

Need Assessment for an Interactive Tutor for Self Learning of Java Programming by Computer Education Students in Nigeria by

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Abstract

The study seeks to assess the need for an interactive tutor for self-learning of Java programming by computer education students in Nigeria. This study adopted descriptive survey research design. The population for the study comprised all the federal universities in South Eastern Nigeria with a population size of 214 Students of Computer Education from all the public Universities in the south-eastern part of Nigeria. The findings revealed that all the Java programming skill listed out are well recognized and accepted by the students as important for a Computer Education Students in Nigeria and also the Computer Education students perform poorly in all the Java programming skills identified. From the findings also, there is a need for an Interactive Java programming tutor for Computer Education Students in Nigeria.

Introduction

Computer has virtually taken over every aspect of human endeavour. The fifth generation of computers which is existing and an on-going generation has opened so wide and varied aspects of software engineering and computing that one tends to look at hardware engineering as a very insignificant though inseparable aspect of computing. Okonor and Ani (2011) figured out various areas of computer science and applications that include: Artificial Intelligence (AI), Cognitive Science, Robotics, Computer Vision, Computer Information Systems, Computer Graphic and Computer Programming. Other areas are Computer Networks, Computer Servicing Technology, Database Systems, Information Science, Knowledge Engineering, Expert Systems, Management Information Systems, Systems Analysis and Design, Neural Networks and Telecommunications Engineering. Also some emerging technologies and new areas as added by Cui, Kharel & Gruev (2017) include Virtual and Augmented reality, Learning Management system, Cloud Computing and others. In both current and emerging technologies in those areas, Software Engineering is centralized.

Software engineering is a branch of engineering associated with the development of software product using well-defined scientific principles, methods and procedures. Software

engineering must be accomplished in a (coding) language usually known as the programming language. A Programming language as defined by Rajaraman (2013), is an artificial language that uses notations for the precise description of computer programs or algorithms, in which the syntax and semantics are strictly defined. There exist various types of programming languages as outlined like procedural programming languages, logic programming languages and object oriented programming languages.

Procedural programming languages (such as Fortran, BASIC, Pascal and C) focused on actions (verbs) rather than things (objects) and made programming awkward (Deitel and Deitel, 2009). However, further advances in programming brought about object oriented programming languages (such as Java, C#, C++ and Visual Basic) with which a programmer programs in an object oriented manner that reflect the natural way the world is perceived. Actually, the emergence of object oriented programming has faced out the use of Procedural programming. Among the object oriented programming languages, Java ranks the most highly used in industries and in academia owing to its productivity, robustness and security (Najumudheen, Mall and Samanta, 2010). Java is used in designing software for very many devices like mobile phones, network devices, televisions, ATM, satellites, detectors

of various kinds, photocopiers, among others. Sequel to this, many different software firms in software engineering hold Java programmers high in priority in their personnel list.

Java programming is taught in both formal and informal certain. Many learners of Java programming enroll in IT private training centers for fees, many students undertake self-learning of Java programming using hard copy as well as electronic books, while a few take up some poorly designed Java programming interactive tutorials. However a large number of students of Java programming are trained through computer education programs offered in universities. The computer science and computer education departments of many higher institutions of learning have well-furnished computer laboratories having Java Development kit (JDK) with good Integrated Development Environment (IDE) installed for use by the students for the same reason of making the learning of Java programming easy and affordable. In addition, the computer departments in these institutions very often use Java programming language as the compulsory object oriented programming language in software engineering/ programming or software development still in a bid to impart the knowledge of Java to the students. According to Yang, Hicks and Chang (2015), Due to the new possibilities it opens up on the Web, the Java paradigm has received much attention. As a result, many universities and colleges have introduced Java into their undergraduate computer science curricula.

However, Galadanci, Mukhtar & Muaz (2019) found that students who learn Java programming do not measure up to expectation. Yang, Hicks & Chang (2015) pointed out that while object-oriented programming in Java has been widely adopted as an introductory programming course in computer science in many universities, it remains a difficult task to teach and learn it, their finding identified that the difficulty is from the underlying object-oriented concepts and principles. The average performance of students of software engineering in Nigeria especially in developing Java program is below average when compared with those in the developed world (Galadanci,

Mukhtar & Muaz, 2019). In the authors' research termed: Correlates of Success in Java Programming: Predicting the performance of students in a Java course from the results of lower level courses, the overall performance of students in Java programming in Nigerian universities is poor. This is evident in the rate foreign software developers thrive in Nigeria while software engineering graduates emerge yearly in their numbers in the same country. Dasuki & Quaye (2016) and Sivasakthi & Rajendran (2011), identified that there is a wide gap between industry expectations and knowledge of students in Java programming pointing out that the gap can only be bridged by improving the technique and methods of teaching and learning of Java programming in academia. Yang, Hicks & Chang (2015) identified that lack of understanding of key Java programming concepts which are the underlying object-oriented concepts and principles, have reduced undergraduates' interests to pursue further exploration and self-experimentation in Java programming. The authors further stated that undergraduates' learning difficulty in Java programming courses is traceable to the use of wrong teaching methodology. In other words, the Java Programming instructor does not have the necessary skills or has not used the appropriate teaching techniques that will make Java programming education less difficult. It is for this reason, to palliate the problem of difficulty resulting from poor teaching and learning in computing, that Computer Education programme was introduced.

Computer education is a programme designed to educate a learner on computers and their operations (like Java programming) as well as how to educate others with the knowledge acquired. Computer education has been defined by Obi and Ibezim (2013) to be an education which equips the learners with the overall knowledge of computer and computing as well as the pedagogical skills and techniques in imparting the same knowledge to others. The Computer education programme in Nigerian Universities has object oriented Programming I and object oriented programming II, as compulsory courses for her students. Most of those universities compulsorily adopt Java

programming language for study as required by Object Oriented programming. In other words, failure of a student in Java programming amounts to failure in object oriented programming (Dasuki & Quaye, 2016). Hence, a student having undergone through Java programming training in computer education, is not only expected to have acquired knowledge and skills in Java programming for IT industrial operations, but also be equipped with pedagogical skills and techniques in Java programming education and training.

Java Programming is usually more commonly taught by lecture method which Yang, Hicks & Chang (2015) identified to decreases students' interest level and brings about fatigue among them. Again, Java programming is complex with respect to object oriented paradigm. Deitel and Deitel (2010) outlined 17 units which are major topics containing subtopics that a learner of Java programming is expected to master. These units include classes & object, Object Oriented programming–Inheritance & Polymorphism, Graphical User Interface, Exception Handling, Files & Streams, Recursion, Searching & Sorting, Data Structures and Generics. Others include Collections, Java and Multimedia Applets, Multithreading, Networking, Databases with JDBC (Java Database Collection), Servlets and JavaServer Pages (JSP). Also, some new features that emerged recently include Lambdas, Streams, New Concurrency primitives, new Java Virtual Machine (JVM) languages and AI and Machine Learning. In view of this, teaching and learning of Java programming requires much more periods of laboratory and classroom instruction than procedural programming and even other object oriented programming languages. Sequel to that, the usual few hours per week duration of laboratory and classroom instruction would hardly suffice for total mastery (Gross and Pinkwart, 2015).

Moreover, effective learning of computer programming like Java requires hands-on experience in writing programs and continuous assessment from the lecturer to ensure proper skill acquisition in programming. With the increasing popularity of computing

courses at universities, the provision of these services involves progressively heavier demands on human resources when courses are delivered in the traditional manner like lecture method, discussion and other methods. These demands, in turn, lead to pressure to reduce the amount of practical work and continuous assessment causing an attrition of the standard attained by the graduates. The alternative then according to Gross and Pinkwart (2015) is to make use of a technology for massive and interactive programs for self-learning to remedy the situation.

The existing online interactive tutors for self-learning of Java programming like Learn Java- Free Interactive tutorial do not include the new features added to Java Programming which include Lambdas, Streams, New Concurrency and new Java Virtual Machine (JVM) languages. Moreover, those existing interactive tutors are not user friendly enough to tackle the major challenge of using an interactive tutor for self-learning which according to Dietel and Dietel (2004) in Otteh (2012) borders on fatigue and stress. A user friendly tutor should be such that resembles the traditional classroom scenario yet computer mediated, incorporating both positive and negative reinforcements, like varying responses to learners' answers during assessments and evaluations, using varying options for digression, and others.

Owing to this fact, there is a need for an interactive Java programming tutor for self-learning for computer education student in Nigeria. Enhanced tutors that will be user-friendly, incorporating Java new features, self-paced yet timely ordered, and through series of interactive lessons in modules with stress-free evaluation quizzes during or at the end of lessons, guide a student of Computer Education through Java programming. Upon this background, it became pertinent to design an Interactive Java programming tutor for self-learning for computer education student in Nigeria. The study was delimited to developing and test running an interactive tutor for self-learning of java programming by computer education students in universities in Nigeria but excludes maintenance and support systems of

the Interactive Tutor for Self Learning of Java programming

Statement of the Problem

The curriculum of Java programming in computer education programme in Nigerian universities stated clearly the various concepts required to be mastered as skills for one to be professionally equipped in the field of object oriented programming and Java programming in particular. Efficiency in object oriented programming (Java programming in particular) requires that specialists be equipped with skills in the perfect utilization of Classes & Object, OOP-Inheritance and Polymorphism, GUI, Exception Handling, Files & Streams, Data Structures and Generics. Others include the implementation of Collections, Java and Multimedia Applets, Multithreading, Networking, Databases with JDBC, Servlets and JavaServer Pages (JSP). Students of Java programming are not only required to be masters of the already existing technologies but also new and emerging technologies in Java programming, the knowledge of which makes the students of computer education especially those specializing in Java well skilled and employable.

Unfortunately, the students and graduates of this programme do not completely acquire these skills in Java programming (Galadanci, Mukhtar & Muaz, 2019). This has resulted to the fact that graduates of Java programming lack much in their skills and do not easily secure employment in Programming fields. This also makes them enroll for out-of-school further training in Java programming despite their paper certificates in programming. There have been complaints by graduates of computer education of not meeting up with Java programming needs of acquiring in-depth knowledge in Java programming that make them have no need of additional months of training in Java programming after graduation.

The students of Java programming in computer education in universities usually undergo through some traditional teaching and learning method which are non-interactive. Learning Java programming through a well-

designed interactive tutor for self-learning avails the students the opportunity of having more periods of learning in an interactive manner, present the lessons and practices several times at the learner's pace, give quicker evaluations and responses to learners, and provide a more detailed and consistent learning content. This study therefore seeks to assess the need of an interactive Java programming tutor for computer education students of universities

Purpose of the Study

The main purpose of the study is to assess the need of an interactive Java programming tutor for Computer Education students of Universities. Specifically, the study sought to determine:

1. the perceived importance of Java programming skills for Computer Education students
2. the level of performance of Computer Education students in Java programming.
3. identify the learning techniques used by Computer Education Students in Java programming

Research Questions

1. What are the perceived importance of Java programming skills for Computer Education students?
2. What are the levels of performance of Computer Education students in Java programming?
3. What learning techniques are used by Computer Education Students in Java programming?

Hypotheses

- H₀₁: There is no significant difference in the mean ratings of opinions of male and female students on the perceived importance of Java programming skills.
- H₀₂: Year of study in not a significant source of difference in the mean ratings of students on the level of performance of Computer Education students in Java programming.
- H₀₃: Year of study in not a significant source of difference in the mean ratings of students on the learning techniques used by

Computer Education Students in Java programming.

Methodology

This study adopted a descriptive survey research design. According to Osuala in Onahand others (2016), survey research helps the researcher to identify present conditions, present needs as well as information on which to base sound decisions. This study was carried out in South East Nigeria in all the public universities that offer computer education in their institutions namely: University of Nigeria, Nsukka, Nnamdi Azikiwe University, Awka, Ebonyi State University, Abakaliki, Chukwuemeka Odumegwu Ojukwu University and Enugu State University of Science and Technology. The choice of this area was based on the fact that their students work hard but achievement is very minimal. The universities have almost the same socio-cultural background. The population for this study consists of 214 respondents comprising of both male and female 300 and 400 level students who have gone deep into the programme. No sample was taken as the determined number was considerably manageable.

The instrument for data collection was a structured questionnaire based on designing an interactive Java programming tutor for

Computer Education student in south east universities in Nigeria. The questionnaire was subjected to face validation by three experts. The reliability of the instrument was established using Cronbach Alpha with reliability coefficient of 0.91.

Copies of the questionnaire were administered on the respondents by the researcher himself and were collected after one week. From the 214 copies of the questionnaire distributed, only 198 were well returned. The data collected from the respondents were analyzed using mean, standard deviation and t-test statistics. The mean and standard deviation were used to answer the research questions. In the first, second and third table analyses, items with a mean ratings of 2.50 and above were respectively regarded important, high performance and used, while any item with a mean rating less than 2.50 were respectively regarded as not important, low performance and not used. The correlated t-test statistic was used to test the null hypothesis at 0.05 level of significance. Any hypothesis whose significance levels was less than or equal to 0.05 level of significance was rejected while a hypothesis with significance level greater than 0.05 level was not rejected.

Results

Table 1: Mean, Standard Deviation and Test of Hypothesis of Respondents (Male and Female) Responses on the Perceived Importance of Java Programming Skills for Computer Education Students

S/ N	Items (Skills in JAVA programming):	X _M	X _F	X _G	SD	P- Value	Remarks
	Understanding and Applying						I or U HO
1	Classes & Object	2.64	2.61	2.62	3.55	0.10	I NS
2	OOP– Inheritance	2.63	3.25	3.02	3.40	0.10	I NS
3	OOP – Polymorphism	2.67	2.54	2.59	3.19	0.09	I NS
4	Graphical User Interface	2.60	2.69	2.66	3.15	0.09	I NS
5	Exception Handling	3.20	3.45	3.35	3.20	0.09	I NS
6	Files & Streams	2.67	2.54	2.59	3.07	0.09	I NS
7	Recursion	2.31	3.50	3.05	3.17	0.09	I NS
8	Data Structures	3.05	2.34	2.61	3.21	0.83	I NS
9	Collections	2.67	2.54	2.59	3.34	0.87	I NS
10	Java and Multimedia Applets	2.64	2.61	2.62	3.38	0.88	I NS
11	Multithreading	2.63	3.25	3.02	3.70	0.96	I NS
12	Networking	2.67	2.54	2.59	3.05	0.79	I NS
13	Servlets	3.20	2.69	2.66	3.14	0.82	I NS
14	JavaServer Pages (JSP).	2.67	3.45	3.35	3.12	0.81	I NS
15	Searching	2.64	2.54	2.59	3.17	0.82	I NS

16	Sorting	2.31	3.50	3.05	3.21	0.83	I	NS
17	Generics	3.05	2.34	2.61	3.34	0.87	I	NS
18	AI and Machine Learning	2.67	2.54	2.59	3.13	0.81	I	NS
19	Java 9	2.64	2.61	2.62	3.28	0.85	I	NS
20	Spring 5.0	2.63	3.25	3.02	3.26	0.84	I	NS
21	Spring Security 5.0	2.67	2.54	2.59	3.22	0.83	I	NS
22	Microservices	2.60	2.69	2.66	3.28	0.85	I	NS
23	Blockchain	3.20	3.45	3.35	3.29	0.85	I	NS

Key: X_M = mean of the male students, X_F = mean of the female students, X_G = grand mean, SD = Standard deviation, I = Important, U = Unimportant, NS = Not significant, S = significant * $N = 198$ *

Data presented in Table 1 showed that the mean ratings of the responses of the respondents on the 23 identified items relating to the major skills needed in Java programming for computer education students in Nigeria, had mean values ranging from 2.50 to 3.5 which are all greater than the cut-off point of 2.50 on a 4-point rating scale. The data in the table also indicated that the respondents agree that all the 23 items are skills needed in Java programming for

computer education students in Nigeria, The standard deviation values for most of the 23 items ranged from 0.75 to 1.05 which showed that the respondents were not far from one another in their responses and that their responses were not far from the mean. The table also showed that all the p-values of the items 1 to 23 ranged from 0.03 to 0.12 which was greater than 0.05 level of significance and 198 degrees of freedom. This showed that there was no significant difference ($P > 0.05$) between the mean responses male and female students with regards to the perceived importance of Java programming skills for Computer Education students in Nigeria.

Table 2: Mean, Standard Deviation and Test of Hypothesis of Respondents (Third year and Fourth (final) Year Students) Responses on the Levels of Performance of Computer Education Students in JAVA Programming

S/N	Items	X_3	X_4	X_G	SD	P-Value	Remarks	
							H OR L	HO
1	Classes & Object	1.24	2.21	1.73	1.79	0.89	L	NS
2	OOP– Inheritance	1.33	2.12	1.73	1.79	0.89	L	NS
3	OOP – Polymorphism	2.11	2.12	2.12	2.19	1.10	L	NS
4	Graphical User Interface	1.21	2.51	1.86	1.93	0.03	L	S
5	Exception Handling	2.01	2.32	2.17	2.24	1.12	L	NS
6	Files & Streams	1.34	2.34	1.84	1.91	0.95	L	NS
7	Recursion	1.98	2.12	2.05	2.12	1.06	L	NS
8	Data Structures	1.59	2.31	1.95	2.02	1.01	L	NS
9	Collections	1.98	2.34	2.16	2.24	1.12	L	NS
10	Java and Multimedia Applets	2.02	2.21	2.12	2.19	1.10	L	NS
11	Multithreading	1.33	2.23	1.78	1.84	0.92	L	NS
12	Networking	2.11	2.33	2.22	2.30	1.15	L	NS
13	Servlets	1.21	2.54	1.88	1.94	0.04	L	S
14	JavaServer Pages (JSP).	2.01	2.61	2.31	2.39	0.02	L	S
15	Searching	1.34	2.51	1.93	1.99	0.04	L	S
16	Sorting	1.33	2.67	2.00	2.07	0.03	L	S
17	Generics	2.11	2.68	2.40	2.48	0.02	L	S
18	AI and Machine Learning	1.21	2.34	1.78	1.84	0.92	L	NS
19	Java 9	2.01	2.21	2.11	2.19	1.09	L	NS
20	Spring 5.0	1.34	2.23	1.79	1.85	0.92	L	NS

21	Spring Security 5.0
22	Microservices
23	Blockchain

Key: X_3 = mean of the 3rd year students, X_4 = mean of the 4th year students, X_G = grand mean, SD = Standard deviation, H = High, L = Low, NS = Not significant, S = significant.

Data presented in Table 2 showed that the mean ratings of the responses of the respondents on the 23 identified items relating to the level of performance of computer education students in Java programming had mean values ranging from 1.73 to 2.40 which are all less than the cut-off point of 2.50 on a 4-point rating scale. The data in the table indicated that the respondents agree there is a low performance of the students in all the 23 items identified as the level of performance in Java programming for computer education students in Nigeria. The standard deviation values for the 23 items ranged from 1.79 to 2.39 which showed that the respondents were not far

1.98	2.51	2.25	2.33	0.02	L	S
1.59	2.67	2.13	2.21	0.01	L	S
1.33	2.68	2.01	2.08	0.01	L	S

from one another in their responses and that their responses were not far from the mean. The table also showed that the p-values of the items nine (9) items ranged from 0.01 to 0.04 which were less than 0.05 level of significance and 198 degrees of freedom. This showed that there was a significant difference ($P < 0.05$) between the mean responses of students in the nine (9) items on levels of performance in Java programming of computer education students in Nigeria. Fourteen (14) items had their p-values ranging above 0.05 ($P > 0.05$), indicating that there is no significant difference in the mean rating of respondents on those items. These differences in some of the items are partly due to varying year of studies of the respondents. However there is an average low performance of computer education students in Java programming.

Table 3: Mean, Standard Deviation and Test of Hypothesis of Respondents (Third Year and Fourth (final) Year Students) Responses on the Learning Techniques Used by Computer Education Students in JAVA Programming

S/ N	Items	X_3	X_4	X_G	SD	P- Value	Remarks
							U or NU
1	Classroom instruction	3.05	2.34	2.61	2.42	0.96	U
2	Java programming books	2.60	2.69	2.66	2.52	1.00	U
3	Private (non-formal) training centre	3.20	3.45	3.35	2.37	0.94	U
4	Laboratory practical	3.05	2.34	2.61	2.47	0.98	U
5	Peer group learning	2.31	3.50	3.05	2.30	0.91	U
6	Collaborative learning	3.05	2.34	2.61	2.47	0.98	U
7	Interest group learning	2.67	2.54	2.59	2.27	0.89	U
8	Interactive Java programming tutor	1.58	2.18	2.34	1.25	0.50	NU

Key: X_M = mean of the male students, X_F = mean of the female students, X_G = grand mean, SD = Standard deviation, U = Used, NU = Not Used, NS = Not significant, S = significant *N = 198*

Data presented in Table 3 showed that the mean ratings of the responses of the respondents on the 7 of the 8 identified items relating learning techniques used by computer education students in Java programming, 2.59 to 3.35 while only one item has mean rating less than 2.50. Equally, standard deviation of the seven items (with high mean) ranged from 2.27 to 2.47 indicating that the respondents were not far from one another in their responses and that their responses were not far from the mean.

This shows that the both 3rd and 4th year students use all the 7 identified learning techniques in Java programming but do not use an interactive Java programming tutor. All the p-values range above 0.05 indicating that there is no significant difference in the mean ratings of 3rd and 4th year students on the learning techniques used by computer education students in Java programming.

Discussions

Indications in the statistical analysis of Table 1 show that all the Java programming skills listed out are well recognized and accepted by the students as important for a

computer education students in Nigeria. This finding is supported by the findings of Yang, Hicks & Chang (2015) who pointed out that the key skills are the ones based on Object oriented topics/aspects of Java, and were rated high by the students indicating how necessary those skills are. Such skills like OOP (inheritance and polymorphism), Data Structures, Java and multimedia applets, Recursion, multithreading, Generics, Java 9, Micro services and Block chains are very much important in Java, still in line with the findings of Sivasakthi & Rajendran (2011) who listed out 22 areas both old and emerging topics. Other skills though not rated highly are equally important as they form the basic elements on which Java programming is based. Such areas are Files and Streams, Exception Handling, Recursion, Sorting and Searching and others.

Table 2 shows that the Computer Education students perform poorly in most of the Java programming skills identified. This is in line with the findings of Galadanci, Mukhtar & Muaz (2019) who stated that the average performance of Java programming students in Nigeria is poor. However there seems to exist a slight difference in the average opinions of the 3rd and 4th year students on the level of performance, which could be attributed to experience and personal effort due to motivational spirit of graduation in the 4th (final) year students. This difference could not be attributed to the learning technique used by the students as the research identified in table 2. In general, there is a low performance of the students in those skill areas that were rated more important as in the analysis in table 1. The students rating of poor performance is mostly on OOP, topics. This is supported by the findings of Dasuki & Quaye (2016) and Galadanci, Mukhtar & Muaz (2019) who noted that the difficulty in student learning of Java programming is based on the Object oriented concepts. Though some areas seem as though students perform very well, performance in programming is taken as a whole not in units.

Table 3 shows that all the common learning techniques were being used by computer education students at all levels except an interactive tutor. The learning techniques

commonly used are classroom instruction, Java programming books, laboratory practical, peer group learning and Interest group learning. Students have not used the Java Programming Interactive tutor for self-learning. There is then a need for the learning technique lacking in the computer education students' list of learning techniques namely an Interactive Java programming tutor. This finding is in line with Gross and Pinkwart (2015) who noted that the only remedy to students' poor performance in learning Java is to make use of a technology for massive and interactive learning. This is also supported by the findings of Sharma and Bilgic (2017) who pointed out that there is a need for an interactive Java programming tutor considering the increase in the number of students' enrolment in University.

Conclusion

All the skills identified as Java programming skills are recognized by the students as important to computer education students whose performances are low in those skills. Since the students use all the available learning techniques yet needed improvement, there is a need for an interactive Java programming tutor for a stress free and self - paced learning of Java programming

Recommendations

Based on the findings of the study the following recommendations were made:

1. Students should be educated on the importance of all the aspects of Java programming
2. Computer Education Lecturers should explore different ways of teaching Java programming:
3. Students should in addition to using already existing learning technique use an Interactive Java Programming tutor for Self-Learning.

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