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Review

Effective integration of information and communication technologies (ICTs) in technical and vocational education and training (TVET) toward knowledge management in the changing world of work

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The relevance of Information and Communication Technologies (ICTs) in the field of Technical Vocational Education and Training (TVET) cannot be exhausted by studies available in the "knowledge-based" society. The world of work is in continuous change as ICT itself, thus posing more challenges to the workers in the 21st century and the institutions responsible for their preparation. Despite numerous studies revealing the extent to which ICTs are applied at different educational specializations, literature on the effective integration of ICTs into Technical and Vocational Education and Training (TVET) field is scarce and needs further exploration to highlight the TVETs' level of requirement for ICTs integration. Therefore, this paper attempts to add to the available literature on ICTs integration in TVET by bringing out clearly; the need for effective integration of ICTs in TVET, factors influencing the effective integration of ICTs in TVET, overview of the challenges to the effective integration of ICTs in TVET. The paper concludes by recommending for a proper planning and management of ICTs resources in TVET.

Key words: Information and Communication Technologies (ICTs), Technical and Vocational Education and Training (TVET).

INTRODUCTION

Integration of Information and communication Technologies (ICTs) into various fields of education and training has been a topic of discussion by educational researchers (Wang, 2009; Howie and Blignaut, 2009; Bryderup et al., 2009; Rogers, 2002; Gulbahar, 2007; Louw et al., 2009, Jimoyiannis, 2010), organization (OECD, 2004; UNESCO, 2008; ADB 2009), and stakeholders in other sectors of the economy. This might be unconnected to the fact that ICTs gained its application in almost all areas of educational specialization; in architecture (Wang, 2009), mathematics and science (Howie and Blignaut, 2009), social sciences (Louw et-al, 2009), comparative studies (Blignaut et al., 2010), geographical information system (Muniandy and Lateh, 2010), teacher education (Usun, 2006, 2009), vocational education (Jantrakool, 2010) and in other human development programmes too numerous to mention.

Educational, financial, social, and professional development sectors have been benefiting from ICTs for years (Minuandy and Lateh, 2010; Wang, 2009). Basu and Majumdar (2009) noted the "development of broadband communication services, the convergence or telecommunications with the computer and recent advances in the field of communication protocols through World Wide Web (WWW) have drastically changed the world scenario of business, commerce, education, research, governance, entertainment and various aspect of economic activity leading to a distance-fewer worlds".

The development and integration of ICTs into TVET have been one of the major area emphasized by UNESCO, due to the fact that ICT tools are becoming inexpensive, reachable and interactive, in which their application into all levels of education is expected to be imperative in making educational results labour-market oriented, and in the transformation of contents,

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methodology, as well as promoting “information literacy”. Information literacy is predicted as a basic to “human survival” (ADB, 2009), in an increasingly digitalized world as it authorizes individuals “in all walks of life to seek, evaluate, use and create information effectively to achieve their personal, social, occupational and educational goals” (UNESCO, 2008). “Information literacy is the sustaining force of a knowledge society” (ADB, 2009).

Though, studies reiterating the advantages of ICTs in education cannot be exhausted in the dynamic knowledge based society, the literature on the integration of ICTs in TVET is often not comparable to other fields of specializations and has attracted only few scholars advocacy. This paper emanates out of concern for additional literature on the integration of ICTs in TVET and to further support the contributions (publications) by ‘ICT in TVET professionals’ around the globe (Kotsik, 2009; Basu and Majumdar, 2009; kearns, 2009; Zarini, 2009, etc.).

The purpose of this article is to bring out clearly, the advantages for effective integration of ICTs in TVET. Specifically, the paper highlights the need for effective integration of ICTs in TVET, factors influencing the effective integration of ICTs in TVET, and the challenges that could hinder the effective integration of ICTs in TVET. Based on the specific objectives, three fundamental questions were further formulated and answered by selective literature regarding the effective integration of ICTs into general education and TVET in specific.

THE NEED FOR EFFECTIVE INTEGRATION OF ICTS IN TVET

Technical Vocational Education and Training (TVET) is one of a recognized and effective process by which quality, up-to-date, information literate and knowledgeable workers are prepared, trained or retrained worldwide. UNESCO and ILO (2002) defined TVET "as a comprehensive term referring to those aspects of the educational process involving, in addition to general education, the study of technologies and related sciences, the acquisition of practical skills, attitudes, understanding and knowledge relating to occupations in various sectors of economic and social life." In a nutshell, TVET prepares human resources for the ever changing world of work. In that, for effective participation in the world of work the ‘study of technologies and related sciences’ as reflected in the definition, is of paramount significance that can be realized with adequate ICT arrangement in TVET institutions.

Practical skills can now be delivered virtually via a well organized ICT set up; gone are the days where practical skills are taught using hands-on learning only. Programmed instruction in form of software and interactive video made it easy for practical skills to be taught using ICTs. So also, job that requires only hands-on experiences are now possible via computer controlled programmes. As such, the need for ICTs integration in TVET remains a great challenge, considering the impact ICTs make in the world of work that ‘needs a knowledgeable workers skilled in information technologies (Rojewski, 2009). By implication, the use of ICTs in the training, up-grading and re-training of workers is of paramount significance, and “an essential aspect of teaching’s cultural toolkit in the twenty first century, affording new and transformative models of development” (Leach, 2005).

The aim of TVET is to prepare people for (self-) employment and to be a medium of evolution for people to the world of work; by making individual to have a sense of belonging in their communities. Consequently, TVET is seen as an instrument for reducing extreme poverty (Hollander and Mar, 2009). These distinctive features of TVET make ICTs application a mandatory component that can aid to achieve a sustainable and globally recognized workforce. ICTs according to Zarini et al. (2009), ‘facilitate the development and strengthening of TVET around the world by enhancing networking and knowledge sharing opportunities’.

The implication is for TVET institutions to further deploy and strengthen their commitment toward training and producing “ICT-capable” graduates that will meet up with the challenges of virtual workplaces. Thus, knowledge in the exploitation of ICTs is critical to the present day workers (Zarini et al., 2009). One of the possible means of acclimatizing TVET to develop human resources for the ever dynamic world of work is to focus its investment in the integration of ICTs in the curriculum implementation process (teaching and learning).

Zarini et al. (2009) further stressed; “Information and communication are becoming ubiquitous. By 2015, virtually all people living in industrial countries will have access to multimedia services based on mobile or other terminals. The same trend will take place in the developing world. Services based on ubiquitous computing, telecommunications and information retrieval are developing very rapidly.

The key-words are real-time information, multilinguism, location awareness, targeting and personalization. Government functions and services are increasingly moving on-line. Internet shopping is also ever increasing. Furthermore, business companies and public administrations are working to develop and introduce more automated and self-service solutions.”

As a result, application of ICTs into TVET changes the entire focus of manpower needs in the world; from “skilled-based” to “ICT-Capable” work force. Therefore, the demand of an effective “ICT-based” TVET is not an over generalization. TVET, being one of the most distinguished fields of education right from Stone Age to the present era of industrial development, still maintain its tempo toward the infrastructural, industrial, human and material resources development. Therefore, a swift

application of ICT resources into the teaching and learning process of TVET should be emphasised at all levels.

Effective integration of ICTs eases the expansion and reinforcement of TVET by enhancing networking and knowledge sharing opportunities and would extremely curtail the supply of mechanically operated training hardware, thereby offering students individualize learning even after school hours. Furthermore, ICTs in TVET has the capability to make available practical learning experiences that are needed to the instantaneous work situations. Despite the fact that, the need for information and communication technologies in education and TVET is a global phenomenon, but it is most needed and should be used in developing economies where poverty, conflicts and health are still issues that are not yet resolved (Assaf, 2009). Hence, Asia and Africa (author's countries of affiliation) cannot be an exception.

FACTORS INFLUENCING THE EFFECTIVE INTEGRATION OF ICTS IN TVET

Several factors have been identified to have influenced effective integration of ICTs in general education by different review studies (Brummelhuis, 1995 in Drent and Meelissen, 2008) and agencies (BECTA, 2004). However, these studies were limited only to general education. Among the 21st century studies, Kotsik et al. (2009) observed that integration of ICTs into TVET could be achieved, when the following factors are not neglected; strategic readiness, pedagogical readiness, organizational readiness and technical readiness. Each of these conditions embedded in it some significant and distinctive criteria that must be attained for the smooth integration of the ICTs in TVET. The authors further described the components as presented further.

Strategic readiness is the preparation stage that is accomplished by developing a wide-ranging master plan for the incorporation of ICTs into TVET. This preparation should include the vision, mission, values, objectives, strategies, timeframe and the evaluation scheme for ICT initiatives. It should also outline the budget to cover costs related to hardware and software, connectivity, maintenance and staff training. The plan should clearly delineate the purposes of ICT-mediated learning with respect to current practices. It should be widely disseminated amongst all key stakeholders.

Pedagogical readiness focuses on the fit between ICTs and current teaching and learning practice. To be pedagogically ready, TVET institution must complete an assessment of the compatibility of ICTs with the current philosophy of learning, an examination of various opportunities for including ICTs in TVET, an assessment of the technological proficiency requirements for teachers and learners, ensuring that ICTs will meet learners' educational needs, and provision that instructors are competent to facilitate ICT-mediated learning.

Organizational readiness focuses on teachers' involvement in integrating ICTs into TVET. The following key questions are used to assess organizational readiness. To what extent do TVET institutions embrace innovation and change? Do teachers support the integration of ICTs in TVET? Has the necessary leadership been provided to champion and rally support for ICT integration? Has the existence of training support systems been communicated to TVET teachers? Organizational readiness also ascertains that the necessary actions have been taken to ensure that TVET teachers possess the necessary ICT competencies. These actions include conducting needs assessments to determine the ICT comfort level of teachers, establishing minimum training standards, developing training plans and establishing appropriate mechanisms to monitor training results.

Technical readiness addresses issues related to infrastructural requirements for ICT integration. The following key questions are used to assess technical readiness. Has an overview of existing technologies been established? Have existing technologies been benchmarked against those available in the marketplace? How well does the current technological infrastructure meet the basic requirements for ICT integration in terms of hardware, connectivity, educational software, software licenses, systems maintenance and staff training? Is it necessary to develop a plan for a new technological infrastructure? Has the existence of technological support systems been communicated to all key stakeholders?

Figure 1 summarizes the relationship among ICT readiness components for TVET as put by Kotsik et al. (2009)

OVERVIEW OF THE CHALLENGES TO THE EFFECTIVE INTEGRATION OF ICTS IN TVET

Effective integration of ICTs in TVET cannot be fully realized without some drawbacks, either material, or human. Several problems having direct bearing on the topic under discussion were identified by researchers and educators.

Studies on the extent to which ICTs are applied to general educational fields and TVET reveals some challenges encountered by stakeholders toward successful integration of ICTs, for example, lack of time in the preparation of teaching materials and lack of knowledge and skills for the presentation of advanced ICT teaching materials manifested in a study conducted in VTET Institutions in Malaysia (Saud et al., 2010); cost and access (security, purchase, software and maintenance), inadequate technical and administrative staff and insufficient time to plan instruction (Collins and Halverson, 2009); beliefs about teaching, about computers, established classroom practices and unwillingness to change (Lawrence, 2007); lack of funds (Jantrakool, 2010) for

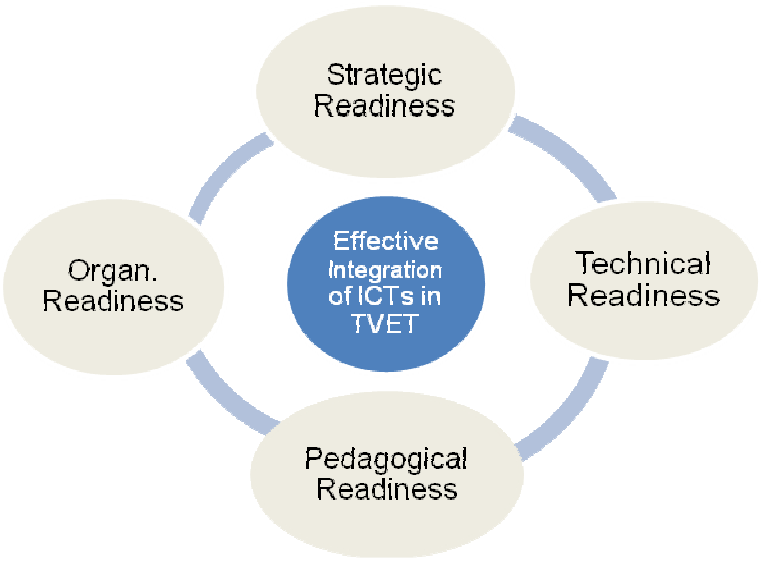

Figure 1. Components of ICT readiness.

training, unstable electricity supply and lack of ICT awareness among principals.

Despite its numerous contribution, available and functional infrastructures, sophistication in technology and continues provision and upgrade by schools, ICTs full integration into teaching learning process is still in progress (Hayes, 2007). Hayes further stated that teachers "slowness to adopt ICT reflects their effort to discern how best to incorporate new technologies into old teaching practices". (p. 394). Study in south East Asian countries reveals that, the progress toward full integration of ICTs in education, especially TVET, require additional commitment from teachers (Paryono and Quito, 2010).

While ICTs provides a platform for virtual manipulation of skills, TVET emphasize hands-on experience among learners. As such, the critical challenge lies in the possibility of ICTs to substitute physically trained specialist/instructors and training facilities. In view of the aforementioned fact, ICTs can only replace a portion of hands-on experience where manual skills are necessary require-ments in teaching and learning process (Zarini et al., 2009). Though ICTs are crucial component that no training programme (TVET) can afford to neglect, face-to-face interaction among learners and between a learner and a teacher equally holds great promise. Teacher training and retraining are major challenges for the integration of technology-based learning since for most teachers ICTs are both invigorating in their potential and intimidating in the improbability created by the speed of change.

The most pressing challenges to the effective integration of ICTs in TVET according to Kotsik et al. (2009) includes; "content and curriculum; appropriateness and efficacy; quality and branding of ICT-mediated learning; stakeholders' resistance; lack of appropriate software; the digital divide; the cognitive and copy right issues". The points are further summarized in Figure 2.

Albirini (2006) found lack of teacher competency, and lack of access to computers by teachers in schools as a main obstacle to their acceptance or rejection, but the finding is not connected to negative attitude toward computers also identified by his study. As such, serious work needs to be done to curtail the worseness of the situation, considering the fact that the fast changing world of work never awaits anybody. This situation also poses a great challenge to stakeholders, policy makers, curriculum implementers, etc.

Louw et al. (2009) in their study "instructional technologies in social science instruction in south Africa"; teachers reported some factors that constraint their use of ICTs, the major ones include; inadequate technology (network connection), pedagogical issues, (for example, plagiarism), lack of time to develop or adapt ICT materials, and integrating into courses.

CONCLUSION

"Knowledge management and information technology cannot be separated. With this amalgamation, the nature of the work at the work places is becoming more and more digitally based and multilateral in nature. The skills required in workplaces are therefore becoming wider and more complex, with the composition of both technical and non-technical competencies" (Kim and Park, 2009).

It is pertinent by the implication of the afore quote for TVET institutions to acknowledge the reality that information age necessitates, and to device a confrontation

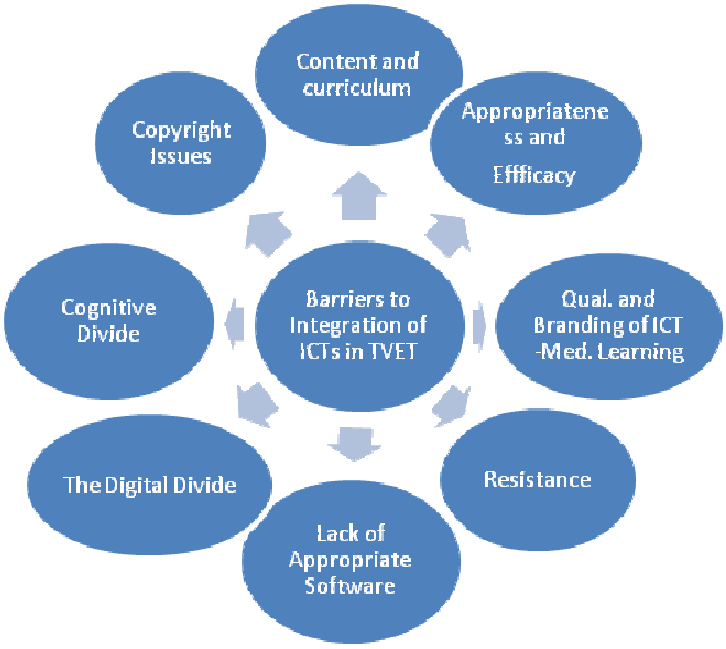

Figure 2. Barriers to effective integration of ICTs in TVET.

mechanism that will guarantee the trainee's skills move in the direction and nature of employment in a changing world of work. Industrial automation and control, e-commerce, e-government, fibre optics, cellular technology, solar vehicles, etc., and a work which time and space is no longer a factor has increased the demand on the level of ICT skills required from a graduate of TVET, which in turn ask for more input to the process of human resources development.

Tas (2010) concluded in his analysis on the topic "ICT for development: A case study" that; "ICT education is a "must" for the ever growing and ever changing global economy. Only in five years time regardless of the industry or the position, most jobs will require at least basic IT levels. That is why IT education has significant importance in development and welfare of people and communities". Regardless of the educational specialization, training and professional development courses, the integration of ICTs has now become basic requirement and the area that needs special investment.

Based on the analysis presented in this paper, the paper draws its conclusion on the fact that ICTs are globally recognized tools that needs to be fully integrated in all educational fields especially TVET, considering the nature and sophisticated the field of TVET to the economic, industrial and human resources development, in public or private sector. However, all challenges identified from the literature reviewed have been duly acknowledged, their impact on the effective ICTs integration into TVET could be properly addressed through adequate planning, and management of ICT resources.

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