This is because the calculated t-values of 18.7149 and 10.0468 for Integrated Science and Introductory Technology were greater than the critical t-values of 2.101 and 2.179 for Integrated Science and Introductory Technology programmes respectively.

The pilot study provided insight that gave indications that the main study would yield viable results. The results showed that the instruments proposed for the study were valid and reliable for use in the main study. This is because the reliability coefficients for PEIT for Integrated Science and Introductory Technology teachers were 0.90 and 0.78 respectively (See Appendix J and I) The pilot study thus proved a useful guide for the execution of the design for the study and consequently for obtaining data for providing solutions to the problem of the main research.

CHAPTER FOUR

RESULTS AND DISCUSSION

This study aimed at evaluating the Integrated Science and Introductory Technology programmes in secondary schools in Benue State. Data were obtained using the study instruments and the data analyzed using the appropriate statistical tools. This chapter therefore, presents the results of the data analysis and discusses the major findings of the research.

4.1 RESULTS

The results of the study were organized around the research questions and the hypotheses formulated and these are presented as follows:

4.1.1 Research question one

How relevant are the contents of Integrated Science and Introductory Technology to the attainment of the programme objectives?

In order to obtain the opinions of the teachers regarding the relevance of the contents of Integrated Science and Introductory Technology to the attainment of the programmes objectives, the five point Likert Scale was collapsed into three (i.e. Agree (A), undecided (U) and Disagree (D). The extent to which these programmes fulfill the programme objectives is indicated by the opinions of the teachers expressed in percentages as shown in Table 4.

Table 4
Responses of Integrated Science Teachers on the Extent to which the Contents of Integrated Science Fulfill the Programme Objectives.

Item	A	U	D	Total
The contents of the IS and IT fulfill the programme objectives	56 (92)	-	5 (8)	61
The programme fulfill the objectives of NPE	55 (90)	-	6(10)	61
The aims and objectives of the programme are being realized	58 (95)	-	3(5)	61

Note. Numbers in brackets indicate %.

The results in Table 4 show that, more than 90% of Integrated Science teachers accept that the contents of the Integrated Science programme were relevant to the attainment of the programme objectives.

On the same issue of relevance of the contents of the curriculum to the attainment of the programme objectives, the analysis of the responses of Introductory Technology teachers are shown in Table 5.

Table 5
Responses of Introductory Technology Teachers on the Extent to which the Contents of Introductory Technology Achieve the Programme Objectives.

Item	A	U	D	Total
The contents of the IS and IT fulfill the programme objectives	45(94)	-	3(6)	48
The programme fulfill the objectives of NPE	47(98)	-	1(2)	48
The aims and objectives of the programme are being realized	44(92)	-	4(8)	48

Note. Numbers in brackets indicate %.

The results in Table 5 show that more than 90% of Introductory Technology teachers accept that the contents of the Introductory Technology programme were relevant to the attainment of the programme objectives.

4.1.2 Research question two.

How relevant are the Integrated Science and Introductory Technology curricula contents to the learners range of experience and ability?

In order to answer this research question, the questionnaires ISCCEI and ITCCEI were administered to experts to speculate individually and then reach consensus collectively regarding the contents of the curricula. The number of topics considered relevant to students range of experience and ability and those not relevant as pointed out by experts in Integrated Science and Introductory Technology are shown in Table 6.

Table 6
Responses of Experts on the Appropriateness of Integrated Science and Introductory Technology Topics in the Curricula of JSS Students.

Level	Number and Percentage of relevant topics		Number and percentage of topics not relevant	
	IS	IT	IS	IT
JSS I	20(31%)	13(26%)	5(8%)	4(8%)
JSS II	10(16%)	9(18%)	9(14%)	2(4%)
JSS III	12(19%)	17(34%)	8(12%)	5(10%)
Total	42(66%)	39(78%)	22(34%)	11(22%)

Note. Number in bracket indicates %

The results in Table 6 show that 42(66%) out of 64 Integrated Science topics were found to be relevant to the student's range of experience and ability while 22(34%) out of the 64 topics were found not to be relevant. For Introductory Technology, while 39(78%) out of 50 topics were found to be relevant to the student's range of experience and ability, 11(22%) out of the 50 topics were found not to be relevant. The Integrated Science and Introductory Technology topics considered not relevant to students' range of experience and ability are shown in Appendix K.

4.1.3 Research question three

What new developments and current issues in the fields of science and technology need to be included in the Integrated Science and Introductory Technology curricula?

In order to answer this research question, the experts were also given the instruments (ISCCEI and ITCCEI) to identify these new developments and current issues in the fields of science and technology that need to be included in the Integrated Science and Introductory Technology curricula. The analysis of the responses of ten Integrated Science experts are as presented in Table 7.

Table 7
Analysis of Responses of Experts on New Developments and Current Issues that Should be Included in Integrated Science Curriculum.

S/No	New Developments and current Issues to be included in IS Curriculum	Number and percentage of experts.
1	Sex Education	10(100%)
2	HIV/AIDS	10(100%)
3	Personal hygiene	8(80%)
4	Medicine and health issues	9(90%)
5	Environmental Issues (pollution)	7(70%)
6	Energy	8(80%)
7	Population Issues	8(80%)
8	Interconnectedness (unity) of science	7(70%)

Table 7 shows that the new developments and current issues in the field of science that need to be included in Integrated Science curriculum include sex education, HIV/AIDS, personal hygiene, medicine and health issues, environmental issues, energy, population issues and interconnectedness (unity) of science. The results of Table 7 show that more than 70% of the experts accept that the issues identified are relevant areas to be incorporated into the Integrated Science curriculum.

On the same issue of new developments and current issues that need to be included in the curriculum of Introductory Technology, the analysis of the responses of ten experts in the field of Introductory Technology are as shown in Table 8.

Table 8
Analysis of Responses of Experts on New Developments and Current Issues in Technology that should be included in Introductory Technology Curriculum.

S/No	New Developments and current Issues to be included in IT Curriculum	Number and percentage of experts.
1	Basic computer education	10(100%)
2	Traditional (indigenous) Technology	8(80%)
3	Transportation Technology	7(70%)
4	Rudiments of printing Technology	8(80%)
5	Construction Technology	8(80%)
6	Manufacturing Technology	7(70%)
7	Electrical Appliances/Maintenance	8(80%)
8	Tools and equipment for Agriculture	10(100%)
9	Information and communications technology	9(90%)

Table 8 also shows that the current issues and new developments in technology that should be included in the Introductory Technology curriculum include basic computer education, traditional (indigenous) technology, transportation technology, rudiments of printing technology, electrical appliances and maintenance, tools and equipment for agriculture and information and communications technology. The results further showed that, more than 70% of the experts were of the view that these areas highlighted are vital issues to be incorporated into the Introductory Technology curriculum.

4.1.4 Research question four

How adequate are the Integrated Science and Introductory Technology programmes in motivating JSS students to offer and progress in science and technology subjects at the SSS level?

In order to answer this research question, the Integrated Science and Introductory Technology curricula were studied carefully and the number and percentage of topics per subject area identified. The number and percentage of the topics in the different subject areas that make up the Integrated Science and Introductory Technology curricula are presented in Tables 9 and 10.

Table 9
Number and Percentage of Topics in the Different Subject Areas that make up the Integrated Science Curriculum.

Level	Biology	Chemistry	Physics
JSS I	14(22%)	6(9%)	5(8%)
JSS II	6(9%)	5(8%)	6(9%)
JSS III	10(16%)	7(11%)	5(8%)
Total	30(47%)	18(28%)	16(25%)

The results in Table 9 show that Biology, had the highest number of topics 30(47%) in the Integrated Science curriculum followed by Chemistry 18(28%) and Physic 16(25%).

On this same issue of number and percentage of topics in the different subject areas that make up the Introductory Technology curriculum, the distribution of topics in the different subject areas are presented in Table 10.

Table 10
Number and Percentage of Topics in the Different Subject Areas that make up the Introductory Technology Curriculum.

Level	Auto-mechanics	Technical drawing	Woodwork	Metalwork	Electricity/ Electronics
JSS I	2(5%)	4(9%)	4(9%)	7(17%)	2(5%)
JSS II	1(2%)	-	2(5%)	1(2%)	3(7%)
JSS III	1(2%)	2(5%)	4(9%)	4(9%)	5(12%)
Total	4(9%)	6(14%)	10(23%)	12(28%)	10(24%)

The results in Table 10 show that Metalwork had the highest number of topics 12(28%) followed by Electricity/Electronics 10(24%), Woodwork 10(23%) Technical Drawing 6(14%) and Auto-Mechanics 4(9%).

4.1.5 Research question five

What is the level of integration of the different disciplines that make up the Integrated Science and Introductory Technology curricula?

To answer this research question, the opinions of experts were sought. The responses of these experts on the level of integration of the different disciplines that make up the Integrated Science and Introductory Technology curricula are presented in Table 11.

Table 11
Analysis of Responses of Experts on the Level of Integration of the Different Disciplines that make up the Integrated Science and Introductory Technology Curricula.

Subject	Level of Integration of the Different Disciplines			
	None	Low	Moderate	High
Integrated Science	2(20%)	5(50%)	3(30%)	-
Introductory Technology	3(30%)	6(60%)	1(10%)	-

The results in Table 11 show that the level of integration of the different disciplines that composed the Integrated Science and Introductory Technology curricula was low. None of the experts however, believed that there is high level of integration of the different disciplines that compose the Integrated Science and Introductory Technology curricula.

4.1.6 **Research question six**

What relationship exists between the curriculum contents of Integrated Science and that of the Introductory Technology programmes?

In order to answer this question, the curricula contents of Integrated Science and Introductory Technology were compared to see the extent to which the topics complimented each other. The number of topics in Integrated Science and Introductory Technology that complimented each other are shown in Table 12.

Table 12
Analysis of the Extent to which topics in Integrated Science and Introductory Technology are Related to each other.

Level	Number of IS topics	Number of IT topics	Number of related topics
JSS I	25	17	6
JSS II	20	11	5
JSS III	20	22	3

The results in Table 12 show that, only 6 topics in the Integrated Science and Introductory Technology curricula complimented each other at the JSS I while 5 topics complimented each other at the JSS II level and 3 topics at the JSS III level. The details of the Integrated Science and Introductory Technology topics that complimented each other are shown in Table 13.

Table 13
List of Integrated Science and Introductory Technology Topics that Compliment each other.

Level	Integrated Science	Introductory Technology
JSS I	Feeding	Food storage and preservation
	Movement	Gears and gearing
	Classification of matter	Identification of materials
	Tools (machines for work)	Use of bench tools
	Maintenance of machines	Introduction to maintenance
	Activities of living things	Processing of materials (wood, metals, ceramics).
JSS II	Energy and appliances in the home.	Energy conversions.
	Further investigation of air and water.	Water flow, Air flow round an object.
	Measurement	Measuring current, voltage and power
	Maintenance of machines	Maintenance of simple mechanical goods
	Pollutants in the environment	Simple maintenance of domestic goods
JSS III	Energy and appliances in the home.	Energy
	Metals and non-metals	Metal finishing
	Work and energy	Energy

4.1.7 Research question seven.

Are the resources required for the implementation of the Integrated Science and Introductory Technology programmes available and adequate in the secondary schools in Benue state?

To answer this research question, the checklists (ISRAC and ITRAC) were scored for each school using a 3 point scale of adequate (2), inadequate (1) and Not available (0). ISRAC had 166 items and the total score obtainable on the instrument was 332 (i.e. if all the items listed on the checklist were adequate). ITRAC had 105 items and the total score obtainable on the instrument was 210 (i.e. if all the items listed on the checklist were adequate). The checklists were scored for each school and the percentage worked out. A score of 50% and above was chosen as indicating availability and adequacy of the resources in the schools whereas a score below 50% points to the contrary. The number and percentage of schools that scored below 50% and above are as shown in Table 14.

Table 14
Availability of Integrated Science and Introductory Technology Resources in the Schools.

Subject	No of Schools	Level of available items	
		Below 50%	Above 50%
Integrated Science	50	37(74)	13(26)
Introductory Technology	50	40(80)	10(20)

Note. Numbers in brackets indicate %

The results in Table 14 show that more than 70% of the schools had below 50% of the Integrated Science and Introductory Technology resources available in the schools.

On the issue of adequacy of resources, the analyses of data on the level of adequacy of the Integrated Science and Introductory Technology resources in the schools are as shown in Table 15.

Table 15
Analysis of the Adequacy of Integrated Science and Introductory Technology Resources in the Schools.

Subject	No of Schools	Level of adequacy of the items	
		Below 50%	Above 50%
Integrated Science	50	47(94)	3(6)
Introductory Technology	50	48(96)	2(4)

Note. Numbers in brackets indicate %

The results in Table 15 show that Integrated Science and Introductory Technology resources were inadequately provided in the schools. The table shows that 47(94%) had less than 50% of the Integrated Science resources adequate while 48(96%) had less than 50% of the Introductory Technology resources adequate. The results in Table 14 also show that only 3 (6%) schools had adequate Integrated Science resources while 2(4%) had adequate Introductory Technology resources.

4.1.8 Research question eight.

What is the staffing situation in terms of quality and quantity for the implementation of the Integrated Science and Introductory Technology programmes in Benue State secondary schools?

The analysis of data on the qualification and number of Integrated Science and Introductory Technology teachers in the schools are as presented in Tables 16.

Table 16
Qualifications of Integrated Science and Introductory Technology Teachers in the Schools.

Qualification	Integrated Science	Introductory Technology
B.Sc.	4(7%)	1(2%)
B. Ed	12(20%)	1(2%)
N.C.E	41(67%)	39(81%)
H.N.D.	1(2%)	4(8%)
O.N.D	2(3%)	2(4%)
G.C.E	1(2%)	-
T.T.C	-	1(2%)
Total	**61**	**48**

The results in Table 16 show that out of the 61 Integrated Science teachers in the 50 schools only 17 were graduates (4 B.Sc., 12 B.Ed. and 1 HND).41(67%) of the teachers had N.C.E in Integrated Science and other related disciplines while 2 of the teachers had O.N.D and 1 G.C.E.

The results in Table 16 also show that out of the 48 Introductory Technology teachers in the 50 schools, only 5 were graduates (1 B.Sc., 1 B.Ed. and 4 H.N.D). 39(81%) had N.C.E while 2 G.C.E and 1 T.T.C. The number of the Integrated Science and Introductory Technology teachers were found to be insufficient as majority of the schools had an average of 1 teacher for each of these subjects.

4.1.9 Research question nine.

How appropriate are the teaching strategies used by the teacher in teaching the Integrated Science and Introductory Technology subjects.

The teaching strategies of Integrated Science and Introductory Technology teachers in ten schools were observed using the Classroom Observation Schedule. Two lessons were observed per subject in the ten schools selected and the average score for each teacher was worked out in percentages. The score of each teacher on the instrument (COS) was used in determining whether the teaching strategies adopted by the teacher were appropriate or not. A score of 50 and above was chosen as indicating appropriate teaching strategies while scores below 50 indicated inappropriate teaching strategies. The scores of the Integrated Science and Introductory Technology teachers in the ten schools are as shown in Table 17.

Table 17
Relevance of Teaching Strategies Employed by Integrated Science and Introductory Technology Teachers in the Schools.

Lesson	Scores in percentages		Appropriate	
	IS	IT	IS	IT
1	56	47	A	NA
2	51	45	A	NA
3	45	56	NA	A
4	65	51	A	A
5	44	47	NA	NA
6	38	39	NA	NA
7	47	47	NA	NA
8	43	50	NA	A
9	47	54	NA	A
10	45	47	NA	NA

Note: **NA -** Not Appropriate below 50% **A**- Appropriate 50% and above.

The results in Table 17 show that 3 Integrated Science teachers out of 10 teachers employed the appropriate teaching strategies while 4 Introductory Technology teachers out of the 10 teachers employed the appropriate teaching strategies. Majority of the teachers employed inappropriate teaching strategies in teaching Integrated Science and Introductory Technology.

4.1.10 Research Question Ten.

What has been the trend in students' achievements in the Integrated Science and Introductory Technology programmes in the schools?

To obtain student's achievements in Integrated Science and Introductory Technology in the schools, the Junior Secondary School Certificate Examination result sheets for the fifty schools were obtained from the schools from 1999-2003. The total numbers of students that registered and sat for the examinations in the schools for the years under review were noted as well as the total number of students that passed. The percentage passes in Integrated Science and Introductory Technology in the schools for the years are as shown in Table 18.

Table 18
Students' Achievements in Integrated Science and Introductory Technology in the Schools.

Subject	1999	2000	2001	2002	2003
Integrated Science	74%	69%	74%	76%	71%
Introductory Technology	61%	65%	62%	64%	64%

Table 18 shows that achievements in Integrated Science and Introductory Technology from 1999 to 2003 have been fairly high but not consistent. This is as seen in the high percentage scores by the schools for the respective years, however, achievements in Integrated Science were higher as can be seen in the high percentages scores compared to Introductory Technology.

4.1.11 Research Question eleven.

What has been the trend in students' enrolments into science and technology programmes at the senior secondary school level?

The enrolment figures of students into science and technology subjects at the senior secondary school level were obtained from the schools for a period of five years and their percentages worked out. These are as shown in Table 19.

Table 19
Enrolment Patterns into Science and Technology Subjects in the Schools.

Subject	1999	2000	2001	2002	2003
Biology	7290(100)	7459(100)	7919(100)	8078(100)	8176(100)
Chemistry	1615(22)	1553(21)	1757(22)	1738(22)	1914(23)
Physics	1612(22)	1548(21)	1757(22)	1732(22)	1914(23)
Technology	-	-	-	-	-

The results in Table 19 show that apart from Biology which recorded 100% enrolments other subjects recorded less than 30% enrolments, whereas no student registered for technology subjects in the schools sampled.

4.1.12 Research question twelve.

What is the level of community participation in the development of the Integrated Science and Introductory Technology programmes in the State?

To obtain the level of participation of the community to the development of Integrated Science and Introductory Technology, the responses of the integrated science teachers regarding the contributions of the community were computed and they are as presented in Table 20.

Table 20
Analysis of the Responses of Teachers on the level of Community Participation in the Development of Integrated Science Programme.

S/no	Contributions	Number of Teachers	Percentage
1	Building of science laboratory	5	8%
2	Purchase of science materials	11	18%
3	Provision of manpower	5	8%
4	Training scheme for staff	-	-
5	Scholarship for teachers	-	-
6	Scholarship for students	-	-
7	Popularization of science through workshop and seminars	-	-
8	Cash donations	2	3%
9	Provision of library resources	2	3%

The results in Table 20 show that the community had little contributions in the development of Integrated Science programme in the schools. These contributions include building of laboratory, purchase of science materials, provision of manpower, cash donations and library resources. There were no contributions from the community in the area of training of staff, provision of scholarship and organizing seminars and conferences to popularize science.

On the same issue, the contributions of the community in the development of Introductory Technology programme in the schools as given by the teachers were computed and are as presented in Table 21.

Table 21
Analysis of Responses of Teachers on the Level of Community Participation in the Development of Introductory Technology Programme.

S/no	Contributions	Number of Teachers	Percentage
1	Building of workshop	5	10%
2	Purchase of technical equipment	2	4%
3	Provision of manpower	3	6%
4	Training scheme for staff	-	-
5	Scholarship for teachers	-	-
6	Scholarship for students	-	-
7	Popularization of technical education through workshops and seminars	-	-
8	Cash donations	2	4%
9	Provision of library resources	-	-

The results in Table 21 show that the community had little contributions to the development of Introductory Technology in the schools. The contributions were in the area of building of workshop, purchase of technical equipment, provision of manpower and cash donations. They were no contributions from the community in the area of training of staff, scholarships for staff and students, organizing workshops and seminars to popularize technical education and provision of library resources.

4.1.13 Hypothesis 1

There is no significant difference between the mean scores of Integrated Science students in urban and rural secondary schools in Benue State.

The achievements of students in the schools were grouped into two categories namely, the urban schools and the rural schools. On this basis, their mean scores were computed and tested for significance using t-test statistic. The results are summarized in Table 22.

Table 22
Achievements of Students in Integrated Science in Urban and Rural Secondary Schools.

Sample	N	$\bar{X}$	S	t-cal
Urban schools	18	75	10.42	
				1.993*
Rural schools	32	69	9.81	

* P< 0.05.

The calculated t-value of 1.993 was less than the critical value of t (2.000), this result gives the basis for retaining hypothesis one. This means that there was no significant mean difference in achievement in Integrated Science between students in urban and rural secondary schools in the State.

4.1.14 Hypothesis 2

There is no significant difference between the mean scores of Introductory Technology students in urban and rural secondary schools in Benue State.

The achievements of students in the schools in Introductory Technology were grouped into two categories namely urban schools and rural schools. On this basis their mean scores were computed and tested for significance using t-statistic. The results are summarized in Table 23.

Table 23
Achievements of Students in Introductory Technology in Urban and Rural Secondary Schools.

Sample	N	X	S	t-cal
Urban schools	18	63	8.46	
				-0.7407*
Rural schools	32	65	10.31	

* $P < 0.05$.

The results in Table 23 show that the calculated t-value of -0.7407 was less than the critical value of t(2.000). This means that there was no significant mean difference in achievement in Introductory Technology between students in urban and rural secondary schools, consequently hypothesis two was retained.

4.1.15 Hypothesis 3

There is no significant difference between the mean scores of male and female students in Integrated Science in Benue State secondary schools.

The achievements of students in Integrated Science in the schools were grouped into male and female students and the mean scores computed and tested for significance using the t-test statistic. The results are summarized in Table 24.

Table 24.
Achievements of Male and Female Students in Integrated Science.

Sample	N	X	S	t-cal
Male	50	49	7.16	
				14.86*
Female	50	23	10.07	

***** P < 0.05.

The calculated t value of 14.86 was greater than the critical t- value of 2.000, this result gives the basis for rejecting hypothesis three. This means that there was a significant mean difference in achievement in Integrated Science between male and female students in the schools.

4.1.16 Hypothesis 4

There is no significant difference between the mean scores of male and female students in Introductory Technology in Benue State secondary schools.

The achievements of students in Introductory Technology were grouped into male and female students and the mean scores were computed and tested for significance using the t- statistic. The results are summarized in Table 25.

Table 25.
Achievements of Male and Female Students in Introductory Technology.

Sample	N	X	S	t-cal
Male	50	45	8.24	
				15.76*
Female	50	19	8.26	

***** P< 0.05.

The calculated t –value of 15.76 was greater than the critical t- value of 2.021, this result gives the basis for rejecting hypothesis four. This means that there was a significant mean difference in achievement in Introductory Technology between male and female students.

4.1.17 Hypothesis 5

There is no significant difference in the provision of resources for Integrated Science teaching in urban and rural schools in Benue State.

The scores on the Integrated Science Resource Assessment Checklist (ISRAC) for urban and rural schools were separated and the mean scores were computed and tested for significance using the t-test statistic. The results are summarized in Table 26.

Table 26
Provision of Integrated Science Resources in Urban and Rural Schools.

Sample	N	X	S	t-cal
Urban Schools	18	47.2	20.07	
				0.74*
Rural Schools	32	43.3	13.15	

***** P< 0.05.

The calculated t-value of 0.74 was less than the critical value of 2.000. This means that there was no significant difference in the provision of resources for Integrated Science between urban and rural schools in the State, consequently hypothesis five was retained.

4.1.18 Hypothesis 6

There is no significant difference in the provision of resources for Introductory Technology teaching in urban and rural schools in Benue State.

The scores on the Introductory Technology Resource Assessment Checklist (ITRAC) for urban and rural schools were separated and the mean scores were computed and tested for significance using the t-test statistics. The results are summarized in Table 27.

Table 27
Provision of Introductory Technology Resources in Urban and Rural Schools.

Sample	N	X	S	t-cal
Urban Schools	18	38.56	18.52	
				0.66*
Rural Schools	32	35.22	14.80	

***** P< 0.05.

The calculated t-value of 0.66 was less than the critical t-value of 2.000. This means that there was no significant difference in the provision of resources for Introductory Technology between urban and rural schools, consequently hypothesis 6 was retained.

4.2 FINDINGS OF THE STUDY

The major findings of this research were as follows:

1. A greater proportion of the Integrated Science and Introductory Technology teachers accepted that the contents of the Integrated Science and Introductory Technology curricula were relevant to the attainment of the programme objectives (See Table 4 and 5).
2. The study revealed that 42(66%) out of 64 Integrated Science topics and 39(78%) out of the 50 Introductory Technology topics were found to be relevant to the students range of experience and ability. On the other hand 22(34%) and 11(22%) of the Integrated Science and Introductory Technology topics were not relevant to the students range of ability and experience respectively. (See Table 6)
3. The study also identified new developments and current issues in the fields of science (e.g. HIV/AIDS, personal hygiene, sex education, etc) and technology (e.g. computer education, traditional technology, ICT, tools and equipment for agriculture, etc) that need to be included in the

Integrated Science and Introductory Technology curricula respectively to make the curricula current and comprehensive. (see Tables 7 and 8).

4. The study also revealed that the Integrated Science and Introductory Technology curricula were not adequate in motivating JSS students to offer and progress in science and technology subjects at SSS level. This is because there is a defective balance in the contents of some of the discipline that compose the Integrated Science and Introductory Technology curricula (See Table 9 and 10). As a result of this development, students are more likely to be motivated to offer those subjects that have the highest number of topics compare to others with fewer topics and who have been accorded less emphasized at the JSS level.

5. The level of integration of the different disciplines that make up the Integrated Science and Introductory Technology curricula were found to be low and moderate as pointed by majority of the Integrated Science and Introductory Technology experts (50%). None of the Integrated Science and Introductory Technology experts accepted that there was high level of integration of the different disciplines that compose the Integrated Science and Introductory Technology curricula.

6. Majority of the topics in the Integrated Science and Introductory Technology curricula were found not to compliment each other.

Only few topics in the Integrated Science and Introductory Technology were found to be related (6 topics in JSS1, 5 topics in JSSII and 3 topics in JSSIII).

7. The Integrated Science and Introductory Technology resources were inadequately provided in the schools.
8. On the staffing situations for the programmes, the study also revealed that most of the teachers were not qualified to teach the subject and the quantity of staff for the programmes were found to be grossly inadequate.
9. The teaching strategies employed by the teachers in implementing the programme were found not to be appropriate for the programmes.
10. Achievements in Integrated Science and Introductory Technology at the Junior School Certificate Examinations were fairly high but not consistent.
11. Enrolments into science subjects like Physics, Chemistry and Technology were generally very poor in all the schools except Biology that is offered by all the students.
12. The study revealed that, the community had little contributions to the development of the Integrated Science and Introductory Technology programmes in the schools in Benue State.
13. There was no evidence to establish a significant difference between the mean scores of Integrated Science and Introductory Technology students in urban and rural schools in Benue State.

14. The study established a significant difference between the mean scores of male and female students in Integrated Science and Introductory Technology.
15. The study also revealed that there was no significant difference in the provision of Integrated Science and Introductory Technology resources between urban and rural schools in Benue State.

4.3 DISCUSSION OF FINDINGS

Researchers like Bazza (1992), Mohammed (1992), Oloruntegbe (1996), Utulu (1998), Ibole (1999) and Maduabum (2000) report that, the junior secondary school science and technology programmes are confronted with a number of implementation problems. Previous studies like Awotunde (1992), Omoifo (1996) and Akpan (1996) observe that, the curricula contents of these programmes are not adequate for students who go through them to lead useful lives. In view of the fact that these programmes are so crucial to our scientific and technological development as a nation, this study evaluated the Integrated Science and Introductory Technology curricula contents as well as their implementation in secondary schools in Benue State. This is with the view to finding out the strengths and weaknesses in the implementation of these programmes and the curricula contents.

Research question one sought to find out the relevance of the contents of Integrated Science and Introductory Technology to the attainment of the programme objectives. Evidence from this study have shown that the contents of Integrated Science (IS) and Introductory Technology (IT) curricula are relevant to the attainment of the programme objectives. This is because results from Table 4 and 5 show that more than 90% of Integrated Science and Introductory Technology teachers accept that the contents of the Integrated Science and Introductory Technology fulfill the programme objectives. This finding, however, is contrary to the findings of Bedde and Lewin (1997) in Mulenwa (2001) and Ibole (1991) who all point out that, the existing STM curricula (including IS and IT) in many countries including Nigeria have well conceived goals and objectives but that the challenges that exist is in the development of appropriate curricula that would achieve the stated objectives in terms of both content and methodology.

Research question two sought to determine the relevance of Integrated Science and Introductory Technology curricula contents to learners range of experience and ability. The results in Table 6 show that 42(66%) out of 64 Integrated Science topics were found to be relevant to the students range of experience and ability. A total number of 22(34%) topics were found not to be relevant and these topics relate mostly to Chemistry followed by Physics and less in Biology. In Introductory Technology, 39(78%) out of 50 topics were found to be relevant while 11(22%) out of the 50 topics were not relevant. The topics considered not relevant relate mostly to Electricity/Electronics followed by Technical Drawing, few topics in Auto-Mechanics, Metal Work and Wood work (see Appendix P). The major reasons why these topics were considered not relevant include: high cognitive demand of the topics, students were not matured, some of the topics were treated extensively in order subjects among other reasons. The findings are consistent with those of Olarewaju (1987), Agbo (1991), Awotunde (1992) and Ncharam (2000) who all point out some difficult areas in the content of Integrated Science and Introductory Technology curricula. The implication of this finding is that, those topics that are not relevant to the student's range of experience and ability if allowed to remain in the curriculum will be difficult for the students to cope with and this can discouraged them from offering and progressing in the science and technology courses at the senior secondary school level.

Research question three sought to find out the new developments and current issues in the fields of science and technology that need to be included in the Integrated Science and Introductory Technology curricula. The results in Tables 7 and 8 show that, areas like sex education, HIV/AIDS, personal hygiene, medicine and health issues, environmental issues, energy, population issues and interconnectedness (unity) of science need to be included in Integrated Science curriculum. On the other hand issues like computer education, traditional technology, transport technology, rudiment of printing technology, construction technology, manufacturing technology, electrical appliances/maintenance, tools and equipment for agriculture, information and communication technology need to be included in the Introductory Technology curriculum. These findings are consistent with those of Olarewaju (1987) who also pointed out areas like personal hygiene, nutrition, environmental sanitation, etc as areas to be included in the Integrated Science curriculum while Awotunde (1992) points out traditional technologies of the student's environment like construction, smitting, boat making among others. The implication is that, if this new developments and current issues are not incorporated into the curriculum, student's knowledge of science and technology will be deficient.

Research question four sought to find out how adequate are the Integrated Science and Introductory Technology programmes in motivating JSS students to offer and progress in science and technology subjects at Senior Secondary School (SSS) level. The results in Tables 9 and 10 show that there is a defective balance in the contents of some of the disciplines that compose the Integrated Science and Introductory Technology curricula. Table 9 shows that, in the Integrated Science curriculum, Biology has the highest number of topics 30(47%) followed by Chemistry 18(28%) and Physics 16(25%) while Table 10 shows that in the Introductory Technology curriculum, Metalwork has the highest number of topics 12(28%) followed by Electricity/Electronics 10(24%), Woodwork 10(23%), Technical Drawing 6(14%) and Auto-Mechanics 4(9%). These findings are consistent with that of Mohammed (1997) who also showed that, the NCE technical curriculum is not adequate in content for Introductory Technology teachers in areas like food, water technology, ceramics, maintenance and repairs. The implication of these findings are that, students are more likely to be motivated to offer those subjects that have the highest number of topics compared to others with fewer topics. For example in Integrated Science, students are more likely to be interested in Biology compared to physics with the least number of topics because of the emphasis accorded it from the junior secondary school Integrated Science.

Research question five was out to find out the level of integration of the difference disciplines that make up the Integrated Science and Introductory Technology curricula. The results in Table 11 show that, the level of integration among the different disciplines that make up the Integrated Science curriculum was low and moderate as pointed out by 5(50%) and 3(30%) of the Integrated Science experts respectively. For Introductory Technology curriculum, the level of integration was also found to be low and moderate as pointed out by 6(60%) and 1(10%) of the Introductory Technology experts respectively. None of the experts observed that the level of integration of the different disciplines that make up the Integrated Science and Introductory Technology curricula was high. These findings are consistent with Omoifo (1996) who also reports that, the level of integration between the disciplines that make up the NCCE Integrated Science curriculum is low. The implication of this development is that, if efforts are not made towards effecting real synthesis of ideas, concepts or subjects, the integrated curriculum will become an incoherent patch work of isolated ideas from different subjects and the aim of presenting students with a wholistic picture of science and technology will be defeated.

Research question six sought to determine the relationship that exists between the curriculum contents of Integrated Science and that of the Introductory Technology programme. The results in Table 12 show that, only 6 topics in the JSS I Integrated Science and Introductory Technology curricula were related, 5 topics in the JSS II and 3 topics in the JSS III curricula contents. The implication of this finding is that, if majority of the topics in the Integrated Science and Introductory Technology curricula were not complimenting each other, it may be difficult to realize the dream of transforming the country technologically as science and technology are meant to compliment each other.

Research question seven sought to determine the availability and adequacy of resources for the implementation of the programmes. The results in Tables 14 and 15 show that, resources for the teaching of Integrated Science and Introductory Technology were inadequately provided in the schools. Table 14 shows that, majority of the schools 37(74%) and 40(80%) had below 50% of the Integrated Science and Introductory Technology resources available in the schools respectively. Few schools 13(26%) and 10(20%) scored above 50% on the Integrated Science Resource Assessment Checklist (ISRAC) and Introductory Technology Resource Assessment Checklist (ITRAC) respectively. Table 15 further revealed that, majority of the schools 47(94%) and 48(96%) had the Integrated Science and Introductory Technology resources inadequately provided in the schools (scored below 50% on ISRAC and ITRAC) respectively. On the other hand 3(6%) and 2(4%) of the schools scored above 50% on the ISRAC and ITRAC respectively. These findings are consistent with the findings of (Ali, 1986; Awotunde, 1992; Adzape, 1995; Okebulola, 1997, Akpan, 1999; Eule, 2000) who all found that most schools lacked furniture, laboratories, workshops, equipment and facilities for the teaching and learning of science and technology subjects. Integrated Science and Introductory Technology are inquiry-oriented subjects which require the use of various resources to effectively teach them. The implication of this inadequate provision of these resources in the schools is that learning of theory is emphasized to the near neglect of practical skill acquisition. The teaching of this subjects, therefore cannot be consistent with the philosophy of the subjects which emphasize activities as no activity can be carried out effectively without the use of resources (Awotunde, 1992; Wuyep, 1997).

On the staffing situation for the subjects, the results in Table 16 show that most of the teachers of Integrated Science and Introductory Technology were not qualified to teach the subjects and the quantity of staff for the programmes were found to be grossly inadequate. This finding is consistent with studies such as (Akale, 1987; Maduabum, 1990) and (Awotunde, 1992; Okeke, 1997) who all report the lack of sufficient number and purposefully prepared Integrated Science and Introductory Technology teachers respectively. The implication of this finding is that the teaching of these subjects in the schools no doubt will be handled poorly by these incompetent teachers and this can lead to poor attitudes and enrolments into science and technology courses as well as poor performances.

Research question nine sought to find out the appropriateness of the teaching strategies employed by teachers in teaching Integrated Science and Introductory Technology. The results in Table 17 show that only 3 Integrated Science teachers out of 10 employed the appropriate teaching strategies while 4 Introductory Technology teachers out of 10 employed the appropriate teaching strategies. Majority of the Integrated Science teachers 7(70%) and Introductory Technology teachers 6(60%) employed inappropriate teaching strategies. The finding agrees with the findings of (Nwosu, 1991; Awotunde, 1992; Olayiwola, 1999) who all report poor quality teaching of science and technology subjects in the schools. The implication of this finding is that Integrated Science and Introductory Technology subjects are made boring to students because teachers do not make use of modern teaching strategies that allow maximum interaction between teachers and students and this accounts for the loss of interest and poor enrolments into science and technology subjects.

Research question ten sought to find out students' achievements in Integrated Science and Introductory Technology for a period of five years. The results of this study as shown in Table 18 show that achievements in Integrated Science and Introductory Technology were good, but not consistently high from year to year. This can be seen in the high percentage scores recorded by the schools in the subjects for the years under review. This findings is contrary to the findings of (Olayiwola, 1993; Ayinde, 1995; Nwoji 2000) who all report poor achievements in science and technology subjects.

With regards to enrolment into science and technology subjects, the study revealed that apart from Biology which is offered by all students, enrolments into other science subjects like Physics, Chemistry and Technology subjects were generally very poor in all the schools (See Table 19). The finding is supported by (Akpan, 1986; Ibole, 1999) who all report poor enrolments into science and technology subjects. These poor enrolments at the senior secondary school level into science and technology subjects may not be unconnected with the inappropriate teaching strategies, inadequate provision of resources, dearth of qualified manpower as well as the defective balance in the content of the disciplines that compose the Integrated Science and Introductory Technology programmes. This problems may be responsible for the poor enrolment of students into the science and technology courses at the senior secondary school level. The implication is that the dwindling number of youths willing to study science and technology based courses may lead to shortage of personnel in science and technology related jobs and professions.

Research question twelve sought to find out the level of community participation in the development of the Integrated Science and Introductory Technology programmes in the schools. The results in Table 20 and 21 showed that the community had very little contributions to the development of these programmes in the schools. These contributions were in the area of building science laboratory, purchase of science materials, provision of manpower, cash donations and library resources as indicated by 5(8%), 11(18%), 5(8%), 2(3%) and 2(3%) of the Integrated Science teachers respectively. On the other hand, the contributions of the community in the development of Introductory Technology programme include building of workshops, purchase of technical equipment, provision of manpower, cash donations as indicated by 5(10%), 2(4%), 3(6%) and 2(4%) of the Introductory Technology teachers in the schools respectively. However the community had no contributions in the area of training of staff, provision of scholarships for students and staff and organizing seminars and conferences to popularize science and technology.

Hypotheses one and two sought to find out whether there was a significant difference between the mean scores of Integrated Science and Introductory Technology students in urban and rural secondary schools in Benue State. The data presented in Tables 22 and 23 offers no evidence to establish a significant difference between the mean scores of urban and rural students in Integrated Science and Introductory Technology in the schools. This is because the calculated t-values of 1.993 and -0.7407 for Integrated Science and Introductory Technology respectively were less than the critical value of 2.000. This finding is contrary to the findings of (Utulu, 1998; Mulemwa, 2002) who report that, the quality of education tend to be poorer in the rural areas due to lack of resources as well as trained teaches.

Hypotheses three and four sought to find out if there was a significant difference between the mean scores of male and female students in Integrated Science and Introductory Technology in the schools. The data presented in Tables 24 and 25 offers evidence to establish a significant difference in the mean scores of male and female students in Integrated Science and Introductory Technology. This is because the calculated t-values of 14.86 and 15.76 for Integrated Science and Introductory Technology respectively were greater than the critical t-value of 2.000. This is also in line with the findings of Mulemwa (2000) who also reports that, performances of girls were poor relative to boys.

Hypotheses five and six sought to find out whether there was a significant difference in the provision of Integrated Science and Introductory Technology resources between urban and rural schools in the area. The data presented in Tables 26 and 27 offers no evidence to establish a significant difference in the provision of the resources in the schools. This is because the calculated t-values of 0.74 and 0.66 for Integrated Science and Introductory Technology respectively were less than the critical t-value of 2.000. This finding is also contrary to the findings of Utulu (1998) who reveals an imbalance in the allocation of laboratory and workshop equipment between urban and rural schools. The study though points out the inadequacy of Integrated Science and Introductory Technology resources, the shortage was more pronounced in the rural schools than the urban schools as can be seen in their mean scores.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS.

In this chapter, the summary of the study, the conclusion as well as recommendations were presented. In addition, the limitations of the study, suggestions for further studies and contributions to knowledge were also highlighted.

5.1 SUMMARY OF THE RESEARCH REPORT

This study was conducted to evaluate the Integrated Science and Introductory Technology curricula contents as well as their implementation in secondary schools in Benue State. The specific objectives of the study were to find out the nature of the Integrated Science and Introductory Technology curricula in terms of relevance to the attainment of programme objectives and students' abilities, adequacy of content and relationship with each other. The study was also out to assess the availability and adequacy of basic infrastructures and resources (human and material) for the Integrated Science and Introductory Technology programmes, to investigate the quality of teachers and instructions in each of the programmes, to assess the achievements of students in Integrated Science and Introductory Technology programmes in the different schools in Benue State for a period of five years, to investigate students' enrolments into science and technology programmes at the senior secondary school level in Benue State, and to determine the level of community participation in the development of Integrated Science and Introductory Technology programmes in the schools in Benue State.

In order to provide direction and sharpen the focus of this study, twelve research questions and six hypotheses were generated. The research questions considered issues relating to the contents of the curricula like the relevance of the curricula contents to the attainment of programme objectives and relevance to the students' abilities and range of experience, new developments and current issues in the fields of science and technology to be incorporated into the curricula, the relationship between the two curricula and the level of integration of the different disciplines that compose the Integrated Science and Introductory Technology curricula. Other issues included the provision of resources for implementing the programmes, quality of teachers and instructions, level of community participation, etc were also investigated.

The hypotheses tested, focused on the difference between the mean scores of students in Integrated Science and Introductory Technology in rural and urban schools. The difference between the mean scores of male and female students in Integrated Science and Introductory Technology was tested as well as the difference in the provision of Integrated Science and Introductory Technology resources in urban and rural schools.

The study employed a survey design, six instruments namely COS, PEIT, ITRAC, ISRAC, ISCCEIE and ITCCEIE were used to collect data from 50 secondary schools selected from urban and rural areas of the State (18 urban and 32 rural schools), 10 experts in the fields of Integrated Science and Introductory Technology as well as all the Integrated Science and Introductory Technology teachers in the schools sampled for the study. Frequency counts, simple percentages and t-test for independent samples were the statistical tools used to analyze the data for the study at $P<.05$.

The study established that the Integrated Science and Introductory Technology curricula had a number of defects. These include irrelevance of some topics in the curricula to students range of experience and ability, low level of integration of the different disciplines that compose the programmes, little or no attention to new developments and current issues in the fields of science and technology and defective balance in the contents of the disciplines that compose the programmes. The programmes were also confronted with problems such as dearth of qualified manpower, ineffective teaching strategies, inadequate provision of resources for implementing the programmes among others.

The study offered no evidence to establish a significant difference between the mean scores of Integrated Science and Introductory Technology students in urban and rural secondary schools in Benue State. There was evidence to establish a significant difference between the mean scores of male and female students in Integrated Science and Introductory Technology. There was no significant difference in the provision of Integrated Science and Introductory Technology between urban and rural schools in Benue State.

5.2 CONCLUSION

This study evaluated the Integrated Science and Introductory Technology curricula contents as well as their implementation in secondary schools in Benue State. The results of the study show that, the Integrated Science and Introductory Technology curricula had some defects. These include irrelevance of some of the topics to students' range of experience and ability, low level of integration of the disciplines that compose the Integrated Science and Introductory Technology curricula, little or no attention to new developments and current issues in the fields of science and technology as well as lack of relationship between Integrated Science and Introductory Technology topics. These defects no doubt have hindered the programmes from making their proper impacts on the students and the society at large.

The study also revealed that the implementation of the Integrated Science and Introductory Technology programmes after several years of their inception were still confronted with a number of implementation problems. These problems range from inadequate provision of resources, dearth of qualified manpower, inappropriate teaching strategies. These problems have also hindered the proper implementation of these programmes in Benue State. If the Integrated Science and Introductory Technology programmes must serve as the basic science and technology education that will enable students to live and function meaningfully in a world dominated by science and technology as well as serve as bedrocks on which further science and technology studies rest, there is the need to take a look at the curricula with a view to rectifying these defects as well as finding lasting solutions to the implementation problems highlighted.

5.3 RECOMMENDATIONS

On the basis of the findings and conclusion of this study the following recommendations were made:

1. Some topics in the Integrated Science and Introductory Technology curricula were found not to be relevant to the students' range of experience and ability (see Appendix K). In view of this development, there is the need to expunge these topics from the curricula of these programmes so as to prevent the frustration and apparent loss of interest in the programmes on the part of the student.
2. A lot of current issues have come on board and new developments have taken place in the fields of science and technology (see Tables 7 and 8). These developments need to be incorporated into the Integrated Science and Introductory Technology curricula to make the programmes more current and comprehensive.
3. The study also revealed a defective balance in the contents of the disciplines that compose the Integrated Science and Introductory Technology programmes (see Tables 9 and 10). Some disciplines had more topics than others. As a result of this, students are more likely to be motivated to offer the courses that have been accorded more emphasis

and prominence at the junior secondary school when they eventually get to the senior secondary school level. It is in view of this development, that the entire curricula should be revised so as to correct the imbalance in the contents of some of the disciplines that compose the programmes.

4. The level of integration of the different disciplines that compose the Integrated Science and Introductory Technology was found to be low. In order to avoid presenting these integrated curricula to students as an incoherent patch work of isolated ideas from different subjects, curriculum planners, textbooks authors and teachers must put in more efforts towards effecting real synthesis of ideas, concepts or subjects if a high level of integration of the different disciplines that compose the curricula of these programmes must be achieved.

5. The content of Integrated Science and Introductory Technology curricula need to be restructured so that the topics can have some relationships or bearing with each other if the two programmes must compliment each other in our efforts to transform the country technologically.

6. In view of the fact that, this study revealed that resources for the teaching of Integrated Science and Introductory Technology were inadequately provided in the rural and urban secondary schools in the area, government need to provide adequate funds and procure these resources in the schools if proper implementation of these programme is

to take place. In addition, there is the need to have a separate laboratory for Integrated Science as it is the case with Introductory Technology. This will enable students and teachers to be able to carry out scientific activities regularly in the schools.

7. The study also revealed that the qualification and number of Integrated Science and Introductory Technology teachers have not improved significantly. In view of these development, more efforts need to be put into the recruitment and retention of qualified manpower in Integrated Science and Introductory Technology. In line with this, more universities need to be encouraged to offer these programmes at graduate and postgraduate levels so as to improve on the quality of manpower for these programmes.

8. The government need to also provide opportunities for in-service training for teachers on the field to develop themselves further, organize conferences and seminars to update and prepare teachers for the task of implementing these programmes.

9. The community also need to make more contributions to the development of Integrated Science and Introductory Technology in the schools particularly in the area of recruiting more staff, building of laboratories and workshops and equipping them with science and technology resources, provision of scholarships to students and staff, library

resources, cash donations and organizing seminars and conferences to popularize science and technology in the schools.

10. Integrated Science and Introductory Technology teachers need to be acquainted with the methodology of implementing these programmes. This is important if the programmes must be implemented properly. This can be done through organizing seminars and conferences to acquaint the teachers with modern methods of teaching these subjects.

11. The achievement of students in the programmes though good as revealed in the study, efforts must be made to improve and sustain good performance by way of encouraging teachers to work harder through provision of incentives to teacher, procuring the necessary resources required for implementing these programmes.

12. The results of this study show that, enrolments into science and technology subjects at senior secondary school level were very poor particularly for Chemistry, Physics and technology courses. In view of this development, conscious efforts should be made by the government, schools, teachers and all stakeholders in the education sector to properly implement these programmes at the JSS level. If these programmes are presented to students in a manner that will captivate their interest, enrolment into science and technology subjects at SSS level will improve.

13. In view of the fact that the study established a significant difference in the achievement of male and female students in the programmes, there is the need to encourage and give special attention to the female students in order to enhance their achievements in these programmes.

5.4 LIMITATIONS OF STUDY

There were certain constraints that may restrict the extent to which the findings of this study may find applicability and generaliability. These limitations may be seen in the following:

1. In as much as the findings of this study have provided good guides for replicative studies in other populations, the results are most applicable in Benue State.
2. Efforts to secure financial grants to increase the samples for this study were made but to no avail. The researcher therefore, had to rely on his meagre earnings to undertake the study. This is one major reason why the sample size was limited to only 50 schools in Benue State.
3. The data on the population of Integrated Science and Introductory Technology teachers in the respective schools in the State was not available in the Teaching Service Board, Ministry of Education and the Examination Board. In view of this development, a comprehensive sampling plan for the teachers could not be drawn and so all the

Integrated Science and Introductory Technology teachers in the respective schools sampled for the study were used.

4. None of the schools sampled had an Integrated Science laboratory. In view of this development, a decision was taken to assess the provision of resources in the various unit laboratories of Biology, Chemistry, Physics and in some cases multipurpose laboratories for Integrated Science.

5. The male and female students whose mean scores were tested for significant in hypotheses three and four though were from rural and urban schools, the researcher was only interested in the difference in their achievement scores irrespective of their school locations.

5.5 SUGGESTIONS FOR FURTHER STUDY

The findings of this study have opened more areas that future researchers may wish to venture into. These areas are as suggested as follows:

1. Future researchers can replicate this study on a larger scale to cover more secondary schools in the State and even Nigeria as a whole to broaden the coverage.

2. Further research can also be carried out on the impact of the availability and usage of the Integrated Science and Introductory Technology resources on the achievement of students.

3. Researchers may also wish to go into the effect of using different teaching methods on the acquisition of science and technology concepts and skills.

4. There is the need to also compare the achievements of students in these programmes taught by professional and non-professional teachers.

5. Researches to be carried out in the area of effecting real syntheses of ideas, concepts and subjects in the Integrated Science and Introductory Technology curricula so that the level of integration will be high.

5.6 CONTRIBUTION TO KNOWLEDGE

The findings of these study show that a lot of contributions have been made to knowledge. These contributions are highlighted as follows:

1. Some current issues and new developments in the fields of science and technology have been identified in this study (see Table 7 and 8) that need to be incorporated into the Integrated Science and Introductory Technology curricula to make the curricula current and comprehensive.

2. The study also identified some topics in the Integrated Science and Introductory Technology curricula that are not relevant to students range of experience and ability (see Table 6). There is no known previous study that painstakingly engaged experts in the fields of Integrated Science and Introductory Technology to speculate individually and reach consensus collectively regarding the contents of these curricula.

3. The study also revealed that, majority of the topics in Integrated Science and Introductory Technology curricula do not compliment each other. Only very few topics in Integrated Science have some relationship with

topics in Introductory Technology. In view of the fact that, science and technology, should compliment each other, this finding has a lot of implications for the development of the country technologically.

4. The level of integration of the different disciplines that compose the Integrated Science and Introductory Technology curricula were found to be low. This finding is also novel and it is in view of this that this study has thrown a challenge to curriculum planners, teachers and textbook authors to put in more efforts towards effecting real synthesis of ideas, concepts or subjects so as not to present these integrated curricula as an incoherent patchwork of isolated ideas from different subjects.

5. The study revealed a defective balance in the contents of the disciplines that compose the Integrated Science and Introductory Technology programmes. Some disciplines had more topics than others and this imbalance has the tendency of motivating students to offer at the senior secondary school level the courses/disciplines accorded more emphasis and prominence at the junior secondary school level. It is in view of this that the study has called for a review of these curricula to correct this imbalance.

6. The study also revealed that after several years of the inception of the Integrated Science and Introductory Technology programmes, the programmes were not being implemented properly in the schools. The

programmes were confronted with such problems as dearth of qualified staff, inadequate resources as well as the use of inappropriate teaching strategies by the teachers. This poor implementation of these programmes at the junior secondary school level may be responsible for the poor enrolments of students into the science and technology programmes at the senior secondary school level.

7. The community had very little contributions to the development of Integrated Science and Introductory Technology programmes in few schools in the State. In view of the fact that the government alone may not be able to cope with the demands of education, the community need to also make their contributions to the development of these programmes.

8. The study established a significant difference in the achievements of male and female students in the programmes. This finding though not new but confirms previous studies and in view of this, there is need to encourage and pay more attention to the female students to enhance their achievements in the programmes.

9. The achievements of students in the schools though fairly high as indicated by the high percentage scores, efforts should be made to sustain and improve upon these achievements especially Introductory Technology that students achievements were found to be lower.

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APPENDIX A

CLASSROOM OBSERVATION SCHEDULE (COS)

NAME OF SCHOOL………………………………………………………………

SUBJECT……………………………………………………………………….

CLASS………………………………………………………………………….

NUMBER OF STUDENTS…………………………………………………….

TOPIC OF THE LESSON……………………………………………………..

LOCATION OF THE LESSON: LABORATORY [ ] WORKSHOP [ ] CLASSROOM [ ]

N0	**A PLANNING OF THE LESSON (25)**	Excellent	Very good	Good	Average	Poor	Very Poor
1	Objective of the lesson (behaviourally stated and clear)						
2	Arrangement of the lesson (logical and sequential).						
3	Facts of the lesson(Adequacy and comprehensiveness)						
4	Teaching aids (suitability and adequacy)						
5	Plan for students activities/experiment						
	B TEACHING PROCEDURES (50)						
6	Introduction of lesson (relevance, degree of motivation).						
7	Subject content (mastery and adequacy)						
8	Presentation of lesson content						
9	Teacher's personality						
10	Questioning techniques						
11	Use of chalk board and other teaching aids						
12	Command of language						
13	Time management (coverage of lesson as planned)						
14	Teaching method (relevance to the subject, appropriateness)						
15	Evaluation of the lesson taught.						
	C STUDENT ACTIVITIES (15)						
16	Students' participation						
17	Students' attention sustained						
18	Quality of home work etc						
	D CLASSROOM MANAGEMENT AND CONTROL (10)						
19	Teacher-student relationship (alertness to problems, maintenance of order).						
20	Classroom environment (neatness, conducive for experiment/demonstration).						

APPENDIX B

Department of Science and
Technology Education,
University of Jos, Jos.
Plateau State

Dear Sir (Teacher),

This questionnaire is designed to find out how you are implementing the Integrated Science Programme in your school. Your honest answers to the questions that follow will help us to solve your problems.

Please feel free to take part in this exercise. Your responses will be treated confidentially for research purposes only.

Thanks

Yours faithfully,

ADEJOH, MUSA JAMES

PROGRAMME EVALUATION INSTRUMENT FOR TEACHERS (PEIT)

SECTION A

i. What is your highest educational qualification?……………………………

ii. What is your area of specialization?………………………………………..

iii. How long have you been teaching Integrated Science ?

iv. How many periods to you teach Integrated Science in a week?………………………………………………

v. What is the teacher- pupil ratio?……………………………………….

vi. What are the contributions of the community/association in the development of Integrated Science and Introductory Technology in your school?..
....
....

SECTION B

Indicate by ticking (√) in the appropriate columns the extent to which you agree with the following statements (SA- Strongly Agree), A - Agree, U- Uncertain, D- Disagree, SD- Strongly disagree).

S/NO	STATEMENT	SA	A	U	D	SD
1	The Integrated Science/Introductory Technology programme is fulfilling the objectives of the programme					
2	The Integrated Science/Introductory Technology programme meets the requirement for fulfilling the objectives of the National Policy on Education					
3	The aims and objectives of the Integrated Science/Introductory Technology programme are being realized.					
4	Teacher improvises (makes) facilities and equipment that are not available from local materials.					
5.	Teacher uses local examples in the community to teach topics in Integrated Science/Introductory Technology.					
6	Teacher makes use of experts in the locality to teach certain topics in Integrated Science/Introductory Technology.					
7	The curriculum of Integrated Science/Introductory Technology is relevant to needs of the society.					
8	The Integrated Science/Introductory Technology course content is relevant to student's needs and experiences.					
9	Integrated Science/Introductory Technology course will enable students to see a fundamental unity of science/technology.					

10	The course content of the Integrated Science/Introductory Technology is adequate for literacy in science/technology.					
11	The Integrated Science/Introductory Technology course is adequate in academic content.					
12	The Integrated Science/Introductory Technology is a well conceived innovation.					
13	The time allocated for Integrated Science/Introductory Technology is adequate.					
14	Teacher covers all the topics in the syllabus					
15	There is high evidence of the implementation of the Integrated Science/Introductory Technology programme					
16	The infrastructures in terms of library, laboratory, classrooms, workshops are adequate.					
17	Instructional materials in terms of consumables and non-consumables such as chemicals, equipment are adequate					
18	There is adequate provision of manpower for the programme					
19	Teachers make use of modern teaching methods (discovery/activity/inquiry method).					
20	The school is adequately equipped with teaching aids.					

SECTION C

1. Achievements of students in Integrated Science/Introductory Technology.

Students	**1999**	**2000**	**2001**	**2002**	**2003**
Number of male passed					
Number of female passed					
Number of male failed					
Number of female failed					
Total					

2. Enrolment patterns into science and technology subjects in the school.

Subjects	**1999**	**2000**	**2001**	**2002**	**2003**
Biology					
Chemistry					
Physics					
Technology					

APPENDIX C

INTRODUCTORY TECHNOLOGY RESOURCE ASSESSMENT CHECKLIST (ITRAC)

INSTRUCTION: Please indicate the quantity of the following resources in your school as against the minimum number recommended by National Board for Technical Education.

S/N	RESOURCES	MINIMUM NUMBER RECOMM-ENDED	NUMBER AVAIL-ABLE	ADE-QUATE	USED	NOT USED	REASONS FOR NON USE
A	**HUMAN RESOURCES**						
1	Qualified I.T. Teachers	2					
2	Technicians	3					
3	Workshop Attendants	1					
B	**SERVICE POINTS**						
4	Water taps	As available					
5	Gas Cylinders	2					
6	Electrical fittings	As available					
7	Work Benches	20					
C	**LIBRARY RESOURCES**						
8	Intro Tech. Textbooks	5					
9.	Teachers' Guides	2					
10	Students' work book	45					
11	Intro Tech. Curriculum	2					
D	**SAFETY DEVICES**						
12	First Aid Box	1					
13	Fire Extinguisher	1					
14	Bucket of sand	1					
E	**TECHNICAL DRAWING REQUIREMENTS**						
15	Drawing Board	45					
16	T. Square	45					
17	Set Squares	45 sets					
18	Pair of Compasses	45					
19	Pair of Dividers	45					
F	**METAL WORKSHOP REQUIREMENTS**						
20	Pillar Drilling Machine	5					
21	Grinding Machine	2					
22	Hand Drilling Machine (Electrical)	5					
23	Bench Shears	2					
24	Bench Vice	5					
25	Electric Arc Welding Machine	1					
26	Stock and Dies	5 sets					
27	Pipe Wrench (various sizes)	10					

S/N	RESOURCES	MINIMUM NUMBER RECOMM-ENDED	NUMBER AVAIL-ABLE	ADE-QUATE	USED	NOT USED	REASONS FOR NON USE
28	Try Square	10					
29	Panel Saws	15					
30	Set of G. & F. Clamps	5 each					
31	Sandal	2					
32	Hacksaws Frame and Blades	10					
33	Wire brush	2					
34	Steel rule	10					
35	Snips	5					
36	Scribers	10					
37	Centre punch	5					
38	Cold Chisel	5					
39	Files	23					
40	Anvil	3					
41	Hammers	20					
42	Set of Fullers	2					
43	Calipers	5					
44	Punches	5					
45	Tongs	5					
46	Safety Goggle	10					
47	Micrometer	10					
48	Vernier Calipers	10					
G	**WOODWORK REQUIREMENTS**						
49	Planes	10					
50	Brush	10					
51	Mortise Guage	20					
52	Tape	10					
53	Spoke Shares	10					
54	Handsaws	20					
55	Curve Cutting Saws	10					
56	Drilling Bit	1 set					
57	Screw Driver	2 sets					
58	Mallet	10					
59	Pincer	10					
60	Sack clamp	20					
61	Oil Stone	2					
62	Circular Saw	1					
63	Surface plane	1					
64	Wood Lathe	1					
65	Ratchet Brace	2					
66	Bradawls	10					
H	**ELECTRICITY/MAGNETISM AND ENERGEY REQUIREMENTS**						
67	Pliers	10					
68	Soldering Iron	10					
69	Voltmeter	2					

S/N	RESOURCES	MINIMUM NUMBER RECOMM-ENDED	NUMBER AVAIL-ABLE	ADE-QUATE	USED	NOT USED	REASONS FOR NON USE
70	Wattmeter	2					
71	Galvanometer	2					
72	Ohmmeter	2					
73	Accumulator	2					
74	Generator	1					
75	Bar Magnet	5					
76	Iron Filings	As available					
77	Distributor	1					
78	Electrical wiring accessories	As available					
79	Soldering lead	1 reel					
80	Transformer	1					
81	Electric fan	2					
82	Soldering bit	5					
83	Allen Keys	10					
84	Cutters	10					
85	Spanners (flat, ring & socket)	10 sets					
I	**GENERAL**						
86	Motor Jack	1					
87	Motor Vehicle engine	1					
88	Plastic resin	As available					
89	Pottery utensil	As available					
90	Refrigerator	1					
91	Feeler gauges	5					
92	Air conditioner	1					
93	Greese guns	10					
94	Piston rings compressor	2					
95	Tyre pressure gauges	2					
96	Surface plate	5					
97	Vee blocks	5					
98	Weld master vulcanizer	1					
99	Battery Charger	1					
100	Hydrometer	5					
101	Wheel Alignment gauge	2					
102	Battery Service Kit	2					
103	Valve Grinder	1					
104	Cabrator Service Kit	1					
105	Axle Stands	8					

APPENDIX D

INTEGRATED SCIENCE RESOURCE ASSESSMENT CHECKLIST (ISRAC)

INSTRUCTION: Please indicate the quantity of the following resources in your school as against the minimum number recommended by the Federal Ministry of Education.

S/N	RESOURCES	MINIMUM NUMBER RECOMM-ENDED	NUMBER AVAIL-ABLE	ADE-QUATE	USED	NOT USED	REASONS FOR NON USE
A	**HUMAN RESOURCES**						
1	Qualified I.S. Teachers	2					
2	Laboratory Technicians	1					
3	Laboratory Attendants	1					
B.	**SERVICE POINTS**						
4	Water Taps	As available					
5	Gas Cylinder	1					
6	Electrical fittings	As available					
7	Benches	20					
C	**LIBRARY RESOURCES**						
8	Integrated Science Textbooks	5					
9	Teachers' Guide	2					
10	Students' Workbook	45					
11	Integrated Science Curriculum	2					
D	**EQUIPMENT**						
12	Microscopes	10					
13	Incubator	1					
14	Insect cage or jars	10					
15	Kettle	1					
16	Mirrors	1 pkt					
17	Paper clips	2 pkts					
18	Shovels	1					
19	Specimen Jars	20					
20	Ammeter O 3A	4					
21	Aquarium (Plastic)	2					
22	Balances, lever	4					
23	Balance, Spring 0-250g (or in Newton)	10					
24	Calipers (internal and external)	5					
25	Slide Vernier calipers	2					
26	Voltmeter 0 3V	4					
27	Galvanometer 35.0.35 MA	2					
28	Glass Prisms	2 types					
29	Touch (electric)	2 dozens					
30	Batter (cells)	12					
31	Ball bearing (assorted)	1 pkt					

S/N	RESOURCES	MINIMUM NUMBER RECOMM-ENDED	NUMBER AVAIL-ABLE	ADE-QUATE	USED	NOT USED	REASONS FOR NON USE
32	Ball and ring apparatus	1					
33	Electric bell	1 pkt					
34	Rectangular glass blocks	10					
35	Bunsen burners or spirit lamps	10					
36	Pipettes (25cm^3)	10					
37	Burettes (0-50cm^3)	10					
38	Carbon rods	4					
39	Concave lenses (15-20cm focal length)	10					
40	Convex lenses (15-20 cm focal length)	10					
41	Desiccator	1					
42	Dissecting kit	2					
43	Electrode, Carbon plate	10					
44	Electrode, Zinc	10					
45	Electrode, platinum	1					
46	Scalpel	10					
47	Spatula	10					
48	Spirit springs	10					
49	Steel wool	1 pkt					
50	Test tubes (Pyrex)	1 gross					
51	Test tubes brushes	10					
52	Test tubes holders	10					
53	Test tubes racks	10					
54	Tripod stands (with clamps)	10					
55	Delivery tubes	1 ream					
56	Wash bottles, plastic	10					
57	Watch classes	10					
58	Litmus paper, red and blue	4 pkts each					
59	Blades	10 pkts					
60	Bottles	20					
61	Bottle caps	20					
62	Buckets	10					
63	Bulbs (electric)	10					
64	Blotting paper/filter paper	10 pkts					
65	Cage for small animals	2					
66	Card-board box	4					
67	Candle wax	2 pkts					
68	Beakers (various sizes)	20					
69	Reagent bottles	40					
70	Cells (touch 1.5v)	40					
71	Cell holders	20					
72	Copper sheet	1 roll					
73	Copper wire	1 roll					
74	Plastic model of skull (mammals)	1					

S/N	RESOURCES	MINIMUM NUMBER RECOMM-ENDED	NUMBER AVAIL-ABLE	ADE-QUATE	USED	NOT USED	REASONS FOR NON USE
75	Can opener	2					
76	Glass cutter	2					
77	Hacksaw	2					
78	Hand drill (with bits)	1 set					
79	Knife	2 types					
80	Pliers	2					
81	Portable vice	1					
82	Screw driver	1 set					
83	Triangular file	2					
84	Wooden saw	2					
85	Fehlings solutions A&B	1 litre B					
86	Glucose	500g B					
87	Methyl orange	500g B					
88	Turpentine	11 B					
89	Kerosene	As available					
90	Starch	As available					
91	Sugar	As available					
E	**SPECIMENS**						
92	Cockroaches	As available					
93	Earthworms	As available					
94	Fertilized eggs of chicken	As available					
95	Fertilized eggs of toad frog	As available					
96	Fish	As available					
97	Frog or toad	As available					
98	Grasshoppers	As available					
99	Bird	As available					
100	Houseflies	As available					
101	Mammalian skeleton	1					
F	**CHEMICALS**						
102	Aminoethanal (acetomide)	500g B					
103	Propane (alcohol)	1 litre B					
104	Alkanol (alcohol)	1 litre B					
105	Ammonia solution	1 litre B					
106	Ammonium Heptaoxe Dichromate (vii)	500g B					
107	Calcium Chloride	500 g B					
108	Copper (II) Oxide	500 g B					
109	Copper turnings	500 g B					
110	Copper (II) Trioxocarbonate (IV)	500 g B					
111	Trichloromethane	1 litre B					
112	Chloroform	As available					
113	Ethanoic Acid	1 litre B					
114	Alkoxy alkaline	2½ litres B					
115	Hydrogen Chloride acid	2½ litres B					
116	Hydrochloric Acid	As available					
117	Hydrogen disulphide	1 litre B					

S/N	RESOURCES	MINIMUM NUMBER RECOMM-ENDED	NUMBER AVAIL-ABLE	ADE-QUATE	USED	NOT USED	REASONS FOR NON USE
118	Hydrogen Peroxide	1 kg B					
119	Iodine crystals	1 kg B					
120	Iron (II) tetroxosulphate (IV)	500 g B					
121	Lime water	As available					
122	Lead (II) Trioxonitrate (IV)	500 g B					
123	Lead (II) nitrate	As available					
124	Litmus solution	500 cm^2 B					
125	Magnesium Ribbon	1 pkt					
126	Magnesium tetroxosulphate (IV)	500 g B					
127	Magnesium Trioxonitrate (V)	500 g B					
128	Magnesium (IV) Oxide	500 g B					
129	Mercury (II) Oxide	500 g B					
130	Trioxonitrate (V) acid	2½ litres B					
131	Potassium Trioxo chlorate (V)	500g B					
132	Potassium Hydroxide	500g B					
133	Potassium tetroxomangate (VII)	500g B					
134	Potassium Iodide	500g B					
135	Sodium hydrogen Trioxocarbonate (IV)	500g B					
136	Sodium Trioxocarbonate (IV)	500g B					
137	Sodium hydrogen carbonate	1 kg					
138	Tetroxo sulphate (IV) acid	2½ Litres B					
139	Zinc Foil	1 pk					
140	Zinc Trioxocarbonate (IV)	500g B					
141	Zinc Trioxonitrate (V)	500g B					
142	Zinc tetrosulphate (IV)	500g B					
143	Zinc Oxide	500g B					
144	Universal Indicator (BOH)	500g B					
145	Iron fillings	500g B					
146	Sulphur	500g B					
147	Alum	As available					
148	Camphor	As available					
149	Charcoal	As available					
150	Orange juice (Any citrus juice)	As available					
151	Palm oil	As available					
152	Sodium chloride	As available					
153	Shelltox or any insecticide	As available					
154	Vaseline	As available					
155	Iodine (Tincture)	As available					
G	**CHARTS**						

S/N	RESOURCES	MINIMUM NUMBER RECOMM-ENDED	NUMBER AVAIL-ABLE	ADE-QUATE	USED	NOT USED	REASONS FOR NON USE
156	Periodic Table of Elements	1					
157	Physiology and Hygiene charts	1					
158	Representative plant and animal parts	1					
159	Charts for laboratory preparation of gases e.g. Hydrogen, oxygen.	1					
H	**MODELS**						
160	Audio Visual Equipment	1					
161	Models e.g. eye, ear and cross section of leaf, engine models (gasoline, diesel) motor/atomic models, atomic structure model.	1 each					
I	**PROJECTOR(S)** any one of						
162	Projector movie						
163	Film strip projector						
164	Lantern slide projector						
165	Micro projector						
166	Opaque projector						

APPENDIX E

Dept. of Science and Technology
Education
University of Jos, Jos.

Dear Sir (Expert),

This instrument is designed to investigate the relevance or otherwise of the topics in the integrated science curriculum to the learner's range of experiences and ability, to find out the level of integration of the different disciplines that make up the integrated science course as well as what new developments and current issues in the field of science that need to be included in the curriculum.

Your cooperation is highly solicited to unable us come up with an appropriate curriculum for JSS students.

Thanks.

Yours faithfully,

Adejoh, M. J.

INTEGRATED SCIENCE CURRICULUM CONTENTS EVALUATION INSTRUMENT FOR EXPERTS (ISCCEIE)

SECTION A

INTRUCTIONS: Indicate by ticking (√) in the appropriate column the relevance of the following topics in the integrated science curriculum to the learner's range of experiences and ability.

LEVEL	NO	THEMES/TOPICS	RELEVANCE TO LEARNER'S RANGE OF EXPERIENCES AND ABILITY		
			RELEVANT	***NOT RELEVANT***	***REASONS***
	A	**YOU AS A LIVING THING**			
JSS 1	1	Characteristics of living things			
	2	Characteristics of animals			
	3	Human beings as intelligent animals			
	4	Know your body			
	5	Feeding			
	6	Functions of the human body			
	7	Movements			
JSS 2	8	Excretory system			
	9	Respiratory system			

LEVEL	NO	THEMES/TOPICS	RELEVANCE TO LEARNER'S RANGE OF EXPERIENCES AND ABILITY		
			RELEVANT	***NOT RELEVANT***	***REASONS***
	10	Circulatory system			
	11	Digestive system			
JSS 3	12	Food storage			
	13	Sense organs			
	14	Reproductive system			
	15	Health			
	B	**YOU AND YOUR HOME**			
JSS 1	16	Health of the family			
JSS 2	17	Growth and development			
	18	Energy and appliances in the home (forms of energy)			
JSS 3	19	Continuity of the family			
	20	Care of the child			
	21	Energy and appliances in the home			
	C	**LIVING COMPONENTS OF THE ENVIRONMENT**			
JSS 1	22	Classification of matter			
	23	Grouping of organisms			
	24	Activities of living things			
JSS 2	25	Ecology – specific habitat studies including land and aquatic			
JSS 3	26	Resources from living components of the environments			
	D	**NON-LIVING COMPONENTS OF THE ENVIRONMENT**			
JSS 1	27	Observing samples of non-living things			
	28	Classification of non-living components			
	29	Measurements			
	30	States of matter			
	31	Air			
	32	Water			
	33	Man and Space			
JSS 2	34	Physical and chemical changes			
	35	Elements, compounds and mixtures			
	36	Further investigation of air and water			
	37	Hydrogen			
	38	Rusting			
	39	Energy			
	40	Measurement			
JSS 3	41	Chemical symbols, formulae and equations			
	42	Atomic structure			
	43	Metals and non-metals			

LEVEL	NO	THEMES/TOPICS	RELEVANCE TO LEARNER'S RANGE OF EXPERIENCES AND ABILITY		
			RELEVANT	***NOT RELEVANT***	***REASONS***
	44	Activity series			
	45	Acids, bases and salts			
	46	Energy conversion and transfer			
	47	Energy and work			
	48	Kinetic theory			
	49	Man in Space			
	E	**SAVING YOUR ENERGY**			
JSS 1	50	Science related occupation			
	51	Tools (machines) for work			
	52	Force			
JSS 2	53	Force			
	54	Simple machines			
	55	Maintenance of machines			
JSS 3	56	Work and energy			
	F	**CONTROLLING THE ENVIRONMENT**			
JSS 1	57	Environmental sanitation			
	58	Sewage			
	59	Disease vectors			
	60	Preventive medicine (clean water and immunization)			
JSS 2	61	Maintaining balance in the environment			
	62	Pollutants in the environment			
JSS 3	63	Our disappearing forests			
	64	Controlling the weather			

SECTION B

1. Instruction: Indicate by ticking in the appropriate box the extent to which the different disciplines (e.g. Biology, Chemistry, Physics, Earth sciences) that make up the integrated science course have been well integrated to produce a holistic picture of science to students.

What is the level of integration of the different disciplines in the integrated science curriculum?
None [ ] Low [ ] Moderate [ ] High [ ]

2. Instruction: Indicate what new developments and current issues in the field of science that need to be included in the integrated science curriculum

S/N	Current Issues and Developments in Science	Reasons
I		
II		
III		

APPENDIX F

Dept. of Science and Technology Education
University of Jos, Jos.

Dear Sir (Expert),

This instrument is designed to investigate the relevance or otherwise of the topics in the Introductory Technology curriculum to the learner's range of experiences and ability, to find out the level of integration of the different disciplines that make up the Introductory Technology course as well what new developments and current issues in the field of technology that need to be included in the curriculum.

Your cooperation is highly solicited to unable us come up with an appropriate curriculum for JSS students.

Thanks.

Yours faithfully,

Adejoh, M. J.

INTRODUCTORY TECHNOLOGY CURRICULUM CONTENTS EVALUATION INSTRUMENT FOR EXPERTS (ITCCEIE)

SECTION A

INTRUCTIONS: Indicate by ticking (√) in the appropriate column the relevance of the following topics in the introductory technology curriculum to the learner's range of experiences and ability.

LEVEL	NO	TOPICS	RELEVANCE TO LEARNER'S RANGE OF EXPERIENCES AND ABILITY		
			RELEVANT	***NOT RELEVANT***	***REASONS***
	1	Drawing equipment and materials			
	2	Scale and construction			
	3	Freehand sketching			
	4	Board practice			
	5	Identification of materials (i) wood (ii)metal (iii) ceramics, plastic (iv) rubber			

LEVEL	NO	TOPICS	RELEVANCE TO LEARNER'S RANGE OF EXPERIENCES AND ABILITY		
			RELEVANT	***NOT RELEVANT***	***REASONS***
JSS 1	6	Processing of materials, wood, metals, ceramics, plastic and rubber			
	7	Use of materials			
	8	Work Bench and its Appliances			
	9	Use of Bench Tools			
	10	Basic ideas of electricity and magnetism			
	11	Introduction to Maintenance			
	12	Food storage and preservation			
	13	Lines and Angles			
	14	Friction and its effects			
	15	Gears and gearing			
	16	Belt and chain drives			
	17	Electrochemical effects			
JSS 2	18	Measuring current, voltage and power			
	19	Energy conversion			
	20	Power			
	21	Technology of appliances (based on electrical to heat energy conversion)			
	22	Technology of appliances (based on conversion of chemical to heat energy			
	23	Simple maintenance of domestic goods			
	24	Maintenance of simple mechanical goods			
	25	Sheet metal work			
	26	Site preparation (setting cut, foundation, walls)			
	27	Water flow			
	28	Airflow round an object			
	29	Isometric Drawing			
	30	Orthographic			
	31	Linear motion			
	32	Rotary motion			
	33	Transmission and utilization of electricity			
	34	Electronic devices and their use for controlling or generating current			
	35	Technology of Appliances based on electro mechanical principles, mechanical principles			

LEVEL	NO	TOPICS	RELEVANCE TO LEARNER'S RANGE OF EXPERIENCES AND ABILITY		
			RELEVANT	***NOT RELEVANT***	***REASONS***
JSS 3	36	Technology of appliances based on conversion of chemical to electrical, electrical to mechanical energy and mechanical to electrical energy.			
	37	Maintenance of Electrical and Electronic Goods.			
	38	Nails, screws and fittings			
	39	Simple woodwork projects			
	40	Woodworking machine			
	41	Introduction to machine tools			
	42	Metal finishing			
	43	Floors			
	44	Doors and windows			
	45	Roofing			
	46	Building services, Sewage, electrical supply etc.			
	47	Speed and pressure relationships in airflows			
	48	Simple hydraulical pneumatic devices			
	49	Water flow			
	50	Energy			

SECTION B

1. Instruction: Indicate by ticking in the appropriate box the extent to which the different disciplines (e.g. metal work, wood work, electricity, technical drawing, etc) that make up the introductory technology course have been well integrated to produce a wholistic picture of technology to students.

What is the level of integration of the different disciplines in the introductory technology curriculum?
None [ ] Low [ ] Moderate [ ] High [ ]

2. Instruction: Indicate what new developments and current issues in the field of technology that need to be included in the introductory technology curriculum

S/N	**Current Issues and Developments in Science**	**Reasons**
I		
II		
III		
IV		
V		
VI		
VII		
VIII		
IX		
X		
XI		
XII		
XIII		
XV		
XVI		
XVII		

APPENDIX G

DESCRIPTIVE STATISTIC FOR INTRODUCTORY TECHNOLOGY TEACHERS

	N	Sum	Mean	Std. Deviation	Variance
V1	8	34	4.25	0.4629	0.214
V2	8	34	4.25	0.4629	0.214
V3	8	31	3.875	0.3536	0.125
V4	8	29	3.625	1.0607	1.125
V5	8	32	4	0	0
V6	8	27	3.375	1.3025	1.696
V7	8	26	3.25	1.165	1.357
V8	8	23	2875	0.991	0.982
V9	8	32	4	0	0
V10	8	21	2.625	1.0607	1.125
V11	8	30	3.75	0.4629	0.214
V12	8	20	2.5	1.069	1.143
V13	8	20	2.5	0.7559	0.571
V14	8	21	2.625	1.1877	1.411
V15	8	22	2.75	1.165	1.357
V16	8	30	3.75	0.7071	0.5
V17	8	27	3.375	0.9161	0.839
V18	8	25	3.125	0991	0.982
V19	8	30	3.75	0.7071	0.5
V20	8	28	3.5	0.9258	0.857
TOTAL		524	67.75	15.75	15.21

APPENDIX H

DESCRIPTIVE STATISTICS FOR INTEGRATED SCIENCE TEACHERS.

	N	Sum	Mean	Std. Deviation	Variance
V1	8	37	4.625	0.5175	0.268
V2	8	35	4.375	0.5175	0.268
V3	8	30	3.75	0.8864	0.786
V4	8	30	3.75	0.7071	0.5
V5	8	37	4.655	0.5175	0.268
V6	8	21	2.625	1.1877	1.411
V7	8	20	2.5	1.069	1.143
V8	8	22	2.75	1.0351	1.071
V9	8	34	4.25	1.0351	1.071
V10	8	21	2.625	0.9161	0.839
V11	8	29	3.625	1.0607	1.125
V12	8	22	2.75	1.165	1.357
V13	8	15	1.875	0.991	0.982
V14	8	17	2.125	0.8345	0.696
V15	8	27	3.375	0.9161	0.839
V16	8	32	4	1.3093	1.714
V17	8	18	2.25	0.7071	0.5
V18	8	25	3.125	0.991	0.982
V19	8	33	4.125	0.991	0.982
V20	8	22	2.75	1.3887	1.927
TOTAL		527	65.88	18.74	18.87

APPENDIX I

ESTIMATION OF THE INTERNAL CONSISTENCY OF THE RATING SCALES IN PEIT FOR IT TEACHERS USING CRONBACH'S ALPHA METHOD.

S/NO	x	$x-\bar{x}$	$(x-\bar{x})^2$	
1.	34	34-26.2=7.8	60.86	S^2_x =61.14
2.	34	7.8	60.84	
3.	31	4.8	23.04	$\sum S^2_i$=15.21
4.	29	2.8	7.84	$\propto = \frac{n}{n-1}\left[1-\frac{\sum s^2_1}{s^2_x}\right]$
5.	32	5.8	7.84	
6.	27	0.8	0.64	$=\frac{20}{19}\left[\bar{1}-\underline{15.21}\right.$
7.	26	-0.2	0.04	1.05x(1-0.25)
8.	23	-3.2	10.24	1.05x0.75
9.	32	5.8	33.64	=0.78
10.	21	-5.2	27.04	
11.	30	3.8	14.44	
12	20	-6.2	38.44	
13	20	-6.2	38.44	
14	21	-5.2	27.04	
15	22	-4.2	17.64	
16	30	3.8	14.44	
17	27	0.8	0.64	
18	25	-1.2	1.44	
19	30	3.8	14.44	
20	28	1.8	3.24	
	524	$S^2_x = \frac{428}{7} = 61.14$		

$\bar{x} = \frac{524.}{20}$

= 26.2

APPENDIX J

ESTIMATION OF THE INTERNAL CONSISTENCY OF THE RATING SCALES IN PEIT FOR IS TEACHERS USING CRONBACH'S ALPHA METHOD

S/NO	x	$x - \bar{x}$	$(x - \bar{x})^2$	
1	37	10.65	113.42	
2	35	8.65	74.82	
3	30	3.65	13.32	$\propto = \frac{n}{n-1}\left[1-\frac{\sum s^2_1}{s^2_x}\right]$
4	30	3.65	13.32	
5	37	10.65	113.42	$\propto = \frac{20}{19}\left[\bar{1} - \frac{18.87}{130}\right]$
6	21	-5.35	28.62 7	
7	20	-6.35	40.32	1.05x(1-0.145)
8	22	-4.35	10.92	= 1.05x0.855
9	34	7.65	58.52	=0.90
10	21	-5.35	28.62	
11	29	2.65	7.0225	
12	22	-4.35	18.92	
13	15	-11.35	128.82	
14	17	-9.35	87.42	
15	27	0.65	0.4225	
16	32	5.65	13.92	
17	18	-8.35	69.72	
18	25	-1.35	1.8225	
19	33	6.65	44.22	
20	22	-4.35	18.92	
	527		912.51	

$$S^2_x = \frac{912.51}{7} = 130$$

$$\bar{x} = \frac{527}{20} = 26.35 \qquad \sum S^2_i = 18.87$$

APPENDIX K

List of Integrated Science Topics Considered not Relevant to Students Range of Experience and Ability.

Level	Topics
JSS I	1.Tools for work, 2. Force, 3. States of matter, 4. Classification of matter, 5. Man and Space
JSS II	1. Excretory system, 2. Reproductive system, 3. Circulatory system, 4. Digestive system, 5. Physical and Chemical changes, 6. Elements, compounds and mixtures, 7. Force, 8. Simple machines and 9.Maintaining balance in the environment
JSS III	1.Reproductive system, 2.Sense organs, 3.nergy and appliances in the home, 4.Chemical symbols, 5.formulae and equations, 6.Atomic structure, 7.Activity series and 8.Acids, bases and salts

List of Introductory Technology Topics Considered not Relevant to Students Range of Experiences and Ability.

Level	Topics
JSS I	1.Board practice, 2.Electrochemical effects, 3.Friction and its effects, 4.Basic ideas of electricity and Magnetism.
JSS II	5.Technology of appliances (based on electrical to heat energy conversion), 2.Technology of appliances (based on conversion of chemical to heat energy)
JSS III	1.Speed and pressure relationships in airflows, 2.Technology of appliances based on conversion of chemical to electrical, electrical to mechanical energy and mechanical to electrical energy, 3.Isometric drawing, 4.Technology of appliances based on electro-mechanical principles, 5.Simple hydraulical pneumatic devices.

APPENDIX L

t-Calculation for Hypothesis One

$$t = \frac{0_1 - 0_2}{\sqrt{\frac{S^2_1}{N_1} + \frac{S^2_2}{N_2}}}$$

Where 0_1 = Mean for Group 1

0_2 =Mean for Group 2

N_1 =Number of respondents in Group 1

N_2 =Number of respondents in Group 2

S^2_1 =Variance for Group 1

S^2_2 =Variance for Group 2

0_1 = 75

0_2 =69

N_1 =18

N_2 =32

S^2_1 =108.53

S^2_2 =96.23

Substituting in the formula:

$$t = \frac{75-69}{\sqrt{\frac{108.53}{18} + \frac{96.23}{32}}}$$

$$t = \frac{6}{\sqrt{6.03+3.01}}$$

$$= \frac{6}{\sqrt{9.04}}$$

$$= \frac{6}{3.01}$$

$$= 1.993$$

$$df = (N_1-1)+(N_2-1)$$

$$= (18-1)+(32-1)$$

$$= 17+31$$

$$= 48.$$

APPENDIX M

t-Calculation for Hypothesis Two

$$t = \frac{0_1 - 0_2}{\sqrt{\frac{S^2_1}{N_1} + \frac{S^2_2}{N_2}}}$$

Where 0_1 = Mean for Group 1

0_2 =Mean for Group 2

N_1 =Number of respondents in Group 1

N_2 =Number of respondents in Group 2

S^2_1 =Variance for Group 1

S^2_2 =Variance for Group 2

0_1 = 63

0_2 =65

N_1 =18

N_2 =32

S^2_1 =71.59

S^2_2 =106.35

Substituting in the formula:

$$t = \frac{63-65}{\sqrt{\frac{71.59}{18} + \frac{106.35}{32}}}$$

$$t = \frac{-2}{\sqrt{3.98+3.32}}$$

$$= \frac{-2}{\sqrt{7.3}}$$

$$= \frac{-2}{2.70}$$

$$= -0.7407$$

$$df = (N_1-1)+(N_2-1)$$

$$= (18-1)+(32-1) = 17+31$$

$$= 48.$$

APPENDIX N

t-Calculation for Hypothesis Three

$$t = \frac{0_1 - 0_2}{\sqrt{\frac{S^2_1}{N_1} + \frac{S^2_2}{N_2}}}$$

Where 0_1 = Mean for Group 1

0_2 =Mean for Group 2

N_1 =Number of respondents in Group 1

N_2 =Number of respondents in Group 2

S^2_1 =Variance for Group 1

S^2_2 =Variance for Group 2

0_1 = 49

0_2 =23

N_1 =50

N_2 =50

S^2_1 =51.27

S^2_2 =101.49

Substituting in the formula:

$$t = \frac{49-23}{\sqrt{\frac{51.27}{50} + \frac{101.49}{50}}}$$

$$t = \frac{26}{\sqrt{1.03+2.03}}$$

$$= \underline{26}$$

$\sqrt{3.06}$

$= \frac{26}{1.75}$

= 14.86

df = (50-1)+(50-1)

= 49+49

= 98

APPENDIX O

t-Calculation for Hypothesis Four

$$t = \frac{0_1 - 0_2}{\sqrt{\frac{S^2_1}{N_1} + \frac{S^2_2}{N_2}}}$$

Where 0_1 = Mean for Group 1

0_2 =Mean for Group 2

N_1 =Number of respondents in Group 1

N_2 =Number of respondents in Group 2

S^2_1 =Variance for Group 1

S^2_2 =Variance for Group 2

0_1 = 45

0_2 =19

N_1 =50

N_2 =50

S^2_1 =67.82

S^2_2 =68.22

Substituting in the formula:

$$t = \frac{45-19}{\sqrt{67.82 + 68.232}}$$

50 50

$$t = \frac{26}{\sqrt{1.36+1.36}}$$

$$= \frac{26}{\sqrt{2.72}}$$

$$= \frac{26}{1.65}$$

= 15.76

df = $(N_1-1)+(N_2-1)$

= (50-1)+(50-1)

= 49+49

= 98

APPENDIX P

t-Calculation for Hypothesis Five

$$t = \frac{0_1 - 0_2}{\sqrt{\frac{S^2_1}{N_1} + \frac{S^2_2}{N_2}}}$$

Where 0_1 = Mean for Group 1

0_2 =Mean for Group 2

N_1 =Number of respondents in Group 1

N_2 =Number of respondents in Group 2

S^2_1 =Variance for Group 1

S^2_2 =Variance for Group 2

0_1 = 47.2

0_2 =43.3

N_1 =18

N_2 =32

S^2_1 =402.76

S^2_2 =172.98

Substituting in the formula:

$$t = \frac{47.2-43.3}{\sqrt{\frac{402.76}{18} + \frac{172.98}{32}}}$$

$$t = \frac{3.9}{\sqrt{22.38+5.41}}$$

$$= \frac{3.9}{\sqrt{27.79}}$$

$$= \frac{3.9}{5.27}$$

$$= 0.74$$

$$\begin{aligned} df &= (N_1-1)+(N_2-1) \\ &= (18-1)+(32-1) \\ &= 17+31 \\ &= 48. \end{aligned}$$

APPENDIX Q

t-Calculation for Hypothesis Six

$$t = \frac{0_1 - 0_2}{\sqrt{\frac{S^2_1}{N_1} + \frac{S^2_2}{N_2}}}$$

Where 0_1 = Mean for Group 1

0_2 =Mean for Group 2

N_1 =Number of respondents in Group 1

N_2 =Number of respondents in Group 2

S^2_1 =Variance for Group 1

S^2_2 =Variance for Group 2

0_1 = 38.56

0_2 =35.22

N_1 =18

N_2 =32

S^2_1 =342.61

S^2_2 =218.57

Substituting in the formula:

$$t = \frac{38.56-35.22}{\sqrt{\underline{342.61} + \underline{218.57}}}$$

18 32

$$t = \frac{3.34}{\sqrt{19.03+6.83}}$$

$$= \frac{3.34}{\sqrt{25.86}}$$

$$= \frac{3.34}{5.09}$$

$$= 0.66$$

$$df = (N_1-1)+(N_2-1)$$

$$= (18-1)+(32-1)$$

$$= 17+31$$

$$= 48.$$