

THE INTERNATIONAL JOURNAL OF SCIENCE & TECHNOLEDGE

Effects of Computer Assisted Instruction on Computer Science Students' Achievement and Performance Using Qbasic Web-Quest Package in A Nigerian Secondary School

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Abstract:

The purpose of this study was to explore the effect of Web-Quest package as an instructional tool on the academic achievement of senior secondary school students learning QBASIC programming language. The study adopted a pretest-posttest quasi-experimental design involving 80 students of senior school II computer science students. The independent variable was Web-Quest instruction package on one level (lecture method) as the control group. Data were collected using QBasic achievement test (QBAST). Analysis of variance (ANOVA) and analysis of covariance (ANCOVA) was used for analyzing the obtained data. Our findings on mean achievement scores of students exposed to QBASICWQ showed that there are no significant differences in the mean achievement scores of students exposed to QBASICWQP, Post-test (61.78) and Pre-test (53.83). Findings on effects of Web-Quest package to that of lecture methods on SSII students' achievement scores in learning programming (QBASIC) showed significant effects ($f\text{-cal} = 3.341$, $df = 79$, significant level = 0.00, $P < 0.05$). Finding based on the achievement level of the respondents was significant (High (70.63), Medium (54.60), and Low (39.00)). This showed that 50% of the students scored higher, which implies that WebQuest had an effect on students' performance level because a large number of students performed better. Finding between male and female students' performance after being exposed to (QBASICWQP) showed significant difference ($F\text{-cal} = 51.550$, $df = 39$, sig. level = 0.000, $P < 0.05$) in favour of the male students. Based on the findings, it was recommended that curriculum planners should work hand in hand with teachers to develop and evaluate the use of WebQuests for teaching QBasic programming language among others.

Keywords: Web Quest, students' achievement, students' performance, computer assisted instruction, educational technology

1. Introduction

Despite advances in educational technology and basic educational research, teaching and learning in Nigeria continues to experience challenges to acquisition of functional education. However, information and communication technologies have gained more positive impact on educational development of students and teachers around the globe. The focus is on ways in which technology can be used to support instructional delivery as well as students' achievement in education (Gambari, Ezenwa & Anyanwu, 2014; Chukwuemeka & Iscioglu, 2016; Idowu & Odewumi, 2017). In support of this, Onasanya, Fakomogbon, Sheu, and Soetan, (2010) maintained that it has become crucial that teaching and learning process should be given priority through to the utilization of various emerging technology platforms as they play significant role in the advancement of knowledge. For example, information and communication technologies used in distance learning such as computer have brought about increasing benefit like cutting the costs of education; improving access to education; and providing time flexibility for learners (Grabe & Grabe, 2007).

The use of computers and other information technologies have shifted from their uses mainly as instructional delivery platforms to transformational media considered as essential part of the teaching and learning process (Abdullahi, 2004). The use of technology as a veritable tool in the new educational field requires adequate pedagogical approach so that teachers' presentation and students' learning outcomes can be improve. Computers as new technologies are known to provide some essential learning medium like to drill and practice and computer-based tutorials in computer science.

Computer Science is a field of study that deals with information, communication and computation, together with the practical techniques for the implementation and application in all spheres of life. Educational institutions and the organizations that recognize educational programs have accepted the importance of preparing both teachers and learners to use technology efficiently (Duhaney, 2001; Willis & Raines, 2001). Computer Assisted Instruction (CAI) learning style can significantly improve students' achievement and attitudes while decreasing necessary instructional contact times.

Hassanien (2006) opined that one of the most comprehensive effectiveness of using computers is to increase student achievement and that computer-based tutorials produce improvements in learning outcomes of approximately twenty percent (20%) above the average for no computer-based learning. Effective use of simulation, interactive video instruction, hypertext programs, bulletin boards and networks can enhance teaching and learning. In addition to other telecommunication mediums such as the internet, satellite interactive television, and interactive multi-media widely used in developed nations of the world.

Nevertheless, Green and Gilbert (1995) argue that despite an increasing access to technology within education, using the innovative technologies as tools for teaching and learning has remained low. Computer is regarded as a potentially valuable tool for improving teaching and learning in all levels of education. In the same vein, it should be noted that technology alone does not guarantee solutions to educational problems. It can only have an encouraging impact when used within the framework of a good strategic plan to support teaching and learning.

The new technologies have the potential to support education from curriculum development to curriculum implementation. Computer provide opportunities for effective communication between teacher and students in ways that have not been possible before. Many researches have been conducted in the past relating to ICTs usage in education and students' achievement (Idowu & Odewumi, 2017). Idowu and Odewumi (2005) asserted that ICTs usage in education can empower teachers and learners by transforming teaching and learning processes from being highly teacher-dominated to student-centred, and that this transformation will result in increased learning gains for students, creating and allowing for opportunities for the learners to develop their creativity, problem-solving abilities, informational reasoning skills, communication skills, higher-order thinking skills and collaborative learning. Educationists should therefore promote and encourage the use of computer-assisted learning packages especially Web-Quest learning systems, which are rated to providing better opportunities compared to other computer programs.

Although, the perception of Web-Quest as learning tool is new, however, it had been in existence since the mid-nineties. In fact, the term 'Web-Quest', is referring to: "An inquiry-oriented activity in which most or all of the information used by learners is drawn from the web. Web-Quests are designed to use learners' time well, to focus on using information rather than looking for it, and to support learners' thinking at the levels of analysis, synthesis, and evaluation".

Ezell (2003) stated that Web-Quests can be developed for various subject areas at different educational levels. He maintained that Web-Quest is a technological tool which is frequently being used to improve the quality of teaching and learning in all educational level. Ezell (2003) believes that this type of technology has not been sufficiently used and there is room for further development. Web-Quest can provide an effective instructional tool for students at all levels of academic endeavours. For instance, Littlejohn (2003) maintained that the rationale for the use of the Web-Quest for learning can be grouped into four:

- Students are usually more motivated to use computer technology for learning than the traditional method.
- Students can find current information on research and other area of learning by using a range of resources that may otherwise be difficult or expensive to use.
- Students have opportunities to be engaged with interactive resources through the worldwide web
- Research method and other abstract subject are difficult in terms of concepts and philosophies and it was felt that this Web-Quest would enable students to link theory to practice

Dudeney (2003) identifies the Web-Quest model as a potential pedagogical tool by pointing out several advantages. They include providing a relatively easy way to incorporate the internet into the language classroom, encouraging critical thinking, leading to more communication and interaction through group activities, and eliciting greater learner motivation through interdisciplinary studies as well as "real-life" tasks.

AL-Khataybeh and AL-Awasa (2016) recommended that Web-Quests should be used for learning language in several aspects. In engaging in a Web-Quest activity, learners have the possibility of being exposed to the target language by surfing on the web. In making sense out of the web documents while scanning the websites is a useful exercise for learners to increase their language comprehension. In addition, the problem-solving approach of Web-Quests may facilitate language learning.

Research has shown that male students are more resourceful in the use of ICT than female counterparts (Volman, Eck, Heemskerk, & Kuiper, 2005). Wintz (2009) explained in his study that there was a difference in the performance of male and female students when both make use of ICTs for learning. However, Onasanya, Fakomogbon Sheu and Soetan (2010) observed that there was no difference in the male and female students' usage of ICTs for learning. Mudiwa (2003) used WebQuest for social studies students and results shown that the integration of a WebQuest can improved students' performance in the post-test. Amidst all the research reviewed in Nigeria, no one seemed to have been able to produce any developed QBASIC Web-Quest Package that can be used to evaluate computer studies students in senior secondary schools.

1.1. Statement of the Research Problem

Teaching of programming languages has since not been easy and the usefulness cannot be over emphasized. Many at times tutors find it difficult to stay with their learners through the long hours of learning. Thus, this study is to bridge

the gap that exists between the teachers and students in the teaching and learning process; help in teaching the students at the absence of the teachers and also evaluates them at the end of each lesson. In this regards a close look of Web-Quests' effects on student learning of QBASIC needs to be completed to ensure that technologies application currently used in the classroom are having positive effect on teachers and students teaching and learning process. Although this can only happen if the governments, non-governmental organization and well to do individuals are able to provide schools with the modern ICTs gadgets to help teachers overcome lack of confidence. Nevertheless, this study aims at evaluating Web-Quest package as an instructional material for teaching and learning QBASIC programming language among computer science students in senior secondary schools in Nigeria.

1.2. Research Questions

The following research questions were raised to guide the study;

- Are there any differences in the mean achievement scores of students exposed to QBASICWQP?
- Are there any effects of Web-Quest package and traditional method (lecture methods) on SSII students' achievement scores in learning programming learning (QBASIC)?
- Are there any significant differences in the mean achievement scores between High, Medium and Low of students taught using QBASICWQP.
- Is there any difference between the performance of male and female students after being exposed to QBASICWQP?

1.3. Research Hypothesis

The following hypothesis were formulated and tested at a significant level of 0.05

- HO₁: There are no significant differences in the mean achievement scores of students exposed to QBASICWQP and those taught using lecture method.
- HO₂: There are no effects of Web-Quest package to that of traditional method (lecture methods) on SSII students' achievement scores in learning programming learning (QBASIC).
- HO₃: There is no significance difference in the mean achievement scores of High, Medium and Low students taught QBASIC using Web-Quest Package (QBASICWQP).
- HO₄: There is no significant difference between the performance of Male and Female students after being exposed to QBASICWQP.

2. Methodology

The study adopted Quasi Experimental Design (Pre-Test and Post-Test, Experimental and Control Group design). The research involves two levels of independent variable (QBAST and QBASICWQP), two level of gender (male and female) and three levels of academic achievement (High, Medium and low). The design is considered appropriate because this study establishes the evaluation of Web-Quest Package as instructional materials in the teaching and learning of QBasic programmes. All the groups were given Pre-test before the treatment. Experimental group was exposed to the use of Web-Quest Package, while the control group was exposed to lecture method. The post-test was administered on the groups after four weeks treatment. The research design layout is shown in Table 1 below;

GROUPS	PRE-TEST	TREATMENT	POST-TEST
Experimental Group	EG ₁	X ₁	EG ₂
Control Group	CG ₁		CG ₂

Table 1: Research Design Layout

Keys: EG₁ (Pre-Test on Group 1), EG₂P (Post-Test on Group 2), CG₁ (Pre-Test on Group 1), CG₂ (Post-Test on Group 2), X₁ (Treatment)

The target population for the study comprised of all the Senior Secondary School (SS 2 class) Computer students in Niger State. The teachers who taught Computer Studies were used as the research assistants during the study. Multi-stage sampling technique was adopted. The sampled schools were purposive selected. Two (2) secondary schools were sampled based on equivalence (manpower, facilities and laboratories), school type (Federal owned school), gender composition (Mixed schools), ICT Equipment (computer laboratories under SchoolNet Programme), exposure (students and teachers are exposed to computer in their school). Simple random sampling technique was used in selecting 80 students that were involved in this study from within the selected schools. Stratified sampling techniques was later adopted in order to classify the respondents into different strata based on gender (male and female) and achievement level (High, Medium and Low) based on their performance in last promotion examination in Computer Science. High within the upper 75% (3rd quartile), Medium achievement level students' scores were within the middle 50% (2nd quartile), while students whose scores fall within and lower than 25% (1st quartile) were classified as students in low achievement level.

Groups	Gender			Achievement levels			
	Male	Female	Total	High	Medium	Low	Total
QBAST	40	40	80	23	44	13	80
QBASICWQP	40	40	80	40	21	19	80

Table 2: Sample Distribution

Table 2 shows that 40 males and females respectively were exposed to QBASICWQP, as the experimental group while 40 males and females were exposed to QBAST for the control group.

The instruments were categorized into treatment instrument QBASICWQP and test instrument QBAST. The instructional content was developed by researchers based on the content of Senior Secondary School 2 Computer Studies textbook in conjunction with a computer programmer. The Instructional Web-quest package consisted of Introduction to QBasic, Sub-divided into Chapters. The Instructional web-quest Package was developed using HTML Macromedia Flash Java Script and Internet Resources. While the test instrument QBasic Achievement Test (QBAST) for Secondary School in Nigeria was formulated by the researchers, BECE, NABTEB Chief Examiners alongside the computer studies teachers. These instruments were administered to the experimental and control group as pre – test and post – test respectively. In scoring the multiple-choice questions, each of it was awarded 1 mark for correct option chosen and later converted to percentage.

To ensure the validity of the instruments QBASIC Web-Quest Package was assessed by two Educational Technology experts, NABTEB and NECO BECE Chief Examiners and three Computer Lecturers while the QBAST was given to two senior lecturers in the department of Information and Communication Technology from the Federal University of Technology Minna, and two senior Secondary School Computer Studies Teachers for scrutiny and modification of items. The package and the test items were modified and corrected based on comments and suggestion of the experts. The reliability of the QBASIC Web-Quest Package (QBASICWQP) was determined through a pilot test using a sample of 30 randomly selected SS 2 students who were part of the research population but not part of the selected sample schools. The test data collected was tested using the Test-retest method. The reliability coefficient of the instrument was 0.78 using Cronbach Alpha formula.

The QBAST contains 40 questions which was administered both to the experimental and the control groups as pre-test and post-test. Each carry equal marks which were converted to percentage. Hypotheses 1, 2 and 4 will be analyses using Analysis of Variance (ANOVA) while Hypotheses 3 will be analyses using Analysis of Covariance (ANCOVA). All hypotheses were tested at 0.05 alpha level of significance. The data collected was treated and analysed using SPSS version 16.

3. Findings

3.1. Research Question 1

Finding on research question 1, if there are any differences in the mean achievement scores of students exposed to QBASICWQP are presented in Table 3 below;

		Mean	N	Std. Deviation	Std. Error Mean
	PRE-TEST WEBQUEST	53.8312	80	9.90810	1.10776
	POST TEST WEBQUEST	61.7750	80	13.15461	1.47073

Table 3: The Mean Achievement Scores of Students Exposed to QBASICWQP

Table 3 shows the mean pre-test and post-test achievement scores of students exposed to QBASICWQP. The mean pre-test WebQuest score for achievement is 53.83, while the mean post-test Web Quest score is 61.78. Considering H_{01} : There are no differences in the mean achievement scores of students exposed to QBASICWQP, ANOVA was used to explore significance differences in the mean achievement scores of students exposed to QBASICWQP.

		Sum of Squares	Df	Mean Square	f-cal	Sig. Level
	Between Groups	5426.194	25	217.048	1.422*	.139
	Within Groups	8244.256	54	152.671		
	Total	13670.450	79			

Table 4: ANOVA Summary of the Mean Achievement Scores of Students Exposed to QBASICWQP ($P > 0.05$)

The result in table 4 shows that f-calculated 1.422, df= 79, sig. level = 0.139, $P > 0.05$ is not significant. Therefore, the null hypothesis was not rejected which implies that there is no significant difference in the mean achievement scores of students exposed to QBASICWQP.

3.2. Research Question 2

Findings on the effects of Web-Quest package and traditional method (lecture methods) on SSII students' achievement scores in learning programming learning (QBASIC) is presented in Table 5 below;

GROUPS	N	Mean	Std. Deviation	Std. Error Mean
EXPERIMENTAL	160	57.8031	12.27311	.97027
CONTROL	160	37.8406	11.92210	.94252

Table 5: Effects of Web-Quest Package and Lecture Method on SSII Students' Achievement Scores in Learning Programming (QBASIC)

Table 5 shows the mean score of the Experimental Groups is 57.80 and the Control Groups is 37.84. Further analysis was done as to test the null hypothesis of effects of Web-Quest package to that of lecture methods on SSII students' achievement scores in learning programming learning (QBASIC), H_{O_2} .

	Sum of Squares	df	Mean Square	F-cal	Sig. Level
Between Groups	5555.064	34	163.384	3.341*	.000
Within Groups	2200.408	45	48.898		
Total	7755.472	79			

Table 6: ANOVA on the Effects of Web-Quest Package to That of Lecture Methods on SSII Students' Achievement Scores in Learning Programming (QBASIC) ($P < 0.05$)

The result in Table 6 shows that f-calculated 3.341, $df = 79$, significant level = 0.00, $P < 0.05$ is significant. Therefore, the null hypothesis was rejected. This indicates that there are effects of Web-Quest package to that of lecture methods on SSII students' achievement scores in learning programming learning (QBASIC).

3.3. Research Question 3

Findings if there are any significant differences between the mean achievement scores like High, Medium and Low of SSII using QBASICWQP.

Achievement Level	Mean	N	Std. Deviation
HIGH	70.6250	40	7.94754
MEDIUM	54.5952	21	1.36582
LOW	39.0000	19	6.60387
Total	58.9062	80	14.53849

Table 7: The Differences between the Mean Achievement Scores Like High, Medium and Low of SSII Students Taught QBASIC in Computer Science Using Web-Quest (QBASICWQP)

Table 7 shows the means score of High (70.63), Medium (54.60), and Low (39.00) showing that 50% of the students scored higher which implies that WebQuest had effect on the students' performance level. The analysis further tested H_{O_3} using ANCOVA as presented in Table 8 below;

Source	Type III Sum of Squares	df	Mean Square	F-cal	Sig. Level
Corrected Model	2010.542 ^a	2	1005.271	13.474*	.000
Intercept	478.654	1	478.654	6.415*	.013
ACHIEVEMENT	42.383	1	42.383	.568	.453
LEVEL	651.065	1	651.065	8.726*	.004
Error	5744.930	77	74.609		
Total	239579.750	80			
Corrected Total	7755.472	79			

Table 8: ANCOVA Summary of the Mean Achievement Scores of High, Medium and Low Students Taught QBASIC Using Web-Quest Package (QBASICWQP) $R^2 = .259$ (Adjusted $R^2 = .240$), ($P < 0.05$)

The result in Table 8 shows that F-calculated 8.726, $df = 1$, significant level = 0.004, $P < 0.05$ is significant. Therefore, the null hypothesis was rejected which implies that there is significant difference in the mean achievement scores of High, Medium and Low students taught QBASIC using Web-Quest Package (QBASICWQP) because majority of students performed better.

3.4. Research Question 4

Findings if there any difference between the performance of male and female students after being exposed to (QBASICWQP).

	N	Mean	Std. Deviation	Std. Error Mean
MALE	40	56.6750	12.77997	2.02069
FEMALE	40	54.7625	10.78816	1.70576

Table 9: Gender Performance of Male and Female Students after Being Exposed to (QBASICWQP)

Table 9 shows the male mean of 56.68 and female mean of 54.76. The gender group score is almost the same after been expose to the use of WebQuest in teaching QBasic in SS II students.

To test null hypothesis H_{04} regarding gender performance after being exposed to QBASICWQP. The result is presented in table 10 below;

	Sum of Squares	Df	Mean Square	F-cal	Sig. Level
Between Groups	6156.510	14	439.751	51.550*	.000
Within Groups	213.265	25	8.531		
Total	6369.775	39			

Table 10: ANOVA Summary of Difference between the Performance of Male and Female Students after Being Exposed to (QBASICWQP)

* = Significant At ($P < 0.05$)

The result in table 10 shows that F-calculated 51.550, $df = 39$, significant level = 0.000, $P < 0.05$ is significant. Therefore, the null hypothesis was rejected which implies that there is significant difference between the performance of Male and Female students after being exposed to QBASICWQP in favour of the male students.

4. Discussion of Findings

4.1. Research Question 1, Hypothesis

Finding on mean achievement scores of students exposed to QBASICWQ showed that there are no significance differences in the mean achievement scores of students exposed to QBASICWQP, Post-test (61.78) and Pre-test (53.83). This is as a result of the treatment given to them. The improvement on the Post-test shows that the students have learnt what they have been taught using the QBASICWQP. This finding agreed with Sox and Rubinstein (2009) who optioned for the adaptation and use of WebQuest integration to technological competencies and content area knowledge development at secondary level and to support the linguistic needs of English language learners. The researchers are of the view that student should be taught with WebQuest method because it enhances students learning ability.

4.2. Research Question 2, Hypothesis 2

Findings on effects of Web-Quest package to that of lecture methods on SSII students' achievement scores in learning programming learning (QBASIC) showed significant effects. This is as a result of the treatment given to them over the control taught QBasic. Similarly, the findings agree with the studies of Llach and Gallego (2012), who study confirmed that CAI has been effective in enhancing students' performance in other subjects than the traditional lecture method. Also, Ford, Mazzone and Taylor (2005) were of the view that students exposed to CAI in the learning of Musculoskeletal Special Tests performed better than students exposed to conventional method of instruction in the same task. This study is in contradiction with the findings of Idowu and Odewumi (2017), which reported that there was no significant difference on the performance of students taught visual art using computer assisted instructional packages and those taught with conventional classroom instruction.

4.3. Research Question 3, Hypothesis 3

Finding on the achievement level showed significant because large number of students performed better. The result also conforms with that of Emeke and Adegoke (2014), Falaye (2006), Denessen *et al.*, (2008), Karademir and Uçak (2009), who all reported that high ability students performed better than low ability students. Even though it is not compulsory that there should be significant difference between higher and low students' ability as reported by Muhfahroyin (2009) whose findings shows that no difference between higher and lower students' ability in the cognitive achievement of Biology. In addition, they were of the opinion that ability grouping has no effect on students' achievement level.

4.4. Research Question 4, Hypothesis 4

Finding regarding male and female students performances showed significant difference between male and female students after being exposed to (QBASICWQP) in favour of the male students. The study is in agreement Afolabi and Yusuf (2010) and Gambari *et al.*, (2014) findings, which established that male students performed better than the females in science-oriented courses. On the other hand, results of this study contradict that of Gwandu (2005), Ibrahim (2005) and Idowu and Odewumi (2017) whose findings report that there is no significant difference between the mean achievement scores of male and female students learning Biology, Government and Visual art respectively taught with the Computer Assisted Learning Strategy. Their research shows that CALS could motivate male and female in a similar way and promote their performances at the same level.

5. Conclusion

In conclusion, the Web-Quest Package used was found to be effective, the experimental group had a significant improvement in performance after being exposed to teaching and the package goes a long way in making the lesson more interesting and give a better performance to the learners.

6. Recommendations

Based on the findings, the following recommendations were made.

- Curriculum planners should work hand in hand with teachers to develop and evaluate the use of WebQuests for teaching QBasic programming language. This will increase teachers' knowledge on new ICT-Based Instructional Strategies;
- Government at all level and educationalist should endeavour to see the brilliant benefits of WebQuest in teaching and learning, since the application of WebQuest in teaching and learning Computer Science serve as a motivator which encourages students to have positive attitude towards their learning QBasic programme.
- Teachers in Senior Secondary Schools should work hand-in-hand with computer software developers to develop and come out with relevant ICT-Based instructional like WebQuest for use in the school; and
- Workshop and seminars should be given to Computer Science Teachers in Senior Secondary schools to enhance their skill towards developing and evaluating computer assisted instructional packages such as WebQuest Packages.

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