

Impact of Web-Based Learning Tools in Instructional Delivery of Computer Programming in Universities in Developing Countries

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Abstract This research is focused on determining the impact of web-based learning tools in computer programming language for instructional delivery in computer education in universities in Enugu State. 74 second-year students from Enugu State University and University of Nigeria participated in this research. Due to the manageable size of the population, a total population sampling technique was adopted. The Visual Basic Programming Achievement Test (VBPAT), devised by the researcher, was utilized to collect data for this research. This research adopted Cronbach's Alpha coefficient to test the reliability. Statistic package for social science was used to test the pre-test and post-test. The test scores generated from the pre-test and post-test were analyzed using VBPAT. Mean was used to answer the research questions and analysis of covariance (ANCOVA) to test the three hypotheses formulated that guided the study at a 0.5 level of significance (SPSS). Students in the experimental group were given a structured questionnaire to gauge their interest in learning Visual Basic Programming Language when taught via a web-based learning strategy. Students show a high interest level in learning visual basic programming language utilizing a web-based learning technique. Furthermore, results of the hypothesis test demonstrated a major distinction in mean achievement

scores between learners that were trained on Visual Basic Programming via a web-based learning strategy and those trained via traditional teaching technique. For this reason, it was recommended that a web-based learning technique is more effective than traditional teaching methods in enhancing students' Visual Basic Programming achievement.

Keywords Computer Programming, Computer Education, Web-Based Learning Tools, Instructional Delivery

1. Introduction

The primary function of passing information between students has been explored [1]. Simultaneously, curriculum development has been shifted away from descriptions of information to be learnt and toward environments where learning objectives are discrete. Genuine teaching and learning environments with problem-based learning activities have been advocated as student-centered learning environments [2]. The importance of evaluation has been acknowledged, and it

now occupies a more central position during the process of acquiring knowledge. All these advances point to a shift in technological learning design and particularly Web-based digital tools that have been seen to provide several options for both lecturers and students. The innovative learning technologies that have emerged via on-line multimedia advances promote extremely collaborative student-centered learning for successful computer programming language instructional delivery and offer a plethora of new opportunities for both students and teachers.

Computer Programming

Computer programming is the process of creating computer programs, which are a set of instructions written in a programming language to tell a computer to do a certain task and possibly operate external devices like printers, disk drives, and robots [3]. A computer program, on the other hand, is a set of commands and codes which is executed to perform a definite task. Thousands of distinct programming languages have been developed, mostly in the computer area, and thousands more are developed every year. Programming language is a set of functions that tells a computer to accomplish particular functions [4]. A programming language is a structured language used to send instructions to a machine, most commonly a computer. Programming languages can be used to program computer activities. Many programming languages require computation to be stated in imperative form (that is, as a series of actions to be performed), whereas others use the declarative form (that is, the desired output is specified rather than how to obtain it). Therefore, computer programming is considered to be a part of digital literacy and one of the subjects taught in schools especially to students in computing discipline at universities. However, since lecturers facilitate knowledge to students, it is important that the computer programming language instructions are effectively and efficiently delivered to computer education students.

Computer Education

Computer education is all about studying the basics of computer functions so as to realize desired functions. Computer education encompasses not only fundamental computer knowledge, but also many branches of study in various fields and sectors. According to Target research [5], computer education is the process of studying or teaching about computers, which involves basic understanding of computer systems, skills, ideas, and basic terminology connected to computers. The author goes on to say that computer education encompasses the capabilities of a computer system, such as how a computer can be programmed to handle severe difficulties or how a computer can be utilized to address everyday problems. Therefore, computer education as a course in

the university is designed for acquisition of computer and problem-solving skills. However, despite many years of web-based learning tools, it is yet to be fully implemented. Also, computer education lecturers in universities who are supposed to be the pioneers of these web-based learning tools still prefer the use of the face-to-face method of instructional delivery.

Web-Based Learning Tools

Web-based learning aids are things that aid learning by augmenting, amplifying, and guiding learners' cognitive processes [6]. Accessibility, reusability, ease of use, interaction, and visual support are all advantages of web-based tools for instructors and students. Many web-based tools for learning enhancement are interactive tools that enable exploration, investigation, solution construction, and parameter manipulation rather than memorizing and maintaining a series of facts. The constructivist-based model's success has been thoroughly documented [7,8]. Furthermore, a number of web-based programs include a graphical component that aids in the visualization of abstract topics. Furthermore, by reducing cognitive strain, many web-based tools enable pupils to investigate higher-level concepts. Perceptual and cognitive aids are provided by web-based tools, allowing students to investigate more complicated and interesting links. Web-based solutions, on the other hand, are adaptive, allowing students to have some influence over their learning settings, especially when they learn at their own pace.

In industry, government, and higher education, web-based learning tools (WBLT) are becoming a popular way to give instruction and training. WBLT is transmitted by computer over the Internet, allowing for real-time information updating, distribution, and sharing [9]. Presently, various web-based learning resources exist that can be efficiently employed to improve instructional delivery [10]. Web-based tools are web conferencing systems, simulation, learning management systems, podcasts, and a variety of online interactive sites that make use of the World Wide Web's qualities and resources to nurture and support learning [10]. Web conferencing is an advance technology that permits groups of persons to discuss and share information via the internet. Internet technologies provide this service, which allows for an immediate interaction from one person or persons to another person or persons senders to numerous receivers. It allows users to communicate digital data such as text messages, audio, and video messages across geographically scattered sites at the same time. Learning management systems, simulations, and podcasts are some of the other options. This innovative technology can be used to control student database, improve and motivate students to learn. As a result, the importance of using Web-based technology for teaching and learning as a substitute to traditional methods of instructional delivery

cannot be overstated. A learner-centered approach of instruction intended to address the requirements of individual learners is seen to be the key to successful web-based instructional delivery [11].

Instructional Delivery

According to a number of researches, developers should create WBLT with appropriate usability to fulfill the demands of both learners and teachers in order to facilitate instructional delivery. Olelewe [12] proposed a paradigm for assessing the usage of web-based instructional resources that includes three key dimensions: instructive usability, innovative technological usability, and contextual usability. WBLT's educational value is in assisting students in discovering and exploring topics for themselves through interactive, adaptable, diverse, and engaging activities. Most WBLTs, according to Ofoegbu, Agboeze, and Anyanwu [13], offer minimal support for establishing high levels of flexibility, interactivity, feedback, distinctiveness, and cooperation. This is because most WBLTs are created without first doing a needs analysis. Obviously, a learner-centered approach towards WBLT necessitates a shift from teacher-centered to learner-centered education [14]. Technical usability, on the other hand, incorporates approaches for assuring an easy interface with the application software, whereas instructive usability attempts to enhance the instructional process. As a result, technological usability strives to reduce cognitive burden caused by software interaction, facilitating the learning process. Furthermore, technical usability is concerned with ensuring that the software meets the requirements for reliability, learners' satisfaction so as to enhance student learning [15]. Web usability is determined by three criteria, according to Gunga [16], namely page design, content design, and site design. Page design is concerned with cross-platform compatibility, access speed, and linking, hence it explains how trouble-free the pages of web-based materials that include records, multimedia elements, logos, and pictures should be used. The content design of web-based materials reflects how simple and efficient to read and access the content. Site plan is associated with linking, navigation and demonstrating how simple it is to access menus and navigate through web-based materials' connections and displays. Contextual usability refers to the overall relationships that exist between students and their surroundings in a teaching and learning scenario. According to Brousseau [17], learning is originated from interactions among pupils and environment designed with teaching objectives. As a result, milieu encompasses everything in the scenario that learners can influence. There are two types of milieu: material and non-material milieu. In this situation, learning occurs as a result of the student's adaptability to the environment [17]. Therefore, in addition to increasing the academic achievement of computer education students on computer programming

language, podcast among other WBLT's has to be tried out in instructional delivery.

Gender parity in terms of access to and usage of ICTs is still a hot problem, not just in Nigeria but around the globe. However, evidences suggest that, while there is a gender difference in all countries, the high disparity between male and female students' performances in Visual Basic programming language will lessen if proper and efficient innovative teaching technologies are used for instructional delivery [18]. Hence, the present study will determine the impact of web-based learning tools in computer programming language instructional delivery in computer education in Universities in Enugu State.

2. Review of Related Literature

During COVID-19, Cheng-Jui [19] investigated the impact of web-based teaching on the learning performance of education and training in the service industry. The subjects of this research were service industry employees, and the research design included three kinds of instructional delivery: tutorials via video, computer-aided instruction, and web-based instructional delivery. This research used a quasi-experimental design. The seminar was attended by a total of 36 employees from each organization. The study variables are split into three categories in the research framework: independent variable, dependent variable, and moderating variable. In an integrated comparison, all factors are measured using a 7-point Likert Scale Analyses of variance and stepwise regression was adopted so as to analyze learning motivation, learning attitude, and learning performance. The findings revealed that adopting web-based teaching for training of service workers has a significant impact on enhancing their learning outcome in the service business.

The study found a link between the utilization of Web-based learning techniques for teaching and learning. This study adopted a quasi-experimental design. However, during COVID-19, this study focused on the impact of web-based instruction on the learning outcome of training in the service industry, whereas this current research focused on the impact of web-based learning tools in computer programming language for instructional delivery in computer education in universities in Enugu State.

Ajuzie and Ukegbu [20] conducted research using some chosen secondary schools in Owerri, Imo State, to find out Web-based tools for instructional delivery. The research was directed by three research questions. Expost facto design was used in this study. The survey included 250 instructors from 65 secondary schools within the state education zone I. To acquire data for the study, the researchers created the "Web-Based Tools for Instructional Delivery Questionnaire (WDTIDQ)." The findings suggest that incorporating Web-based tools into all aspects of education will help to improve instructional

delivery and effectiveness, resulting in instructors who can efficiently add to the increase and advance of education.

3. Statement of the Problem

Web-based learning tools for teaching and learning help lecturers to perform various teaching and learning activities in a more organized way. As a result, the web-based learning tools needed to include features like announcements, a place to save course comments and features like email, communiqué boards, chat, online quizzes and platform for submission of assignment. However, web-based learning tools were introduced to enable lecturers to deliver instructions, assess students' performance, and communicate with students via Internet, while students have access to the instructional materials anywhere and anytime at their own pace, in stress-free environment and within a more flexible time frame.

But until now, the researcher observed that less attention has been paid to how web-based learning tools by computer education lecturers in instructional delivery should be used, which could enhance the learning activities of computer programming language. The lack of enthusiasm for learning, and disappointing classroom behavior have become a serious concern. In addition, the researcher also observed the availability of web-based learning tools such as content management system, web conferencing system, simulation, learning management system, podcast and various online interactive sites that could be used by computer educational lecturers to enhance instructional delivery of computer programming language, but the tools are not used in computer education. As a result, the study aims to determine the extent to which computer education lecturers and students employ web-learning tools to improve information learning outcomes.

4. Purpose of the Study

This study investigates the impact of web-based learning aids on computer programming language instructional delivery in universities in Nigeria's Enugu state. This study is set to find out:

1. the students' academic achievement means gain in computer programming language when taught with web-based learning tools and when taught without web-based learning tools.
2. the influence of gender on the students' academic achievement means gain in computer programming language when taught with web-based learning tools.

5. Research Questions

1. What are the students' academic achievement mean gains in computer programming language when taught with web-based learning tools and when taught without web-based learning tools?
2. What is the influence of gender on the students' academic achievement mean gain in computer programming language when taught with web-based learning tools?

6. Hypotheses

The following null hypotheses were developed and tested at the 0.05 level of significance to guide the this study.

H₀₁: There is no significant difference between the mean scores of students in computer programming language taught with web-based learning tools and those taught with conventional method.

H₀₂: There is no significant difference between the mean scores of male and female students taught computer programming language using web-based learning tools and those taught using conventional methods.

7. Methodology

The Study Design

The study employed a mixed research design. This design was appropriate for the study since it included a questionnaire about computer education students' interest in learning a programming language (visual basic) through web-based learning resources. This research was carried out in Nigeria's Enugu State. Enugu State is a Nigerian state in the eastern region of the country. The choice of this area was as a result of the researcher's observation and was encountered with computer education students in universities in the area. Enugu State has Universities that offer computer programming courses (visual basic) and are equipped with the facilities required to conduct the study. The survey included 74 second-year Computer Education students from two government-owned universities from the 2017/2018 academic session. Because the population was manageable, the entire population was investigated. As a result, total population sampling was used. The Visual Basic Programming Achievement Test (VBPAT) and a structured questionnaire termed Interest Inventory Questionnaire (IIQ) were utilized to collect data in this study. Face and content validation were performed on the data gathering equipment. Three specialists from the University of Nigeria approved the instruments. The dependability of the Visual Basic Programming Achievement Test (VBPAT) was pilot tested on computer education third-year students at Godfrey Okoye University in Enugu State, with a total of 13 students (4

males and 9 females). Cronbach's alpha was used to assess the questionnaire's reliability. When there are numerous items in a questionnaire that create a scale, it is most commonly used to gauge internal consistency.

Experimental Procedure

After getting approval from the University authorities through the heads of the department, the quasi experimental study was carried out within the regular school lecture hour for computer education second-year students and timetable for the visual basic programming language I (COS201) course. The study relied on regular lecturers who teach the COS201 course. There were two groups of students in this experiment: The experimental group that were taught using web-based learning tools and the control group that were taught via traditional or face-to-face methods. Before the start of the lectures, the two groups were given a pre-test in the universities.

The data gathered during the pretest and posttest administration were evaluated using the mean and standard deviation (SD). The outcome of web-based learning aids on learners' attainment in computer programming was determined by computing the mean gain of each of the treatment groups. The study's hypotheses were assessed using Analysis of Covariance at the 0.05 level of significance. The statistical technique utilized to examine the hypotheses was ANCOVA because the research contained pretest and posttest of intact classes. The selection of intact classes as the study's subject allowed for the use of Analysis of Covariance to control for first non-equivalence mistakes. For the hypotheses, any item with an f-value less than or equal to a significance level of p 0.05 will be considered to have a significant difference, and thus the hypothesis will be discarded, whereas if there is an item with an f-value morer than or equals to a significance level of p 0.05 will be considered to have no significant difference, and thus

the hypothesis will be upheld.

To analyze the data, mean and standard deviation were used to examine the data from the questionnaire. Severely agree (4p), agree (3p), disagree (2p), and strongly disagree (2p) are the values assigned to the response options (1p). Any item with a criterion mean of 2.50 or higher was considered agree, while any item with a criterion mean of 2.5 or lower was considered disagree.

8. Data Presentation and Analysis

Research Question 1: What are the students' academic achievement mean gains in computer programming language when taught with web-based learning tools and when taught without web-based learning tools?

The experimental group that was taught computer programming language using a web-based learning tool had a pretest achievement score of 44.52, a standard deviation of 7.81, a posttest achievement score of 63.35, and a standard deviation of 8.04, as shown in Table 1. The difference between the experimental group's pretest and posttest academic achievement mean score was 18.83. The control group had an achievement score of 34.04 and a standard deviation of 7.63 with a posttest achievement score of 39.47 with a standard deviation of 5.97 after being taught computer programming language using Conventional Teaching Method (CTM). For the control group, the difference between the pretest and posttest attainment score was 5.43. Though, posttest achievement score was higher than pretest achievement score for each of the groups, with the experimental group having a bigger mean gain (18.83 > 5.43). This suggests that teaching computer programming using a web-based learning tool like Google Classroom has a greater impact on students' academic attainment than teaching computer programming without one.

Table 1. Mean and Standard deviation of students' academic achievement mean gain in computer programming language when taught with web-based learning tools and those taught without web-based learning tools

Variable		Pretest		Posttest		
Instructional approach	Number	\bar{x}	Standard deviation	\bar{x}	Standard deviation	Mean Gain
Web-based learning tool	31	44.52	7.81	63.35	8.04	18.83
Typical Instructional Techniques	43	34.04	7.63	39.47	5.97	5.43

KEY: \bar{x} = Mean

Research Question 2: What are the influences of gender on the students' academic achievement mean gain in computer programming language when taught with web-based learning tools?

Table 2 shows that male students who were taught computer programming utilizing a web-based learning tool had pretests of 42.00 and posttests mean of 62.00 and standard deviations of 7.75 and 8.94 respectively. Between the pretest and posttest, their mean score was 20.00. Feminine students, on the other hand, who were taught computer programming using the same technology (web-based learning tool), had pretest and posttest scores of 45.55 and 63.91, respectively and standard deviations of 7.78 and 7.79. The difference in their achievement mean score between the pretest and posttest was 18.36. From this graph, it can be seen that male students' mean gains of 20.00 are higher than female students' mean gains of 18.36, indicating that those students trained on computer programming language by means of a web-based learning tool improved better than female students trained on computer programming language using the same tool (web-based learning tool).

Hypothesis 1: There was no significant difference between the mean scores of students in computer programming language taught with web-based learning

tools and those trained with traditional methods.

The attainment scores of those students trained on computer programming language via a web-based learning tool (Experimental group) and those trained without a web-based learning tool (Control group) are shown in Table 3, with a fraction ratio of 128.55 and a probability value of 0.00. Because the probability value (0.00) is less than 0.05, which was placed as the level of testing the hypothesis, the result of the null hypothesis (H01) was that there is no significant difference among the mean scores of students in programming language taught via web-based learning tools and those trained using conventional techniques was discarded. The conclusion reached is that there is a substantial difference in mean scores between students who were trained on computer programming language using web-based learning tools and students who were taught by means of traditional methods. This result revealed that students who were taught utilizing a web-based learning tool improved their computer programming language achievement. Although students' scores were improved in both instructional modes (web-based learning tool and traditional technique), students taught using the web-based learning tool showed a larger mean increase.

Table 2. Mean and Standard deviation of the influence of gender on the mean academic achievement gain of computer students' in computer programming language when taught with web-based learning tools

Instructional Mode	Variable	Gender	N	Pretest		Posttest		Mean Gain
				\bar{x}	SD	\bar{x}	SD	
Web-based Learning tool	Achievement	Male	9	42.00	7.75	62.00	8.94	20.00
		Female	22	45.55	7.78	63.91	7.79	18.36
		Total	31	44.52	7.81	63.35	8.04	18.83

KEY: \bar{x} = Mean, SD = Standard Deviation, N = Number

Table 3. Analysis of Covariance (ANCOVA) of the mean scores of students in computer programming language when taught web-based learning tools and those taught without web-based learning tools

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Remarks
Corrected Model	11345.136 ^a	2	5672.568	169.844	.000	
Intercept	2700.038	1	2700.038	80.843	.000	
Pretest	1064.485	1	1064.485	31.872	.000	
Group	4293.395	1	4293.395	128.550	.000	S
Error	2371.310	71	33.399			
Total	194837.000	74				
Corrected Total	13716.446	73				

$\alpha = 0.05$, S= Significant

Table 4. Analysis of Covariance of the mean scores of male and female students in computer programming language when trained with web-based learning tool

Source	Type III Sum of Squares	Df	Mean Square	F	Significant	Remarks
Corrected Model	790.351 ^a	2	395.175	9.632	.001	
Intercept	1019.371	1	1019.371	24.847	.000	
Pretest	767.072	1	767.072	18.697	.000	
Gender	1.168	1	1.168	.028	.867	NS
Error	1148.746	28	41.027			
Total	126368.000	31				
Corrected Total	1939.097	30				

$\alpha = 0.05$, NS= Not Significant

Hypothesis 2: There was no significant difference between the scores of male and female students trained on programming language via web-based learning tools.

Table 4 reveals that a fraction ratio of 0.028 was found for performance mean scores of male and female students trained on programming language via a web-based learning tool, with probability value of 0.87. The H_{02} which states that there was no significant difference among the mean grade of male and female students trained on programming language via a web-based learning tool was upheld because the associated probability value (0.87) is greater than the 0.05 placed as the level of significance for testing the hypothesis. Hence, conclusion reached is that there was no difference in mean scores between male and female students that were trained on computer programming utilizing a web-based learning tool. This finding revealed that male and female students who were trained utilizing a web-based learning tool improved their academic performance. This indicates that the high posttest attainment score in programming language is primarily due to the use of a web-based learning tool, rather than gender.

9. Discussion

Data in Table 1 offered a response to the first research question based on data analysis. The study's findings on research question one, which compares students' academic achievement mean gains in computer programming language when taught with and without a web-based learning tool, show that there is an evidence that teaching via web-based learning tool has a greater impact on students' attainment in computer programming language. Serpil's [19] research on the effects of online distance training on vocational school students' mathematics attitudes and an achievement is supported by this research. The findings revealed that students who were taught mathematics using a web-based instruction learning tool did much better than students who were not taught using an online learning tool. Hence, a web-based mathematics instruction learning tool improved mathematical

achievement of vocational school pupils. The outcomes of this study are relevant to our current study because it has been demonstrated that using an online learning tool has a significant favorable impact on student academic attainment when compared to teaching without it.

The information in Table 2 offered an answer to the second research question. The conclusion on research question two; the influence of gender on students' academic achievement mean gain in computer programming language when taught with a web-based learning tool, revealed that using a web-based learning tool in the learning process of programming language improved male students' achievement more than female students' achievement, though there was no significant difference in mean scores. This research is related to [21] study on online uptake and the role of gender. The result revealed that male students improved better than female students.

10. Conclusion

At many different levels, the fast growth of the Internet and expanding software are changing the styles of instructional delivery. The producers of online learning tools are constantly re-designing them to improve their usefulness. Modules offer updated versions of their course tools which are used in the classroom. The utility and effectiveness of these tools are context-dependent, based on a variety of factors, including the tool's design. It's critical to get feedback from genuine users, such as students, in order to improve the product further.

11. Implications of the Study

If the results of this research are implemented, employers of labour in industries will spend less money on re-training of graduates through this curriculum because these students will have acquired the needed computer programming skill required by industries.

This study also has a positive implication for the

curriculum planners in vocational and technical education. Curriculum Planners can use the content of the prototype for curriculum revision. Centre for skill development such as Universities, polytechnics, Colleges of Educations, industrial training centres will find web-based instructional learning tools a good practical teaching model.

According to the findings of this study, lecturers and students who lack the necessary skills for integrating and using online instructional learning tools will seek training on how to integrate and use web-based instructional learning tools in teaching and learning.

Conflict of Interest

There is no disagreement of interest.

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