

INVESTIGATING THE EFFECTIVENESS OF WEB-BASED INSTRUCTION ON JUNIOR SECONDARY SCHOOL STUDENTS' RETENTION IN BASIC TECHNOLOGY IN NIGERIA

**Vivian Njideka ANUNOBI, Amosa Isiaka GAMBARI,
Mohammed Bashiru ABDULLAHI, Thomas Omotayo ALABI**
Federal University of Technology, NIGERIA

Abstract. The study examined the Effects of Web-Based Instruction on Junior Secondary School Students' Retention in Basic Technology in Nigeria. Quasi-experimental design (pretest-posttest, non-equivalent, non-randomized control group design) was adopted in this study. 119 Junior Secondary School class two (JSS II) students were drawn from four co-educational registered private secondary schools in Minna Metropolis, Nigeria. Three research questions with corresponding hypotheses were formulated and tested at 0.05 level of significance. Basic Technology Achievement Test (BTAT) consists of 50 items, multiple choice objectives question was used for data collection. Web-based instruction (WBI) and BTAT were validated by education technology experts, computer experts, industrial and technology education lecturers, secondary school basic technology teachers and basic technology students. BTAT was subjected to pilot test and 0.90 reliability coefficient was obtained using Pearson Product Moment Correlation Coefficient. BTAT was administered on students in experimental and control groups and data obtained were analyzed using Analysis of Covariance (ANCOVA) to test the hypotheses. The results of the study

indicated that students exposed to Web-Based Instruction retained basic technology concepts than their counterparts exposed to Conventional Teaching Method. There was no significant difference between the mean retention scores of male and female student exposed to Web-based instructions; high, medium, and low achievers' students exposed to WBI retained the concept of Basic Technology equally. Based on the above findings it was recommended that Web-Based Instruction should be used to improve students' retention in Basic Technology.

Keywords: web-based instruction, basic technology, retention, achievement level, gender

Introduction

Junior Secondary School education is both pre-vocational and academic, universal and compulsory for all Nigerian children. The goal of Junior Secondary School is to enable students to acquire knowledge and skills which will prepare them for useful living within the society. In specific term, Junior Secondary School Education should give learners opportunity to discover and develop their potentials. The three main objectives of Basic Technology as stated in the national policy of Education are: to Provide pre- vocational orientation for further training in Technology; to provide Basic Technology literacy for everyday living, and to stimulate creativity (Ajani, 2009; FRN, 2013).

Basic Technology is a subject borne out of the desire of educationists of Nigeria origin to have an education that will fit into the culture and development trend of the nation. This is the kind of education that will prepare students towards acquiring manipulative skills for effective participation in nation building. This subject in addition to the above introduces a child into the world of technology. The knowledge of which can help the Nigerian child to acquire technical skills in relevant fields. But in Nigeria society today the reverse is the case. Most of these aspirations are not met and these can be traced to a number

of problems which include:

Curriculum inadequacy; Problem of Funding; Problem of Equipment installation; Shortage of Trained Technical Teachers; Wrong Method of Education and Educational Policy; Inadequate Facilities and Instructional Media; and Poor Methods of Instructional Delivery (Uwaifo & Edigin, 2011).

Presently, the common method of instruction applied by teachers in secondary schools in Nigeria is lecture method which involves verbal presentation of subject matter/content. Lecture method as conventional method, is didactic, stereotype and non-result oriented. It is often described as “talk and chalk” method because it presents information to the students who merely listen. Teachers do all the talk while students listen and copy notes on the chalkboard after the lesson (Akpoghol et al., 2016). This teacher-centered approach dominates the educational system in Nigeria except for a few private schools that are well equipped with modern Information and Communication Technology (ICT) facilities such as computer laboratories with computers and internet facilities, interactive whiteboards, learning software, and many others. These schools have internet connectivity such as Wi-fi with adequate bandwidths to enable their students learn via World Wide Web.

The World Wide Web can be used to provide instruction and instructional support. Web-based instruction offers learners unparalleled access to instructional resources, far surpassing the reach of the traditional classroom. It also makes possible learning experiences that are open, flexible, and distributed, providing opportunities for engaging, interactive, and efficient instruction (Olson & Wisner 2002). Web-based instruction offers multiple dimensions of use in education and training environments. It is capable of providing direct instruction to meet individual learning objectives. Due to its networking capability, the Web can play additional roles. These include promoting and facilitating enrolment into courses, availing the syllabus or program of instruction, posting and submitting assignments, interacting with instructors and fellow students, collaboration on assignments, and building learning communities.

In spite of the potentials of web-based instruction, empirical studies on effects of web-based instruction is conflicting. For instance, Guzeller & Akin (2012) reported that students exposed to WBI achieved better than their counterparts exposed to the conventional instructional strategy. Also, Thrasher et al. (2012) reported that students in the web-based instruction sections of a course outperformed their counterparts in another classroom. Similarly, Yamauchi (2008) observed that students in the experimental group had a significantly higher gain score than students in the control group. In another study, Erdogan et al. (2008) reported that web-based education has positive effects on the improvement of academic achievement and on motivation for learning. However, Okeke & Osuagwu (2012) also reported that the students who learnt in the traditional way performed marginally better than the Technology Enhanced Learning (TEL) students. Similar to Okeke and Osuagwu's report, Wagner et al. (2011) and Stack (2015) reported no significant difference in student performance between the two modes of course delivery (online and traditional instruction).

Retention which is an ability to remember or recognize the content that has been learned or experienced is an importance issue in teaching and learning. Learning is complete when knowledge can be transferred into a new situation. The need to have varied practice tools is to facilitate transfer and enhance retention process. Studies on types of learning tools that promote students' retention is yet to be concluded. For instance, Shieh & Yu (2016) revealed that guided discovery instruction influenced learning retention. Similarly, Wang (2016) results showed that the vocabulary mean scores from both immediate and delayed testing demonstrated significantly better results in word gain and word retention with the customised reading group and that the adaptive reading system was appealing for the students. In a study conducted by Dasdemir (2013) the results revealed that students use of animation in basic education had positive effects on the academic achievements and retention of the students. Similarly, Chang¹⁾

investigates the effects of test trial and processing level on immediate and delayed retention. The results showed that single test trial enhanced immediate retention and deep processing enhanced immediate and delayed retention. However, Ong & Tasir (2015) conducted a study on the information retention among trainee teachers using a self-instructional printed module based on Cognitive Load Theory for learning spreadsheet software. The results showed no effect on information retention. In another study, Bond & Ellis (2013) investigate the effects of metacognitive reflective assessment instruction on student achievement in mathematics, no significant difference was found between the posttest and retention test results for the experimental groups or the control group.

Gender disparity between male and female students' learning outcomes has been identified as one of the factors worthy of investigation. Studies on effects of gender on students' performance is yet to be concluded. For instance, Tsai (2015) reported that females displayed more favorable attitudes than males did regarding the impacts of socioeconomic status on students' performance of Web-based learning. In another study, Clark et al. (2007) found that females performing better than males with Web-based learning and traditional method. Similarly, Johnson (2014) found that female instructors have a significant positive effect on female student performance and do not have a statistically significant effect on male student performance. In support of this study, Kost-Smith et al. (2010) reported that females outperform males on homework and participation, and males outperform females on exams, resulting in course grades of males and females that are not significantly different. Contrarily, Richards-Babb & Jackson (2011) reported that male students' average success rate improvement was double that of female students. Similarly, Murray (2016) found that male students outperform female in the STEM disciplines. However, Dhindsa & Shahrizal-Emran (2011) found that the mean achievement scores of male and female students taught using constructivist approach were statistically non-significantly different.

In a normal classroom setting, students can be categorized based on gender, social economic background, achievement level (high, medium and low achievers) among others. This classification could be identified as individual differences among the students which may influence their academic performance. Studies on students' achievement level (high, medium and low achievers) are inconclusive. For instance, Gambari et al. (2014a) reported that high achievers performed better than medium and low achievers respectively when exposed to Interactive Whiteboard. Similarly, Rajappa et al. (2016) found that low achievers performed better in tutorial than high and medium achiever students. In addition, high and medium achievers obtained more gain from open book assignment, than group tutorials. In another study conducted by Lin & Lin (2016), the results indicated that the science comic book and science text booklet benefited the low, medium and high achievers equally. In addition, Lin et al. (2015) reported that students with average and low academic achievements exhibit small and medium levels of effectiveness, that high academic achievement students. Contrarily, Gambari et al. (2014b) found students of high verbal ability performed better than medium and low verbal ability students respectively.

Secondary education in Nigeria are increasingly focused on improving students' academic achievement and retention through a variety of instructional strategies. Higher retention rates of students at this level of education is directly correlated with system of instructional delivery. Therefore, a number of instructional delivery tools have been developed to enhance students' performance and retention. How well can Web-based instruction influence students' ability in retaining basic technology concept being taught in junior secondary schools in Nigeria? It is against this background that this study investigates the effectiveness of three modes of presentation on achievement and retention of Junior Secondary School Students' Basic Technology in Nigeria.

Research questions

The following research questions were raised to guide the study: (i) what is the difference in mean achievement scores between students taught using web-based instructional package and those taught with traditional method; (ii) what is the difference in mean retention scores of students taught using web-based instructional package and those taught with traditional method; (iii) what is the difference between the mean retention scores of male and female students' taught basic technology using web-based instructional package; (iv) what is the difference in the mean retention scores of high, medium and low achievers' students' exposed to web-based instructional package.

Research hypotheses

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

Ho₁: There is no significant difference in the mean achievement scores of students taught basic technology using web-based instructional package and those taught with traditional method.

Ho₂: There are significant differences in the mean retention scores of students taught Basic Technology using Web-based Instruction and those taught with lecture method.

Ho₃: There is no significant difference in the mean retention scores of male and female students taught using Web-based Instruction.

Ho₄: There is significant difference in the mean retention scores of high, medium and low students taught using Web-based Instruction.

Methodology

The research design adopted for the study is a quasi-experimental design involving pre-test, posttest, non-equivalent, non-randomized control group using a single treatment factorial design. A 2 x 2 x 3 factorial design was employed to test the three hypotheses in the study. Two levels of independent variable

(experimental & control groups), two levels of gender (male & female), and three levels of achievement (high, medium & low) were investigated on students' performance in Basic Technology. The factorial design is shown in Table 1.

Table 1. 2 x 2 x 3 factorial design

Groups	Gender	Ability levels		
		High (1)	Medium (2)	Low (3)
Experimental Group (WBL)	Male 1	111	112	113
	Female 2	121	122	123
Control Group (CTM)	Male 1	211	212	213
	Female 2	221	222	223

All the groups (experimental and control) were given pretest before the treatment. Experimental group 1 was exposed to the use of Web-based Learning instructional (WBL) strategy while the control group was exposed to Conventional Teaching Method (CTM). The posttest was administered on the groups after four weeks' treatment. The research design layout is as shown below in Table 2.

The population for the study is made up of the entire population of JSS II students in all the 296 private schools having JSS II classes (source: Annual School Census 2014/2015 Ministry of Education Niger State). The purposive sampling technique was used to select the four schools in Minna Niger State for this study. These schools were selected for the study based on the following criterion: Equivalence (laboratories, facilities and manpower), school type (private schools), gender composition (mixed schools), ICT equipment (computer laboratories under the SchoolNet programme), and candidates' enrolment (enrolling students for JSSCE basic technology examination for a minimum of ten years). The schools were assigned into experimental group and control group.

119 students were selected using stratified random sampling technique. One arm of intact class was randomly selected from each school.

Table 2. Research design layout

Groups	Pre-test	Treatment	Posttest	Retention
Experimental Group	O ₁	X ₁	O ₂	O ₃
Control Group	O ₄	X ₀	O ₅	O ₆

O₁, O₂, O₃: represents the pre-test, posttest and retention test of the experimental group, O₄, O₅, O₆: represents the pretest, post-test and retention test of the control group, X₁ represents the treatment (Web-based instruction) for the experimental group, X₀ represents the traditional teaching method for the control group.

The treatment (WBI) was developed by the researcher and the programmers where the researcher took care of the content of the package and the programmer designed the Website. The contents of Basic Technology were prepared by the senior teachers and researchers after outlined the difficult concepts in Basic Technology. The computer programmers helped in designing the user interface which was a combination of static and dynamic web pages using Macromedia Dreamweaver (8) and Macromedia Fireworks (8), PHP programming language and MYSQL software for creating database and finally host the site. The web presents information and displays animation to the learner on each of the unit/lesson after which the students attempted some multiple choice- objective questions. Each of the units/lessons were presented by the web through interactive mode, that is, exposure to information, facts and practice on the topics and immediate feedback/response to the questions. The students were made to have at least 90% mastery of one topic before moving on to the next.

The Basic Technology Achievement Test (BTAT) has two sections namely A and B. The section A contains the students' biodata and section B consists of 50 multiple choice objective questions with five options (A-E) as possible answers to the questions. The questions were structured from JSS II Basic Technology curriculum on (I) Materials and their uses and, (ii) Wood

lathe machine covered in the WBI. The test item covered different levels of understanding based on Bloom's taxonomy of educational objectives (i.e. knowledge of facts, application of knowledge, interpretation of concepts). Students were requested to indicate the correct answers by ticking or circling the correct answers matching the questions and only one option was correct from the options A-E. On the scoring of the multiple-choice items, '1' was awarded for each correct answer and '0' for each wrong answer. The instrument was scored over 50 (1x50 items).

Both WBI and BTAT were validated by experts in Basic Technology Teachers, Industrial and Technical Education Lecturers, Educational Technology specialists, Computer Programmers respectively. Comments, opinions and suggestions of the experts were used to make necessary amendments on the instrument. Field trial validation was carried out on WBI using 83 students from a selected school which is part of the population but not participate in the real study. Similarly, a pilot test was conducted on 42, JSS II students from a school that was not part of the selected schools for the real study. The test was administered twice and the reliability coefficient of 0.90 was obtained using Pearson Product Moment Correlation (PPMC).

The objectives and the modalities of the study were specified and clarified before the teachers and students. The researcher administered the BTAT on sample students as pretest to ascertain the equivalence of the students before the treatment. Treatment was followed immediately and lasted for four weeks, thereafter BTAT was administered as posttest to measure the achievement of the sample students in each school. The scores obtained were subjected to data analysis. The data were analyzed based on the stated hypotheses, using mean, standard deviation and Analysis of Covariance. The significance of the various statistical analyses was ascertained at 0.05 alpha level.

Results

The data obtained from BTAT after pretest and posttest were analyzed

using mean and standard deviation to answer research questions while Analysis of Covariance (ANCOVA) was used for testing the research hypotheses at 0.05 level of significance.

Research question one

In answering research question one, mean scores of the students in experimental and control groups were analyzed using mean and standard deviation as shown in Table 3.

Table 3. Mean and standard deviation of pretest and posttest scores of experimental and control groups

Group	N	Pretest		Posttest		Mean Gain
		Mean	SD	Mean	SD	
Experimental Group	60	19.80	5.38	80.53	8.84	60.73
Control Group	59	18.34	6.30	41.05	9.43	22.71

Table 3 shows the mean and standard deviation of the pretest and posttest scores of the experimental and control groups. The result reveals that the mean and standard deviation of the pretest and posttest scores of experimental group are 19.80 ± 5.383 and 80.53 ± 8.844 respectively. This gives a mean gain of 60.73 in favour of the posttest. Similarly, the mean and standard deviation of the pretest and posttest scores of the control group are 18.34 ± 6.304 and 41.05 ± 9.427 respectively. This gives a mean gain of 22.71 in favour of the posttest. Also from the result, it can be seen that there is difference between the mean posttest scores of the experimental group (80.53) and the control group (41.05). The difference being 38.48 which is in favour of the experimental group.

Research question two

In answering research question one, mean scores of the students in experimental and control groups were analyzed using mean and standard deviation as shown in Table 4.

Table 4. Mean and standard deviation of posttest and retention scores of experimental and control groups

Group	N	Posttest		Retention		Mean Gain
		Mean	SD	Mean	SD	
Experimental Group	60	80.53	8.84	81.20	7.89	0.67
Control Group	59	41.05	9.42	39.08	9.52	-1.97

Table 4 shows the mean and standard deviation of the posttest and retention scores of the experimental and control groups. The result reveals that the mean and standard deviation of the posttest and retention scores of experimental group are 80.53 ± 8.84 and 81.20 ± 7.89 respectively. This gives a mean gain of 0.67 in favour of the retention test. Similarly, the mean and standard deviation of the posttest and retention scores of the control group are 41.05 ± 9.42 and 39.08 ± 9.52 respectively. This gives a mean loss of -1.97 in favour of the posttest. Also from the result, it can be seen that there is difference between the mean retention scores of the experimental group (81.20) and the control group (39.08). The difference being 42.12 which is in favour of the experimental group.

Research question three

In answering research question two, mean scores of the male and female students in experimental group were analyzed using mean and standard deviation as shown in Table 5.

Table 5. The mean and standard deviation of pretest and achievement scores of male and female experimental group

Group	N	Posttest		Retention		Mean Gain
		Mean	SD	Mean	SD	
Male	30	60.53	21.51	59.77	22.41	0.76
Female	30	61.59	22.88	61.14	23.61	-0.45

Table 5 shows the mean and standard deviation of the retention scores of male and female in experimental group. From the result. It can be seen that the mean score of the posttest and the retention scores of the male are 60.53

± 21.51 and 59.77 ± 22.41 . The mean gain is 0.76 in favour of the male retention score. Similarly, the mean and standard deviation of posttest and retention scores of female are 61.59 ± 22.88 and 61.14 ± 23.61 . The mean loss is 0.45 in favour of the female posttest score. Also the result reveals the difference of 1.37 between the posttest score of male and female in favour of the female.

Research question four .

In answering research question three, mean scores of high, medium and low level students in experimental group were analyzed using mean and standard deviation as shown in Table 6.

Table 6. The mean and standard deviation of the pretest and achievement scores of low, medium and high level experimental group

Group	N	Posttest		Retention		Mean Gain
		Mean	SD	Mean	SD	
Low Level	21	74.86	7.07	75.62	7.38	0.76
Medium Level	19	81.05	7.98	81.68	6.50	0.63
High Level	20	86.00	7.86	86.60	5.58	60.90

Table 6 shows the mean and standard deviation of the posttest and retention scores of low, medium and high level experimental group. The result revealed that the posttest and retention scores for low level students in experimental group are 74.86 ± 7.07 and 75.62 ± 7.38 respectively while the mean gain is 0.76 in favour of the low level retention score. Similarly, the mean score for the posttest and retention scores for the medium level students in experimental group are 81.05 ± 7.98 and 81.68 ± 6.50 respectively while the mean gain is 0.63 in favour of medium level students in retention score. Also the mean of the posttest and retention scores for high level students in experimental group are 86.00 ± 7.86 and 86.60 ± 5.58 respectively while the mean gain is 0.6 in favour of the high level retention scores. It can also be seen from the result that there is difference between posttest scores of the three levels. The high level students have

the highest mean retention score of 86.60 followed by the medium level with 81.68 while the low level students have the least mean posttest score of 75.62.

Testing of hypotheses

Hypotheses one

There is no significant difference in the mean achievement scores of students taught basic technology using web-based instructional package and those taught with traditional method. In testing hypotheses one, the mean scores of students exposed to web-based instructional package and those taught with traditional method were analyzed using ANCOVA as shown in Table 7.

Table 7. ANCOVA result of achievement scores of experimental and control groups

Source	Type III Sum of Squares	df	Mean Square	F-value	P-value
Corrected Model	51692.595	2	25846.297	673.717	.000
Intercept	15242.180	1	15242.180	397.307	.000
Pretest	5319.586	1	5319.586	138.662	.000
Groups (Treatment)	41844.822	1	41844.822	1.091*	.000
Error	4450.195	116	38.364		
Total	498332.000	119			
Corrected Total	56142.790	118			

*: Significant at $p < 0.05$

Table 7 shows the ANCOVA results of the achievement scores of groups taught using the web-based instructional package (experimental group) and those taught with traditional method (control group). From the table, the F-value = 1.091 and $p < 0.05$. This indicates that there is significant difference between the mean scores of the experimental group and the control group. Hence, hypotheses one is rejected. Therefore, there is significant difference in the mean

achievement scores of students taught Basic Technology using Web-based Instructional Package and those taught with traditional method. This reveal that the treatment has effect on the students' performance.

Hypotheses two

There is no significant difference in the mean retention scores of students taught basic technology using web-based instructional package and those taught with traditional method. In testing hypotheses one, the mean retention scores of students exposed to web-based instructional package and those taught with traditional method were analyzed using ANCOVA as shown in Table 8.

Table 8. ANCOVA result of retention scores of experimental and control groups

Source	Type III Sum of Squares	df	Mean Square	F-value	P-value
Corrected Model	60401.631	2	30200.816	2.6903	.000
Intercept	105.616	1	105.616	9.408	.003
Posttest (Covariate)	7637.942	1	7637.942	680.370	.000
Groups (Treatment)	268.746	1	268.746	23.939*	.000
Error	1302.234	116	11.226		
Total	494676.000	119			
Corrected Total	61703.866	118			

*: Significant at $p < 0.05$

Table 8 shows the ANCOVA results of the retention scores of groups taught using the web-based instructional package (experimental group) and those taught with traditional method (control group). From the table, the F-value = 23.939 and $p < 0.05$. This indicates that there is significant difference between the mean retention scores of the experimental group and the control group. Hence, hypotheses one is rejected. Therefore, there is significant difference in the mean retention scores of students taught Basic Technology using Web-based

Instruction and those taught with traditional method. This reveal that the treatment has effect on the students' performance.

Hypotheses three

There is no significant difference in the mean retention scores of male and female students taught Basic Technology using web-based instruction. In testing hypotheses two, the mean retention scores of male and female students in experimental group were analyzed using ANCOVA as shown in Table 9.

Table 9. ANCOVA results of the achievement scores of male and female experimental group

Source	Type III Sum of Squares	df	Mean Square	F-value	P-value
Corrected Model	3100.471	2	1550.236	154.177	.000
Intercept	170.170	1	170.170	16.924	.000
Posttest (Covariate)	3023.404	1	3023.404	300.690	.000
Gender	8.279	1	8.279	0.823 ^{ns}	.368
Error	573.129	57	10.055		
Total	399280.000	60			
Corrected Total	3673.600	59			

ns: not significant at $p > 0.05$

Table 9 shows the ANCOVA results of the retention scores of male and female students in experimental group. From the result, there is no significant difference between the mean retention scores of the male and female experimental group at 0.05 level of significance. ($F = 0.823$; $p > 0.05$). Therefore, hypotheses two is not rejected. Hence, there is no significant difference in the mean retention scores of male and female students taught Basic Technology using Web-based Instructional Package.

Hypotheses four

There is no significance difference in the mean retention levels (high, medium, low) of students taught Basic Technology using web-based instruction.

In testing hypotheses three, the mean retention scores of high, medium and low level experimental group were analyzed using ANCOVA as shown in Table 10.

Table 10. ANCOVA results of the achievement scores of high, medium and low level experimental group

Source	Type III Sum of Squares	df	Mean Square	F-value	p-value
Corrected Model	3141.345	3	1047.115	110.170	.000
Intercept	212.668	1	212.668	22.375	.000
Posttest (Covariate)	1899.602	1	1899.602	199.862	.000
Levels	49.152	2	24.576	2.586 ^{ns}	.084
Error	532.255	56	9.505		
Total	399280.000	60			
Corrected Total	3673.600	59			

ns: not significant at $p > 0.05$

Table 10 shows the ANCOVA results of the retention scores of high, medium and low level experimental group. From the table, there is no significant difference in the mean retention scores of the three levels at 0.05 level of significance. ($F = 2.586$; $p > 0.05$). Therefore, hypotheses three is not rejected. Hence there is no significant difference in the mean retention scores of students' achievement levels (high, medium and low) when taught Basic Technology using Web-based Instruction. This also revealed that the WBI enhanced the learning outcomes of the students in the three levels especially the medium and the low level learners.

Discussion

The students taught with web-based instructional package performed better than those taught with traditional method. This finding is in agreement with the finding of Guzeller & Akın (2012) and Yamauchi (2008) which showed

that students exposed to WBI achieved better than their counterparts exposed to the conventional instructional strategy. It also agrees with the finding of Erdogan *et al.* (2008) who reported that web-based education has positive effects on the improvement of academic achievement and on motivation for learning. In contrary, this finding is not in agreement with the finding Okeke & Osuagwu (2012) who reported that the students who learnt in the traditional way performed marginally better than those taught with Technology Enhanced Learning (TEL) students. It also disagrees with Wagner *et al.* (2011) and Stack (2015) who reported no significant difference in student performance between the two modes of course delivery (online and traditional instruction).

The study revealed that students taught basic technology using web-based instruction had a better retention than those taught with traditional method. This finding is in agreement with the finding of Shieh & Yu (2016) which revealed that guided discovery instruction influenced learning retention. It also agrees with the finding of Wang (2016) which showed that students taught vocabulary demonstrated significantly better retention. The result also agrees with the result of Dasdemir (2013) which revealed that students had positive effects on academic achievement and retention when exposed to animation in basic education. This study concurred with the finding of Chang¹⁾ which showed that single test trial enhanced immediate retention and deep processing enhanced immediate and delayed retention. In contrary, this finding is not in agreement with the finding the result of Ong & Tasir (2015) which no retention effect on trainee teachers when taught with spreadsheet software. It also disagrees with the finding of Bond & Ellis (2013) which showed no significant difference between the posttest and retention test results for the experimental groups or the control group.

This study also revealed that male and female students retained the concept of basic technology equally. This finding is not in agreement with the result of Chen & Tsai (2007) which showed that females displayed more favorable

attitudes than male students' performance of Web-based learning. It also contradicts the results of Clark et al. (2007) and Johnson (2014) which revealed that females performing better than males with Web-based learning and traditional method. Contrarily, this study also disagrees with the result of Richards-Babb & Jackson (2011) which showed that male students' average success rate improvement was double that of female students. It also disagrees with the results of Murray (2016) which revealed that male students outperform female in the STEM disciplines. However, this study agrees with the findings of Dhindsa & Shahrizal-Emran (2011) and Kost-Smith et al. (2010) which showed males and females that are not significantly different when taught using constructivist approach.

The study also showed that high, medium and low achiever students performed equally better when taught basic technology using web-based instruction. This finding is in agreement with result of Gambari et al. (2014a) and Gambari et al. (2014b) which showed that high achiever students performed better than medium and low achiever students when exposed to Interactive Whiteboard and Oral English respectively. However, the finding contradicts the results of Rajappa et al. (2016) which showed that low achievers performed better in tutorial than high and medium achiever students. It also in disagreement with the result of Lin & Lin (2016) which revealed that science comic book and science text booklet benefited the low, medium and high achievers equally. It also disagrees with the finding of Lin et al. (2015) which revealed that students with average and low academic achievements exhibit small than high academic achievement students.

Conclusion

This study has critically examined the concepts of basic technology at junior secondary school level in a rapidly changing world. It is the view of the authors that there is still a wide gap to be bridged in the area of teaching and learning. The innovative technology using web-based instruction seems to be

the answer. The study showed that, Web-Based Instruction (WBI) improved students' achievement in Basic Technology better than Conventional Teaching Method. The male and female students exposed to WBI achieved equally better in Basic Technology. Web-Based Instruction (WBI) improved students' abilities levels irrespective of high, medium and low levels.

Recommendations

Based on the findings of this study the following recommendations was proffered: (i) Since the treatment (WBI) was found to be effective, teachers should be encouraged to teach their students with WBI to enhance the teaching and learning of Basic Technology; (ii) Gender imbalance in teaching and learning Basic Technology could be bridged by teaching with WBI which promote active learning and is gender friendly; (iii) Web-based Instruction could be used to bridge the gap between students of different abilities level. Basic Technology teachers should be encouraged to use WBI to bridge the gap within High, Medium and Low achievers' performance; (iv) The students should be encouraged on the use of web-based package to learn since it is interactive, student-centred approach and user friendly.

NOTES

1. <http://files.eric.ed.gov/fulltext/ED567759.pdf>

REFERENCES

- Ajani, S.M. (2009). Effects of workshop practices on students' performance in introductory technology. *Unpublished Manuscript*. Imo State University. Owerri.
- Akpoghol, T.V., Ezeudu, F.O., Adzape, J.N. & Otor, E.E. (2016). Relative effect of lecture method supplemented with music and computer animation on senior secondary school students' retention in electrochemistry. *J. Educ. & Practice*, 7(4), 87 - 95.

- Bond, J.B. & Ellis, A.K. (2013). The effects of metacognitive reflective assessment on fifth and sixth graders' mathematics achievement. *School Sci. & Math.*, 113(5), 227 - 234.
- Clark. A.M., Monk, J. & Yool, S.R. . (2007). GIS pedagogy, web-based learning and student achievement. *J. Geography Educ.*, 31, 225-239.
- Dasdemir, I. (2013). The effect of use of animations on the academic achievements of the students, retention of the knowledge learned, and the scientific process skills. *Balkan Phys. Lett.*, 21, 113-131.
- Dhindsa, H.S.& Shahrizal-Emran. (2011). Using interactive whiteboard technology-rich constructivist learning environment to minimize gender differences in chemistry achievement. *Int. J. Environ. & Sci. Educ.*, 6, 393-414.
- Erdogan, Y., Bayram, S., & Deniz, L. (2008). Factors that influence academic achievement and attitudes in web based education. *Int. J. Inst.*, 1(1), 31-47.
- FRN [Federal Republic of Nigeria]. (2013). *National policy on education*. Abuja: NERDC.
- Gambari, I.A., Balogun, S.A. & Alfa, A.S. (2014a). Efficacy of interactive whiteboard on psychomotor skills achievement of students in isometric and orthographic projection. *Cont. Educ. Techn.* 5, 316-330.
- Gambari, A.I., Kutigi, A.U. & Fagbemi, P.O. (2014b). Effectiveness of computer-assisted pronunciation teaching and verbal ability on the achievement of senior secondary school students in oral English. *GIST Educ. & Learning Res. J.*, No. 8, 11-28.
- Güzeller, C. O. & Akın, A. (2012). The effect of web-based mathematics instruction on mathematics achievement, attitudes, anxiety and self-efficacy of 6th grade students. *Int. J. Acad. Res. Progr. Educ. & Develop.*, 1(2), 42-54.
- Johnson, I. Y. (2014). Female faculty role models and student outcomes: A caveat about aggregation. *Res.Higher Educ.*, 55, 686-709.

- Kost-Smith, L.E., Pollock, S. J. & Finkelstein, N. D. (2010). Gender disparities in second-semester college physics: the incremental effects of a "smog of bias". *Phys. Rev. Special Topics – Phys. Educ. Res.*, 6, art. no. 020112.
- Lin, H.-C. K., Chen, M.-C. & Chang, C.-K. (2015). Assessing the effectiveness of learning solid geometry by using an augmented reality-assisted learning system. *Interactive Learning Environments*, 23, 799-810.
- Lin, S.-F. & Lin, H.-s. (2016). Learning nanotechnology with texts and comics: the impacts on students of different achievement levels. *Int. J. Sci. Educ.*, 38, 1373-1391.
- Murray, M. (2016). The effect of gender on perception of case studies and performance. *J. College Sci. Teaching*, 45(3), 48-53.
- Okeke, I.O. & Osuagwu, C.C. (2012). Design and evaluation of a web-based courseware for higher institutions (pp. 2037-2043). In: Resta, P. (Ed.). *Proceeding of Society for Information Technology & Teacher Education International Conference 2012*. Chesapeake: AACE.
- Olson, T.M. & Wisher, R.A. (2002). The effectiveness of web-based instruction: an initial inquiry. *Int. Rev. Res. Open & Distributed Learning*, 3(2), 45-53.
- Ong, C.P. & Tasir, Z. (2015). Self-instructional module based on cognitive load theory: a study on information retention among trainee teachers. *Educ. Techn. Res. & Develop.*, 63, 499-515.
- Rajappa, M., Bobby, Z., Nandeesh, H., Suryapriya, R., Ragul, A., Yuvaraj, B., Revathy, G. & Priyadarssini, M. (2016). Using optimal combination of teaching-learning methods (open book assignment and group tutorials) as revision exercises to improve learning outcome in low achievers in biochemistry. *Biochem. & Mol. Biol. Educ.*, 44, 321-325.
- Richards-Babb, M. & Jackson, J.K. (2011). Gendered responses to online homework use in general chemistry. *Chem. Educ. Res. & Practice*, 12, 409-419.

- Shieh, C.-j. & Yu, L. (2016). A study on information technology integrated guided discovery instruction towards students' learning achievement and learning retention. *EURASIA J. Math., Sci. & Techn. Educ.*, 12, 833-842.
- Stack, S. (2015). Learning outcomes in an online vs traditional course. *Int. J. Scholarship Teaching & Learning*, 9(1), 27-33.
- Thrasher, E.H., Coleman, P.D. & Atkinson, J.K. (2012). Web-based versus classroom-based instruction: an empirical comparison of student performance. *J. Inst. Ped.*, 7, 1-9.
- Tsai, C.-W. (2015). Applying web-based co-regulated learning to develop students' learning and involvement in a blended computing course. *Interactive Learning Environments*, 23, 344-355.
- Uwaifo, V.O. & Edigin, J.E.O. (2011). Evaluating basic technology instruction in Nigerian secondary schools. *J. Res. Nat. Development*, 9(1), 17-22.
- Wagner, S.C., Garippo, S.J. & Lovaas, P. (2011). A longitudinal comparison of online versus traditional instruction. *J. Online Learning & Teaching*, 7(1), 68-73.
- Wang, Y.-H. (2016). Promoting contextual vocabulary learning through an adaptive computer-assisted EFL reading system. *J. Comp. Assisted Learning*, 32, 291-303.
- Yamauchi, L.G. (2008). *Effects of multimedia instructional material on students' learning and their perceptions of the instruction: MSc thesis*. Ames: Iowa State University.

✉ Vivian Njideka Anunobi
Information and Technology Services
Federal University of Technology
Minna, Nigeria
E-Mail: vivian@futminna.edu.ng

✉ Dr. Aмоса Isiaka Gambari
Educational Technology Department
Federal University of Technology
Minna, Nigeria
E-Mail: gambari@futminna.edu.ng

✉ Mohammed Bashiru Abdullahi
Department of Computer Science
Federal University of Technology
Minna, Nigeria
E-Mail: el.bashir02@futminna.edu.ng

✉ Thomas Omotayo Alabi
Educational Technology Department
Federal University of Technology
Minna, Nigeria
E-Mail: thomasalabi2011@yahoo.com

© 2016 BJSEP: Author

