

MODELLING ICT INTEGRATION IN TEACHING AND LEARNING OF TECHNICAL EDUCATION

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ABSTRACT

The use of ICT facilities in teaching and learning is promising as it continues to yield impressive result from the studies conducted around the developed world economies. Results of similar studies from developing economies revealed gap in the use of ICTs in teaching and learning, especially, in some higher institutions offering Technical and Vocational Education (TVE). Emerging developing economies like Nigeria, is now striving to integrate the use of ICTs in teaching and learning of its TVE programmes. In view of that, this research aimed at developing a functional model that consisted of areas considered important for integration of ICTs into teaching and learning process in TVE. Regression Model Analysis was used to analyse data collected from a Rasch analysed questionnaire distributed to a total of one hundred and forty (140) respondents drawn from five higher institutions offering TVE in north-eastern Nigeria. Being a mixed method adopted research; a qualitative data collected through interview was further subjected to qualitative analysis procedures. A functional model of five (5) important areas and 4 categories emerged.

Keywords: ICT, Teaching, Learning, Technical, Vocational and Education

1. INTRODUCTION

There is great concern by researchers in the 21st century about the relevance of ICT in teaching and learning (Chai *et al.*, 2011). Some found the impact of ICT technology on teaching and learning in higher education institutions (Mijares and Chan, 2012); some have identified various prospects and problems/barriers in the integration of ICT facilities for teaching and learning (Bingimlas, 2009; Chen *et al.*, 2012). Among the 21st century studies on the application of ICT in teaching and learning in higher education institutions in Nigeria was a conceptualized model comprising of 4 themes generated "perception, integration, motivation and challenges" (Afolake *et al.*, 2012). This finding has shown the relevance of integrating ICTs in higher education institutions and paves way for the present research.

ICTs integration in teaching and learning has been proven to be so advantageous and despite some

challenges due to some constraints (Assan and Thomas, 2012). ICTs found application in teaching of engineering related disciplines that require specific approaches different from that of theoretical disciplines. The deployment of ICTs in the field of chemical engineering discipline is evident and well documented (Perry and Bulatov, 2010). In Technical and Vocational Education (TVE), a discipline that is unique in curriculum contents, objectives and structure, although offered in faculty of education mostly, the course is highly technical in nature and will be in high demand need for ICTs integration in teaching and learning activities. Use of ICTs in engineering or technology based discipline as virtual laboratories tools and simulation environment will definitely find application in teaching of technical content to students of TVE.

Deployment of ICTs as Virtual Learning Environment (VLE) contributed significantly impact in management of in teaching and learning resources by teachers, as it helps them discover students

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capabilities and manage teaching resources easily (Perry and Bulatov, 2010). However, prior to integration of ICTs in TVE teaching and learning process, there is need to identify areas of priority in which ICTs are to be integrated depending on the availability of facilities; here the question is what aspect of curriculum content is to be considered very important to integrate ICTs while using it for teaching and learning activities. In order to successfully integrate ICTs for teaching learning process in TVE, a functional model consisting of important areas of priority need to be developed, hence, the need for this research.

1.1. Research Objective

The research is aimed at identifying and developing a functional model of important areas to be considered for the integration of ICTs in teaching and learning process in higher education institutions that offer technical and vocational education in Nigeria.

1.2. Research Question

What areas are considered important for the integration of ICTs in teaching and learning process in higher education institutions that offer TVE in Nigeria?

2. MATERIALS AND METHODS

This research adopted mixed method (explanatory research design). The selection of explanatory research design was done in accordance with the nature of data collected in this research; initially, the samples of the population (policy makers, administrators and lecturers) were served with a structured questionnaire (quantitative data collection instrument). After that, interview guide developed by researcher guided the interview held with policy makers, administrators and lecturers of higher institution offering TVE in Nigeria to further explore their opinions on how to integrate ICTs in teaching and learning, as well as their opinions about areas considered important for ICTs integration in teaching and learning of TVE.

2.1. Sample and Sampling Procedure

Sample of 140 respondents were selected purposively based on their definitive characteristics that qualifies them to participate in this research. In this case, only respondents at TVE

departments/programmes were involved and have been selected from only Federal Government owned higher institutions offering TVE at Diploma, Higher Diploma, Nigeria Certificate in Education (NCE) and Bachelor Degree levels, with the understanding that higher institutions owned by Federal Government operates using the same guidelines, rules and regulations in their admission, curriculum and graduation requirements. However, 5 TVE specialists participated in the interview process, selected purposely based on.

2.2. Data Collection Procedure

Two research assistants were trained on the procedures for quantitative collection; they helped researchers collect quantitative data by distributing and collecting back questionnaires to and from respondents. Interviews were conducted by one of the researchers residing in Nigeria. As stated earlier, the interview guide/protocol was used to explore further opinions on important areas for ICTs integration in TVE that was later used in the development of a functional model.

3. RESULTS

Pilot study result was Rasch Analysed using Bond and Fox (2013) Steps Rasch Model software. In addition, Linear Regression Model Analysis was used to identify the most important quantitative predictor variables representing areas considered important for the integration of ICTs in teaching and learning process in TVE in Nigeria. Transcription, coding, thematic and categorization procedures were used in qualitative data analysis. The results are as presented in **Table 1-4**.

Table 1 present a summary of Rasch Analysis of model fit of item responses on questionnaire items relating to ICTs integration in aspect of teaching and learning. Shown on a table are item reliability coefficients (Real) of 0.67 with separation index of 1.43. Since, the separation is slightly above 1.0 and then there is tendency of having variability on the traits. Model fit analyses further revealed that Mean INFIT (MNSQ) and OUTFIT (MNSQ) of 0.98 and 0.99 respectively. These values are also below the expected score of 1.0 and this further shows that the data over fit the model and redundant items are highly expected from the questionnaire.

Table 1. RASCH analysis summary of model fit on item responses on ICTS in teaching and learning

	Raw			Model Error	Infit		Outfit	
	Score	Count	Measure		MNSQ	ZSTD	MNSQ	ZSTD
Mean	96.80	30.00	0.00	0.28	0.98	-0.1	0.99	-0.1
S.D.	7.40	0.00	0.51	0.02	0.42	1.3	0.42	1.2
Max.	106.00	30.00	1.19	0.32	2.55	4.2	2.48	3.6
Min.	78.00	30.00	-0.73	0.24	0.56	-2.2	0.51	-2.1
Real RMSE	0.29 ADJ.SD	0.42 Separation			1.43 Item reliability		0.67	
Model RMSE	0.28 ADJ.SD	0.43 Separation			1.55 Item reliability		0.71	

S.E. OF Item Mean = 0.11

Table 2. Regression analysis result on significant determinants for ICT integration in teaching and learning in TVE

Significant determinants of ICTs in teaching and learning in TVE	UC		SC Beta	t	Sig.	95% B	
	B	S. E.				B	B
1 a) Teaching safety rules and regulations	0.700	0.015	0.962	47.877	0.000	0.671	0.729
2 a) Teaching safety rules and regulations	0.423	0.032	0.523	13.118	0.000	0.359	0.487
b) Teaching technical skills	0.318	0.035	0.421	9.087	0.000	0.248	0.388
3 a) Teaching safety rules and regulations	0.291	0.038	0.391	7.637	0.000	0.215	0.367
b) Teaching technical skills	0.281	0.032	0.342	8.904	0.000	0.218	0.343
c) Virtual lab. and workshop	0.200	0.039	0.292	5.110	0.000	0.122	0.279
4 a) Teaching safety rules and regulations	0.246	0.036	0.265	6.828	0.000	0.174	0.318
b) Teaching technical skills	0.177	0.037	0.211	4.796	0.000	0.104	0.251
c) Virtual lab. and workshop	0.182	0.036	0.207	5.109	0.000	0.111	0.254
d) e-learning tools	0.173	0.039	0.201	4.384	0.000	0.094	0.252
5 a) Teaching safety rules and regulations	0.190	0.037	0.257	5.140	0.000	0.116	0.263
b) Teaching technical skills	0.153	0.035	0.143	4.351	0.000	0.083	0.223
c) Virtual lab. and workshop	0.162	0.034	0.134	4.806	0.000	0.095	0.229
d) e-learning tools	0.151	0.037	0.123	4.043	0.000	0.076	0.225
6 a) Teaching safety rules and regulations	0.156	0.036	0.249	4.307	0.000	0.084	0.229
b) Teaching technical skills	0.133	0.034	0.131	3.939	0.000	0.066	0.200
c) Virtual lab. and workshop	0.140	0.033	0.114	4.303	0.000	0.075	0.205
d) e-learning tools	0.142	0.035	0.112	4.041	0.000	0.072	0.213
e) Online group discussion	0.120	0.035	0.109	3.458	0.001	0.051	0.188

Table 3. Summary on significant determinants for integrating ICTs in teaching and learning in TVE

Most important predictor variables	R	R ²	Adjusted R ²	S. E.
Teaching safety rules and regulations	0.982 ^a	0.965	0.944	0.47283
Teaching technical skills	0.991 ^c	0.982	0.972	0.33678
Virtual lab. and workshop	0.993 ^d	0.987	0.981	0.29509
E-learning tools	0.995 ^e	0.989	0.984	0.26692
Online group discussion	0.995 ^f	0.991	0.992	0.24850

From the Mean Standardised INFIT (ZSTD) and Mean Standardised OUTFIT (ZSTD) of .01 and 0.2 (below expected score of 0.0) the data is not predicted to have perfectly fit the model, which equally indicates the need to revisit some items and subsequently reduce the number of items. Therefore, from the initial questionnaire having 16 items, a modified version of the questionnaire with 10 items was finally produced and used in this research.

Table 2 presents the result of Linear Regression Analysis using the 'Stepwise Criteria', although a significant regression model emerged with $F_{5, 85} = 1595.853$, $p < 0.05$, $R^2 = 0.991$, 5 variables (Teaching Safety Rules and Regulation, Teaching Technical Skills, Virtual Laboratories/Workshops, e-Learning Tools and Online Group Discussion tool) with standardized Beta Coefficients of 0.249, 0.131, 0.114, 0.112 and 0.109, $p < 0.05$ are significant determinants considered important for integrating ICT in the Teaching and Learning of TVE.

Table 4. Qualitative results on ICTs integration in teaching and learning in TVE

Participants /(Responses)	Cat. 1 Classrooms	Cat. 2 Libraries	Cat. 3 Laboratories	Cat. 4 Hostels
RU1	Tools for aiding teachers in lectures/classroom presentation	Tools that give student access to materials for reading and assignments	Virtual laboratories	Making ICTs readily available every where
RU2	Environment for e-learning	Give students and teachers enabling environment for study and research	Software for simulation	Wi-fi access to students dormitories
RP1	Assignments, class work, attendance and teaching learning tools	In library for providing text materials to students and teachers	Online tool for evaluating practical and experiments	It can be deployed to students accommodation
RP2	Used as multimedia environment for effective teaching	Aid in providing access for conducting research and publications	As computer laboratories for data processing	Giving students, scholars ability to share information, use it and prepare it right from hostels
RF1	To be deployed in classroom for teaching and learning process	Access to e-books, journals, periodicals and information relevant to both staff and students	Access to workshop manuals and tutorials for practical/experimentation	Give students offer to use ICTs gadgets right from bedrooms

Other variables (Audio and Video conference tool, course preparation, web-based course management system and Job skills development tool) were not significant determinants and are hereby excluded from the table i.e., to say, they are not considered as significant determinants for consideration in integrating ICT in the teaching and learning of TVE in Nigeria's Higher Institutions of Learning.

The value of Adjusted R^2 of 0.991 in **Table 3** indicates that the regression model account for 99.1% variance in the areas considered being important in integrating of ICT in TVE Administration. This further reveals that 6 out of 10 determinants are most significant for consideration in integrating ICTs in teaching and learning aspect of TVE in Nigeria.

From the interview protocol/guide the research question was further divided into 2 open ended questions that aided the collection of data related to integration of ICTs in aspect of teaching and learning in TVE. Open ended questions (what is the relevant of ICTs in the teaching and learning in TVE? what areas could be given priority for integrating ICTs in teaching and learning in TVE?). After subjecting data to qualitative analysis procedures, results in **Table 4** presents three major categories (classrooms, libraries, laboratories and hostels) identified from the interviewees opinions on important areas to integrate ICTs in teaching and learning in TVE.

Table 4, presents opinions and perceptions of interview participants RU1, RU2, RP1, RP2 and RF1 on categories identified based on qualitative data analysis. Based on their perceptions of ICTs integration in

teaching learning under category of classroom application, it can be used as 'tools for aiding teachers in lectures/classroom presentation'; 'environment for e-learning'; 'assignments, class work, attendance and teaching learning tools'; 'multimedia environment for effective teaching' and 'for teaching and learning process'. In addition, all the participants opined that ICTs can be integrated in teaching and learning via successful application to libraries, hence, RU1 looks at ICTs as 'tools that give student access to materials for reading and assignments'; RU2 as 'give students and teachers enabling environment for study and research'; RP1 opined that ICTs be applied in 'library for providing text materials to students and teachers'; RP2 as 'aid in providing access for conducting research and publications' and RF1 for 'access to e-books, journals, periodicals and information relevant to both staff and students'. It can be deduced from their responses that to integrate ICTs in teaching learning process, library should be given priority.

Categories 3 and 4 revealed laboratories and hostels application of ICTs in teaching learning process. From **Table 4**, RU1 is of the opinion that ICTs should be used to create 'virtual laboratories' and be made available everywhere in the institutions including hostels; RU2 is equally with the view that ICTs can serve as 'Software for simulation' and be made available in hostels as 'Wi-Fi access to students dormitories'; RP1 and RP2 feels that ICTs be used as 'online tool for evaluating practical and experiments' and 'as computer laboratories for data processing' respectively. Finally

RF1 is of the opinion that ICTs should serve as a tool to 'access workshop manuals and tutorials for practical/experimentation' and 'should be provided at students bedrooms. Therefore, based on participants' positions on ICTs integration in teaching and learning in TVE, places like classrooms, libraries, laboratories and hostels should be given due consideration.

4. DISCUSSION

Several areas were identified in this research in which ICTs can be integrated in the aspect of teaching and learning in TVE (**Fig. 1**). According to the finding, ICTs should be used for teaching of safety rules and regulations, teaching of technical skill, used for virtual laboratories, for workshop practice, as e-learning tools and for online group discussion. On the use of ICTs for teaching of safety rules and regulation, it was recently identified that the use of virtual reality would enhance the safety of electrician in built environment (Barrett, 2012) and also proposal was made to put into use virtual safety reality in chemical engineering since 1999 (Bell and Fogler, 1999). The importance of safety in TVE cannot be overemphasized, in that, it builds students habit that can eventually be transferred throughout their working career (Bell and Fogler, 1999).

Technical skills in TVE can also be taught using ICTs which is one of the components that was found to be given more emphasis in integration of ICTs in TVE from this research. Although this finding is in contrast with the fact that vocational technical teachers uses ICTs in managerial than for instructional purposes (Mumcu and Usluel, 2010). Consequently, in some higher institutions in Nigeria, the use of ICTs for conducting students' practical in workshops/laboratories especially in technical and engineering related fields is in its infancy compared to what is obtainable in countries like Malaysia and Singapore where the use of ICTs in educational sector proves to be above average. Nevertheless, with findings like this one, the hope for technical and vocational instruction to be done is still within the possibility domain. The use of ICTs helps simplify the concept to the learning levels of students (Abu-Obaidah *et al.*, 2012), apart from the flexibility the environment offers to teachers and students in the process of learning difficult concept, ICT in career technical education offers means of simplifying difficult learning experiences (Jawarneh, 2013).

The finding of this research on the use of ICTs in TVE for virtual laboratories is timely considering the way world is turning to a global village; a world in

which experts share ideas, research output, exchange vital information without coming in contact physically. On the other hand, cross boarder collaboration is now possible via ICTs. Virtual laboratory offers safe working and hazardous free environment for learners and laboratory instructors; it is cheaper in terms of cost; such that consumables are recycled virtually. However, due to its numerous advantages, virtual laboratory has found application into various technical and engineering courses; in electrical (Lei *et al.*, 2012). Despite the advantages and benefits of using virtual laboratory which made the respondents to give it more recognition, yet most of the African institutions have not started putting the tool into the real practical situation. This is evidence in the finding of the study conducted in Zimbabwe that pre-service teacher are aware about the existence of virtual laboratory, but have not utilize it in their teaching (Bhukuvhani *et al.*, 2010). In a similar vein, science education lecturers were also found to prefer the use of lecture notes and internet downloads instead of new learning technologies (Bhukuvhani *et al.*, 2010).

It has been reported by several studies that students that receives practical via simulated laboratories performed better than the one that attended expository laboratory experiments in terms of time taken to complete the experiments, which gives simulated laboratories upper advantage than traditional hands-on laboratories (Pyatt and Sims, 2012), virtual laboratory has proven to help carried out measurement of scientific phenomena (Oidov *et al.*, 2012). Therefore, with this numerous advantages in using virtual laboratories in teaching of science related courses in which technical and vocational is inclusive, the integration of ICTs in TVE specifically for virtual laboratories is paramount and worthy of implementation.

This study found the importance of using ICTs in TVE as e-learning tool. This is evident in consideration of the way higher institutions around the globe strives to turn all their academic activities electronically. Some institutions of advanced developing countries like Universiti Teknologi Malaysia, based on authors personal experience have so far embraced the use of e-learning environment for teaching students, students up loading assignment, lecturers accessing, marking and giving feedback to students within shortest possible time. If that is fully achieved in such institutions, higher institutions in Nigeria as a developing country with abundance talents and determination could effectively achieve the use of e-learning in their day to day teaching learning activities.

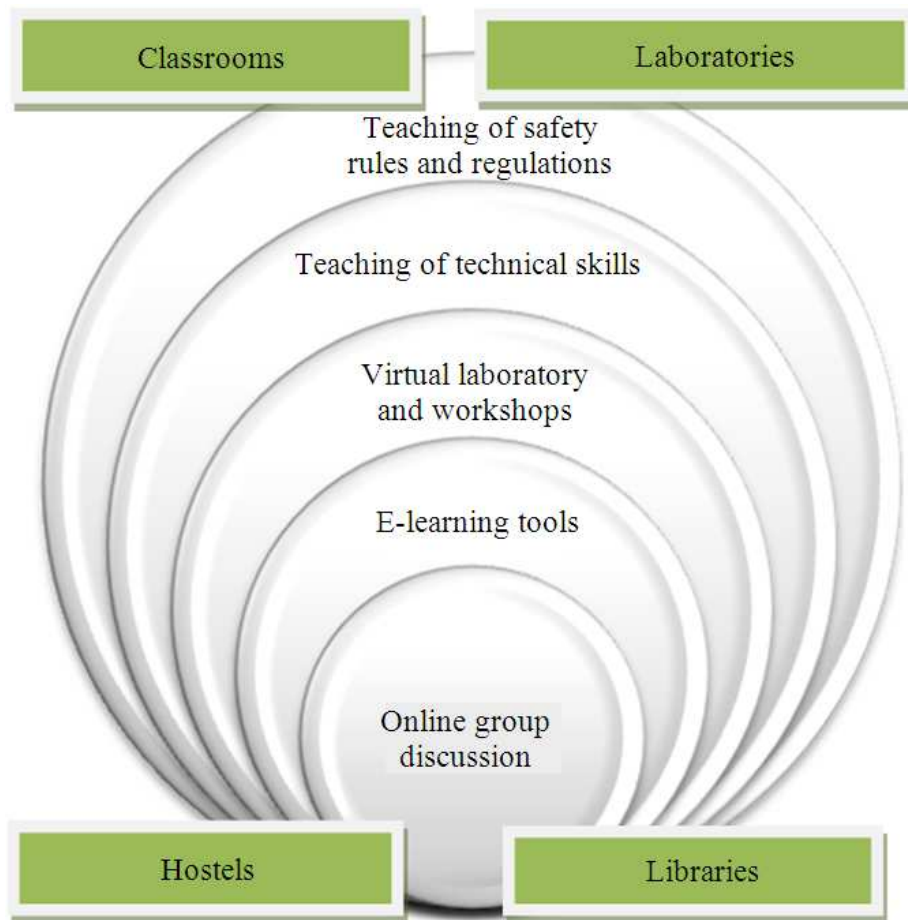


Fig. 1. Model of ICTs integration in teaching and learning of TVE

In that, with the use of e-learning, higher education transformation is under way (Garrison, 2011).

It is also worthy of acknowledgement that e-learning tool or environment can make impact into the delivery of TVE in Nigeria, students can access materials anytime and anywhere independent of location and time if ICTs are put in place within the reach of users. E-learning was identified as a significant tool for TVE which the institutions cannot afford to overlook (Bappa-Aliyu, 2012) that is why online-Web-Based Learning (WBL) to enhance the TVE students learning and competencies toward the satisfaction of present industrial requirement in Bahrain was developed (Alsiddiqi *et al.*, 2010) and information quality framework to measure the effectiveness of e-learning content for technology based learning system for Engineering Education Courses (EECs) in Technical and Vocational Education (TVE) in Bahrain was also

developed (Alsiddiqi *et al.*, 2012). These mechanisms have further supported the findings of this research that e-learning is such a significant tool/environment higher institutions offering TVE in Nigeria should as a matter of urgency embrace for smooth teaching and learning process for both staff and students.

It was also found in the present study, that ICTs in TVE should incorporate ICTs for online group discussion among various lecturers, management staff and students. This is to say that in a present globally connected world, TVE should also not be left out in using ICTs for forming groups that are connected and sharing information, ideas, research output and new development online. Online discussion has been identified as a very important strategy for effective delivery of courses, in which moderators and facilitators are expected to possess skills on information provision, invitation, monitoring and acknowledgement. In

technical and vocational education, the central objective is skill acquisition for industrial development, as such, online group discussion forums create an enabling environment for students come in contact with experts invited from industries to share experience on skill, requirements and new technologies.

5. CONCLUSION

Now that weblog is becoming a common thing that every student and lecturer can develop, manage, own and control, students or lecturers find it very easy to access and schedule meeting or discussion. In addition, students were found to be more inclined to the use of ICTs than traditional learning environment, though gender and age were variables in this study (Akbulut, 2010). Nevertheless, ICTs remains significant tool for effective delivery where space and time are no longer significant variables. Considering the nature of TVE in preparing skilful workers, work space collaboration is another component that is to be considered and only achievable via ICT. Therefore, by integrating ICTs in TVE, students can learn how to work collaboratively and transfer the concept to work place after graduation. In line with this development, students of post graduate diploma level were engaged in collaborative online workspaces, they were monitored and the result showed the level of participation of each member in a group by submitting progress report of their level of contribution, which also help teachers "track and monitor the collaborative learning process" (Wang, 2010).

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