ICT Impact Assessment in Education

Nafisat Afolake Adedokun-Shittu
Universiti Utara, Malaysia

Abdul Jaleel K. Shittu
Universiti Utara, Malaysia

INTRODUCTION

It has been noted that while there is clearly much promise in the use of ICT for education, there is also concern of a widespread ignorance of the specific impact of ICT on education goals and targets (World Bank, 2003). Trucano (2012) lamented about the situation in less-developed countries (LDC) that the lack of evaluation tools and methodologies for the assessment of ICT impact on teaching and learning (T&L) constitutes a limitation. Adedokun-Shittu and Shittu (2011) identified that LDCs with an emerging thrust in technology are gradually deploying technology because of its prowess, but they do not seriously consider evaluating the impact of technology on the system it is deployed for. In an attempt to respond to these limitations, Adedokun-Shittu (2012) conducted a study to assess the impact of ICT in teaching and learning (T&L) in higher education in LDCs. The outcome of the study produced an operational model to address concerns relating to ICT impact assessment in LDCs which composed of four elements (perceived impact, integration, motivation and challenges). This article presents the developmental stages of the model and provides operational definitions of certain concepts relating to the elements of the model. Having identified that barriers or challenges to ICT use in LDCs need to be assessed, Adedokun-Shittu developed a model that extends the elements of Kirkpatrick and Stufflebeams' Context, Input, Process, Product (CIPP) models by adding the "challenge" element. Thus, to determine the efficacy of this operational model, the study developed a set of instrument on ICT impact assessment and validated it by establishing interaction between the dependent variable (ICTrate) and the independent variables (perceived impact, integration, motivation and challenges). These predicting factors of ICT impact are subsequently developed into an ICT impact assessment model that fits the current situation of LDCs.

BACKGROUND TO THE STUDY

Technology penetration in LDCs has been observed to be driven by the promises inherent in technologies however, evaluating its impact have been evasive (Adedokun-Shittu & Shittu, 2011; Unwin & Day, 2005). This illusive perception of technology has beclouded the specific and local impacts technology has on education in LDCs. This has consequently led educators in LDCs to entirely refer to technology impacts derived by evaluation tools designed in developed countries (DC) rather than create local tools that derive specific and local impacts. Ashraf, Swatman and Hanisch (2008) argue that applying indicators for measuring ICT impact which are designed in one context and then applied in another has led to many failures of ICT4D projects. Researches by InfoDev (2006) emphasized that the aims of any impact evaluations are to see how far the intervention has reached its desired audience, to identify effects and to measure impacts considering different quantifiable local indicators. Heeks (2005) maintains that improved ICT4D interventions must be associated with local data content and ICT skills for sustainable impacts to be feasible.

Having realised that ICT frameworks for education used in DCs are not totally suitable for ICT implementation in LDCs, researchers have taken the initiative to develop suitable models that take into consideration the peculiarities of education and level of ICT pen-

DOI: 10.4018/978-1-4666-5888-2.ch244

etration in those countries. Bass (2010) developed an eight-level maturity model that defines the ICT infrastructure resource levels required to achieve student learning outcomes. The model shows management, teaching and technical staff and donors how to make most efficient use of ICT resources by maximising opportunities for student learning. Reijswoud (2009) also developed a theory for the design and implementation of ICT projects in LDCs that takes into account local conditions while incorporating existing theories used in DCs. Ashraf et al. (2008) developed an extended framework that demonstrates that ICT projects can lead to development, but only when local constraints are addressed. After series of review on ICT impact in education, authors (World Bank, 2003; Trucano, 2012) conclude that evidence is scarce and limited and that the impact of ICT use on learning outcomes is unclear. Therefore they call for the need for cautiously carried out research in different countries with widely accepted methodologies and indicators to assess the impact on education. In response to this, Adedokun-Shittu (2012) develops an ICT impact assessment model by employing two grounded impact evaluation models (Kirkpatrick and CIPP) as a theoretical framework to guide the development of the model and the data gathering instruments for impact evaluation.

Theoretical Framework: Blending Kirkpatrick and CIPP Evaluation Models

Kirkpatrick's successive four-level model of evaluation and Daniel Stufflebeam's Context, Input, Process, Product (CIPP) evaluation model were synchronized because of the similarities inherent in their elements and named blend model to guide the development of the ICT impact assessment model. Kirkpatrick's model follows the goal-based evaluation approach and is based on four simple questions that translate into four levels of evaluation. These four levels are widely known as reaction, learning, behavior, and results. CIPP model on the other hand is under the systems approach and the acronym is formed from Context, Input, Process and Product. However, this study limits its scope to the product evaluation in this model which is suitable for impact studies like the one reported in this article (Wolf, Hills, & Evers, 2006).

To substantiate the essence of blending these two models, authors who have either employed both models in their study or recommended a mix of models to solidify research findings are cited. Khalid, Abdul Rehman and Ashraf (2012) explored the link between Kirkpatrick and CIPP models in public organization in Pakistan and came up with an extended and integrated framework. Taylor (1998) employed both CIPP and Kirkpatrick management-oriented approaches to guide his study on technology in curriculum evaluation. He noted that the Kirkpatrick model is often utilized by internal evaluators to measure the impact of a specific treatment on students while the CIPP model is designed for external evaluators to collect data about program-wide effectiveness that can assist managers in making judgments about programs' worth. Lee (2008) concludes his assessment on research methods in education by saying; "there is no such thing as a perfect teaching model and a combination of models is needed to be able to adapt to the changing global economy and educational needs" (p. 10). He discovers that there is always an overlap in the building and development of learning models and thus suggests a combination of closely related models to meet the needs of educators. A comparison of Kirkpatrick's goal-based four-level model, CIPP and TVS was offered by Eseryel (2002). Owston (2008) also looked into both Kirkpatrick and CIPP models among other models. He offers comprehensive suggestions for evaluators thus: (i) to look broadly across the field of program evaluation theory to help discern the critical elements required for a successful evaluation, (ii) to choose whether a comparative design, quantitative, qualitative, or a combination of methods will be used, and (iii) to devise studies that will be able to answer some of the pressing issues facing T&L with technology.

Similarly, Wolf, Hills, and Evers (2006) combine Wolf's Curriculum Development Process and Kirkpatrick's to inform the assessment and design of the curriculum. The two models were tabulated and assessed in stages making it worthwhile to use similar measures to determine whether they foster the desired objectives. They affirmed that combining the two models has resulted in intentional and sustainable choices that were used as tools in creating strategies and identifying sources of information useful in creating a snapshot of the situation in the case study chosen. Among the tools

they employed were: survey, interview, focus group, testing, content analysis, experts and archival data which they claim is a process that can be repeated overtime, using the same sources, methods, and questions. Consequently, Adedokun-Shittu (2012) employed a mixed method of approaches (survey, interview, observation) and a graphical and systematic blend of two models to develop an operational model for LDCs.

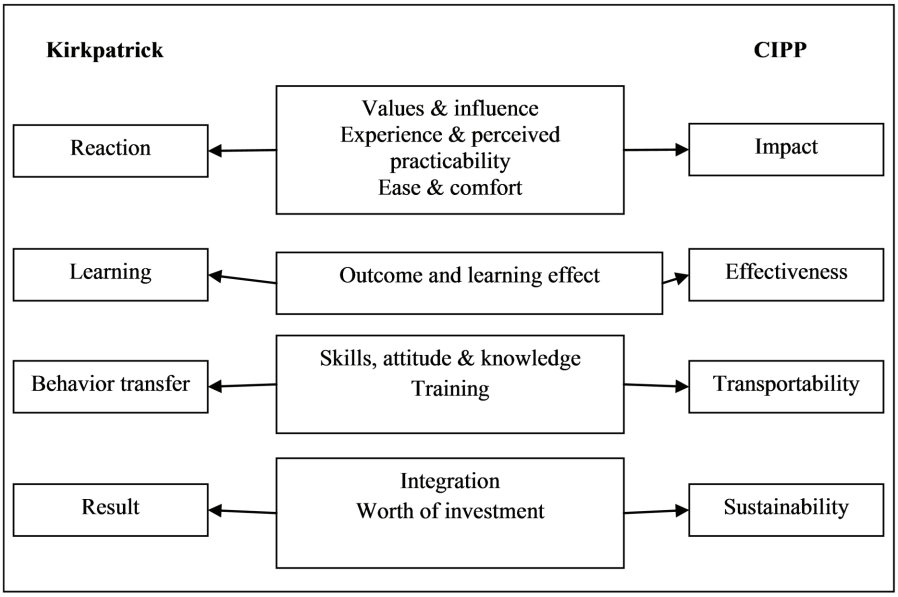
The theoretical synchronization of these two models emanates from the synonymous four levels involved in Kirkpatrick's and the subparts in the product evaluation in the CIPP model. Firstly, the reaction in Kirkpatrick measures similar elements as impact in the CIPP. They both assess the values and influences of technology on both lecturers and students. The ease and comfort, experience, perceived practicability and potential for applying the ICT in T&L can also be assessed in this part. Secondly, the learning and effectiveness in both models evaluate the outcome and learning effect the ICT has on students and lecturers, proficiency and confidence level of knowledge, skills and attitude they have acquired. This is what Wagner et al. (2005) called students' impact (see Figure 1).

Thirdly, transportability and transfer in CIPP product and Kirkpatrick serve the same function of analyzing whether the skills, attitude and knowledge learnt from the ICT use or training is useful for the teaching or learning situation. What is the level of encouragement, motivation, drive, reward and on-going training students and lecturers are provided with? Finally, sustainability and results in both help measure the worth of the investment to determine whether the results are favourable enough to sustain it, modify or stop the project. It also measures whether the desired outcome are being achieved (see Figure 1).

METHODOLOGY

This study looks into the impacts derived from employing ICTs in T&L in a Nigerian University through a mixed method approach. Evaluation studies are better conducted employing mixed methods because of its comprehensiveness and to achieve a valid and well-substantiated conclusion (Stufflebeam, Harold, & McKee, 2003; Cresswell, 2009). Independent Evaluation Group (IEG), (2006) strongly recommends mixed method for impact study given the lack of credibility identified against impact studies that focus mainly on quantitative method. With the use of a convergence mixed method design, the impact of ICT deployment in T&L at a Nigerian University was examined. The survey data drawn from 593 respondents (students and lecturers) was analyzed using linear regression. One-on-one and focus group interviews conducted among the 7 students and 8 lecturers sought their opinion

Figure 1. Blend model for impact studies



on ICT impact on T&L. Lecture-room observations conducted across 3classes were used to observe how ICT is integrated. These multiple means findings were triangulated, compared and contrasted to validate the study. Four predictors of ICT impact (positive effects, challenges, incentives and integration) were generated and named ICT IMPACT ASSESSMENT MODEL serving as a conceptual framework for researchers on impact assessment.

The quantitative survey takes its strength from the large sample size while the qualitative part takes its strength from the richness of the samples, depth of the interviews and the thoroughness of the classroom observations. A justification for this is given by Creswell and Plano (2007) that the strength of each approach is influenced by the goals, research questions and procedure. The quota sampling method used for the survey is known for its representativeness (Trochim, 2006). This study could benefit from transferability to other settings because of the high reliability of the survey (.894) The instrument employed is a 58-item questionnaire that was subdivided into seven parts.

Data Analysis

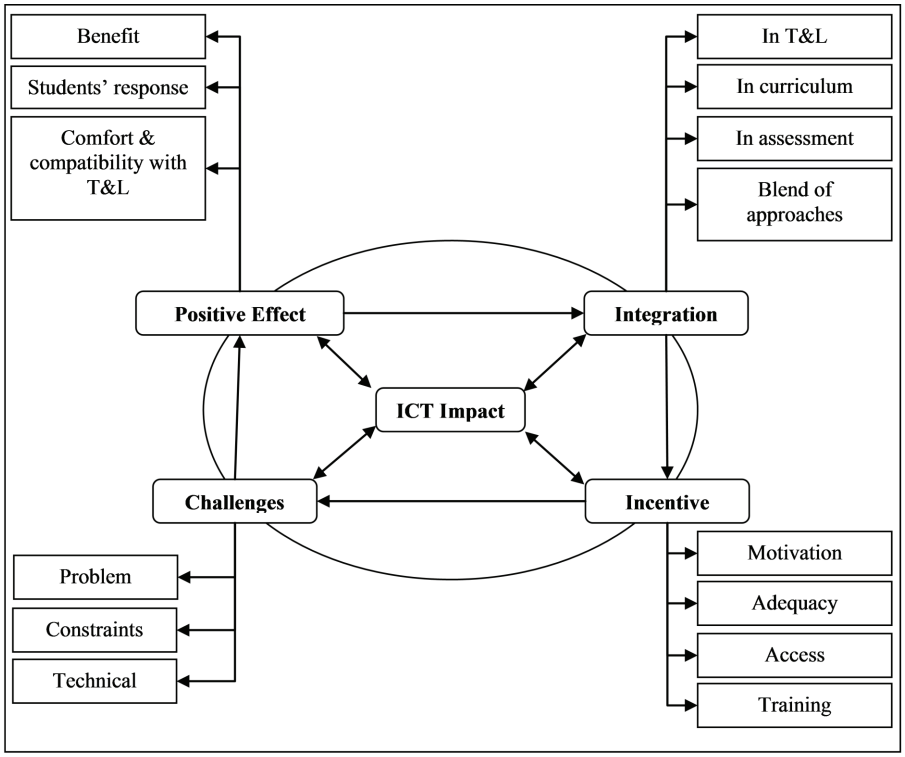
Linear regression was conducted to explain how the four scales of dimensions (perception, integration, motivation and challenges) predict the value of ICT in T&L (ICTrate). The result of the regression indicated that 3 predictors explained 41.5% of the variance ($R = .41$, $F(4, 477) = 24.8$, $p<.001$). All the independent factors are significant and positive indicators of ICT impact except integration that is not statistically significant ($p=.306$) and has a negative standardized beta value of (-.050). This explains that some factors such as access hinder integration. Perception has the highest beta value of .276, while challenges have the lowest regression weight of .125. Perception leads among the four indicators of ICT impact generated in the analysis with a standardized beta value of .276 and a p value < 0.05. It indicates a positive and significant interaction with ICT impact.

The qualitative analysis entails the range of interviews conducted and lecture rooms observation carried out to assess how ICT is integrated in the university. The interviews are analyzed based on the themes generated from the interviews. Four themes (positive effects, incentives, integration and challenges) were generated and are discussed from both students and lecturers' point of view by elaborating on the main ideas that accrue from all responses. The interview analysis reveals that both students and lecturers perceived ICT as having a positive impact on T&L. Among the positive effects attributed to ICT are: ease in T&L, access to information and up-to-date resources, online interaction between staff and students, establishing contact with the outside world through exchange of academic work, lecturers' and students' comfortability with ICT and its compatibility with their T&L needs. Though, it was discovered that some challenges exist such as plagiarism, absenteeism, over reliance on ICT, power problem, technical problem and network problem, large students' population, inadequate facilities and limited access in terms of working hour that minimize the positive impacts derived from ICT use. However, if these challenges are properly addressed and better incentives in the form of adequate access, training and motivation are provided; more positive impacts and effective ICT integration in T&L, assessment and across curriculum will be achieved.

Data gathered from the three classes observed are descriptively analyzed and situated under the corresponding themes that emerge from the interview for validity purposes. The first two classes observed were ICT-based while the third class was traditional complemented by ICT. It was observed that ICT integration does not replace the traditional practice in the classrooms; it only improves T&L practices. Among the positive effects observed in the classrooms were students and lecturers' comfortability and high proficiency in ICT use in T&L, formal and informal students and lecturer interaction. Slow Internet connection, power outage, inadequacy of facilities and distraction by ICT are some of the challenges noticed. Availability of Internet service, software and other facilities, good ICT skills of both students and lecturers, and students' participation were recorded as part of the incentives available while blend of approaches (traditional and ICT-based) was the form of integration observed.

The predictors of ICT IMPACT (Positive effect, Integration, Incentives and Challenges) generated from this study is conceived into an operational model for researchers in LDCs on ICT impact assessment. It explains the stages needed to go through while assessing the impact of ICT in T&L and offers an extension element (challenges) which is missing in the blend model. It is represented in a cyclic form (see Figure

Figure 2. ICT impact assessment model



2) to allow flexibility of the assessment process. This makes it useful for both formative and summative assessment of ICT in T&L. The mixed method approach (survey, interviews and observations) used to generate this model also supports its usefulness in any kind of evaluation.

THE ICT IMPACT ASSESSMENT MODEL

This model is considered worth developing because trying to fit models designed for DCs in LDCs may be out of context in terms of overemphasizing or underestimating issues with regards to ICT in T&L. It is thus essential to build a model that fits into context without omission or commission. Unwin and Day (2005) in Wagner et al. (2005) explicitly stated that using internationally developed evaluation tools can provide important ways to compare and contrast results of ICT for education worldwide, but they may also mask important ways in which locally developed tools can provide greater precision for project implementation. Consequently, they encourage researchers to build on examples of successful initiatives to develop evaluation practices that are integral to their education process.

Thus, this model presented in a cyclic form indicates the central strength the elements in the model provide to ICT impact and depicts that; to assess ICT impact on T&L, the process can start from any of the four elements. The first element of the model - positive effects derived from deploying ICT facilities into T&L could be assessed earlier or the second element which is incentives provided in the form of training, mentoring and adequate facilities. Next is the level of usage and integration of ICT in the curriculum, assessment and pedagogy, this could be measured before looking at the last element - barriers and challenges to the limitation in the level of integration. This process could be reversed to suit the situation or the researchers' discretion (Figure 2).

All the elements in this model have sufficient backing from literature and are properly linked to the theoretical framework employed in this study. Wagner (2005) in his conceptual framework for ICT refers to positive effect in this model as students' impact and ICT outcomes in terms of skills and proficiency. His intervention design in ICT use in the curriculum,

pedagogy and assessment is translated to integration in this model while the infrastructure, training and support all sum up to incentives. Again, no mention was made of challenges in his conceptual framework but Kozma (2005) having conducted researches on ICT in education in LDCs asserted that policymakers in LDCs need to address the barriers to ICT use. The elements in the ICT impact assessment model are discussed below.

Positive Effects

Positive effects comprise benefits, students' response and ICT compatibility/comfort in T&L. The benefits include; ease in T&L, access to information and up to date resources, online interaction between staff and students and establishing contact with the outside world through exchange of academic work are some of the contributions of ICT to T&L. Among the students' response to the use of ICT are; students' punctuality and regularity in class, attentiveness, high level of ICT appreciation, interactivity, preference for online assessment. Students are also pleased with the product of their learning with ICT and lecturers' proficiency in ICT skills has aided their comfort and ability to adapt ICT to their teaching needs. Authors (Wright et al., 2007; King et al., 2007) have also found similar outcomes as positive effects of ICT in T&L. Wagner et al. (2005) categorized ICT outcomes as students' ICT skills, attitudes, information, communication skills; lecturers' ICT, teaching and pedagogical skills. These are explained as proficiency in the positive effects element of this model.

Incentives

Incentives comprise four issues that include accessibility, adequacy, training and motivation. King et al. (2007) in a related study derived incentives as part of the four themes found in their study. Wagner et al. (2005) in their conceptual framework for IT named: equipment, software and network as infrastructure and they highlighted software use, equipment operation and instructional integration as required training. They also emphasized the need for professional, administrative and technical support for teachers and students which are all part of incentives in this model. It is implicit that incentives need to generate some impact to be felt in the area of integration into T&L before the deployment of ICT facilities could be deemed productive.

Integration

Some of the areas where integration is required are; ICT integration in T&L, ICT integration in curriculum, ICT-based assessment, and a blend of ICT-based T&L methods with the traditional method. Wagner et al. (2005) recommends that any plan for monitoring and evaluating ICT should elaborate on how ICT is integrated into the curriculum, the pedagogy, and assessment. Robinson (2007) also formulated the concept of re-conceptualizing the role of technology in school to achieve student learning. He recommends coordinated curricula, performance standards and a variety of assessment tools as part of best practices in the school reform.

Challenges

Challenge(s) is a unique element in this model that is missing in both the CIPP and Kirkpatrick models. It was found that many problems, constraints and technical issues inhibit ICT impact on education. Among the problems are plagiarism, absenteeism and over reliance on ICT. Constraints identified are; large students' population, inadequate facilities, insufficient buildings for the conduct of computer based exam, insufficient technical staff, no viable policy on ICT and epileptic power supply. The technical issues revolve around hardware, software and Internet services.

Linking the Blend Model to the ICT Impact Assessment Model

To determine how this ICT impact assessment model fits in the blend model, a link model is derived to see the similarities and differences between them. It shows a gap in the blend model which was closed by this model. The relationships between the blend model and the ICT impact assessment model are illustrated in Figure 3. Reaction and Impact in both models respectively explain the values and influence, ease and comfort, perceived usefulness and practicability of ICT in T&L. The learning and effectiveness focus on

its learning effect or outcome. All these combine as positive effect in the ICT impact assessment model. Behaviour transfer and transportability both measure the skill, attitude and knowledge or T&L situation that occur with the implementation of ICT. These are regarded as the incentives in the ICT impact assessment model. Integration is linked to results and sustainability which determines the worth of the investment and lead to a decision on how sustainable the ICT integration in T&L could be (Figure 3).

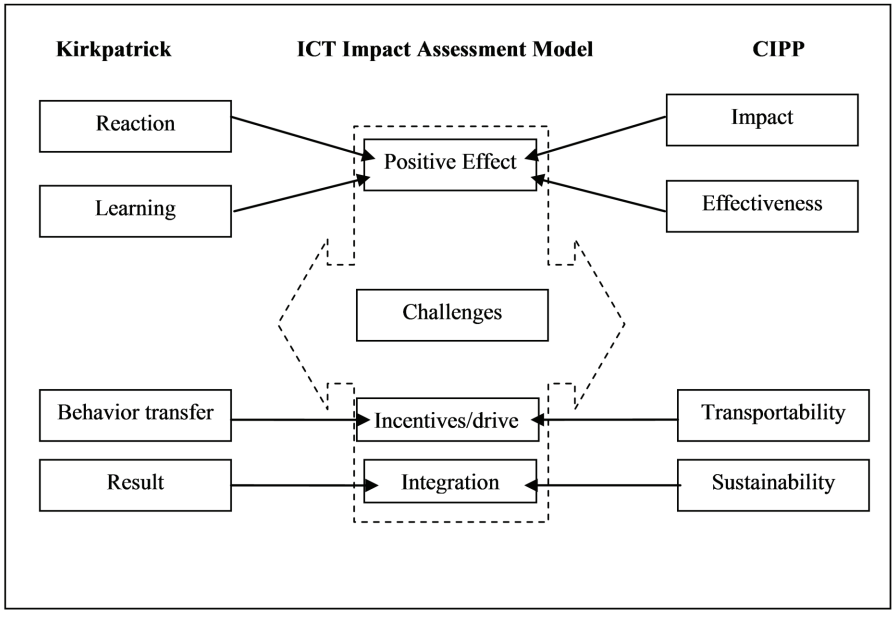
As expressed by Unwin and Day (2005) DCs evaluation tools may mask important discoveries that could be found in local settings. LDCs unlike DCs are faced with constraints of many kinds (infrastructure, network, software, funding, technical, expertise…) when it comes to the deployment of ICT in educational settings. Hence, Challenges is a part of this model that is missing in the blend model. No matter how perfect an implementation is, it will have some loopholes that need to be observed to achieve optimal benefit. Likewise the essence of assessment or evaluation is to examine if an implementation is achieving its desired goals. Thus, it is essential to foresee any immediate or future challenges to the successful implementation of the program. Specifically since ICT is an ever evolving subject; it is appropriate to periodically assess the challenges, gaps and update needed to meet up with the developing nature of ICT.

Kozma (2005) in Wagner et al. (2005) corroborates this by saying; "Impact research results are not static, but rather and especially in the fast-moving area of ICT must be seen as subject to change over time" (p. 17). A confirmation on this could be made through the concluding words of Wright et al. (2007) in a study assessing how blended model improves teachers' delivery of education curriculum. They resolved through Murphy's Law dictum thus; "… 'Anything that can go wrong will!' certainly applies to technology…. These issues of access and connection speed continue to present challenges" (p. 59).

FUTURE RESEARCH DIRECTIONS

The findings of this study have produced insightful information that contributes to scholarly research on the impact of ICT in T&L in higher education and in education at large. This model serves as a framework for evaluating ICT impact on T&L. It could also improve on the practice of ICT in T&L whether in initial implementation, existing practice or policy reforms on ICT implementation in education at all levels in LDCs. The model provides a practical evaluation tool suitable for assessing ICT impact in T&L in LDCs for policy makers, researchers and *educators.*

Figure 3. The link model



CONCLUSION

In summary, the findings of this study provide relevant and significant implications on ICT impact in teaching and learning and are suggestive of new perspectives thus: (i) positive effects of ICT in teaching and learning abound but, they could be negated by countless other barriers associated with ICT deployment, (ii) incentives such as training and adequate access to ICT facilities should be relentlessly provided for lecturers and students, (iii) ICT Integration should be ensured across curriculum, assessment and pedagogy. ICTs should also be systematically blended with existing pedagogical practices, and (iv) challenges constantly crop up when ICT is deployed in education thus, efforts should be geared towards alleviating their effects on ICT in teaching and learning.

REFERENCES

Adedokun-Shittu, N. A. (2012). *The deployment of ICT facilities in teaching and learning in higher education: A mixed method study of its impact on lecturers and students at the University of Ilorin, Nigeria*. (PhD Thesis). International Islamic University Malaysia.

Adedokun-Shittu, N. A., & Shittu, A. J. K. (2011). Critical Issues in Evaluating Education Technology. In M. S. Al-Mutairi, & L. A. Mohammad (Eds.), *Cases on ICT utilization, practice and solutions: Tools for managing day- to- day issues* (Vol. 4, pp. 47–58). Hershey, PA: IGI Global.

Ashraf, M., Swatman, P., & Hanisch, J. (2008). An extended framework to investigate ICT impact on development at the micro (community) level. In *Proceedings of the 16th European Conference on Information Systems*. Galway, Ireland.

Bass, J. M. (2010). *A new ICT maturity model for education institutions in less-developed countries. Centre for Development Informatics Institute for Development Policy and Management*. SED Manchester.

Creswell, J. W., & Plano, C. V. L. (2007). *Designing and conducting mixed methods research*. Thousand Oaks, CA: Sage Publications.

Eseryel, D. (2002). Approaches to evaluation of training: Theory & practice. *Educational Technology & Society* - ETS, *5*(2).

Heeks, R. (2005). Foundation of ICTs in development: The information chain. *e Development Briefing, 3*(1), 1-2.

IEG. (2006). *Impact evaluation experience of the Independent Evaluation Group of the World Bank*. Washington, DC.

InfoDev. (2006). *About us* Washington: InfoDev. Retrieved July 25, 2006 from http://www. infodev.org / section/aboutus.

Khalid, M., Abdul Rehman, C., & Ashraf, M. (2012). Exploring the link between Kirkpatrick (KP) and context, input, process and product (CIPP) training evaluation models, and its effect on training evaluation in public organizations of Pakistan. *African Journal of Business Management*, *6*(1), 274–279. Retrieved from http://www.academicjournals.org/AJBM

King, K. P., Melia, F., & Dunham, M. (2007). Guiding our way: teachers as learners in online learning, modeling responsive course design based on needs and motivation. In L. Tomei (Ed.), Integrating information and communications technologies into the classroom (vol.1, pp. 307-326). Advanced Directions in Instructional Technology Series Pittsburgh: Idea Group.

Kirkpatrick, J. D., & Kirkpatrick, W. K. (2010). *Training on trial*. New York, NY: AMACOM.

Kozma, R. B. (2005). *National policies that connect ICT-based education reform to economic and social development, 1*(2), 17-156. Retrieved August, 2009 from http://www.humantechnology.jyu.fi/articles/volume1/2005/kozma.pdf.

Lee, R.E., (2008). Evaluate and assess research methods in work education: Determine if methods used to evaluate work education research are valid and how assessment of these methods is conducted. *Online Journal of Workforce Education and Development, 3*(2).

Owston, R. D. (2008). *Models and Methods for Evaluation. Handbook of Research on Educational Communications and Technology* (3rd ed., pp. 605–617). New York, NY: Routledge.

Reijswoud, Victor. (2009). Appropriate ICT as a tool to increase effectiveness in ICT4D: Theoretical considerations and illustrating cases. *The Electronic Journal on Information Systems in less-developed countries (LDC), 38*(9), 1-18.

Robinson, L. K. (2007). Diffusion of educational technology and education reform: Examining perceptual barriers to technology integration. In L. Tomei (Ed.), *Integrating information and communications technologies into the classroom*. USA: Idea Group. Information Science Publishing.

Stufflebeam, D. L. (2003). *CIPP Evaluation Model Checklist.* Presented at the 2003 Annual Conference of the Oregon Program Evaluators Network (OPEN). Retrieved June 5, 2010 from http://goeroendeso.files.wordpress.com/2009/01/cipp-modeloregon10-031.pdf

Trucano, M. (2012). *Quick guide: Monitoring and evaluation of ICT in education*. Retrieved May 8, 2012 from www.infodev.org/en/publication.150.html. InfoDev/ World Bank.

Wagner, D., Day, B., James, T., Kozma, R., Miller, J., & Unwin, T. (2005). *Monitoring and evaluation of ICT in education projects: A handbook for developing countries.* Washington, DC: infoDev / World Bank. Retrieved from http://www.infodev.org/en/Publication.9.html.

Wolf, P., Hills, A., & Evers, F. (2006). *Handbook for curriculum assessment*. Canada: University of Guelph.

World Bank. (2003). *Infrastructure Services: The building blocks of development*. Washington, DC: World Bank.

Wright, V. Stanford, R. & Beedle, J. (2007). Using a blended model to improve delivery of teacher education curriculum in global settings. In L. Tomei (Ed.), Integrating Information and Communications Technologies into the classroom (pp. 51-61). USA: Idea Group. Information Science Publishing.

ADDITIONAL READING

Balanskat, A., Blamire, R., & Kefala, S. (2006). *The ICT Impact Report: A review of studies of ICT impact on schools in Europe*. European Schoolnet.

Centre for Global Development. (CGD). (2006). When will we ever learn? Improving lives through impact evaluation. Washington DC: Center for Global Development.

KEY TERMS AND DEFINITIONS

Challenges: Barriers that hinder lecturers' and students' use or integration of ICT in their teaching and learning. Eight items were developed to measure this variable and they include barriers, problems and constraints of ICT.

ICT Impact: The influence, effect, contributions and changes that occur in a system as a result of ICT intervention to study and improve routine activities within the system.

ICT in Education: any kind of technology that facilitates teaching and learning, improves learning environment and enhances learning outcomes.

Impact Assessment: Evaluation of the positive effects, incentives, level of integration/assimilation of a particular intervention and challenges associated with it within the system it is designed for.

Information and Communication Technology (ICT): All forms of evolving technologies that help in facilitating information collection, processing, usage, transfer, storage, retrieval, sharing, interpretation, and adoption. It includes: mobile devices, computers, tablets, podcast, Internet, scanners, printers, LCDs, ubiquitous computing, WWW, and a host of yet to be developed technologies.

Integration: How ICT is used by both lecturers and students for the purpose of teaching and learning. This construct was measured by ten items in the instrument such as: ICT integration in teaching and learning, curriculum and assessment.

Learning: The process of acquiring new or existing knowledge, behaviors, skills, values by gathering information through a facilitator, accessible resources, ICTs or other available means.

Less-Developed Countries (LDC): Nations that depend on developed countries (DC) for technological advancement, research development, intellectual enrichment, economic upliftment, financial empowerment, medical enhancement and a host of other resources for their own development.

Motivation: The incentives that are likely to increase learners' and teachers' use or integration of ICT in their teaching and learning. Motivation as a predictor of ICT impact in this model measures learners' and teachers' ICT skills and proficiency, their ease of use of ICT, relative advantage and compatibility of ICT with their teaching and learning needs, adequate ICT training and mentoring, and ample access to resources.

Perceived Impact: Teachers' and learners' views on the positive effects of ICT on their teaching and learning. It constitutes one of the elements of the ICT impact assessment model which assesses whether ICT leads to: improved quality education, improved students' assessment, reduced learners' and teachers' task, improved collaboration, transformation of learning environment, increased positive effects on learning, improved access to resourceful information, resource sharing, improved critical and higher order thinking, problem-based learning, and other measures of learning outcomes.

Teaching: The activities involved in facilitating or educating to impart knowledge or skills to learners.

Value of ICT: Lecturers and students perception of the use of ICT in their teaching and learning as contributing to their teaching and learning output. One item was used to measure this construct in the questionnaire and it acts as the dependent variable against which the independent variables (perceived impacts, integration, motivation and challenges) were measured.