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A MULTIDISCIPLINARY STUDY ON THE RELATIONSHIP BETWEEN ICT LITERACY LEVELS AND ACADEMIC PERFORMANCE OF E-LEARNERS IN AN E-LEARNING SETTING

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ABSTRACT

There is not much research that has been in Nigeria on the influence of ICT literacy on the academic performance of e-learners. This study focuses on this research gap as identified in the literature. The objective of this study is to investigate the relationship between ICT literacy levels and academic performance of distant e-learners based on their course of study in Nigeria. To achieve this objective, seven null hypotheses were formulated which guided the study. The population was the total number of distance e-learners in different faculties and different years of study of all the distance e-learners in Osogbo, Akure, Ado Ekiti and Ibadan study centres. Given the large numbers, the study was conducted in four selected study centres of the National Open university of Nigeria, and a total of 1025 participants completed the survey-based questionnaire that was used for data collection. The data collected was analysed using one-way analysis of variance (ANOVA) at .05 level of significance. The results show that there is some relationship between ICT literacy level of distance e-learners and their academic performance based on their disciplines. ICT literacy levels have a significant relationship with academic performance in Arts and Social

ISSN 1728 – 9157

Science, Health Science, Management Science and Science and Technology e-learners, but do not play a significant role in academic performance in agriculture, education and law e-learners. Recommendations focus on the role of governments in setting up and improving wireless environments which will assist e-learners to have access to educational benefits, and discover knowledge on their own.

Keywords: academic performance and distance e-learners, ICT literacy levels, multidisciplinary study

1. INTRODUCTION

Information and Communication Technology (ICT) has a global impact on almost all aspects of human life, and education is no exception. Oladunjoye et al. (2014) view computer literacy, an aspect of ICT, as the amount of computer knowledge required and the extent of computer usage. According to Adeyinka and Mutala (2008), computer literacy can be viewed as basic skills in using the computer, for example, to save and open a file, use a word processing programme, and send and receive e-mail. The Internet, which is the result of information innovation, has changed the way individuals work together (e-commerce), the way individuals communicate (e-mail), the way individuals train or instruct (e-training), and the way individuals learn (e-learning). Electronic learning is viewed as the use of ICTs to enhance and support learning, teaching and research.

E-learning is expected to redefine education; increasingly, the classroom will no longer be demarcated by brick walls. Sam (2011) states that students can communicate with their teachers from their bedrooms or wherever they are, especially during strikes, while housewives can receive lectures from their kitchens without having face-to-face interaction with their teachers. Christie and Ferdos (2004) characterise e-learning in advanced education as a system to improve learning encounters, and as a device to teach students through computerised media, with or without the direction of their educators. E-learning can be used to replace traditional face-to-face teaching completely, for example, via distance learning, or partially, as an additional teaching tool

to be used alongside face-to-face teaching. Khan (2005) states that e-learning has been described in various ways as learning using a number of different technologies and methods of delivery, for example, Computer-based Training (CBT), Internet-based Training (IBT), Web-based instruction (WBI), advanced distributed learning (ADL), distributed learning, distance learning, online learning, mobile learning or m-learning or remote learning and learning management systems (LMS).

Al-Ammari and Hamad (2008) observe that in an e-learning system, students are able to interact at any time from any place with different instructional material such as text, sound, pictures and video through the Internet. In addition, learners can communicate with teachers and classmates both individually and as a discussion group with the use of message boards, instant message exchanges and video conferencing.

Lin (2006) points out that e-learning is turning out to be increasingly important to learners as they can consolidate their learning backgrounds with the evolution of information technology. This method of learning gives learners more self-sufficiency to continue at their own pace, while their progress is checked to survey their accomplishment (Rhode, 2009; Spector et al., 2008). With e-learning, there is a movement from the traditional method of instructor-coordinated instruction to modern techniques where computer technology assumes a significant part, subsequently enhancing the quality, proficiency and adequacy of educating, learning, research and educational management. Neto and Brasileiro (2007) note that the developments in computers and computer-related technologies have cultivated the development of e-learning and given distance learners better opportunities to decide when, where, what and how to learn. Andrews and Haythornthwaite (2007) are of the opinion that these innovations will remove the difficulties of geographic separation that isolate learners from institutions, teachers and one another. Innovation in ICT has developed greatly in every aspect of learning, making it a necessity for educational institutions to benefit from this rapid development in ICT to enhance learning situations and adapt to the continually expanding interest in education and

training. Does this affect the academic performance of distance e-learners based on their course of study? This study intends to provide an answer to this question and make a finding that will be useful for research purposes.

1.1 Research questions and hypotheses

The following research question arises in order to capture the objectives of this study:

> Is there any relationship between ICT literacy levels and academic performance of distance-learners based on their respective disciplines?

1.2 Research hypotheses (for purposes of this paper, the null hypotheses are represented using H_0).

The hypothesis was that there is a significant relationship between ICT literacy levels and academic performance of distance e-learners in a range of disciplines viz. Agriculture, Arts and Social Science, Education, Health Science, Law, Management Science and Science and Technology.

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

- **H_{01}:** There will be no significant difference between ICT literacy levels and academic performance of Agriculture distance e-learners.
- **H_{02}**: There will be no significant difference between ICT literacy levels and academic performance of Arts and Social Science distance e-learners.
- **H_{03}**: There will be no significant difference between ICT literacy levels and academic performance of Education distance e-learners.
- **H_{04}**: There will be no significant difference between ICT literacy levels and academic performance of Health Science distance e-learners.
- **H_{05}**: There will be no significant difference between ICT literacy levels and academic performance of Law distance e-learners.
- **H_{06}**: There will be no significant difference between ICT literacy

levels and academic performance of Management Science distance e-learners.

- **H_{07}**: There will be no significant difference between ICT literacy levels and academic performance of Science and Technology distance e-learners.

2. REVIEW OF RELATED LITERATURE

Hall (2005) identifies four classes of computer users as emergent users, the progressive users, the high users and the dependent users at the University of Newcastle. He describes the emergent users as those who have access to computers at home and at work. They have access to, and know how to use word processing, e-mail, web, and how to download information to compact discs. The progressive users are those who are prepared to learn everything necessary about computers. They invest their energy and finances to benefit more from the relevant innovation. The high users are the individuals who are well versed in computer technology and know how it works and how it can be controlled. The dependent users, on the other hand, are the individuals who do not know anything about computers and are not making any attempt to learn. They rely on the individuals who know much about computers whenever they have something to do on the computer. Do the students' computer literacy levels influence the academic performance of distance e-learners? What effect do the classes of computer users have on academic performance of distance e-learners? The current study will try and provide answers to these questions and also determine how best the students' ICT literacy levels predict the academic performance of a distance e-learner.

Arbaugh (2008) writes that prior web learning knowledge is one of the most grounded indicators of learner fulfilment. There are studies that support this finding, demonstrating that experienced online learners are more likely to rate their online programme as the best or fulfilling (Lim & Morris, 2009; Martínez-Caro, 2011). Eskil et al. (2010) argue that when students have prior information about computer technologies, they can be more effective in their

studies. They conclude by saying that direct and indirect effects of ICT usage at school should be considered.

House (2010) conducted studies on the impact of computer use on student achievement by using multiple regression analysis on a sample of 13-year-olds from the Trends in International Mathematics and Science Study (TIMSS) of 2003, to study the effect of computer activity on science achievement for American (n = 8,093) and Japanese (n = 4,540) students. The outcome suggested that not all computer activities improve academic achievement. In the United States sample, he observes that the use of a computer to write reports for school significantly enhanced science achievement, whereas using a computer to process and analyse data had no effect on students' achievement. Furthermore, he noted cross-country contrasts in the impact of computer use on achievement. The utilisation of the computer to search for knowledge and information about science significantly affected science achievement of Japanese students, yet had no impact on American students. Carrillo et al. (2010) conducted a comparative study of the impact of ICT utilisation on mathematics and language by assessing a public programme of computer-aided instruction. They found that this programme positively affected mathematics test scores but did not influence dialect test scores or language test scores.

Various studies, conversely, have found that ICT usage contributes to higher science scores but with negative impact on mathematics (Antonijevic, 2007). Gil-Flores (2009) conducted a comparative study of mathematics and language scores, analysing the differential impact at home and at school. He found a positive outcome of ICT usage on academic achievement in both cases. In Iran, Mohagheghzadeh et al. (2014) report that there was an immediate and statistically significant relationship between ICT and academic performance of medical and dental students at Shiraz University of Medical Sciences. As with the study just referred to, the current study examines the influence of ICT on the academic achievement of distance e-learners based on their faculties or course of study. The general trend is that the higher the computer proficiency, the better the scores obtained by students in the distance learning course. Kim and Chang (2010) focused on

the mathematics achievement gap between students originating from Hispanic and Asian students at the Virginia Polytechnic Institute and State University who frequently used a computer for mathematics. They found that home computer use diminished the gap in achievement in mathematics. One of the reasons for this observation could be that the students were faced with many challenges at home. Contrary to this study, Aypay (2010), found that there was no significant relationship between students' ICT usage and academic achievement, taking into account the consequences of PISA 2006 in Turkey.

Machin et al. (2006) investigated the question of whether changes in ICT investment had any causal impact on changes in educational outcomes in English schools over the period from 1999 to 2003 at the University College London. They used an Instrumental Variable (IV) approach with regard to the control of ICT usage. The authors found evidence for a positive causal impact of ICT investment on educational performance in primary schools. In India, Banerjee et al. (2007) reported that Indian students who are usually skilled in instructional games and software for mathematics scored significantly higher in mathematics. They sampled two groups that received, or did not receive, the programme, and collected student test scores twice, before and after the programme. They regressed the difference in test score between before and after the experiment on the scores before the experiment and the 18 dummy variables, which is a binary specification of whether or not the school received a programme. They thereby observed how many students improved their mathematics score, relative to what would have been expected based on the pre-test score, compared to the control group. Consequently, Computer-Assisted Learning (CAL) has a solid impact, with a standard deviation of 0.35 and 0.47 in the first and second year, respectively. The U.S Department of Education (2007) carried out a study to assess the utilisation of programming items in the classroom. Items to be utilised as a part of the trial were chosen based on voluntary support. Participating schools and regions were focused on those with low student achievement and very poor. According to their report, the effectiveness of an educational software programme in the treatment group, which was

randomly assigned, was partly observed in the first and fourth grades. The research which has just been cited is an experimental research while the current one is a survey research. The findings of that particular research may be influenced by the fact that it was conducted in developed countries where ICT literacy is part of the university curriculum.

What is the situation in a developing country like Nigeria? In Nigeria, Aitokhuehi and Ojogho (2014), show that computer-literate students perform better than the computer-illiterate; computer-literate female students perform better than male students who are also computer literate; computer-literate students who are not addicted to the use of computer facilities perform better than those who are addicted; computer-literate students in co-educational secondary schools perform slightly better than those in schools for one gender only. This study was conducted in a Nigerian secondary school and this may explain the fact that computer facilities were made available for convenient and easy learning processes and enabled them to practise and access the Internet on a daily basis in search of information that could enhance their academic performance.

Osunade, Ojo and Ahisu (2009) point out a significant difference in academic performance between those who had Internet access and those without it in Nigeria. This could suggest that Internet access in an e-learning setting is a key determinant of academic performance of students. In South Africa, Barlow-Jones and Westhuizen (2012) are of the opinion that the computer-literate students performed significantly better during the first semester compared to the computer-illiterate students. The computer-illiterate students indicated that the lack of computer experience influenced their ability to pass computer-related subjects. That particular study is similar to the current study which will determine whether students' prior ICT experience influences their academic performance within the same African country. Barrow et al. (2007) acknowledge the positive role of computerised instruction in mathematics at the University of Chicago. Students randomly assigned to computer-aided instruction scored higher than those in control groups. They use an empirical model similar to that utilised by Rouse and Krueger (2006). Academic outcomes measured by test scores are regressed

on a binary variable, a vector of student characteristics and dummy variables, and the binary variable is regressed with instrumental variables. Lei and Zhao (2007) did a study in the United States, with a sample of 130 students from a middle school in order to examine the impact of the amount and nature of computer use on academic achievement. Their analysis of variance results shows that both quantity and quantity are significant indicators of academic achievement.

Kim and Chang (2010), in their study done in the United States, express the view that computer use for mathematics is connected with narrowing the achievement gap. In the Netherlands, Pelgrum and Plomp (2002) discovered results that distinguished those of OECD (2005), by utilising information from the 1999 TIMSS. They group students as high ICT users (most frequent users) or low ICT users (never or once-in-a-while). High ICT users had lower achievement scores compared to low ICT users in all 26 participating countries: Belgium-French, Bulgaria, Canada, Hong Kong, Taiwan, Cyprus, Czech Republic, Denmark, Finland, France, Hungary, Iceland, Israel, Italy, Japan, Latvia, Lithuania, Luxembourg, New Zealand, Norway, Russian Federation, Singapore, Slovenia, Slovak Republic, South Africa and Thailand. In Canada, the score differential represented approximately 1.5 years of achievement growth. The research concluded that the indicators of the available ICT infrastructure differ among countries as well as in school levels. This study provides answers to the question whether high ICT users' performance surpasses the low ICT user under an e-learning setting. The current study in Nigeria investigates whether the level of student ICT literacy determines the academic performance of distance e-learners in an e-learning setting.

Wittwer and Senkbeil (2008) investigated PISA 2003 information to determine whether or not home computer accessibility is connected with German arithmetic education, after considering the impact of additional determinants of school performance such as SES, gender, immigrant status, cognitive abilities, reading and watching television. A class definition was used to investigate how students differed in their ICT use at home. Students

were grouped into four classes: (a) smart users, who had some heightened interest and confidence in using computers, and used them for a variety of applications; (b) rational users, who used the computer frequently for school-related learning activities, but not for playing games or communicating with other people; (c) recreational users, who only used the computer for playing games, watching movies, or listening to music, and (d) indifferent users, who had very little enthusiasm for utilising computers and only occasionally used them. The authors in question found that there was a slightly positive effect on problem-solving and mathematics literacy for students in the smart user and rational user group, using multilevel modelling.

Thus, Wittwer and Senkbeil (2008) infer that students' computer-related behaviour at home marginally predicts mathematics performance in Germany. This study observed that the effect of technology on students' academic performances has been the focus of an extensive literature review, over the last two decades, but there is no substantive research on the influence students' ICT literacy level on the academic performance of distance e-learners, especially in a Nigerian context. The researcher has also observed that studies on the impact of students' ICT literacy on their academic performance were mostly conducted outside the Nigerian context and those that were carried out in Nigeria, focused on regular university students. This study is meant to fill the identified gap. Consequently, it focuses on the question of whether students' ICT literacy levels is a key determinant of the academic performance of distance e-learners based on their respective disciplines.

3. RESEARCH METHODOLOGY

The current study adopted a quantitative approach which was predictive or inferential in nature. To achieve this, ANOVA and Post Hoc Tests were used to analyse the data. The analysis involved SPSS statistical software, reporting inferential statistics.

The South-West geopolitical zone of Nigeria was the focus of the study. The population was the total number of distance e-learners in different faculties

and different years of study in all the study centres in the National Open University of Nigeria (NOUN) in the geopolitical zone, made up of six states – Lagos, Ekiti, Oyo, Osun, Ondo and Ogun - with 13 different study centres. It was difficult for the researcher to manage the target population due to constraints such as money, time and practical issues. Hence the target population was downsized to a manageable four study centres. Consequently, the study was made up of all the distance e-learners in Osogbo, Akure, Ado Ekiti and Ibadan study centres with a population of 15,223. The study was conducted in the four selected study centres of the university and a total of 1025 participants completed the survey-based questionnaire. Six items were incorporated in the questionnaire to measure students' ICT literacy levels. The scale that was used in this item was an interval scale. The participants were asked to rate on a 4-point Likert scale their students' ICT literacy levels in respect of the statements, with 1 = none, 2 = little, 3 = moderate and 4 = high. All six items under students' ICT literacy were aggregated into Index ICTLTR. Ten items were incorporated in the questionnaire to determine academic performance. The scale that was used in this item was an interval scale. The participants were asked to indicate their academic performance for each of their courses taken over one semester. This was based on a 6-point Likert scale where A = distinction, B = good, C = credit, D = pass, E = poor and F = fail. Thereafter, the researcher arrived at an overall academic performance (ACADPERF) by determining their average performance based on actual results. This involved the summation of each course result (C1–C10) divided by NC, where NC is the number of courses taken by each student in the semester under consideration, and was done because not all the students took all the 10 courses per semester.

In total, the researcher retrieved 1050 from the four study centres out of 1400 distributed. There were 25 questionnaires that were considered to be spoilt because they were partially completed and illegible. At the end of the exercise, the researcher used data from 1025 questionnaires for data analysis. This study applied convenience sampling for the quantitative aspect because it was an easy way to contact participants and collect information within a

short period of time. Statistical analyses were performed using SPSS Statistical Package 17.

The researcher was only able to cover four centres of NOUN in South-Western Nigeria, because of the vast extent of the land and spread of study centres across the nation. The current study has been conducted on e-learners only. Therefore, any prediction or generalisations can only be applied over these four study centres.

4. RESULTS AND DISCUSSION

In testing statistically, the null hypotheses presented were used, with the following results.

Hypothesis 1: There will be no significant difference between ICT literacy levels and academic performance of agriculture distance e-learners.

Table 1: ICT literacy levels and Agriculture e-learners

Variable	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.917	3	.306	.726	.546
Within Groups	10.950	21	.421		
Total	**11.867**	**26**			

Hypothesis 2: There will be no significant difference between ICT literacy levels and academic performance of Arts and Social Science e-learners.

Table 2: ICT literacy levels and Arts and Social Science e-learners

Variable	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.187	3	1.396	3.577	.015
Within Groups	79.578	204	.390		
Total	**83.764**	**207**			

Hypothesis 3: There will be no significant difference between ICT literacy levels and academic performance of Education e-learners.

Table 3: ICT literacy levels and Education e-learners

Variable	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.163	3	.721	1.912	.131
Within Groups	50.158	133	.377		
Total	**52.321**	**136**			

Hypothesis 4: There will be no significant difference between ICT literacy levels and academic performance of Health Science e-learners.

Table 4: ICT literacy levels and Health Science e-learners

Variable	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.420	3	1.473	4.239	.009
Within Groups	19.810	57	.348		
Total	**24.230**	**60**			

Hypothesis 5: There will be no significant difference between ICT literacy levels and academic performance of Law e-learners.

Table 5: ICT literacy levels and Law e-learners

Variable	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.037	3	.346	.877	.461
Within Groups	15.759	40	.394		
Total	**16.795**	**43**			

Hypothesis 6: There will be no significant difference between ICT literacy levels and academic performance of Management Science e-learners.

Table 6: ICT literacy levels and Management Science e-learners

Variable	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.822	3	1.274	3.463	.017
Within Groups	96.005	261	.368		
Total	**99.826**	**264**			

Hypothesis 7: There will be no significant difference between ICT literacy levels and academic performance of Science and Technology e-learners.

Table 7: ICT literacy levels and Science and Technology e-learners

Variable	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6.524	3	2.175	5.137	.002
Within Groups	116.848	276	.423		
Total	**123.371**	**279**			

The results of the analysis in Tables 2, 4, 6 and 7 showed that the calculated F-ratio for Arts and Social Science (3.577), Health Science (4.239), Management Science (3.463), and Science and Technology (5.137) were each higher than the critical F-ratio of 3.00 at .05 level of significance. This

implies that ICT literacy level has a significant relationship with academic performance (ACADPERF) in Arts and Social Science, Health Science, Management Science and Science and Technology distance e-learners. Based on these results, the null hypotheses 2, 4, 6 and 7 were rejected. This was an interesting result since it correlates with Rakap (2010), who found moderate positive relationship between computer skills and the academic performance of students.

The results of the analysis in Tables 1,3 and 5 also showed that the calculated F-ratio for Agriculture (.726), Education (1.912), and Law (.877) were each less than the critical F-ratio of 3.00 at .05 level of significance. Based on these results, the null hypotheses 1, 3 and 5 were not rejected. The results of this study are in line with Zhu et al. (2009) and Azizi (2014), who noted in their research there was no significant positive relationship between computer competency and academic achievement of Science students at the level of a Bachelors degree.

The results show that there is some relationship between ICT literacy level of distance e-learners and their academic performance based on their disciplines. As stated, ICT literacy levels were measured on a scale of high, moderate, little and none. The results highlighted in Tables 2, 4, 6 and 7 showed that there was a positive relationship between ICT literacy levels and academic performance of Arts and Social Science, Health Science, Management Science and Science and Technology distance e-learners. This may be because it is crucial that distance e-learners gain some basic computer literacy skills such as word processing, spreadsheet, database, presentation, e-mail and the Internet, to enable them to submit TMA, interact with colleagues and facilitators and write electronic or online exams. It may also suggest that ICT literacy is essential for the success of distance e-learners' collaborative learning. This study is in agreement with Mohagheghzadeh et al. (2014), who found that there was a statistically significant relationship between ICT and the academic performance of medical and dental students at Shiraz University of Medical Sciences.

The current study is also in agreement with Rakap (2010), who found a moderate positive correlation between computer skills and students' success. The results of this study are also consistent with Osunade, Ojo and Ahisu (2009), and Barlow-Jones and Westhuizen (2013), who demonstrate a significant difference in academic performance between those who had Internet access or were computer literate, and those without Internet access and/or computer illiterate students. As this aspect of the study is quite consistent with other studies, this further supports the finding that ICT literacy level does play a role in influencing academic performance.

The results highlighted in Tables 2, 4, 6 and 7 also shows that there is no positive relationship between ICT literacy levels and academic performance in agriculture, education and law distance e-learners. This may suggest that their ICT literacy levels do not play a significant role in their academic performance. This accords with Aypay (2010), who found that there was no significant relationship between students' use of ICT and academic achievement based on the results of PISA 2006. The results of this study are also in line with Zhu et al. (2009), Al-Fadhli (2008), Sun et al. (2008) and Azizi (2014), who point out that the competence of students in computer skills has no significant impact on students' performance or that there is no significant positive relationship between Internet competency and academic achievement of science students at the level of a Bachelor's degree.

5. RESULTS AND RECOMMENDATIONS

ICT literacy levels have a significant relationship with academic performance in Arts and Social Science, Health Science, Management Science and Science and Technology e-learners. However, ICT literacy levels do not play a significant role in academic performance in agriculture, education and law e-learners. This may be attributed to the fact that some e-learners use more ICT for academic purposes than other purposes, anytime. It may also suggest that ICT usage depends on course of study.

5.1 Recommendations

Based on the findings, the following recommendations are made:

- The government in Nigeria should concentrate on setting up and improving wireless environments which will assist e-learners to have access to educational benefits, and discover knowledge on their own.

- Government and the management of Nigerian universities should provide suitable ICT centres in all the study centres of universities and also provide distance e-learners with appropriate training on computer literacy.

- The university management should take necessary measures and develop guidelines and administrative strategies that will accelerate ICT usage in universities for educational purposes in order to improve academic performance.

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