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Assessment of the Implementation of Integrated Science Teacher Education Programme for Pre-Service Teachers' Preparation in Colleges of Education in Benue State, Nigeria

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ABSTRACT

The study assessed the implementation of Integrated Science Teacher Education Programme for Pre-Service Teachers' Preparation in Colleges of Education in Benue State, Nigeria. Six specific objectives with corresponding research questions guided the study. The study adopted a descriptive research design. The population for the study comprises 4 Colleges of Education (public and private) in Benue State with Integrated Science Department staff strength of 50 (36 academic and 14 non-teaching staff). Since the population was not large, the four Colleges of Education and the 50 Academic and supporting staff were used. Two instruments – a questionnaire and a checklist adopted from the NCCE minimum guideline for implementation of Integrated Science Programme were used for the data collection. The data collected were analyzed using descriptive statistics of Frequency Counts and Percentages to answer the research questions raised for the study while pie chart and histogram was used to present some of the data analyzed. Findings of the study revealed that the Integrated Science teachers possess the minimum teaching qualification in relation to the NCCE guidelines. The findings also revealed that the Colleges of Education only met two of the requirements (laboratory assistant and cleaner) for availability of Integrated Science support staff. It was further revealed that lecture, discussion, discovery, demonstration and project for Integrated Science programme were the teaching methods adopted in relation to the NCCE guidelines in preparing pre-service teachers while excursion/field trips and individualized instruction were not adopted. In addition, it was revealed that only two out of the Colleges of Education met the recommended ratio (1:25) for student-teacher ratio. Furthermore, it was revealed that botanical garden and nursery for plants were the only Integrated Science outdoor laboratories that were available in all the Colleges of Education in Benue State and that Integrated Science laboratory equipment were not adequate in relation to the NCCE guidelines in Colleges of Education in Benue State. The study concluded that while certain aspects, such as teacher qualifications and support staff, align partially with the guidelines, evident gaps are apparent in teaching methodologies, student-teacher ratios, the presence of outdoor laboratories, and the adequacy of laboratory equipment. Recommendations were made that Workshops, seminars, and training sessions should be organized by the management of Colleges of Education to ensure teachers remain up-to-date with the latest teaching methodologies and scientific developments that can provide students with practical exposure, critical thinking skills, and a deeper understanding of scientific concepts beyond the classroom setting and stakeholders should advocate for the right student-teacher ratio as prescribed by NCCE and conscious efforts should be made to adopt the recommended 1:25 as indicated

Keywords: **Assessment, Integrated Science, Teacher Education and Pre-Service Teachers**

Introduction

The importance of Integrated Science in Nigerian educational system particularly in teaching and learning of science cannot be over emphasized. This is why Yoloye as cited in Ibrahim (2014) stated that Integrated Science as a subject was introduced to improve the quality of science teaching in Nigeria at the Junior Secondary School and where it is taught in higher institutions as a course or programme, it is meant to have adequate and well trained science teachers who would have acquired necessary skills to handle the subject more effectively. Taking from this, the effectiveness of the teacher training programme in Integrated Science to ensure that quality teaching is done for effective education motivated this study.

Teacher training programme in Nigeria is aimed at providing trainees (pre-service teachers) with intellectual and professional background adequate for their assignment and to make them adaptable to any changing situations in the country and the world. This goal according to Adeosun, Oni, Oladipo, Onuoha and Yakassai (2009) remains a mere wish as most trained teachers do not exhibit the required competencies needed, especially to teach Integrated Science (Basic Science) at the foundation level. In effect despite the laudable objectives of Integrated Science, observations have shown that the state of Integrated Science teaching /learning is fast deteriorating. In support of this claim, Mani in Ibrahim (2014) reported that Integrated Science has not been taught as intended particularly in secondary schools by trained teachers and that lesson presentation are mostly teacher centered which are not in line with the philosophy of Integrated Science. With this submission, one is tempted to question the effectiveness of teacher education programmes in preparing these teachers. Interestingly as it is, researches have shown that students' performance in Integrated Science in secondary schools have not been encouraging as reported by Ogunkola and Samuel (2011) and Omiko (2016). Consequently, students seem to be becoming disenchanted with the study

of Integrated Science. With this scenario, one is tempted to question the quality of Integrated Science teachers produced particularly in teacher training programmes like the Colleges of Education.

The maxim that no educational system can rise above the quality of its teachers clearly demonstrates the role of teacher and teacher education programmes in national development. The realization enforces each country and its institutions of learning to make vigorous efforts to produce qualified persons to take up the teaching of her citizens as teaching is a versatile field that requires at all times the correct identification of indices of developments in the society (Adeosun et al, 2009). No wonder, the effectiveness of any educational system may depend greatly on the educational attainment of teachers because no system of education can be qualitatively higher than the quality of its teachers. It is the teachers who are ultimately responsible for translating policy into action and principles into practice in their interactions with their students. This means that teacher education should be given critical attention.

Teacher education is that component of any educational system charged with the responsibility of educating and training teachers to acquire the competences: classroom management, instructional delivery, formative assessment, and personal competencies of teaching for the improvement in the quality of teachers for the school system (Afe in Adeosun, Oni, Oladipo, Onuoha & Yakassai, 2009). It is the provision of professional education and specialized training within a specified period for the preparation of individuals who intends to develop and nurture the young ones into responsible and productive citizens. It is informed by the fact that teaching is an all-purpose profession which stimulates the development of mental, physical and emotional powers of students. Such educated citizens would be sensitive and equipped with peaceful co-existence, environmental management and democratic process. It is noted that the success of students in every field of endeavor depends largely on qualified and dedicated teachers. This is why Omiko (2016) stated that the implementation of school programme like Junior Secondary School Curriculum effectively depends on the quality of the teachers. Anyakoha in Ogunyika, Okeke and Adedoyin (2015) stated that educational policies are written by knowledgeable writers who have foresight and believe strongly in what they write for the future but the problem arises when it comes to translating theory into practice by implementers (teachers) especially in tertiary institutions of learning where prospective teachers are prepared. Hence, it is largely believed that if teachers are well prepared for the job of teaching, their on-the-job performance is likely to improve the performance of their students. The researcher observed from extant literature that the effectiveness of Integrated Science teacher training programmes in tertiary institutions which prepares teachers for teaching is often neglected by researchers in their quest to ascertain the problems of Integrated Science teaching and learning and students' poor performance in secondary schools. This has warranted the researchers' investigation. Hence the research is tailored towards an assessment of the implementation of Integrated Science teacher education programme in Colleges of Education in preparing pre-service teachers in Benue State.

Colleges of Education are teachers' training institutions in Nigeria. The objective of government in establishing these colleges of education is to produce graduates who will be teaching in Primary and Junior secondary school (Ibrahim, 2014). Academic programme of these institutions were designed to combine two teaching subjects with education and also a double major. The minimum duration for students' training in Colleges of Education leading to the award of Nigerian Certificate in Education (NCE) is three years. In colleges of education, students are trained to form habits that will help them become capable teachers who will shoulder responsibilities, be initiative and be of good conduct worthy of emulation to their future pupils/students. The curriculum lays emphasis on subject mastery and pedagogy. To be eligible for the award of NCE, a student must earn required units (usually 128) to graduate. This curriculum covers education courses, research projects, general studies, teaching practice and a double major or two teaching subjects (National Commission for Colleges of Education, NCCE, 2012).

For effective preparation of prospective teachers of Integrated Science in Colleges of Education, the Federal Republic of Nigeria through the National Commission for College of Education, NCCE, (2000; 2004; 2012) set out National bench mark for the implementation of the programme. This implementation refers to those actions that are geared towards the achievement of the objectives of the Integrated Science Curriculum. Some of the salient benchmarks for implementation of the Integrated Science curriculum in Colleges of Education as prescribed by NCCE (2012) that are of interest to this research are as follows:

i. At least Bachelor of Science Degree in Education (B.Sc. Ed) or its equivalent with NCE or Post Graduate Diploma in Education (PGDE) or B.Ed with a minimum of Second Class Lower. The staff should preferably be qualified in Integrated Science. Master Degree in Science education is acceptable. For the double major programme staff strength of: (a) a minimum of 10 lecturers for double major programme (b) a minimum of 8 lecturers for single major programme will be required.

ii. For the supporting staff, one Laboratory Technologist, one Laboratory Technician, one Laboratory Assistant, one Workshop Attendant, one Laboratory Attendant, one Cleaner and one Typist/Computer Operator is required

iii. The method of teaching should be activity-based: demonstration, discussion, discovery and problem solving. This is because, it has long been noted that students 'teach as they have been taught'. The aim of this programme is to capitalize on this phenomenon so that graduates of the programme will continue with the activity-based approach when they get to schools to teach pupils.

iv. The Students-teachers ratio should be 1:25. Where the student intake exceeds this number in a class, they should be grouped into parallel groups

v. *Availability of outdoor laboratories like* weather station, fishpond, botanical garden/zoological and a nursery for the plants to provides students an opportunity to study nature and earth science in an interactive setting

vi. Laboratory equipments should be made available. Some of these equipments include 3 Skeleton System, 3 Muscular System, 3 Brain and Nervous System, 3 Circulatory System, 3 Digestive System, 3 Eye and Vision, 1 Skin and Excretory organs, 40 Microscope, 30 Binocular Microscope, 10 Measuring Tape, 18 Bunsen Burner, 1 Slide Projector and 2 Overhead Projector among a host of others.

It is sufficed to state that the essence of specifying the benchmark by Federal Ministry of Education-FME and NCCE is to ensure effective implementation of Integrated Science in order to prepare quality teachers that can take up the teaching of the subject in secondary schools. Ascertaining whether a programme like that of the Integrated Science is effectively implemented required an assessment of the programme. When Integrated Science programme is assessed from time to time to ascertain its level of implementation, decisions on whether the programme has been able to prepare pre-service teachers effectively or not will be taken. The chosen areas of the benchmark for assessment in this study are because, they are considered to have direct impact on students' preparation in terms of learning. If teachers of Integrated Science in Colleges of Education are not qualified; supporting staff are not available; wrong method of teaching is used; lecture halls are overcrowded with students; outdoor laboratories are not available and teaching equipments are not available/adequate, chances are bound that teachers will not be effectively prepared for the job of teaching. This is why Ibrahim (2014) stated that for pre-service teachers (students) to learn Integrated Science effectively in institutions of higher learning in order to be able to deliver effectively, they would have to be taught appropriately with quality teachers using the right methodology and laboratory facilities.

Effective pre-service teacher preparation consists of a plethora of factors earlier highlighted that tend to produce high level students' involvement in the classroom activities, with minimal interruptions and efficient use of instructional time. In other words, whatever actions that are required to stimulate learners thinking, enlarge their imagination, promote initiative, sustain attention, make learning real and enhance teaching and learning process is worth looking at critically. With a major shift in education especially in Nigeria to prioritize Science Education and the introduction of new innovation in Science teaching to bring about effective learning and retention due to technological advancement, the question which comes to mind is whether the students of Integrated Science in Colleges of Education are being effectively prepared to take up the daunting task of teaching in secondary schools.

The level of compliance of Colleges of Education with the NCCE guidelines will determine the extent at which the aims of the minimum standards are achieved. According to Alumode and Onuma (2016), when minimum educational standards are articulated and prescribed, there must be a mechanism put in place to monitor the actualization and if need be, impose sanctions for noncompliance. Therefore, if that is not done the entire exercise of minimum standards would be futile. A college is said to be complying with the benchmark by being established, possess all the necessary requirement by the curriculum and implementing the programme adequately through the stakeholders.

Colleges of Education are expected based on NCCE curriculum to produce teachers who have sound dominance of critical thinking abilities, create profoundly energetic, ethical and proficient classroom teachers for the teaching of basic science in junior secondary schools. Today, the society seems not to be pleased with the products of higher institutions of learning like Colleges of Education. This is in light of the fact that graduates of Colleges of Education seem not to be efficient enough to influence learners to have a good mastery of the subject matter like the Integrated Science. Could this be that the prospective or pre-service teachers are not well enough prepared to take up this daunting task of teaching? This prompted the researcher to assess the implementation of Integrated Science teacher education programme in preparing pre-service teachers in Colleges of Education in Benue State, Nigeria.

Problem Statement

The quality of teachers is a major component for effective implementation of any classroom educational policy. Quality Integrated Science teachers in Nigeria remain the only hope for improving science teaching in schools in primary and post primary schools. For effective preparation of Integrated Science teachers, Colleges of Educations ought to operate strictly in consonant with the minimum guideline for implementation prescribed by National Commission for Colleges of Education. Some of these guidelines include but not limited to: qualified teachers, appropriate students-teacher ratio, use of recommended/appropriate teaching methodology availability of supporting staff, outdoor laboratories and laboratory facilities.

However, the researcher, an Integrated Science Teacher (now known as Basic Science) in secondary school through observation discovered that, most of her fellow teachers of Integrated Science particularly NCE graduates seem to lack prerequisite skills to effectively teach the subject. This is often demonstrated in their method of teaching and use of laboratory equipment. Most of them fail to effectively adopt the right instructional approaches in teaching certain topics and hardly take the students for practical classes. Could this observation be why Adeosun, *et al* (2009) stated that the goal of teaching and learning Integrated Science (Basic Science) remains a mere wish as most trained teachers do not exhibit the required competencies needed, especially to teach Integrated Science (Basic Science) at the foundation level?

The consequence of this is that the quality of teaching Basic Science in secondary schools will continue to sink into a quagmire of perplexing educational problem despite the laudable benchmark for implementation spelt out by the NCCE and the remarkable objectives of Integrated Science subject. Another consequence of this is that a faulty laid foundation for Integrated Science (Basic Science) teachers will subsequently affect secondary school students' performance in the subject. In view of this, one is tempted to question the effectiveness of the implementation of the teacher education programme in preparing Integrated Science teachers in Colleges of Education in Benue State to sufficiently take up the challenge of teaching in secondary schools. It is against backdrop that the researcher assessed the implementation of Integrated Science Teacher Education Programme for Pre-Service Teachers' Preparation in Colleges of Education in Benue State, Nigeria.

Objectives

Specifically, the study sought to achieve the following objectives:

1. Identify the qualifications of Integrated Science Teachers in relation to the NCCE guidelines in Colleges of Education in Benue State, Nigeria

2. Investigate the availability of Integrated Science support staff in relation to the NCCE guidelines in Colleges of Education in Benue State, Nigeria
3. Investigate the teaching methodology adopted by Integrated Science teachers in relation to the NCCE guidelines in Colleges of Education in Benue State, Nigeria
4. Assess the students-teacher ratio adopted for Integrated Science Programme in relation to the NCCE guidelines in Colleges of Education in Benue State, Nigeria
5. Determine the availability of Integrated Science outdoor laboratory in relation to the NCCE guidelines in Colleges of Education in Benue State, Nigeria
6. Assess the adequacy of Integrated Science laboratory equipment in relation to the NCCE guidelines in Colleges of Education in Benue State, Nigeria

Research Questions

The following research questions are raised to guide the study

1. What are the qualifications of Integrated Science Teachers in relation to the NCCE guidelines in Colleges of Education in Benue State, Nigeria?
2. What are the available Integrated Science support staffs in relation to the NCCE guidelines in Colleges of Education in Benue State, Nigeria?
3. What are the teaching methodologies adopted by Integrated Science teachers in relation to the NCCE guidelines in preparing pre-service teachers in Colleges of Education in Benue State, Nigeria?
4. What is the students-teacher ratio adopted for Integrated Science Programme in relation to the NCCE guidelines in preparing pre-service teachers in Colleges of Education in Benue State, Nigeria?
5. What are the available Integrated Science outdoor laboratories for preparing pre-service teachers in relation to the NCCE guidelines in Colleges of Education in Benue State, Nigeria?
6. How adequate are Integrated Science laboratory equipment in relation to the NCCE guidelines in Colleges of Education in Benue State, Nigeria?

Methodology

The study adopted a descriptive research design. The population for the study comprised four Colleges of Education (public and private) in Benue State with an Integrated Science Department staff strength of 50 (36 academic and 14 non-teaching staff). These Colleges of Education were: College of Education Oju (public), College of Education, Kastina-Ala (public), Gboko College of Education (private), and Calvin Foundation College of Education, Naka (private). Since the population was not large, no sampling was employed. Hence, the entire four Colleges of Education with the 36 academic and non-academic staff of Integrated Science Department in the two Colleges of Education were used. Two adopted instruments – a questionnaire and a checklist adopted from the NCCE minimum guideline for implementation of Integrated Science Programme were used for data collection. The questionnaire was titled 'Teacher Qualification and Teaching Method Questionnaire (TQTMQ)' and was divided into two clusters: A and B, while the checklist was divided into four clusters: A, B, C, and D, all focusing on the purposes of the study. Since the instruments were standards for implementation adopted from the National Commission for Colleges of Education minimum guideline for the implementation of Integrated Science, they were only subjected to face validation by an expert. The data for the study was collected by the researcher with the aid of four (4) research assistants. The Data collected were analyzed using descriptive statistics of Frequency Counts and Percentages to answer the research questions raised for the study. Histogram and Pie Chart were used to represent the data analyzed. To ascertain the adequacy of the laboratory equipment in answering research question six, the number of equipment available in each of the colleges of education was compared to the standard or minimum requirement as prescribed in the NCCE guideline for implementation.

Results

Research Question 1:

What are the qualifications of Integrated Science Teachers in relation to the NCCE guidelines in Colleges of Education in Benue State, Nigeria?

Table 1: Frequency Counts and Percentage of the Qualifications of Integrated Science Teachers in Colleges of Education in Benue State, Nigeria

Qualifications	No. of Respondents	Percentage (%)
HND	-	-
HND + PGDE	-	-
B.Sc (ED) Degree	16	44%
B.Sc Degree + PGDE	3	8%
B.Sc Degree	6	17%
M.ED	5	14%
M.SC	2	6%
M.SC + PGDE	4	11%
PhD (ED)	-	-
PhD (Sc)	-	-
PhD (Science) + PGDE	-	-

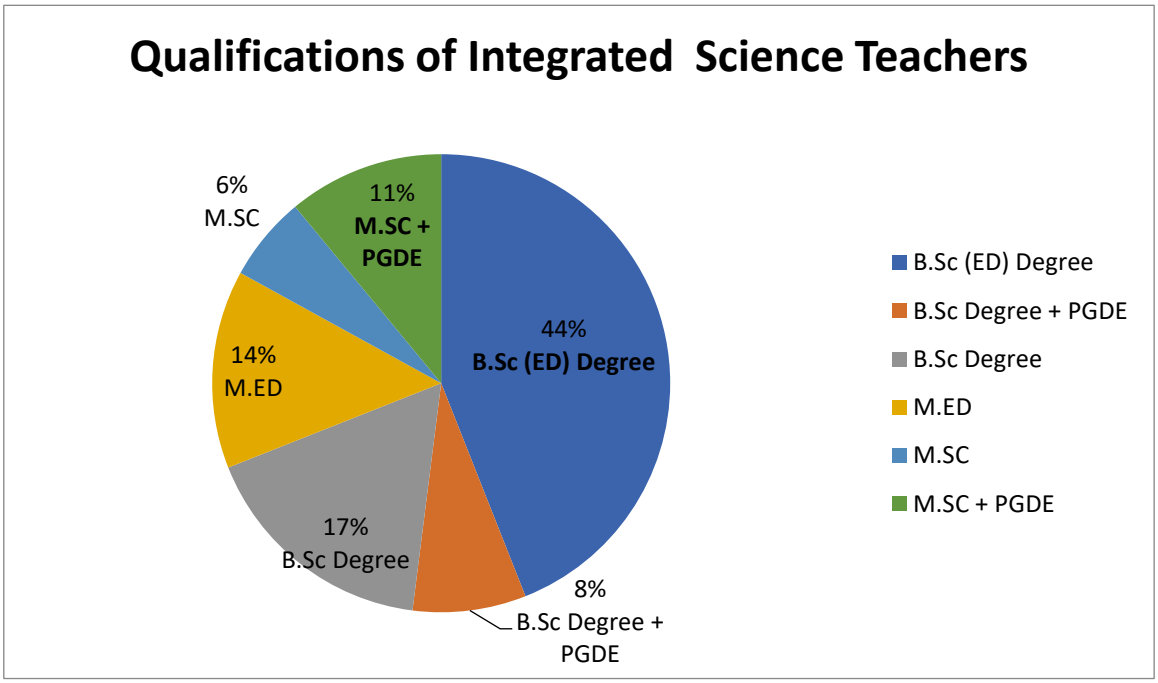

Fig 3: Pie Chart Showing the Qualifications of Integrated Science Teachers

Table 1 shows the qualifications of Integrated Science Teachers in relation to the NCCE guidelines in Colleges of Education in Benue State in frequency counts and percentages. From the table, it can be seen that majority of the academic staff 16(44%) have B.Sc (ED) Degree as their qualification followed by B.Sc Degree 6(17%) and M.ED 5(14%). The table also revealed that 4(11%) have M.SC + PGDE, 3(9%) have BSc + PGDE and 2(6%) have M.SC. None of the academic staff have HND + PGDE, PhD (ED), PhD (Sc) and PhD + PGDE as shown on the table.

Research Question 2:

What are the available Integrated Science support staff in relation to the NCCE guidelines in Colleges of Education in Benue State, Nigeria?

Table 2: Available Integrated Science Support Staffs in Relation to the NCCE Guidelines in Colleges of Education in Benue State, Nigeria

S/N	Supporting Staff	Min. N	COE Oju	COE K/Ala	COE Naka	COE Lessel
1	Laboratory Technologist	1	0	0	0	0
2	Laboratory Technician	1	1	1	0	0
3	Laboratory Assistant	1	1	1	1	1
4	Workshop Attendant	1	1	1	0	0
5	Laboratory Attendant	1	1	1	0	0
6	Cleaner	1	1	1	1	1
7	Typist/Computer Operator	1	1	1	0	0

Min. N = Minimum Number Required, COE Oju = College of Education Oju, COE K/Ala = College of Education Katsina-Ala, COE Naka = College of Education, Naka, COE Lessel = College of Education, Lessel

Analysis: 1 = Available, 0 = Not Available

Table 2 shows the available Integrated Science support staff in relation to the NCCE guidelines in Colleges of Education in Benue State, Nigeria. From the table, it can be seen that, For COE Oju and COE K/Ala, laboratory technician, laboratory assistant, workshop attendant, laboratory attendant, cleaner and typist/computer operator (Items 3, 4, 5, 6 and 7) were available while laboratory technologist and laboratory technician (Items 1 and 2) were not available. For COE Naka and COE Lessel, only laboratory assistant and cleaner (Items 3 and 6) were available while items 1, 2, 4, 5 and 7 were not available.

Research Question 3

What are the teaching methodologies adopted by Integrated Science teachers in relation to the NCCE guidelines in preparing pre-service teachers in Colleges of Education in Benue State, Nigeria?

Table 3: Frequency Counts and Percentage Analysis of teaching methodologies adopted by Integrated Science teachers in relation to the NCCE guidelines in preparing pre-service teachers in Colleges of Education in Benue State

S/N	Method	Adopted	Not Adopted	Remark
1	Lecture Method	36 (100%)	0(0&)	Used
2	Discussion Method	36(100%)	0(0%)	Used
3	Discovery Method	26(72%)	10(28%)	Used
4	Demonstration Method	19(53%)	17(47%)	Used
5	Excursion/Field Trips	6(17%)	30(83%)	Not Used
6	Project Method	36(100%)	0(0%)	Used
7	Individualized Instruction	4(11%)	32(89%)	Not Used

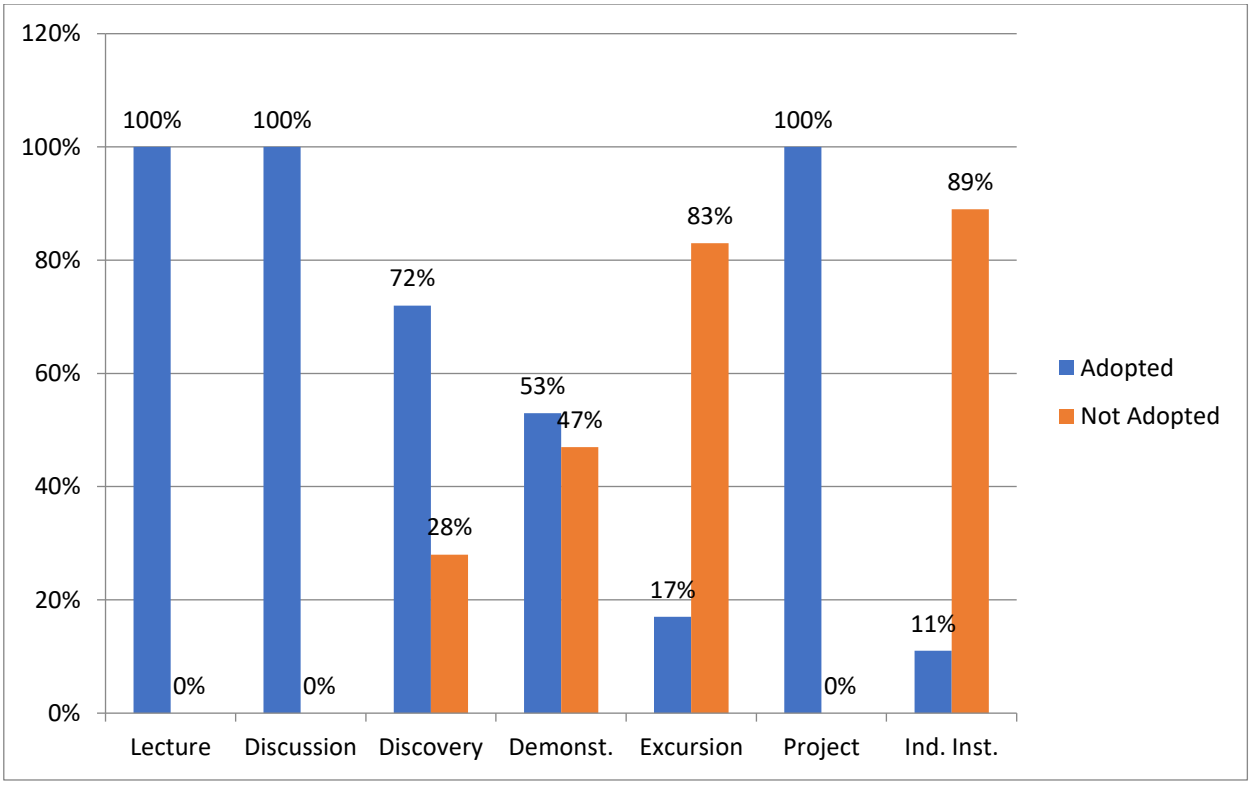

Fig 4: Histogram showing the teaching methods adopted by Integrated Science teachers

Table 3 shows the teaching methodologies adopted by Integrated Science teachers in relation to the NCCE guidelines in preparing pre-service teachers in Colleges of Education in Benue State in frequency counts and percentages. From the table, it was revealed that items 1, 2, 3, 4 and 6 have percentage values of 100% indicating that they are the teaching methods adopted. Items 5 and 7 have percentage values below 50% indicating that they are not adopted.

4.1.4 Research Question 4:

What is the students-teacher ratio adopted for Integrated Science Programme in relation to the NCCE guidelines in preparing pre-service teachers in Colleges of Education in Benue State, Nigeria?,

Table 4: Students-Teacher Ratio Adopted for Integrated Science Programme in Colleges of Education in Benue State

S/N	Students-Teacher Ratio	Min. N	COE Oju	COE K/Ala	COE Naka	COE Lessel
1	Below 25	1:25	0	0	1	1
2	1: 25	1:25	0	0	1	1
3	Above 1:25	1:25	1	1	0	0

Min. N = Minimum Number Required, COE Oju = College of Education Oju, COE K/Ala = College of Education Katsina-Ala, COE Naka = College of Education, Naka, COE Lessel = College of Education, Lessel

1 = Adopted 0 = Not Adopted

Table 4 shows the students-teacher ratio adopted for Integrated Science Programme in relation to the NCCE guidelines in preparing pre-service teachers in Colleges of Education in Benue State. From the table, it can be seen that two of the Colleges of Education, COE Naka and COE Lessel met the recommended ratio (1:25) for student-teacher ratio while COE Oju and COE K/Ala did not meet the requirement.

Research Question 5:

What are the available Integrated Science outdoor laboratories for preparing pre-service teachers in relation to the NCCE guidelines in Colleges of Education in Benue State, Nigeria?

Table 5: Available Integrated Science outdoor Laboratories for preparing Pre-service Teachers in Relation to the NCCE Guidelines in Colleges of Education, Nigeria

S/N	Outdoor Laboratories	COE Oju	COE K/Ala	COE Naka	COE Lessel
1	Weather Station	1	1	0	0
2	Fish Pond	1	1	0	0
3	Botanical garden	1	1	1	1
4	Nursery for the plants	1	1	1	1

Min. N = Minimum Number Required, COE Oju = College of Education Oju, COE K/Ala = College of Education Katsina-Ala, COE Naka = College of Education, Naka, COE Lessel = College of Education, Lessel

1 = Available, 0 = Not Available

Table 5 shows the available Integrated Science outdoor laboratories for preparing pre-service teachers in relation to the NCCE guidelines in Colleges of Education in Benue State. From the table, it can be seen that items 1 and 2 are available in COE Oju and COE K/Ala but not available in COE Naka and COE Lessel. The table also showed that items 3 and 4 are available in all the Colleges of Education.

Research Question 6:

How adequate are Integrated Science laboratory equipments in relation to the NCCE guidelines in Colleges of Education in Benue State, Nigeria?

Table 6: Adequacy of Integrated Science laboratory equipments in Colleges of Education in Benue State, Nigeria

S/N		Min Req.	COE Oju	COE K/Ala	COE Naka	COE Les.	Remark
1	Skeleton System	3	3	3	3	3	Adequate
2	Muscular System	3	3	3	3	3	Adequate
3	Brain and Nervous System	3	3	3	3	3	Adequate
4	Circulatory System	3	1	1	1	1	Not Adequate
5	Digestive System	3	3	3	3	3	Adequate
6	Eye and Vision	3	3	3	3	3	Adequate
7	Skin and Excretory Organs	1	1	1	1	1	Adequate
8	Microscope	40	7	9	1	1	Not Adequate
9	Incubator/ Sterilizer	1	1	1	1	1	Adequate
10	Autoclave (portable)	3	1	1	0	0	Not Adequate
11	Top Loading Balances	4	2	2	0	0	Not Adequate
12	Hot Plates	1	1	1	0	0	Not Adequate
13	Refrigerator	1	1	1	0	0	Not Adequate
14	Water Filter	1	1	1	1	1	Adequate
15	Hygrometer	1	1	1	0	0	Not Adequate
16	Drying Oven	1	1	1	0	0	Not Adequate
17	Microstome	1	1	1	0	0	Not Adequate
18	Automatic Tissue Processor	3	1	1	0	0	Not Adequate
19	Centrifuge	1	1	1	0	0	Not Adequate
20	Herbarium Cabinet	9	3	4	1	1	Not Adequate
21	Herbarium Index Boxes	3	2	2	1	1	Not Adequate
22	Air Pump	1	1	1	1	1	Adequate
23	Photometer	1	1	1	1	1	Adequate
24	Kymograph	1	0	0	0	0	Not Adequate

25	Dissecting Microscope	3	1	1	1	1	Not Adequate
26	Insect Light Traps	3	3	3	1	1	Not adequate
27	Insect Box (large)	Many	Many	Many	Many	Many	Adequate
28	Slide Projector	1	1	1	0	0	Not Adequate
29	Overhead Projector	2	2	2	0	0	Not Adequate
30	Steel Frame Aquarium	1	0	0	0	0	Not Adequate
31	Oxygen Meter	3	3	3	1	1	Not Adequate
32	Herbarium	4	3	3	1	1	Not Adequate
33	Binocular Microscope	30	30	30	15	11	Not Adequate
34	Embedding Bath	30	30	30	13	10	Not Adequate
35	Manesty Still	30	30	30	16	14	Not Adequate
36	Water Bath	30	30	30	10	7	Not Adequate
37	PH meter	30	30	30	13	15	Not Adequate
38	Tissue Grinder lan	30	30	30	11	9	Not Adequate
39	Calorimeter	30	30	30	15	17	Not Adequate
40	Auxanometer (Electric)	30	30	30	18	14	Not Adequate
41	Soil Auger	4	2	2	0	0	Not Adequate
42	Plant Press	2	1	1	0	0	Not Adequate
43	Soil Testing Kit	2	1	1	0	0	Not Adequate
44	Wooden Quadrant	1	1	1	1	1	Adequate
45	Measuring Tape	10	10	10	10	10	Adequate
46	Biological Tape	1	1	1	1	1	Adequate
47	Bunsen Burner	18	15	16	5	6	Not Adequate
48	Gas Cylinder	2	2	2	1	1	Not Adequate
49	Meter Balance	2	2	2	2	2	Adequate
50	Cone Balance	3	3	3	1	1	Not Adequate

Table 6 shows the adequacy are Integrated Science laboratory equipments in relation to the NCCE guidelines in Colleges of Education in Benue State. From the table, it can be seen that items 1, 2, 3, 5, 6, 7, 9, 14, 22, 23, 27, 44, 45, 47 and 49 are adequate in all the Colleges of Education. Items 4, 8, 12, 20, 21, 25, 26, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 47, 48 and 50 are available in all the Colleges of Education but not adequate. The table also revealed that items 10, 11, 13, 15, 16, 17, 18, 19, 28, 29, 41, 42 and 43 are available in two of the Colleges of Education (COE Oju and COE K/Ala) but not available in the other two (COE Naka and COE Lessel). Finally, the table revealed that items 24 and 30 are not available in any of the Colleges of Education.

Discussion

The finding of the study revealed that the Integrated Science teachers possess the minimum teaching qualification in relation to the NCCE guidelines in Colleges of Education in Benue State. The findings are in tandem with that of Salami, Oladipupo, Oloyede and Adefioye (2019) whose study on assessment of Biology Curriculum Implementation in Colleges of Education found that the lecturers in both public and private Colleges were qualified for the implementation of the N.C.C.E. Biology programme. The finding also corroborates with that of Esomonu (1998) who found that the teachers in Colleges of Education possess qualifications with respect to the minimum staff requirement by the National Commission for College of Education (NCCE). The finding however, contradicts the report of Oyenike, Adesoji, Adebayo and Onuoha (2009) who reported that teachers were not qualified and have insufficient knowledge of subject matter. The finding also disagrees with that of Ogungbesan (2012) and Ali (1983) who reported that most teachers were not professionally qualified to teach. Further, the finding disagrees with that of Olatunbosun, Daramola and Babarinde (2017) who found that acute shortage of trained personnel was a problem of implementation. Furthermore, the finding disagrees with that of Odey and Opoh (2015) and

Otarigho and Oruese (2013) who bemoaned teachers' lack of relevant competencies necessary for programme implementation. The findings of the current study suggest that the faculty members within the Colleges of Education in Benue State meet the stipulated qualification criteria set by the NCCE. This implies that these teachers possess the necessary qualifications to effectively teach the subject of Computer Science within the Colleges of Education in Benue State. This outcome likely stems from the diligent adherence of the recruitment panel to the established guidelines outlined by the NCCE when selecting qualified personnel for teaching roles especially, Integrated Science programme.

The second finding of the study revealed that the Colleges of Education only met two of the requirements (laboratory assistant and cleaner) for the available Integrated Science support staff in relation to the NCCE guidelines in Colleges of Education in Benue State, Nigeria. Overall, 50% of the Colleges of Education (COE Oju and COE K/Ala) met six of the requirements out of seven while the other only met two of the requirements. This finding agrees with that of Ali (1983) who reported that some of the persons used to facilitate the teaching of Integrated Science in the sampled schools include inexperienced laboratory attendants as well as "Ignorant or travelling teachers". This finding also corroborates with that of Odey and Opoh (2015) whose study on the problems of Curriculum Implementation in Tertiary Institutions found that teachers perceived low quality of human resources as one of the major problems that affect implementation of programmes. Also, the finding is in agreement with Isyaku (2016) who found that manpower in the Colleges of Education were inadequate. The shortage of supporting staff in colleges of education for the implementation of an integrated science program can be attributed to several factors. One of such factors could be that, the colleges of education often face financial limitations, leading to restrictions on hiring additional staff members. Another reason could be that there is high demand for skilled professionals in the field of science education which create competition between colleges of education and other educational institutions or industries. This competition may make it challenging for colleges to attract and retain qualified supporting staff. In addition, Integrated science programs require support staff with diverse subject knowledge and expertise, and finding individuals who possess a strong foundation in multiple scientific disciplines and can effectively contribute to the program's implementation might be difficult. This result may also be due to the focus and priorities of the colleges of education which may not align with the implementation of integrated science programme, leading to limited efforts in recruiting and retaining supporting staff for this purpose.

The findings of the study further revealed that five of the recommended teaching methods (lecture, discussion, discovery, demonstration and project) for Integrated Science programme were adopted in relation to the NCCE guidelines in preparing pre-service teachers in Colleges of Education in Benue State while excursion/field trips and individualized instruction were not adopted. Despite the fact that majority of the teachers use the recommended teaching methods, this does not align with the prescription of the NCCE as two others were not adopted. The finding corroborates with Otarigho and Oruese (2013) whose study on problems and prospects of teaching Integrated Science found that teacher's methodology was one of the major areas of concern as the respondents held that their integrated science teacher lacked methodology of teaching. Sambo, Kukwi, Eggari and Mahmuda (2014) who found that lecture method, discussion method, guided discovery and cooperative method are the methods of teaching commonly adopted by teachers in the Colleges of Education. This finding however disagrees with that of Esomonu (1998) who found that discovery method and project method were not used. The finding also disagrees with that of Isyaku (2016) who found inappropriate use of teaching methodologies by teachers. In the present study, a plethora of the recommended methods were used except for excursion/field trips and individualized instruction. Several factors can contribute to integrated science teachers not using excursion/field trips and individualized instruction teaching methods. For instance, organizing excursions or field trips and implementing individualized instruction often requires additional resources, such as transportation, entry fees, and materials and as such, limited funding or inadequate resources can hinder teachers from planning and executing such activities. Also, both excursions/field trips and individualized instruction demand additional time for preparation and implementation. Teachers may feel constrained by curriculum demands and tight schedules, making it difficult to allocate the necessary time for these methods. In addition, navigating administrative procedures to gain approval for excursions or field trips can be complex and time-consuming. Similarly, implementing individualized instruction might require adjustments to existing classroom structures, which could face resistance or challenges from administrative levels. This finding may be due to teachers' familiarity with the traditional instructional methods and might resist adopting new strategies. Implementing excursions or individualized instruction requires a shift in teaching philosophy and classroom dynamics, which some teachers may find challenging.

Furthermore, the findings of the study revealed that two out of the Colleges of Education (COE Naka and COE Lessel) met the recommended ratio (1:25) for student-teacher ratio while the others, COE Oju and COE K/Ala did not meet the requirement. This finding agrees with that of Odey and Opoh (2015) who found in their study that teachers perceived problems of curriculum implementation to include increased workload due to classroom over population. Also, the findings agree with that of Ofem (2019) whose study on evaluation of Computer Studies Curriculum Implementation found that overcrowded classes was among the factors militating against effective implementation of computer studies curriculum. From the finding of the present study therefore, it can be said that implementing a 1:25 student-teacher ratio for teaching and learning of Integrated Science in colleges of education can be challenging due to a variety of factors, many of which stem from resource limitations, logistical constraints, and systemic issues within the education system. For example, colleges of education often operate with limited budgets, making it difficult to hire a sufficient number of qualified teachers to achieve a 1:25 student-teacher ratio. Hiring additional faculty members and providing competitive salaries can strain already stretched financial resources. Also, there may be a shortage of qualified Integrated Science teachers in the education system, making it difficult to meet the demand for classrooms with a low student-teacher ratio. This shortage could be due to a lack of specialized teacher training programs or the attraction of higher-paying opportunities outside of education. More so, physical infrastructure, such as classrooms and laboratories, may not be adequately equipped to accommodate smaller class sizes. Limited classroom space and insufficient laboratory facilities can hinder colleges of education from effectively implementing a 1:25 student-teacher ratio. Another possible reason could be that teachers in colleges of education often have a heavy workload that extends beyond the classroom, including administrative duties, curriculum development, and research. This workload could limit their capacity to provide individualized attention to a larger number of students.

The findings also revealed that botanical garden and nursery for plants are the only Integrated Science outdoor laboratories that are available in all the Colleges of Education in Benue State. Weather station and fish pond are available in two of the Colleges of Education (COE Oju and COE K/Ala) but not available in COE Naka and COE Lessel. This means that the prescription by NCCE has only been met by the public Colleges of Education in Benue State. This finding corroborates with that of Oladipupo, Oloyede and Adefioye (2019) who found that there were good laboratories in the study area, although the directive of N.C.C.E. for the general laboratories was not met and that the maximum number of laboratories were two, found in public Colleges of Education. The finding also corroborates with that of Esomonu (1998) who found that one of the problems militating against the implementation of the programme is insufficient laboratory facilities. The finding is also in tandem with that of Oyenike, Adesoji, Adebayo and Onuoha (2009) who in their study, the respondents bemoaned lack of special facilities in Colleges of Education for programme implementation. Further, the finding agrees with that of Olatunbosun, Daramola and Babarinde (2017) who found that inadequacy of laboratories is one of the challenges of programme implementation. The finding of the present study suggest that outdoor laboratories have not been sufficiently made available especially in private Colleges of Education in Benue State to warrant effective implementation of Integrated Science programme as prescribed by the National Commission for Colleges of Education (NCCE). The non-availability of a weather station and fish pond in private colleges of education could be attributed to a variety of factors, including financial constraints, resource allocation priorities, lack of expertise, and logistical challenges. Private colleges of education may operate on tighter budgets compared to public institutions, making it challenging to allocate funds for the establishment and maintenance of specialized facilities like weather stations and fish ponds. Also, private colleges of education may prioritize other aspects of their educational programs and infrastructure, such as classrooms, laboratories, and technology, over the development of weather stations and fish ponds. Moreover, weather stations and fish ponds require regular maintenance, monitoring, and operational costs and private institutions may find it financially burdensome to cover these expenses in addition to their regular operating costs. Furthermore, establishing and maintaining specialized facilities like weather stations and fish ponds often require collaboration with external organizations, government agencies, or industry partners. Private colleges may face difficulties in establishing such partnerships.

Finally, it was revealed that skeleton system, muscular system, brain and nervous system, digestive system, eye and vision, skin and excretory organs, incubator/sterilizer, water filter, air pump, photometer, insect boxes (large), wooden quadrant, measuring tape, biological tape and meter balance are the only Integrated Science laboratory equipment that are adequate in all the Colleges of Education in relation to the NCCE guidelines in Colleges of Education in Benue State. While some of the laboratory equipment were adequate in the public Colleges of Education, such was not in the case the private Colleges of Education. The findings agree with that of Salami, Oladipupo, Oloyede and Adefioye (2019) who found that the available laboratory equipment/apparatus in colleges of education were enough to cover a larger percent of the Biology contents on N.C.C.E. benchmark for Nigeria Certificate in Education. The finding also corroborates with that of Isyaku (2016) who found that there was inadequate provision of equipment for programme implementation in Colleges of Education (Computer Science). In addition, the finding corroborates with that of Bamidele and Bakare (2015) who in their study revealed that the major problems in the poor implementation of Computer Science Programme in schools is the non-provision of Computer facilities for teaching and learning. With respect to the adequacy of laboratory equipment in Integrated Science Laboratories, the Colleges of Education in Benue State failed to meet this requirement. The inadequate provision of laboratory equipment for integrated science implementation in colleges of education could be attributed to various factors, including financial constraints, resource allocation priorities, logistical challenges, and administrative issues. The colleges of education may have limited budgets allocated for infrastructure development, including the purchase of laboratory equipment. Financial limitations could hinder the acquisition of necessary equipment. Also, the allocation of funds and resources may be prioritized for other aspects of education and infrastructure, such as classrooms, faculty salaries, and administrative expenses, leaving less funds available for laboratory equipment. In addition, decision-makers and administrators may not fully recognize the importance of well-equipped laboratories in enhancing the quality of integrated science education and this lack of awareness about the educational benefits of laboratory experiences could result in underfunding. Furthermore, colleges of education might struggle to keep up with the rapid advancements in science and technology. Outdated or obsolete equipment may deter effective laboratory instruction.

Conclusion and Recommendations

Based on the findings of the study, it was concluded that, while certain aspects, such as teacher qualifications and support staff, align partially with the guidelines, evident gaps are apparent in teaching methodologies, student-teacher ratios, the presence of outdoor laboratories, and the adequacy of laboratory equipment. This underscores the urgency for targeted interventions to bolster various dimensions of Integrated Science education in these institutions, aiming to ensure a comprehensive and impactful learning journey for pre-service teachers.

Based on the finding of the study, the following recommendations were made

i. Workshops, seminars, and training sessions should be organized by the management of Colleges of Education to ensure teachers remain up-to-date with the latest teaching methodologies and scientific developments that can provide students with practical exposure, critical thinking skills, and a deeper understanding of scientific concepts beyond the classroom setting.

ii. To bridge the gap in available Integrated Science support staff, Colleges of Education should consider employing additional personnel as stipulated in the NCCE guidelines. Adequate support staff, such as laboratory assistants and cleaners, is essential to facilitate smooth and effective laboratory sessions, which are integral to the practical learning experience.

iii. Stakeholders should advocate for the right student-teacher ratio as prescribed by NCCE and conscious efforts should be made to adopt the recommended 1:25 as indicated. Colleges that fall short of this ratio should explore measures to balance class sizes, allowing educators to engage with students more effectively and provide personalized guidance.

iv. Considering the limited availability of outdoor laboratories, there is an opportunity to establish additional facilities like weather stations and fish ponds in the colleges that lack them. These outdoor learning spaces can offer hands-on experiences and foster a deeper connection between theoretical knowledge and practical application.

v. Colleges should prioritize equipping their Integrated Science laboratories with a broader range of essential equipment beyond those currently deemed adequate. A comprehensive set of laboratory equipment, spanning various scientific disciplines, will enrich students' learning experiences and enable thorough exploration of scientific concepts.

vi. The stakeholders of science education in collaboration with other agencies and non-governmental organization should come to the aid of Integrated Science programme by procuring adequate laboratory equipment for Integrated Science teaching and learning in Benue State.

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