Effect of Nandom's Java Intelligent Tutor System on Computer Education Students' Academic Achievement in Java programming Language in Universities in Nigeria

[1]**Ibebuife Enemchukwu Ugwu**; [2]**Roland Offorbike Ugwoke**; [3]**Caroline I. Okorie** [4]**Ikenna Victor Elam**

[1-4]Madonna University Nigeria, Okija campus, Anambra state, Nigeria

Abstract: *This study determined the effect of the Nandom's Java Intelligent Tutor System (NJITS) on the academic achievement of students in Java programming language in Universities in south-east Nigeria. Population for the study is 136 students. Total population sampling technique was used. Data was collected using Java Programming Achievement Test (JPAT). The instrument was validated by five experts. Reliability index of 0.78 was established. After pretest, the experimental group was taught with NJITS and control group taught using lecture method. After the experiment, a posttest was given to both groups. Data collected were analyzed using Statistical Package for Social Science (SPSS). Mean and standard deviation were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the null hypothesis formulated at 0.05 level of significance. Findings revealed that NJITS improved students' academic achievement in Java programming language more than lecture method. Also, male students taught Java programming language using the NJITS had higher academic achievement than the female students taught Java programming language using the same tool. A significant difference exists in the mean academic achievement scores of students of students, taught Java programming language using NJITS and those taught using the lecture method.*

Keywords: java programming language; intelligent tutor system; academic achievement; computer education students.

INTRODUCTION

Computer Education is designed to train learners on computers and their operations and to impart in them the skills for educating others with the knowledge acquired. Computer education according to Jegede and Owoelabi (2019) is an education that endows the learners with the overall knowledge of computer and computing as well as the pedagogical skills and techniques of imparting the same knowledge to others. Computer Education has been designed to meet up with the need of all in the world of computers and computing and include such areas like Networking, Information communication and security, Database Management, and Network security and Computer Programming among others.

Computer programming refers to the entire process of writing suitable, maintainable, and extensible source code that can be translated by a computer to perform one or more specific tasks. Jalolov (2023) defined computer programming as the process of planning and developing a workable and executable computer program in a selected programming language to accomplish a specific computing task. According to Jegede and Owoelabi, programming encompassed all the technical activities from requirement analysis to implementation, involved in the production of a workable computer program, accomplishable in a programming language.

Programming language as a formal language comprises of a set of instructions used to implement algorithms that generate definite kinds of output. According to Sunday, Ocheja, Hussain, Oyelere, Samson & Agbo (2020), a computer programming language as one with accurate syntaxes used to write computer programs that computers execute to generate output. Four programming language types were outlined by Jalolov to include procedural programming language like Pascal, C; functional programming language like C#, C++; scripting language like Ruby, Python; and Object-oriented programming language like C#, JavaScript, Java among others. Procedural programming is identified as being easier to code and use than others, but is not secure and easily portable. Object-oriented programming languages have advantages over other programming language types in its robustness and security. The object-oriented programming languages is the most commonly used computer programming language in academics and in industries, due to its efficiency in software development (Agbo and Oyelere, 2019). The author also identified that among all the Object-oriented programming languages, the most commonly used owing to capability specifically in its extensibility is Java.

Java programming language is a popular object-oriented programming (OOP) language. This signifies that it is a programming language that is executed based on the idea of "objects" as instances of classes, which may contain data as fields, usually named attributes; and code, in the form of procedures, usually termed methods (Sunday, Ocheja, Hussain, Oyelere, Samson & Agbo, 2020). Okpanachi (2019) noted that Java is used in developing various applications that can be used across different devices, such as Mobile and Network devices, Televisions, Automated Teller Machines (ATM) among others.

Java programming education is obtainable in both formal and informal settings. Many learners of Java programming enroll in schools, private training centers, as well as engage in self-learning practices (Galadanci, Mukhtar and Muaz, 2019). A huge number of learners of Java programming are trained through Computer Education programs offered in Universities (Jegede and Owoelabi, 2019). Thus,

Java is taught and learnt as both theory and practical in most Federal Universities in Nigeria and most students see it as abstract as it involves the manipulation of a vast amount of unnatural codes and its practical involvement demands a lot of time of code manipulation (Nandom, 2018).

Owing to students' perception of Java programming as abstract, they find it difficult to understand. Nandom identified from the average performance of students in Java programming in Nigerian Universities, that 11.5% of the population had A, 17.9% had B, 22.3% had C, 12.7% had D, 18.1% had E and 17.5% had F. This statistic shows that the average achievement of students in Java programming in Universities is low. According to Chima (2021), the average performance of students in Java programming in Universities in south east Nigeria is low with over 70 percent failure in performance. This trend brings about students going through the course without acquiring the needed programming skills, resulting in the students enrolling in private training centres after graduation to acquire those requisite Java programming skills which they supposed to have acquired in their undergraduate years. Nandom opined that the low performance can only be bridged by using requisite intelligent tutor system for self-learning by students of computer education and related fields. One of such training guides for self-learning of Java programming is NJITS (Nandom). In support of Nandom, Ayelaagbe (2024) noted that the challenges students encounter when learning with conventional method of instruction is solvable through the use of an intelligent tutor system.

Intelligent Tutor System is referred to as an interactive system that aims at offering instant and customized instruction or feedback to learners. Okpanachi (2019), defines intelligent tutor system as a machine with an embedded computer system with internet connection having the capacity to gather and analyze data and communicate effectively with other systems/programs and so can guide a learner through the learning process. Ayelaagbe (2024) added that an Intelligent Tutor System, as guide is usually designed for the purpose of learning in a specific field or area and is imbued with the capacity of giving intelligent instructions to learners, and is responsive to learners' requests in an interactive manner.

There exist various Intelligent Tutor Systems and interactive training packages both online and offline that have been developed by various authors and developers for self-learning of Java programming languages. These training packages are costly and were not developed according to the curriculum that has special focus on learners' and teachers' needs and of computer education in Federal Universities in Nigeria. They are therefore not suitable training guides for self-learning of Java programming languages by students in computer education in Nigerian universities due to cost as well as non-curriculum compliant (Sharma & Harkishan, 2022).

However, an intelligent tutor system developed by Nandom for learning of Java programming in tertiary institution called Nandom's Java Intelligent Tutor System (NJITS) was designed locally according to the computer education curriculum in federal universities in Nigeria. On that basis that NJITS was designed in accordance with the curriculum of computer education in federal universities in Nigeria, it has been adopted for this study by the researcher. NJITS is seen to impact positively on student academic achievement in Java programming.

Academic achievement is the extent to which a student, teacher or institution has achieved their educational goals. Moore (2019) defines academic achievement as the level to which a person has

accomplished specific goals that were the focus of experiences in institutional environment, especially in school, colleges and University. In learning in general, academic achievement can either be low or high. Low academic achievement in Java programming is the state of students not achieving their short or long-term educational goals of acquiring and mastering the Java programming skills. Low achievement results in students going through a course without a grip of the required skills. On the hand, high achievement denotes a high level of students achieving their educational goals. In any case, according to Ugwuanyi and Okeke (2020), if students are offered equal educational opportunities by using the same learning tool and altering the responsibility of the teacher from being a mere teacher to being a dedicated guide brings about enhanced academic achievement irrespective of gender differences.

Gender significantly impact students' academic achievement. Omeh and Olelewe (2021) describes gender as one of the two sexes namely: male or female, especially when referring more to cultural and social differences other than biological ones. Gender disparity has been a source of concern as it has greatly influenced the use of Information and Communication Technologies globally. Thus, it has also been perceived that a gap in gender issues exists regarding Information technology usage thereby leading to disparities in the achievement of male and female learners when taught practically oriented and skill acquisition courses like Java programming (Omeh and Olelewe). However, this comparative disparity existing in gender performances in Java programming can be minimized by using an appropriate Intelligent Tutor System in the teaching and learning process. Therefore, an effort was also made to ascertain the effect of gender on the academic achievement of students in Java programming language when using NJITS.

Based on the above, it is assumed that introducing NJITS in teaching and learning of Java programming language may have the latency for providing knowledge and building skills in a more effective way of meeting the teachers' and learners' demands. Therefore, this study seeks to identify the effect of NJITS on academic achievement of students in Java programming language in Universities in south east Nigeria.

Statement of the Problem

Java programming education is such that under normal conditions of infrastructures such as computer hardware and software systems and other learning resources, students learn and improve on their academic achievement, without stress and in good time, thereby acquiring employability skills in the programming, regardless of gender disparities.

Unfortunately, students' academic achievement in Java programming in Nigeria universities has not been encouraging despite the continuous use of the conventional teaching method. The effect of this is that students go through the course without a grip of the requisite programming skills making them to lose interest in the course and then either change their desired career or even drop out of school entirely with a view to enrolling in alternative training centres to acquire Java programming skills which they should have acquired when offering the course.

This persistent poor academic achievement among students in Java programming became a source of concern to the researchers, lecturers and stakeholders leading to development of NJITS locally designed

that is in accordance with the curriculum. Therefore, the problem of this study was to investigate the effect of NJITS on academic achievement of Students of Computer Education in Java programming in federal Universities in South East Nigerian.

Purpose of the Study
The general purpose of this study was to determine the effect of NJITS on academic achievement of students in Java programming language in Computer Education in Nigerian Universities. Specifically, the study determined the:

1. mean achievement scores of students taught Java programming language using NJITS and those taught using lecture method,
2. mean achievement scores of male and female students taught Java programming language using NJITS,

Research Questions
1. What are the mean achievement scores of students taught Java programming language using NJITS and those taught with lecture method?
2. What are the mean achievement scores of male and female students taught Java programming language using NJITS?

Hypotheses
The following hypotheses were tested at 0.05 level of significance.

H_{O1}: There is no significant difference in the mean achievement scores of students taught Java programming language using NJITS and those taught with the lecture method.

H_{O2}: There is no significant difference in the mean achievement scores of male and female students taught Java programming language.

LITERATURE REVIEW

Available literature on intelligent tutoring systems (ITS) places interest their efficiency and effectiveness in improving academic achievement of students in different domains, including programming. According to Akyuz (2020), ITS can offer individualized feedback, be modified to suit learners' pace, and fortify the understanding of numerous concepts that are key to mastery of computer programming languages. In Nigeria, there is an increase in technological research that is hinged around enhanced learning in computer education though only very few studies have looked closely into Java programming. Recently, studies have suggest that localized systems, like Nandom's Java Intelligent Tutor System (NJITS), may offer context-relevant assistances through addressing curriculum-aligned and other challenges. Nevertheless, empirical assessments of NJITS in Nigerian universities remain limited, necessitating further study on its effect on students' academic achievement in Java programming.

METHODOLOGY

Design

The study adopted quasi-experimental research design. Specifically, a non-equivalent pre-test post-test control group design since intact classes were used. The researcher adopted this design due to the fact that there would be unlikelihood of random sampling. In this case, the intact classes were used. These intact classes were randomly assigned to experimental and control group respectively without disrupting the academic plan of the schools.

However, the research design is illustrated below:

Experimental Group   *O1*   *X*   *O2*

Control Group   *O1*   *-*   *O2*

KEY:
O1 = Pre-tests,
X = Treatment for Exp. Group I,
O2 = Post-tests,
-   = No Treatment.

Area of Study

This study was carried out in federal Universities in South East, Nigeria. South East, Nigeria comprises five states, namely: Abia, Anambra, Ebonyi, Enugu, and Imo states. Three of these states have federal Universities: Michael Okpara University of Agriculture, Umudike (MOUAU); Nnamdi Azikiwe University, Awka (NAUA) and University of Nigeria, Nsukka (UNN) that offer computer education where Java programming is taught. These three Universities are where the effect of NJITS on the computer education students' academic achievement in Java programming was determined. The choice of federal Universities is to ensure uniform resources for the research since they are all owned and managed by the federal government.

Population and Sampling

The population for the study is 136 third year undergraduate students of computer education from University of Nigeria, Nsukka (18); Nnamdi Azikiwe University,Awka (54); and Michael Okpara University of Agriculture, Umudike (64). The choice of third year students is because Java programming is offered in third year with the 300 level students. The information on population of the study were obtained from the computer education department of the universities (2020/2021 academic session). Total population sampling techniques was used. However, random sampling using balloting was used to choose schools for control and treatment groups. UNN with 18 students (12 male and 6 female) and NAUA with 54 students (30 male and 24 female) form the experimental group while MOUAU with 64 students (35 male and 29 female) form the control group.

Instruments for Data Collection

The instrument for data collection was Java Programming Achievement Test (JPAT). The JPAT is a 50 items multiple choice objective questions with four options of A - D with only one option as the correct answer. The JPAT is a teacher-made test which was developed by the researcher and covered Basics of Java Programming, Concepts and Terminologies of OOP and their syntaxes, creating basic

java programming language program and developing Java applications, and was based on the Bloom's taxonomy of Table of specification.

The initial draft of the instrument was subjected to face and content validation by five experts comprising of three lecturers from the Department of Computer and Robotics Education and two from Department of Measurement and Evaluation. The researcher administered 13 copies of the Java programming achievement test (JPAT) on Computer education third year students in Madonna University Nigeria, Anambra State that has 13 students in number, comprised of 9 males and 4 females. The reliability of the instrument was determined using Kuder Richardson 21 (KR-21) formula and the reliability index of 0.78 was established for internal consistency.

Experimental Procedure
Data collection involved the use of Pre-test, Treatment and Post-test. This experiment was carried out during the usual school lecture period for computer education third year students. Pre-test was administered simultaneously to both experimental and the control groups before treatment or teaching to established equivalence with help of research assistants. The two groups (experimental and control group) were subjected to the Java Programming Achievement Test (JPAT) as a pre-test. The treatment lasted for Ten (10) weeks. While the experimental group was taught using NJITS strategy, the control group was taught with lecture method on the same content used for experimental group. All the teachings were done by the lecturers teaching the course. After the treatment, both groups were exposed to the Java Programming Achievement Test (JPAT) as post-test. The pre-test questions were reshuffled for the use in the post-test.

Control of Extraneous Variables
1. *Treatment Bias*: Students in both groups were notified that the exercise is all about research and that it would not be used in any way against them, so that students demonstrated their natural behaviours during the experiment without any bias
2. *Experimental Bias*: To evade experimental bias the regular lecturer in the respective students' institutions were used to respectively guide and teach their own students in the experimental group and control group. Thus, the researcher was not directly involved in administration of research materials.
3. *Subject Interaction*: The researcher did not select the treatment and control groups from the same University, for the students in both groups not to mix-up, so that the errors arising from interaction and exchange of ideas may be completely reduced.

Method of Data Collection and Analysis
The lecturers of the course in the respective Universities were used as research assistants to administer and collect the tests before and after the treatment. There was a 100% collection of the instruments by the researcher. Mean and standard deviation were used to answer the research questions while the null hypotheses were tested using Analysis of Covariance (ANCOVA) at 0.05 level of significance. ANCOVA is a statistical technique which enables a researcher to adjust the post-test mean scores on the dependent variable for each group to compensate for the initial differences between the groups on the pre-test measures. As students in their intact classes took part in the experiment, the use of ANCOVA helped to compare the mean of the groups. Thus, Statistical Package for Social Science (SPSS) was used

for the analysis. The null hypothesis was accepted if the p-value is less than 0.05 otherwise, it was rejected at 0.05 alpha level of significance.

RESULTS

Research Question

Research Question I
What are the mean achievement scores of students taught Java programming language using NJITS and those taught using lecture method?
Data on this research Question is analysed and presented in table 1

Table 1: Mean and standard Deviation of pre-test and post-test of students taught Java programming language using NJITS and those taught using lecture methods

Groups	N	Pre-test		Post-test		Mean gain
		$\bar{x}$	SD	$\bar{x}$	SD	
Treatment	72	13.02	3.07	33.29	3.69	20.27
Control	64	12.50	3.18	21.06	7.99	8.56

$N = Number\ of\ students,\ \bar{x} = mean, SD = Standard\ Deviation$

The result presented in Table 1 shows that the mean achievement score of students taught Java programming language using NJITS is 13.02 with standard deviation of 3.07 in the pre-test but a mean of 33.29 with standard deviation of 3.69 in the post-test, making a pre-test, post-test mean gain of 20.27. On the other hand, the control group had a mean achievement score of 12.50 with standard deviation of 3.18 in the pre-test and a mean score of 21.06 with standard deviation of 7.99 in the post-test, making a pre-test, post-test mean gain of 8.56. This shows that NJITS improved students' achievement in Java programming language better than those taught with lecture method.

Research Question 2
What are the mean achievement scores of male and female students taught Java programming language with NJITS?
Data on this research Question is analyzed and presented in Table 2

Table 2: Mean and standard Deviation of pre-test and post-test of male and female students taught Java programming language using NJITS

Groups	N	Pre-test		Post-test		Mean gain
		$\bar{x}$	SD	$\bar{x}$	SD	
Male	42	13.10	3.61	35.14	6.55	22.04
Female	30	12.93	2.15	30.70	4.57	17.77

From Table 2, male students taught Java programming language using NJITS had a mean achievement score ($\bar{x}$) of 13.10 in pretest and 35.14 in posttest with standard deviations (SD) of 3.61 and 6.55

respectively. The mean gain in their pretest and posttest achievement mean score was 22.04. Whereas, female students that were taught Java programming language with the same tool had a pretest and posttest achievement scores of 12.93 and 30.70 with a standard deviation of 2.15 and 4.57 respectively. The difference between their pretest and posttest achievement mean score was 17.77. Going by this figure, since the mean gains of 22.04 of male students is higher than 17.77 of female students, it shows that male students taught Java programming language using NJITS had higher mean achievement than the female students taught Java programming language using the same tool.

Hypotheses

Hypotheses 1

H_{O1}: There is no significant difference in the mean achievement scores of students taught Java programming language using NJITS and those taught using lecture method.

Summary of Analysis of Covariance (ANCOVA) for hypothesis 1 is shown in Table 3

Table 3: Summary of Analysis of Covariance (ANCOVA) of the mean achievement scores of students taught Java programming language using NJITS and those taught using lecture method.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5757.017[a]	2	2878.508	133.17	.000
Intercept	2419.676	1	2419.676	111.94	.000
Pre-test	689.826	1	689.826	31.914	.000
Group (Achievement)	**4719.901**	**1**	**4719.901**	**218.36**	**.000**
Error	2874.799	133	21.615		
Total	111757.000	136			
Corrected Total	8631.816	135			

a. R Squared = .667 (Adjusted R Squared = .662)

The results presented in Table 3 shows that the F-value is 218.36 with a significant of F at .000, which is lower than the level of 0.05 alpha value at which it is been tested. The null hypothesis is therefore rejected at 0.05 level of significant. The result implies that, there is a significant difference between the mean achievement scores of students taught Java programming language using NJITS and those taught the lecture method.

Hypotheses 2

H_{O2}: There is no significant difference in the mean achievement scores of male and female students taught Java programming language

Summary of Analysis of Covariance (ANCOVA) for hypothesis 2 is shown in Table 4

Table 4: Summary of Analysis of Covariance (ANCOVA) mean achievement scores of male and female students taught Java programming language.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	345.083[a]	1	345.083	5.580	.020
Intercept	100814.377	1	100814.377	1630.211	.000
Gender (Achievement)	**345.083**	**1**	**345.083**	**5.580**	**.020**
Error	8286.734	134	61.841		
Total	111757.000	136			
Corrected Total	8631.816	135			

a. R Squared = .040 (Adjusted R Squared = .033)

The result in Table 4 shows that from the achievement scores of male and female students taught Java programming language, an F-value of 5.58 was obtained with a significance of F at 0.02. Since then the associated probability value (0.02) is less than 0.05, this indicates that the null hypothesis (H$_{O3}$) stating that no significant difference existed between the mean achievement scores of male and female student taught Java programming language using NJITS, is rejected. Inference drawn is that there is a significant difference between the mean achievement score of male and female students taught Java programming language. This result reveals that the male and female students taught Java programming language improved on their academic achievements. This then suggests that the high posttest mean achievement scores in Java programming language was as a result of both the use of NJITS and gender.

FINDINGS

Findings showed that
1. There is an improvement on students' academic achievement gain in Java programming language when taught using NJITS.
2. Male students taught Java programming language using NJITS had slightly higher academic achievement than the female students taught Java programming language using the same tool.
3. There is a significant difference between the mean achievement scores of students taught Java programming language using NJITS and those taught using lecture methods.
4. There is a significant difference between the mean achievement scores of male and female students taught Java programming language.

DISCUSSION OF FINDINGS

Students' academic achievement in Java Programming

From the analysis, the data presented in Table 1 provided answer to the research questions one. The findings of this study on research question one that deals with the students' academic achievement gain in Java programming language when taught using NJITS and when taught with the lecture method, revealed that there is a mean achievement gain of 20.27 for students taught Java programming language using NJITS as against mean achievement gain of 8.56 for students taught using lecture method. The findings of this study also show that, the mean gains of 22.04 of male students taught Java programming using NJITS is higher than the mean gains of 17.77 of female students taught using

same tool. This shows that male students taught Java programming language using NJITS had slightly higher mean achievement than the female students taught Java programming language using the same tool. This study upholds the research done by Çakir (2019) on impact of Web-Based Intelligent Tutoring System on Students' Achievement and Motivation. The study revealed that Web-Based intelligent Tutoring System positively impacted academic achievement among students. In the study, the author hypothesized that there was no significant difference between the mean academic achievement of students who used Web-Based Intelligent Tutoring System for learning and those who used the conventional method. The hypothesis was not upheld and the inference was that there existed a significant difference in the mean achievement of students who used Web-Based Intelligent Tutoring System for learning and those who used the lecture method.

In a similar vein, Garcia and Garcia (2023) undertook a study on Intelligent Tutoring System as an Instructional Technology in Learning Basic Nutrition Concepts. The study looked into the effect of intelligent tutoring system as an instructional technology on academic achievement of students in Learning Basic Nutrition Concepts. The study compared the mean achievement scores of students taught Basic Nutrition Concepts using Intelligent Tutor System (ITS) and those taught using exploratory sequential mixed methods design (conventional approach). In the study, the mean achievement gain of the learners taught using the Intelligent Tutor System (ITS) was 20.34 while that of those taught using exploratory sequential mixed methods design is 18.36. This result implies that the intelligent tutor system improves academic achievements among learners. Similarly, Akyuz (2020) researched on the Effects of intelligent tutoring systems (ITS) on personalized learning as relates to its impact on academic achievement of students. The intelligent tutoring system was identified to keep learners engaged for longer, enables a self-paced and more interactive learning, and increased motivation and better time management. The result of this research also ascertained that 90% of students and instructors prefers learning with the aid of ITS. Additionally, it was obtained that 27% of student improved drastically through the use ITS for personalized learning thereby improving academic achievement. The result of the study also revealed that those who used the intelligent tutoring system outperformed those using the lecture method.

Gender influences on Students' academic achievement in Java Programming

Findings of this study on research question two dealing with the mean achievement score of male and female students taught Java programming language using NJITS, showed that male students taught Java programming language using NJITS had slightly higher academic achievement than the female students taught Java programming language using the same tool. The findings showed that the mean achievement gain of male students (22.04) is higher than that of the female students (17.77). This study upholds the study of Soofi (2019) on a systematic review of domains, techniques, delivery modes and validation methods for intelligent tutoring systems. The study revealed that the experimental group had a mean gain of 18.46 as against 13.28 of the control group (conventional approach) in their pre-test and post test scores and the achievement of the students was not influenced by gender.

The inference drawn contradicted that of the present study in that there is no significant difference in the mean achievement of male and female students taught using that intelligent tutoring system. In the study that Garcia and Garcia (2023) carried out on Intelligent Tutoring System as an Instructional Technology in Learning Basic Nutrition Concepts, the findings show that the results of the pre-test

and the post test was not influenced by gender. The null hypothesis formulated that states that 'there is no significant difference in the mean achievement scores of male and female students taught basic nutrition concepts using Intelligent Tutoring System as an Instructional Technology was upheld. The F-value was 1.58 with a significance of 2.12 resulted in upholding the null hypothesis and inferring that there is no significant difference in the achievement of male students taught basic nutrition concepts using Intelligent Tutoring System as an Instructional Technology and female students taught using the same tool.

CONCLUSION

Owing to the high rate of failure in Java programming coupled with the increasing number of learners in the field of programming and the difficulty in provision of adequate human and material infrastructure to cushion the effect, their arose a need to find an intelligent tutoring system. A system that is highly interactive, designed in accordance with the curriculum of computer education programme in Nigeria, and can guide the students through learning of Java programming at own pace and time. One such system is NJITS. This study therefore tested and revealed the effect of NJITS among users.

The study revealed that the use of NJITS in learning Java programming language is effective. The use of NJITS resulted in improvement on students' academic achievement in learning Java programming language. Again, male students taught Java programming language using NJITS had higher academic achievement than the female students taught Java programming language using the same tool.

Finally, it was concluded that NJITS is useful for self-learning of Java programming language at one's own pace without stress. This is an approach to the much-desired individualized instruction that has been the wish of educational systems as it addresses the need of learners or group of learners with different needs.

Declarations

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Funding

No funding was received for this study

Consent to participate

Informed consent was obtained from all individual participants included in the study.

Consent to publish

The participants in the study have consented to the submission of the report to the journal.

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List of Abbreviations

JPAT	Java Programming Achievement Test
MOUAU	Michael Okpara University of Agriculture, Umudike
NAUA	Nnamdi Azikiwe University, Awka
NJITS	Nandom's Java Intelligent Tutor System
OOP	Object Oriented Programing
UNN	University of Nigeria, Nsukka