



Journal of Educational Sciences

Journal homepage: <https://jes.ejournal.unri.ac.id/index.php/JES>



P-ISSN
2581-1657

E-ISSN
2581-2203

Effect of Bilingual Instruction-Mode on Pre-Service Integrated Science Teachers' Cognitive and Practical Skill Achievements in Ecology

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ARTICLE INFO

Article history:

Received: 11 Feb 2022

Revised: 01 April 2023

Accepted: 04 April 2023

Published online: 24 April 2023

Keywords:

Bilingual Instruction-Mode;

Ecology;

Pre-service;

Integrated Science Teachers;

Cognitive Achievement;

Practical Skill Achievement

ABSTRACT

Nigeria is a multilingual country with diverse cultural background. The language (English) used when Nigeria was a British Colony is still the only official language and medium of instruction in the Nigerian schools. The purpose of this study therefore is to investigate the effect of bilingual (English and English-Yoruba) instruction-mode on cognitive achievement and practical skill achievements in ecology among colleges of education integrated science students in Lagos State, Nigeria. A 2x2 pretest posttest nonrandomised quasi-experimental design was adopted for the study. Ecology Cognitive Achievement Test (ECAT) and Ecology Practical Skills Achievement Test (EPSAT) were the two instruments used to collect data for the study. The two research questions and null hypotheses formulated were analysed with mean, standard deviation and t-test at 0.05 alpha level using Statistical Package for Social Science (Version 23.0). Results showed that there is statistical significant effect of the treatment (bilingual instruction-mode) on the cognitive achievement of students in ecology concepts [$t(283)=9.583$; $p<.05$]. Mean score of Bilingual teaching strategy is (=12.669) and control group scored the least (=9.683) in achievement in Ecology. Study finding also revealed statistical significant effect of the treatment on the practical skills achievement of students [$t(283)=13.917$; $p<.05$].

1. Introduction

Language is central to human life. Language is a beauty that is peculiar to every group of people. It is through language that people express their feelings, ideas, cultural diversity, and social relation to manage their world (Evans & Avila 2016).

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Students' population has been observed to becoming more diverse culturally and linguistically. Consequently, instruction should allow diverse students to link their cultural background with anticipated expectations. In addition, instruction with diverse students should be directed towards the attainment of national standards as well as uphold their cultural and linguistic identities. Hence, teachers are faced with the challenge of integrating science and students' languages and cultures in ways that are meaningful and relevant for their students. The Federal government of Nigeria appreciates the importance of language as a means of promoting social interaction and national cohesion; and preserving culture. Thus, it is believed that every child shall learn the language of the immediate environment (Federal Republic of Nigeria, FRN, 2013).

Nigeria as a multilingual country has diverse cultures with Yoruba, Hausa and Igbo as major languages. English language which is inherited from the British Colonial Masters is recognized as the first official language in the Constitution of the Federal Republic of Nigeria (FRN, 1999). Thus, students are taught through the medium of English in the best possible way to understand and assimilate learning content with ease and insight in Nigeria (FRN, 2013).

Pennycook (1994) noted that:

“As English spread into Africa through trade, missionary work and education, it developed close ties with religion, intellectual work and politics. As the definition of what it meant to be 'educated' came to be seen increasingly in terms of Western education, and , therefore, in terms of ability in English ..., speaking English and being an intellectual came to be almost synonymous”.

Emenanjo (1998) observed that the National Policy on Languages (in Education) in Nigeria recognises the multidimensional, multi-lingual three tier political-polity which tries to capture the multi-ethnic and multi-lingual polity. The policy provides for:

1. English as the language of formal literacy, the bureaucracy, secondary and higher education and so on.
2. The three major (national) Languages - Hausa, Igbo and Yoruba are potential national languages which are to be developed and used as L2 (Language of Vicinity) all through the formal educational system for national culture and integration.
3. Mother-Tongue (MT) and or Language of the immediate community (LIC) as the language of initial literacy at the pre-primary and junior, primary levels, and of adult and non-formal education.
4. Selected foreign languages especially, French, and Arabic, as the languages of international communication and discourse (FRN, 2013).

Thus, the emergence of the National Policy on Languages (in Education) led to the introduction of bilingual education in which teaching is provided through the language of learning in schools. Bilingual Education is teaching an academic subject in two languages, i.e. a mother language (first language, L1) and a second

language (L2), with various amounts in an instructed program models (Najat & Muttalib, 2021). Recognizing the importance of mother tongue, scholars over the years, have stressed that it is imperative for a child's development and grasping of the basic element of teaching and learning (Fafunwa & Fasokun, 2000; Oluniyi & Akinyeye, 2013).

According to Najat and Muttalib (2021), the early viewpoint about the brain tends to assert that learning an second language negatively affects the first language (mother tongue) by dismissing it outside the brain, and it emphasizes that the idea of bilingualism creates a problem in the teaching process but the late researches on bilingualism disapproved the conclusions and made it clear that persons who speak two languages (bilinguals) have cognitive merits much more than those who speak just one language (monolinguals). Therefore, as for bilingual education in recent times, there are still contradictory opinions as some researchers believed that learning the first language will not hurt the second one (English) and that new knowledge learned in first language will gradually transfer to the second language, English. On the other side, some maintained that developing the first language will essentially affect the learners' progress in English learning if they don't get full English immersion (Baker & Wright, 2017). In order to keep high-level bilingualism, learner of two languages (the bilingual person) needs to use both languages constantly and with great effort.

Ajewole, (2016) argued that language is an important component of communicating scientific concepts to students and this constitutes the message components of communication in science classrooms. John and Sheil, (2010) in their study on the value of bilingualism in pupils' understanding of scientific language asserted that science has a language of its own. However, many science teachers would agree that school pupils need to learn and understand this language of science in order to assimilate the materials presented to them in science lessons, to communicate effectively in science and to think in a scientific way (Danmole & Lameed, 2014). Evans and Avila (2016) in their study on enhancing science learning through dynamic bilingual practices also posited that for bilingual and multicultural children in particular, language plays a critical role in the development of their identity. If emergent learners do not feel confident in their bilingual identities, they may find it more challenging to make meaning and construct knowledge in schools.

The International Organisations like United Nations Education Scientific Cultural Organisation (UNESCO), United Nations International Children's Emergency Fund (UNICEF) and especially United Nations (UN) General Assembly's Convention on child right have also stressed the need to educate children, at least at primary school level using mother tongue as medium of instruction. It argued that researches have shown that mother tongue-based schooling improves learning. More so, Zakharia, (2017) stressed that many universities worldwide have adopted a bilingual medium of instruction with teachers from the same cultural background as that of their students for better understanding of how their students learn and awareness of any negative influencing factors from the home language. This among others informed the Lagos State Lawmakers to resolve and

pass into law the bill mandating the use of mother tongue in the state education system in Lagos State. They submitted that the use of indigenous language (Yoruba) would serve as a yardstick to promote the African Culture which will in turn bring about development (Olatunji, 2017).

To implement the above, the Lagos State government in 2018 passed into law, “the Yoruba Language Preservation and Promotion Law”. This law aims at providing for the preservation and promotion of the use of Yoruba language for connected purposes. Yoruba is the mother tongue language of natives in the Southwestern part of Nigeria. The law which is the first to be enacted by any state government in Nigeria for preservation and promotion of indigenous language provides that all the laws in Lagos State will be translated into Yoruba Language while all state-owned tertiary institutions should incorporate the use of Yoruba Language in the General Studies (GNS) courses (Akinsanmi, 2018; Lagos State Government, 2018).

The Law also provides that: “The use of Yoruba Language shall be an acceptable means of communication between individuals, establishments, corporate entities and government in the state if so desired by the concerned. The law makes it mandatory for all schools within the state to set aside a day on a weekly basis, within the state’s school calendar, as a Yoruba only day and all lessons are expected to be delivered in Yoruba language. Furthermore, the teaching of the language as a core subject to students at all levels of education in both private and public schools in the state has been made mandatory by the state government. The language will be taught as a General Studies (GNS) in the state owned tertiary institutions. The law further emphasizes that it shall not be an offence for a person to speak Yoruba language in schools. This is to ensure growth and development of indigenous language and culture thereby preventing Yoruba language from going into extinction in Lagos. Hence, the learners can be taught school subjects with Yoruba along with English language as media of instruction.

It is on this premise, that the study investigated the effect of bilingual (English-Yoruba) mode of instruction on students’ cognitive and practical skill achievements in Ecology in Colleges of Education in Nigeria. Ecology is one of the topics under Man and Environment as a core courses in Nigeria Certificate in Education (NCE) Integrated Science Curriculum (National Commission for Colleges of Education, NCCE, 2020). Ecology is an environmental biology topic which studies the interactions among organisms and their environment. Objects of study include interactions of living organisms [biotic] with each other and with the non-living [abiotic] components of their environment. In other words, to enable learners to understand the concepts well, the teaching and learning of ecology should be by practical, exploratory and experimental methods.

Therefore, the study answered the following questions:

1. What is the difference between the cognitive achievement of students taught ecology concepts with English language and those taught with English-Yoruba Instruction-mode?
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2. What is the difference between the practical achievement skills of students taught ecology concepts with English language and those taught with English-Yoruba Instruction-mode?

Hypotheses

- Ho1: There is no statistically significant difference between the cognitive achievement of students taught ecology concepts with English language and those taught with English-Yoruba Instruction-mode.
- Ho2: There is no statistically significant difference between the practical skills of students taught ecology concepts with English language and those taught with English-Yoruba Instruction-mode.

2. Methodology

The design adopted in this study was a 2x2 nonrandomised pretest posttest quasi-experimental factorial design. The dependent variables tested for, were students' cognitive achievement and students' practical skill achievement while the independent variable was the language of instruction which was at two levels (English and English-Yoruba). The population of the study comprised all pre-service integrated science students in Adeniran Ogunsanya College of Education, Otto/Ijanikin and Federal College of Education (Technical), Akoka, both in Lagos State, Nigeria. While the sample comprised year two pre-service Integrated Science students in the two Colleges of Education who participated the study. Two intact classes were used; the intact class for the experimental group had 95% of students with proficiency in Yoruba language. Two hundred and eighty-five students participated in the study. The experimental group (English-Yoruba mode of instruction) consisted of one hundred and forty three students and the control group (English mode of instruction) contained one hundred and forty two students.

Two instruments were used to collect data for the study: Ecology Cognitive Achievement Test (ECAT) and Ecology Practical Skills Achievement Test (EPSAT). The ECAT contained twenty multiple choice questions while the EPSAT contained ten fill in the gap questions on ecology topics as contained under ISC 213 (Man and Environment) in the National Commission for Colleges of Education (NCCE) 2020 Edition Integrated Science Curriculum. The instruments were validated by three Lecturers in the field of Integrated Science and Biology education from the two Colleges of Education and a Science Education Lecturer from the Faculty of Education, Lagos State University, Ojo. The reliability indices of the ECAT and EPSAT were determined using Kuder Richardson Formular-21; the analyses gave coefficients of 0.84 and 0.76 respectively. The values indicate that instruments were good and adjudged as been reliable.

The researchers administered the pre-test to the students to determine their entry knowledge about the concepts and there after taught the ecology concepts using

English as mode of instruction for the control group and bilingual instruction mode (English-Yoruba) for experimental group. Yoruba language was chosen as the other language of instruction because it is the major native language spoken by the people in the south-west of Nigeria, where this study was conducted. The lessons taught lasted for four weeks before the administration of the post-test. Practical activities were also carried out during the lessons.

Some of the concepts taught are definition of ecology, forms of ecology, ecological interactions, food chain and web, and ecological instruments. The English and Yoruba translation of some of the concepts taught are:

English: Forms of biotic interactions
Orísirísii Ìbásepóò lààrìn àwọn ohun èlẹ̀mí.

For instance:

Parasitism - a relationship between species, where one organism, the parasite, lives on or in another organism, the host, causing it harm.

Examples: Parasitism as it occurs between tick and cattle:

Afòmọ́-ẹ̀ran lààrìn eégbòn àti màálù

Parasitism as it occurs between epiphyte and tree e.g. mistletoe and cocoa:

Afòmọ́-ìgi lààrìn ìgi-ìsáná àti ìgi-kòkó.

Mutualism - association between organisms of two different species in which each benefits.

Example: Mutualism as it occurs between cattle and cattle egret

Ìfọ̀wéwéwó lààrìn màálù àti ẹ̀yẹ̀ lékelékèè

Commensalism - a relationship between two species in which one obtains benefits from the other without harming or benefiting it.

Example: Commensalism as it occurs between shark and remora:

Ìbasepọ̀ alailewu lààrìn ẹ̀ja akurakuda àti ẹ̀ja obubu.

Furthermore, for the practical skill, students were guided to identify the various food chains and ecological interactions in the farmland behind the school of science complex. This also included guiding the students to identify various tools used in ecological studies and their uses. Data collected through the Ecology Cognitive Achievement Test (ECAT) and Ecology Practical Skill Achievement Test (EPSAT) were analysed with t-test 0.05 alpha level using Statistical Package for Social Science (SPSS version 21.0). This formed the basis for testing the null hypotheses formulated to guide the study.

3. Results and Discussion

The data collected were analysed and arranged in tables based on each of the hypotheses as indicated below.

Research Questions

Research Question One: What is the difference between the cognitive achievement of students taught ecology concepts with English language and those taught with English-Yoruba Instruction-mode?

Table 1. Mean and SD of pretest and posttest showing difference between the cognitive achievements of students taught ecology concepts with English language and those taught with English-Yoruba instruction-mode

Treatments	N	Pre test		Post test		Difference	
		M	SD	M	SD	M	SD
English Group	142	6.8128	1.9024	9.6831	2.6803	2.8703	0.7879
English-Yoruba Group	143	6.9534	1.7309	12.6690	3.1142	5.7156	1.3833

The table above revealed that students who were taught through English-Yoruba instruction-mode (M=12.6690, SD=3.1142), performed academically better than those taught through English instruction-mode (M=9.6831, SD=32.6803). The result obtained provides that there is a significant effect of English-Yoruba instruction-mode on cognitive achievement of students in ecology.

Research Question Two: What is the difference between the practical achievement skills of students taught ecology concepts with English language and those taught with English-Yoruba Instruction-mode?

Table 2. Mean and SD of pretest and posttest showing difference between the practical achievement skills of students taught ecology concepts with English language and those taught with English-Yoruba instruction-mode

Gender	N	Pretest		Posttest		Difference	
		M	SD	M	SD	M	SD
English Group	142	7.0003	1.2863	8.5634	1.8698	1.5631	0.5835
English-Yoruba Group	143	6.7301	1.0162	12.3310	2.6704	5.6009	1.6542

Table 2 reveals the mean and standard deviation of practical achievement skills of students taught ecology concepts with English-Yoruba instruction-mode (M= 12.3310, SD= 2.6704) and those taught with English instruction-mode (M= 8.5634, SD= 1.8698). The result shows that students taught with English-Yoruba instruction-mode perform better than those taught with English instruction-mode only in practical activities of ecology.

Research Hypotheses

Hypothesis One

H₀₁: There is no statistical significant difference between the cognitive achievement of students taught ecology concepts with English language and those taught with English-Yoruba instruction-mode.

Table 3. t-test showing difference between the cognitive achievement of students taught ecology concepts with English language and those taught with English-Yoruba instruction-mode

Groups Post-test	Mean	N	Std. Deviation	t	p
English Group	9.6831	142	2.6800	9.583	.000
English-Yoruba Group	12.6690	143	3.1142		

Table 3 shows statistical significant difference between the cognitive achievement of students taught ecology concepts with English language and those taught with English-Yoruba instruction-mode [$t(283)=9.583$; $p=.000$]. This implies that the hypothesis which stated that there is significant difference between the cognitive achievement of students taught ecology concepts with English language and those taught with English-Yoruba instruction-mode is rejected.

Hypothesis Two

H₀₂: There is no statistical significant difference between the practical skills of students taught ecology concepts with English language and those taught with English-Yoruba instruction-mode.

Table 4. t-test showing difference between the practical skills of students taught ecology concepts with English language and those taught with English-Yoruba instruction-mode

Groups Post-test	Mean	N	Std. Deviation	t	p
English Group	8.5634	142	1.8698	13.917	.000
English-Yoruba Group	12.3310	143	2.6704		

Table 4 shows statistical significant difference between the practical skills of students taught ecology concepts with English language and those taught with English-Yoruba instruction-mode [$t(283)=13.917$; $p=.000$]. This implies that the hypothesis which stated that there is no significant difference between the practical skills of students taught ecology concepts with English language and those taught with English-Yoruba instruction-mode is rejected.

Discussion of Findings

The findings from hypotheses one and two revealed statistical significant difference between the cognitive achievement and practical skills achievement of students taught ecology concepts with Monolingual (English language) instruction-mode and those taught with Bilingual (English-Yoruba) instruction-

mode. This means that the learning approach improved the performance of the students in ecology. The findings are in consonance with Igboanusi (2008) in her study on mother tongue-based Bilingual education in Nigeria: attitudes and practice where she solicited the responses of 1000 participants from five different states found that the respondents preferred education in both English and the mother tongue (MT) and were not positively disposed to the use of only one of them. It is also interesting that a majority of the respondents wanted the use of the MT beyond the first three years of primary education. This is in congruence with the findings of this study because the students taught with English-Yoruba performed better than their counterpart taught with only English language.

John and Sheil, (2010) corroborated that being bilingual is an advantage in understanding scientific language. In their study, evidence was collected from five schools in the UK and from a British school in Europe where more than 10% of the school population were Bilingual. A comparison was made between two similar schools serving different types of multicultural communities. This comparison suggested that being bilingual was an advantage in understanding scientific language in circumstances where pupils conversed freely in both of their languages. Similarly, this study found Bilingual instruction-mode as an advantage because it enhanced the students' understanding of ecology as it happens in the environment.

The researchers noted that students taught with Bilingual instruction-mode connected better with the environment than the monolingual instruction-mode. This is similar to the work of Smith (2012), who conducted a case study research which analyzed instructional strategies used to integrate the learning of content and English as a foreign language in a Bilingual physics class at a university in Shanghai, China. The researcher built on students' prior knowledge of physics, language, and the everyday world. Analyses of classroom instructional discourse and interviews support the view that language instruction can be integrated into Bilingual science classes.

Benson (2004) noted that bilingual as opposed to monolingual schooling offers significant pedagogical advantages. Classroom participation, positive effect and increased self-esteem are enhanced by Bilingual schooling. In contrast to students in submersion programs who sit listening or reciting, bilingual students participate more often in the classroom and demonstrate greater self-confidence and higher motivation. The finding of this study agrees with the findings of Benson (2004) because the researchers noted that the L2 allows children to express their full range of knowledge and experience and demonstrate their competence, this is.

In making an asset out of bilingual instruction-mode in communicating science, it is pertinent to ensure students' proficiency in the two languages of instruction, this was a precaution ensured by the researchers in this study. This is not at variance with the positions of Ünsal (2017) who conducted a study on emergent bilingual students' learning in science. The study gathered data through classroom observations in one grade 3rd grade (9-10 years old) and one 7th grade (13-14 years old) science class). The study also collected data through interview of students in

7th grade. One of the findings of the study was the need to bridge the gap of students' proficiency in language of instruction especially where students do not share the same minority language as all of their classmates and teachers. The researcher further argued that it is also important to remember that "our possibilities to conduct bilingual science education are limited in comparison to classes where teachers and students share the same minority language".

Furthermore, the Fafunwa's Ife Six-Year Primary Project employed the Yoruba language as the medium of instruction on the assumption that the child would benefit cognitively, socially, culturally and linguistically through the use of his/her mother tongue as the language of instruction throughout primary school. English was taught as a second language using specially trained teachers throughout the six years. In the experimental classes, five subjects were taught using Yoruba language; these were: social and cultural studies; science, mathematics, Yoruba language and literature; and English as a second language. The study found that a child learned best in his or her native tongue (Fafunwa & Fasokun, 2000). In line with Fafunwa's Ife project, this study supports that native tongue be used to teach science with a slight difference that science could be taught with the native tongue along with the country's lingua franca. This will help the students to interact considerably with other science students beyond the students' land of nativity.

It should be noted that Bilingual students cannot be out rightly divorced from their mother tongue in everyday life and learning. This study therefore emphasises that Bilingual instruction-mode could be utilized as an asset in the science class, when students' other major language is used with the lingua franca (in this case, English language). This will help the students to connect with their environment better and also prevent the African indigenous language from going into extinction.

4. Conclusion

The findings of the study revealed that pre-service integrated science learners who were exposed to Bilingual instruction-mode in ecology performed better than those in the control group. When this learning strategy was employed, it made ecology concepts clearer and learners were motivated in integrated science class. The findings of this study showed Bilingual instruction-mode as a resource in teaching science rather than as a hindrance because the students taught with the Bilingual instruction-mode were able to connect ecology taught in school with ecology as it happens in the environment more than their counterparts who were taught with Monolingual instruction-mode. This study also affirms that science can be taught using the students' indigenous language.

Recommendations

The following recommendations were made to brighten the prospect of bilingual instruction-mode on pre-service biology teachers' achievement and practical skills in ecology:

1. Indigenous languages should be used for teaching science in Nigerian schools from Basic 1-4 as stipulated in the National Policy on Education.
2. Biology teachers should utilize bilingual approach to support teaching of integrated science in Nigeria tertiary institutions to enhance students' understanding of concepts and academic achievement.
3. Further research could be conducted by science teachers in collaboration with linguists on correct and adequate translations of science concepts into indigenous Nigerian language for the use of learners.

Science educators, science teachers and linguists should produce textual materials with a bilingual approach for textbook authors and publishers in order to assist students connect school science with their everyday life.

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How to cite this article:

Taibat, D. B., Olajide, S. S., & Olatorera, O. M. (2023). Effect of Bilingual Instruction-Mode on Pre-Service Integrated Science Teachers' Cognitive and Practical Skill Achievements in Ecology. *Journal of Educational Sciences*, 7(2), 122-133.
