
**Algorithm Development Skills and Programming Capability of Computer Education
Students in Colleges of Education in South-South, Nigeria**

BY

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ABSTRACT

The study was aimed to determine the extent to which algorithm development skills predict programming capability of Computer Education students in Colleges of Education in South-South, Nigeria. Two specific purposes and their corresponding research questions and hypotheses were formulated and tested at 0.05 level of significance. The ex-post facto research design was used in the study and it was carried out in South-South Nigeria. The population of the study consisted 125 Computer Science Education lecturers in the Colleges of Education in South-South Nigeria. The sample for the study consisted of 95 respondents selected using stratified sampling technique. Two researcher-made instruments were used for data collection. Instruments titled Algorithm Development Skill Needs Questionnaire (ADSNQ) containing 20 items and Extent to which algorithm development skill predict programming capability containing 11 items were developed and used for data collection. The questionnaires were structured on a 5-point rating scale. The instruments were face validated by three experts from the Faculty of Education, University of Uyo. The internal consistency reliability of the instruments obtained using Cronbach Alpha technique yielded 0.78 and 0.84 respectively for the Algorithm Development Skill Needs and programming capability Questionnaire. The instruments were administered on the respondents by the researcher with the help of research assistants. Out of the 95 questionnaire administered, all were returned with valid data and this account for 100% response and return rate. Data were analyzed using Simple Linear Regression to provide answers to the research questions and to test the null hypotheses. Based on the data analysis, the study revealed that there is significant extent to which algorithm logic development skill and algorithm control skill predict programming capability of students in Colleges of Education in the South-south, Nigeria. Based on the finding, it is recommended that the management of Colleges of Education in South-south Nigeria should give concern attitude to the provision of learning resources in the areas of computer programming to enhance skills in software development. Also, the National Commission for Colleges of Education (NCCE) in collaboration with the Teachers Registration Council of Nigeria (TRCN) should enforce the policy that only those with good background in computer science plus relevant teaching qualifications should be allowed to teach computer courses in Colleges of Education in Nigeria.

KEYWORDS: Algorithm, Development Skills, Programming Capability, Computer Education Students, Colleges of Education, South-South, Nigeria

Introduction

Teaching and learning of Computer Science Education at all level of tertiary institutions cannot be said to be effective and impacting the required skills and competency without a good knowledge in computer programming and algorithm development. Computer programming and algorithm development is an integral part of Computer Science Education programme which must be properly prepared so as to achieve the overall goals. Programming has become an important skill and strategic power in the 21st Century. Programming is an art and it requires the individuals' ability to interpret challenges into solutions. This art of programming includes knowledge of programming tools and languages, problem-solving skills, and effective strategies (algorithm) for program design and implementation (Sarpong, Arthur and Owusu, 2013).

Programming according to Miller and Ranum (2013), is the process of taking an algorithm and encoding it into a notation, a programming language, so that it can be executed by a computer. Miller and Ranum observed that although many programming languages and many different types of computers exist, the important first step is the need to have the solution and that without an algorithm, there can be no program. Some student programmers lack the knowledge and skills of programming experts and several different separating factors have been studied in the literature and were also reviewed by Rist (2006). Rist stated that common features for some student seem to be that they are limited to surface knowledge of programs and generally approach programming "line by line" rather than at the level of bigger program structures. Rist (2006), further observed that some students spend little time in planning and testing code, and when necessary, try to correct their programs with small local fixes instead of more thoroughly reformulating programs. However, according to Kessler and Anderson (2009), the knowledge of some students tends to be context specific rather than general, and students also often fail to apply correctly the knowledge they have obtained.

Knuth (2011) defines algorithm as an effective method expressed as a finite list of well-defined instructions for calculating a function and that all algorithms must possess the following properties: Input - There are zero or more quantities that are externally supplied; Output - At least one quantity is produced. Definiteness - Each instruction is clear and unambiguous; Finiteness - If the instructions of an algorithm traced, then for all cases, the algorithm terminates after a finite number of steps; and Effectiveness - Every instruction must be basic enough to be carried out, in principle, by a person using only pencil and paper. It is not enough that each operation be definite as in (3); it also must be feasible.

According to Daniel (2015), algorithm is the step by step procedure which defines a set of instructions to be executed by the computer in order to get the desired or required outputs. Algorithm skill tells the programmer how to code the program and has never been written to support a particular programming language. Computer programmers should note that programming languages share basic code construct such as if-else, while-loop statements and flow control. These common constructs are used to write algorithm. Students are expected to have a good knowledge of algorithm development skills in order to write a standard program or software. These skills include; algorithm logic development skill, algorithm control skill, logic thinking skill, algorithm problem-solving skill and data structure handling skill.

The acquisition of algorithm development skills by graduates of computer education especially in Colleges of Education forms the need for students in both private and public colleges of education to become professional programmers, thereby enhancing employability,

advances in substantive knowledge and skills in approaches to problem solving, improved techniques in logical thinking and rational reasoning and thus, there is need for a study to determine the extent to which algorithm development skills predicts programming capability of Computer Education students in Colleges of Education in South-south, Nigeria.

Statement of the Problem

Computer programming is one of the most important skills that every graduate of computer science education from College of Education must acquire in order to enhance teaching performance and adequate impartations that can help students in their programming capability. Efficient computer programming largely depends on the student's ability to understand the concept, formation and application of algorithm development skills in computer programming. Thus the fundamental issue in computer programming lays in the understanding of algorithm logic development, algorithm control development, logical thinking, algorithm problem-solving and data structure handling skills.

Many researchers have shown failure of students in programming courses. This may be as the result of weakness of the students to understand the concepts including algorithm development and data structures (Sarpong, Arthur and Amoako, 2013). Most students find programming to be difficult and disheartening especially when students are beginners and even when they take advanced programming courses. In a related survey, many researchers identified several problems responsible for students failure in computer programming to include weaker students admitted to pursue career in computer science, lack of problem-solving skills, lack of analytical thinking skills, lack of logical and reasoning skills, lack of programming planning, lack of programming conceptual understanding of the programming task, the conceptual difficulty of various elements of the curriculum, the level of feedback that is available to students with regard to various components of the programming task and how patterns of study, namely low level of face-to-face contact experiences by individual learners, impact on the first two issues (Ismail, Ngah and Umar, 2010; Butler and Morgan, 2007).

It is also observed that even direct entry student from colleges of education are also facing similar problems. In view of the above, this study therefore was designed to investigate the extent to which Algorithm Development Skills predict Programming Capability of Computer Education students in Colleges of Education in South-South Nigeria.

Purpose of the Study

The main purpose of this study was to determine the extent to which algorithm development skills predict programming capability of Computer Education students in Colleges of Education in South-South, Nigeria. Specifically, the objectives intend to:

1. Determine the extent to which Computer Education Students algorithm logic development skills predict their programming capability of Computer Education students in Colleges of Education in South-South, Nigeria.
2. Determine the extent to which Computer Education Students algorithm control development skills predict their programming capability of Computer Education students in Colleges of Education in South-South, Nigeria.

Research Questions

The study provided answers to the following research questions:

1. To what extent does algorithm logic development skill predict programming capability of Computer Education students in Colleges of Education in South-South, Nigeria?
2. To what extent does algorithm control development skill predict programming capability of Computer Education students in Colleges of Education in South-South, Nigeria?

Research Hypotheses

The following null hypotheses were and were tested at 0.05 level of significance

- H0₁ Algorithm logic development skill does not significantly predict programming capability of Computer Education students in Colleges of Education in South-South, Nigeria.
- H0₂ Algorithm control development skill does not significantly predict programming capability of Computer Education students in Colleges of Education in South-South, Nigeria.

Design of the Study

The researcher used ex-post facto design for the study. This is because the events to be investigated had already occurred. In this case, the student projects in programming research work in both state and federal colleges of education in South-south, Nigeria). In the opinion of Nworgu (2009), ex-post facto studies seek to establish what relationship exists between tow variables. In this case, algorithm development skills need and programming capability. Therefore, the design is considered suitable since information on algorithm development skills need were sought from Colleges of Education students through their programming research work by lecturers in South-South Nigeria using questionnaire to determine their programming capability.

The independent variable in this study is algorithm development skill need which was further broken into five independent sub-variables; algorithm logic development, algorithm control development, logical thinking, algorithm problem-solving, and data structure handling skills. These variables were measured in this study because it is confirmed that when students acquire skills in them, they will be able to design and develop computer program accordingly that is up to international standard and acceptable for deployment by organisations.

Area of the Study

The area of the study is South-South geo-political zone of Nigeria. This zone is popularly known as the oil rich zone of Nigeria. It is made up of six States in the Federal Republic of Nigeria namely: Akwa Ibom, Bayelsa, Cross River, Delta, Edo and Rivers.

Population of the Study

The target population of this study consisted of 125 Computer Science lecturers in the Colleges of Education in the South-South geopolitical zone of Nigeria, (NCCE report, 2017). The states are; Rivers State, Cross River State, Delta State, Bayelsa State, Akwa Ibom State and Edo State. The population distribution of the lecturers in each State and Federal Colleges of Education in the south-South zone showed that Federal College of Education (T), Omoku, Rivers State has 19 lecturers, Federal College of Education, Obudu, Cross River State has 16, Federal College of Education, Asaba, Delta State has 18 Lecturers, Isaac Boro College of Education, Sagbama, Yenoagoa – Bayelsa has 15 lecturers, Akwa Ibom State College of Education, Afaha Nsit has 10 lecturers, College of Education, Etienoro, Edo State has 16 lecturers, Rivers State College of Education, Rumuolumenu has 18, and College of Education, Ebejeba - Warri, Delta State has 13 lecturers.

Sample and Sampling Technique

The sample size for the study consisted 95 lecturers of Computer Science in the department of Computer Science Education in the Colleges of Education in the zone. The adoption of the sample size was based on the Krejcie and Morgan (1970) who presented a table for various level of population with corresponding sample sizes. The sample was also supported by statistically determined using Taro Yamane formula.

Instrumentation

The researcher-developed instrument titled “Algorithm Development Skill Needs (ADSNQ)”. Questionnaire was used in collecting data for the study.

Validation of the Instrument

The research instruments were given to three research experts for face validation. Two of the experts from the Department of Vocational Education and one from the Department of Educational Foundations, Guidance and Counselling all in the University of Uyo. These experts were requested to read through the instrument item by item, make corrections, indicate the suitability of the items, language used and the arrangement of the items in logical and chronological sequence. Their comments, suggestions, corrections and other inputs were included in the instrument and used for the final copy.

Reliability of the Instrument

The internal consistency of the instrument was determined using Cronbach’s Alpha technique. A trial test was carried out using 10 Computer Education lecturers who were not part of the main study. The resulting data was subjected to Cronbach’s Alpha analysis. Reliability coefficients of 0.78 and 0.84 were obtained for students’ algorithm development skills and their programming capability respectively. This indices being high indicates that the two instruments were reliable for use in the study.

Method of Data Collection

The distribution of the questionnaire was carried out by the researcher in order to achieve high rate of returns and as well prevent loss of instrument. One research assistant was selected from each of the State and Federal Colleges of Education that were selected for the study to help in the

administration and collection of the instrument from the respondents through introduction letter by the department. All the copies were completed and returned.

Method of Data Analysis

The data collected from the study were analyzed using Statistical Package for Social Sciences (SPSS) to compute Simple Liner Regression in order to answer the research questions and for testing the null hypotheses at 0.05 level of significance. This statistical tool was used because it would enable the researcher to determine the extent the independent sub-variables predict the dependent variable.

Results

This section presents the results of the analysis of the date obtained and its interpretation. The R and R² of the Simple Linear Regression analysis were used in answering the research questions while the p-value was used for testing the null hypotheses at 0.05 alpha levels

Research Question One

To what extent does algorithm logic development skill predict programming capability of Computer Education students in Colleges of Education in South-South, Nigeria? R-value and R-square value of simple regression analysis were used for answering the research question. The result of the analysis is summarised in Table 1

Table 1: R and R² value of the extent to which algorithm logic development skill predict programming capability of Computer Education students in Colleges (N=95)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Remark
1	.427 ^a	.182	.174	.99865	Very Low Prediction

The result presented in Table 1 shows the linear regression analysis of the extent to which algorithm logic development skill predict programming capability of Computer Education students in Colleges of Education. The table shows the R-value of 0.427 while R-square (coefficient determination is 0.182. This implies that in the regression model, the independent variable (algorithm logic development skill) accounts for 18 percent of the variance in the dependent variable (programming capability). This result indicate that the extent to which algorithm logic development skill predict their programming capability in computer programming is at a very low extent

Research Question Two

To what extent does algorithm control development skill predict programming capability of Computer Education students in Colleges of Education in South-South, Nigeria?

The data for answering research question 2 is summarised in Table 2

Table 2: R and R² values of extent to which algorithm control development skill predict programming capability of Computer Education students in Colleges of Education (N=95)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Remarks
1	.382 ^a	.146	.137	1.02058	Very Low Prediction

The result of the linear regression analysis of the extent to which algorithm control development skill predict programming capability of Computer Education students in Colleges of Education is presented in Table 2. The R-value is 0.382 while R-square value is 0.146. This implies that in the regression model, the independent variable (algorithm control development skill) accounts for 14 percent of the variance in the dependent variable (programming capability). This result indicates that the extent to which algorithm control development skill predict their programming capability in computer programming is at a very low extent

Research Hypothesis 1 (H₀₁)

Algorithm logic development skill does not significantly predict programming capability of Computer Education students in Colleges of Education in South-South, Nigeria. The data relating to this hypothesis is summarised in Table 3

Table 3: Summary of Linear Regression Test of Students algorithm logic development skill as a significant predictor of programming capability of Computer Education students in Colleges of Education (N=95)

Model		Sum of Squares	Df	Mean Square	F	Sig.	Decision
1	Regression	20.690	1	20.690	20.746	.000	
	Residual	92.750	93	.997			S
	Total	113.440	94				

The F-statistics testing on the extent to which algorithm logic development skill as a significant predictor of programming capability of Computer Education students in Colleges of Education is shown in Table 3. The test yields an F-value of 20.7 with a p-value of 0.00. Since the p-value (0.00) is less than 0.05, the null hypothesis tested is rejected. It implies therefore that logic development skill is a significant predictor of programming capability of Computer Education Students in Colleges of Education.

Research Hypothesis 2 (H₀₂)

Algorithm control development skill does not significantly predict programming capability of Computer Education students in Colleges of Education in South-South, Nigeria. The data relating to this hypothesis is summarised in Table 4.

Table 4: Summary of Linear Regression Test of Students algorithm control development skill as a significant predictor of programming capability of Computer Education students in Colleges of Education (N=95)

Model		Sum of Squares	Df	Mean Square	F	Sig.	Decision
1	Regression	16.573	1	16.573	15.911	.000	S
	Residual	96.867	93	1.042			
	Total	113.440	94				

The F-statistics testing on the extent to which algorithm control development skill as a significant predictor of programming capability of Computer Education students in Colleges of Education is shown in Table 4. The test yields an F-value of 15.9 with a p-value of 0.00. Since the p-value (0.00) is less than 0.05, the null hypothesis tested is rejected. It implies therefore that algorithm control development skill is a significant predictor of programming capability of Computer Education Students in Colleges of Education

Findings

The following are the findings of the study based on the research questions and the hypotheses.

1. There is a very low prediction of algorithm logic development skill on computer education students programming capability in Colleges of Education in South-south Nigeria.
2. There is a very low prediction of algorithm control development skill on computer education students programming capability in Colleges of Education in South-south Nigeria.
3. Algorithm logic development skill significantly predicts computer education students programming capability in Colleges of Education in South-south Nigeria.
4. Algorithm control development skill significantly predicts computer education students programming capability in Colleges of Education in South-south Nigeria.

Discussion of Findings

Students algorithm logic development skill and their programming capability in Colleges of Education in South-south Nigeria.

The findings of the study are discussed as follows:

The analysis reveals that there is a very low algorithm logic development prediction on their programming capability. The study also reveals through testing of the null hypotheses which was rejected that algorithm logic development significantly predict programming capability of students in Colleges of Education in South-south Nigeria. This implies that many computer education students in Colleges of Education do not have the algorithm logic development skill needed for improving programming capability. This finding is very obvious that the reason why computer education students in Colleges of Education do not write good program is because they lack algorithm development logic skill.

The study revealed that for computer education students in Colleges of Education to effectively design standard program, they need to acquire algorithm logic development skills. The

knowledge of logic development has always been an essential skill for computer education students and this cannot be achieved without the understanding of the construct and syntax of programming language.

The findings of this study does not differ from the findings of Rosmah and Zamzuri (2014) who studied difficulties in understanding programming among computer science students. The findings of his study reported that algorithm logic development skill can help in being effective in programming, without which it would be difficult to write a successful programming code.

Students algorithm control development skill and their programming capability in Colleges of Education in South-south Nigeria.

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The findings agree with the findings of Etokebe (2015) who conducted a study on the relationship between algorithm control skills and students' ability to develop websites for companies. The findings of his study reported that there is a significant relationship between possession of algorithm control skills and website design and development.

Conclusion

Within the scope of the study, it is concluded that algorithm development skills among Computer Education Students have significant impact on their programming capability, particularly in the areas of software development during project writing. In other word, the study found that majority of Computer Education students in Colleges of Education do not effectively master algorithm development processes before attempting to write programs. It is therefore very important that lecturers teaching Computer Science courses in Colleges of Education in south-south Nigeria should endeavour to acquire the relevant teaching competences in algorithm development to enable them teach effectively. Also, students of computer science education should as well develop their interest in algorithm and programming to enhance their academic performance and skill acquisition in the course.

Recommendations

The following recommendations were made based on the findings of this study

1. Students of Computer Science Education in Colleges of Education in South-south, Nigeria should endeavour to update their knowledge in various strategies of algorithm development, particularly; algorithm logic development skill, algorithm control development, algorithm logical thinking skill, algorithm problem-solving skill, and data structure handling skill. These will surely improve their programming capability for standard software development
2. The management of Colleges of Education in South-south Nigeria should give concern attitude to the provision of learning resources in the areas of computer programming to enhance skills in software development
3. The National Commission for Colleges of Education (NCCE) in collaboration with the Teachers Registration Council of Nigeria (TRCN) should enforce the policy that only those with good background in computer science plus relevant teaching qualifications should be allowed to teach computer courses in Colleges of Education in Nigeria.

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