ASSESSMENT OF MATHEMATICS LECTURERS' AWARENESS AND UTILISATION OF SOFTWARE APPLICATIONS FOR DEVELOPING MATHEMATICS INSTRUCTIONS IN TERTIARY INSTITUTIONS

O. C. FALODE, I. D. AWOYEMI, T. O. ILUFOYE & Z. N. USMAN

Abstract

This study was carried out to assess Mathematics lecturers' awareness and utilisation of software applications for developing mathematics instructions in tertiary institutions. Descriptive type of survey research design was adopted and Mathematics lecturers were sampled as respondents. Two research questions and two hypotheses guided the study. A 22-item questionnaire was used as instrument for data collection. The questionnaire was validated by educational technology experts and mathematics subject-matter experts. Pilot study was carried out and reliability coefficients of 0.83 and 0.93 were obtained for each of the two sections of the questionnaire. Data collected from the administration of the research instruments were analysed using descriptive statistics of Mean and Standard Deviation. Findings revealed that the awareness of Mathematics lecturers on software applications was high. However, further findings revealed that lecturers are not using the software applications for developing mathematics instructions. Based on these, it was recommended among others that enabling environments that will aid lecturers' utilization of Mathematics software applications in the development of Mathematics instructions should be provided in institutions of higher learning.

Keywords: Mathematics instructions, Software applications, Tertiary institutions, Awareness, Utilization

Introduction

Information and Communication Technology (ICT) is one of the most effective tools for improving knowledge and skills. Oliver (2002) asserted that the use of ICT in higher education enhances student-centered learning. Hence, ICT tool is necessary for quality education in Nigerian tertiary institutions thus, helps to accelerate the learning process, increase teachers' efficiency and effectiveness, and provides remedial instruction and enrichment of material, which could guarantee higher quality standard of education through its utilisation (Osakwe, 2012).

The utilization of ICT and its devices in all fields of study has resulted into enormous development in the past two decades due to its remarkable effect on all areas of human endeavour. ICT can quicken, improve, and extend abilities, to inspire and captivate students, to help relate school experience to work practices, make monetary practicality for tomorrow's labourers, fortifying teaching and help in changing the fate of education most especially mathematics as a subject (Yusuf, 2005).

The study of Mathematics cannot be over emphasized. The evidence of this is obvious in the utilization of Mathematics in all spheres of life, which ranges from simple skills in computation to complex calculation for solving economics problems (George, 2014). Mathematics has been one of the core subjects in the Nigerian educational program. National Policy on Education (2004) stated that Mathematics is a central subject for every student which implies that it has been integrated into all subjects. There are various software applications which are product of ICT tools that can be used for effective teaching and learning of Mathematics (George, 2014).

Mathematics software is an application that allows one to teach and learn Mathematics and solve complex Mathematical problems easily. According to Domínguez and Rodríguez (2006) Mathematics software application offers various features such as: solving mathematical problems in various topics such as graphs, matrices, permutation and combinations, teaching of geometry; drawing of various types of geometrical shapes such as cone, triangle, circle, cube, line and many more.

It can also be used in learning of difficult mathematical topics such as linear programming, complex analysis, vectors, probability, discrete Mathematics, calculus, Statistics, Algebra, functions and graph among others (Albano & Desiderio, 2002). Mathematical Software Applications (MSA) provide the user with the means for doing symbolic, algebraic and graphical manipulations with computers. This means that users cannot only count with numbers, but can also manipulate symbols and carry out complex calculations. These Mathematics Software Application can be a powerful tool for developing Mathematics instructions in tertiary institutions.

Tertiary institution is referred to as post-secondary education; it is the education following successful completion of secondary or post-primary school. Ajadi (2010) defines Tertiary Institutions as schools of higher learning that teach specific disciplines within the capacity of higher learning. The Nigeria's goal of tertiary education is channeled towards higher education through high level manpower training, self-reliance, national utility and international understanding Federal Republic of Nigeria (FRN, 2009). In pursuit of this goal, tertiary education is stratified into different categories which include Universities, Polytechnics, Monotechnics, Colleges of Education, among others (Abu-Dalbouh, 2013). There is need for both students and lecturers in tertiary institution to be aware of the available Mathematics software applications in order to utilize them very well.

Wyart and Tallon-Baudry (2009), define awareness as the ability to perceive, to feel, or to be conscious of events, objects, thoughts, emotions, sensory patterns but more broadly; it is the quality of being aware of something. In biological psychology, awareness is defined as a human's or animal's perception and cognitive reaction to a condition or event. It was also revealed that developing countries like Nigeria still lack

sufficient awareness of ICTs and Software applications. Lecturers tend to feel anxious and even worried when engaging with technology for learning purposes, because of their perceived sense of utilisation (Sife, Lwoga & Sanga, 2007).

Lecturers can utilise the advantages of the software application to develop Mathematics instruction thereby, making them to be more efficient and productive in their field. With varieties of Mathematics software applications in existence, Mathematics lecturers can adopt or adapt Mathematics instructions with ease.

Despite the enormous benefits of Mathematics software applications in teaching and developing Mathematics instructions, it is not clear whether Mathematics lecturers in tertiary institution in Niger State are aware of the existence of Mathematics software applications, even if they are aware, to what extent are they utilizing the mathematic software applications? Hence, this study seeks to assess the level of awareness of Mathematics lecturers in Niger State about the existence Mathematics software application, if they are aware, to what extent are they utilising those software applications.

Research Questions

The following research questions guided the study:

(1) To what extent are lecturers aware of the existence of software applications for developing mathematics instructions?

(2) To what extent are lecturers using software applications for the development of mathematics instructions?

Research Hypotheses

The following research hypotheses are formulated and tested in the study:

Ho_1: There is no significant difference in lecturers' level of awareness of Mathematics software applications in higher institutions based on years of teaching experience.

Ho_2: There is no significant difference in lecturers' extent of utilisation of Mathematics software applications in higher institutions based on years of teaching experience

Methodology

The research design that was adopted for this study is a descriptive survey design. The methodology involved the use of questionnaire to elicit needed data from respondents on their awareness and utilisation of Mathematics software applications. The population for this study comprises all lecturers from tertiary institutions in Niger State. The target population for this study comprise 97 Mathematics lecturers in five tertiary institutions of learning in Niger State. A cluster sampling technique was employed in selecting respondents for this study. In the first stage, the purposive

sampling procedure was used to select five tertiary institutions of learning in Niger State, because the institutions have Mathematics department. Sample selected cut across both the less and experienced Mathematics lecturers in the selected tertiary institutions.Thereafter, convenience sampling was used to select 71 Mathematics lecturers which were sampled based on their availability, representing 86% of the population and the 71 respondents' data were analyzed.

The research instrument that was used in this study to collect needed data is questionnaire and it was designed by the researcher. The questionnaire is titled "Questionnaire on Mathematics Lecturers' Awareness and Utilisation of Mathematics Software Application (LAUMSA)." was used to elicit responses from the participants. The questionnaire was divided into three sections; A, B and C. Section A, consists of demographic information about the respondents. Section B comprised of 11 items which showed respondents level of awareness of Mathematics software application. Section C comprised of 11 items which ask the respondents the extent of utilization of Mathematics software applications for developing Mathematics instruction. A five-point rating scale of Strongly Agree, Agree, Undecided, Disagree and Strongly Disagree was used in weighing responses to the questionnaire items.

The questionnaire was validated by five lecturers, all from the Department of Educational Technology, Federal University of Technology Minna. Their suggestions were used to modify and improve the items. To determine the internal consistency among the items of the questionnaire, a pilot study was carried out using 10 Mathematics lecturers selected from Niger State College of Education, Minna. The administration was done once and a reliability coefficient of 0.93 and 0.83 were obtained using Cronbach Alpha formula for awareness and utilization sections respectively. Hence, the questionnaire was considered suitable for the study.

Data gathered from the administered questionnaires were analyzed using descriptive statistics. Mean and standard deviation were used to answer the two research questions. A five-point rating scale of Strongly Agree (SA, 5 points), Agree (A, 4 points), Undecided (U, 3points), Disagree (D, 2 points) and Strongly Disagree (SD, 1 point) was used in weighing responses to items in the questionnaire. A mean response below 3.00 was considered disagree while a mean response of 3.0 and above was considered as agree. Descriptive statistics of t-test was used for testing the hypotheses in the study and the significance level was ascertained at 0.05 alpha level. The Statistical Package for Social Science (SPSS Version 20) was used for the analysis.

Results

In this section, Table 1-4 are presented with their interpretations tailored towards providing answers to the research questions raised to guide this study.

Research Question 1:To what extent are lecturers aware of the existence of software applications for developing mathematics instructions?

Table 1: Lecturers' mean response on awareness of mathematics software application

No	Items	N	x	S.D	Decision
1	I am aware that **Matlab** can be used to develop Mathematics instruction in tertiary institutions	71	4.63	0.51	Agree
2	I am aware that **Magma** can be used for computing linear algebra and number theory.	71	3.38	0.88	Agree
3	I know that **Mupad** could be used to give students assignment, thereby making learning individualized.	71	3.28	0.96	Agree
4	I am aware that **Maxima** could be used to compute algebraic system.	71	3.55	0.89	Agree
5	I am aware that **Mathematica** can be used to compute abstract algebra	71	4.03	1.04	Agree
6	I know that **Geogebra** can be used by lecturers to make the students to be more involved in learning.	71	3.31	1.04	Agree
7	I am aware that **Kant** could be used for computing Laplace transforms, inverse Laplace transforms, z-transforms and inverse z-transforms	71	3.51	0.91	Agree
8	I am aware that **Maple** can be used in Calculation of differential geometry and approximation theory	71	4.42	0.69	Agree
9	I am aware that **TK Solver** could be used for Solving system of equations	71	3.45	0.91	Agree
10	I know that **Scilab** can be used to analyze and calculate in graph, and is helpful in learning function, analytic geometry, vector, solid geometry and preliminary infinitesimal calculus.	71	3.48	1.05	Agree
11	I am aware that MSA can be used to develop mathematics instruction	71	3.76	0.89	Agree
	Grand Mean		**3.71**		Agree

Decision Mean = 3.00

Table 1. shows the Mean and Standard Deviation of Mathematics lecturers' response on their awareness of mathematics Software Applications. The table reveals the computed mean score of 4.63 with Standard Deviation of 0.51 for item one, 3.38 with Standard Deviation of 0.88 for item two, 3.28 with Standard Deviation of 0.96 for item three, 3.55 with Standard Deviation of 0.89 for item four, 4.03 with Standard Deviation of 1.04 for item five, 3.31with Standard Deviation of 1.04 for item six, 3.51 with Standard Deviation of 0.91 for item seven, 4.42 with Standard Deviation of 0.69 for item eight, 3.45 with Standard Deviation of 0.91 for item nine, 3.48 with Standard Deviation of 1.05 for item ten, and 3.76 with Standard Deviation of 0.89 for item eleven. The table reveals further that, the grand mean score of responses to the eleven items was 3.71 which was greater than the decision mean score of 3.00. This implies that Mathematics lecturers in Niger State are aware of Mathematics Software Applications.

Research Question 1:To what extent are lecturers using software applications for the development of mathematics instructions?

Table 2: Lecturers' mean response on utilization of mathematics software application

S/N	Items	N	x	SD	Decision
1	I use **Matematica** to perform Computation of algebra and work with most of the basic structures in Abstract Algebra	71	2.68	0.98	Disagree
2	I compute linear algebra and number theory with **Magma**.	71	2.38	0.85	Disagree
3	I use **Mupad** to develop innovative, challenging and exploratory teaching modules.	71	2.59	0.73	Disagree
4	I use **Maxima** to compute algebraic system.	71	2.48	0.84	Disagree
5	I Solve system of equations with **TK Solver** .	71	2.52	0.73	Disagree
6	I can use **Geogebra** to compute vectors and discrete mathematics.	71	2.62	0.83	Disagree
7	I use **Matlab**for sophisticated computations in number fields and in global function fields.	71	2.48	1.12	Disagree
8	I compute analytic and solid geometry with **Scilab**.	71	2.79	0.81	Disagree
9	I use **Kant** to compute Laplace transforms, inverse Laplace transforms, z-transforms and inverse z-transforms	71	2.87	0.91	Disagree
10	I use **Maple** for calculations in modern differential geometry and approximation theory	71	2.72	1.16	Disagree
11	I develop and compute mathematics instructions with the used MSA.	71	2.75	1.23	Disagree
	Grand Mean		2.63		Disagree

Decision Mean = 3.00

Table 2: shows the Mean and Standard Deviation of Mathematics lecturers' response on their extent of utilization of Mathematics Software Applications. The table reveals the computed mean score of 2.68 with Standard Deviation of 0.96 for item one, 2.38 with Standard Deviation of 0.85 for item two, 2.59 with Standard Deviation of 0.73 for item three, 3.48 with Standard Deviation of 0.84 for item four, 2.52 with Standard Deviation of 0.73 for item five, 2.62 with Standard Deviation of 0.83 for item six, 2.48 with Standard Deviation of 1.12 for item seven, 2.79 with Standard Deviation of 0.81 for item eight, 2.87 with Standard Deviation of 0.91 for item nine, 2.72 with Standard Deviation of 1.16 for item ten, and 2.75 with Standard Deviation of 1.25 for item eleven. The table reveals further that, the grand mean score of responses to the eleven items was 2.63 which was less than the decision mean score of 3.00. This implies that Mathematics lecturers in Niger State are not using Mathematics Software Applications.

Hypothesis One (HO_1): There is no significant difference in lecturers' level of awareness of Mathematics software applications in higher institutions based on years of teaching experience.

To test this hypothesis, sample t-test independent is applied on the less experienced and experienced mathematics lecturers mean responses score regarding their awareness of Mathematics Software Applications as presented in Table 4.7.

Table 3: t-test result on mean awareness responses of less and experienced mathematics lecturers

Group	N	df	x	SD	t-value	p-value
Less Experienced	17	69	76.76	16.41	1.335^{ns}	0.186
Experienced	54		72.04	11.39		

NS: Not significant at 0.05 level

Table 3 shows the t-test analyses of mean response of mathematics lecturers' awareness of Mathematics Software Applications. The result indicated that there was no statistically significant difference between the two groups, t= 1.335, df=69, p > 0.05 with a mean score of 76.76 for less experienced lecturers and 11.39 for experienced lecturers. Base on this, hypothesis one was retained. This implies that both the less experienced and experienced lecturers have the same level of awareness of Mathematics Software Applications in Niger state, Nigeria.

Hypothesis Two (HO_2): There is no significant difference in lecturers' extent of utilization of Mathematics software applications in higher institutions based on years of teaching experience

Table 4: t-test result on mean utilization responses of less and experienced mathematics lecturers

Group	N	df	x	SD	t-value	p-value
Less Experienced	17	69	53.65	7.314	0.595^{ns}	0.554
Experienced	54		52.11	9.793		

NS: Not significant at 0.05 level

Table 4 shows the t-test analyses of mean response of Mathematics lecturers' extent of utilization of Mathematics Software Applications. The result indicated that there was no statistically significant difference between the two groups, t= 0.595, df=69, p >0.05 with a mean score of 53.65 for less experienced lecturers and 52.11 for experienced lecturers. Base on this, hypothesis two was retained. This implies that both the less experienced and experienced Mathematics lecturers in Niger state, Nigeria have the same level of utilization of Mathematics Software Applications.

Discussion of Findings

Finding of this study on the level of awareness on the existence of open educational resources by lecturers in tertiary institutions in Niger State, Nigeria indicated that lecturers are aware of the existence of Mathematics software applications. This finding is in agreement with the earlier finding of Ani (2005) who discovered that all the teachers (lecturers) in his study are aware of different sorts of Software Applications that could be used for educational purposes. However, this finding is not in agreement with the finding of Oladosu (2012) that revealed that instructors in Nigeria are not aware of computer software applications for instructional purposes. The lecturers' awareness of Mathematics software applications was due to their attendance of seminars, workshops and conferences. Hence, they have been acquainted with different mathematics software applications.

Hypothesis one finds out if there is significant difference between less and experienced lecturers' level of awareness of the existence of Mathematics software applications. The result shows that year of experience has no influence on lecturers' level of awareness of the existence of Mathematics software applications with the mean of 76.76 for less experienced and 72.04 for experienced lecturers and the p-value of 0.186 which is not significant at 0.05 alpha level. This finding is in line with the finding of Agbonlahor (2008) who found out that lecturers' usage and awareness of ICT is not influenced by their experienced, level of awareness of ICT and attitude towards ICT are independent of age and experience of lecturers.

However, this finding is not in line with the findings of Lawal (2004) who opined that there is significant difference in the years of experience of lecturers on the awareness of ICT tools (computer software applications inclusive). Also, this finding is not in line with Bamidele and Olayinka (2012) who reported that there is significant difference in teachers' (lecturers') teaching experience on their awareness of ICT tools. This finding may be due to the fact that awareness depends on the exposure of an individual to ICT tools and not years of teaching experience. Therefore, there is no significant difference between less experienced and experienced lecturers' level of awareness of mathematics software application.

Finding of this study on lecturers' utilisation of Mathematics software applications reveal that Mathematics lectures are not using Mathematics software applications with the grand mean of 2.63 which is less than the decision mean of 3.0. This finding is in line with the finding of John and Sutharland (2014) that found out that majority of lecturers are not using ICT tool for instructional purpose. Mathematics lecturers are not using mathematics software applications because they believed they can develop mathematics instructions without using mathematics software applications since they have been doing that before. Another reason why Mathematics lecturers are not using the mathematics software applications is because of some of the barriers associated with the use of ICT tool like lack of regular power supply, the cost of some of these software application or the cost of downloading them. Hence, Mathematics lecturers are not using mathematics Software Application not because they are not aware but because of barriers associated to the use of software Applications.

The findings of this study also revealed that there is no significant difference in lecturers' extent of utilization of Mathematics software applications in tertiary institutions based on years of teaching experience. This finding is in line with the finding of Agbonlahor (2008) who found out that lecturers' usage and awareness of ICT is not influenced by their experienced, level of awareness to ICT and attitude towards ICT are independent of age and experience of lecturers. However, this finding is not in line with the findings of Wang, Ertmer and Newby (2004) who found out that there is significant difference in the years of experience of less experienced and experienced lecturers on the usability of computer software. Also, this finding is not in line with the findings of

Onasanya, Sheu, Oduwaiye and Sheu (2010) who found out that there is significant difference between less and experienced lecturers' utilization of ICT tools. The finding is not also in line with the views of Bamidele and Olayinka (2012) who reported that there is significant difference in teachers' teaching experience on their perception of integrating the use of mobile phones/ICT tools for educational purpose. This finding may be due to the fact that the usage of ICT tool depends on the willingness of an individual to use ICT tool and not years of teaching experience. Therefore, there is no significant difference between less experienced and experienced lecturers' utilization of mathematics software application based on year of teaching experience.

Conclusion

This study has revealed that mathematics lecturers are aware of mathematics software applications. But Mathematics lecturers are not using mathematic software applications to develop mathematics instructions. Therefore, Lecturers should be encouraged to use Mathematics software applications by making necessary facilities that will aid the utilization available. The use of Mathematics software applications would help the lecturers to be more efficient and effective in developing mathematics instructions.

Recommendations

Based on the findings of this study, the following recommendations are pertinent:

1. Enabling environments that will aid lecturers' utilisation of Mathematics software applications in the development of Mathematics instructions should be provided in institutions of higher learning.
2. Government should provide constant power supply in tertiary institutions in order to prevent the barriers to the use of ICT tools like Mathematics Software Applications.
3. School administrators with the help of non-Government Organisation should equip schools with adequate ICT facilities, which will motivate lecturers to use Software Applications.

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