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Review

A review on the relationship among information and communication technology, curriculum content and pedagogy: Implications for tertiary education, administration, policy and practice

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ABSTRACT

This paper describes the relationship among Information and Communication Technology (ICT), curriculum content and pedagogy as an important issue for faculty and administrators in tertiary institutions with an aim to consider it in the light of the increasing use of ICT use in the world today. This is underpinned by the notion for technology integration called technological pedagogical content knowledge originally depicted by Mishra and Koehler, and is critical for effective teaching with technology. The paper begins with an introduction of the concept of ICT and the technological environment of tertiary institutions in sub Saharan countries. It then examines ICT and its relation with curriculum content and pedagogy in the context of tertiary education. Putting these together the relationship among ICT, curriculum and pedagogy are considered. Ultimately the implications of this relationship among the tertiary education Administration, Policy and Practice are considered. To ensure that quality and access to tertiary education are realized in developing countries, with specific reference to Ghana, are achieved, the relationship among ICT, curriculum content and pedagogy must be acknowledged by both faculty and management.

Keywords: Information and communication technology, tertiary education, curriculum content, pedagogy, tertiary administration.

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INTRODUCTION

Information and Communication Technology (ICT) is a very broad concept. It includes the use of computers, the internet and other communication facilities to access, retrieve, store and disseminate information electronically. Tertiary education within this context refers to both post-secondary academic and professional education offered at a university, polytechnic, specialist institution, Open University or any other institution that offers training leading to diploma and degree qualifications. The mandate of tertiary institutions comprises the production and dissemination of knowledge, research, development of competencies or skills, improving morals and socialisation. In achieving this mandate the 'movement' of information is critical and the use of ICT for this therefore becomes imperative as ICT facilitates and enhances the dissemination of information. Noting that ICT plays an important role in all aspects of education and administration today, tertiary institutions are faced with some challenges with its use. As aspects of ICT, curriculum, and pedagogy are continually changing it is important to note these changes and roles of management that change with it. In educational institutions realising the relationship among ICT, curriculum and pedagogy is important in achieving the goal of quality education. Academic staff therefore need to understand what technology is about and how it can be effectively used. They also have to understand the curriculum, to effectively disseminate it to learners and finally they have to understand pedagogy to be able know the best way to integrate ICT in the teaching and learning process. According to Koehler and Mishra (2009) the interactions between and among technology, curriculum and pedagogy, play out differently across diverse contexts, account for the wide variations seen in the

extent and quality of educational technology integration.

Purpose

This paper reviews the relationship among ICT, curriculum and pedagogy in tertiary institutions. This is to be able to critically appraise this relationship in order to note the implications for tertiary education administration, policy and practice with particular reference to Sub Saharan countries.

THE CONCEPT OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT)

ICT is defined by UNESCO as forms of technology used for creating, displaying, storing, manipulating, and exchanging information (Meleisea, as cited in Nguyen et al., 2012). Generally, ICT is the application of computing and telecommunications technologies to all aspects of managing and processing information. This paper looks at ICT from the perspective of its use and integration for teaching and learning as well as research and administration in tertiary institutions. In this respect the importance of computer literacy as the knowledge, skills and ability to use computers and technologies for these activities, information literacy as the ability to select relevant information organize it by evaluating it and using it effectively and integration literacy as the ability to use computers and other technologies combined with pedagogy that enhances student learning (Shelly et al., 2002) is critical. Also the ability to determine how to match appropriate technology to curriculum and learning objectives are essential for quality education in tertiary institutions. The integration of ICT involves ensuring technology based curricular goals and including it as a routine part of the classroom environment. Also ICT is not only used by lecturers but by students and administrators to encourage higher level thinking skills and facilitate teaching, learning and administrative activities.

TECHNOLOGICAL ENVIRONMENT OF TERTIARY INSTITUTIONS

The information age promotes the use of technology in tertiary institutions today. In developing countries, the increase in student population and pressure on facilities means traditional methods of knowledge delivery have had to change. According to UNESCO (2010) enrolment in tertiary education grew faster in sub-Saharan Africa than any other region over the last four decades. For example, in 2009 the tertiary Gross Enrolment Ratio (GER) exceeds the regional average in the following countries: Cameroon (9.0%), Cape Verde (14.9%), Côte d'Ivoire (8.4%), Ghana (6.2%), Guinea (9.2%), Mauritius (25.9%), Namibia (8.9%) and Senegal (8.0%).

Although there is a rapid growth, sub-Saharan tertiary institutions have the challenge of inadequate favorable conditions (human, financial, physical) to promote the integration of ICT in teaching and learning. This is because public expenditure per tertiary student relative to gross domestic product (GDP) is especially high (UNESCO, 2010). Other challenges tertiary institutions face with the integration of ICT are the high cost of equipment, maintenance and replacement. There is also the high cost of electricity. Most institutions do not have feasible replacement plans. A computer has an average life span of 3 to 5 years and institutions are not able to obtain new computers once the initial ones are acquired. Apparently most of the first computers are obtained from donations or projects funded by international organizations. Funds for Internet, adequate broadband are inefficient; this limits access to varied IT programs that modify pedagogy. Then there is the issue of the inability to obtain appropriate software licenses. Although training in ICT is increasing, tertiary institutions do not have adequate technical and managerial support staff to promote the effective use of ICT. According to the Association of African Universities (2014), the low utilisation of ICT in Africa is attributable, partly to the high cost of bandwidth, inadequate expertise in ICT, and the related costs of soft and hardware. The effective formulation and implementation of ICT policies in institutions is another issue to be addressed to improve the use of ICT. However although expensive there is some increase in use of information and communication technologies in teaching and learning. With specific reference to Ghana, according to Bon (2010) the main challenges faced in tertiary institutions are a lack of strategic vision; a shortage of ICT support staff and tight maintenance budgets; poor ICT staff retention; and limited collaboration among peer institutions.

The primary importance of ICT to tertiary education is that it facilitates easy and fast access to diverse information from worldwide sources. According to Etebu (2010) advances in ICT have launched the world into the information age such that no institution can only rely on traditional printed information resources to perform effectively and efficiently. As tertiary institutions primary functions of research, teaching and learning depend on accessing, retrieving, utilizing, analyzing and communication, the use of ICT becomes critical. In the higher African educational institutions, ICT integration also appears to be considered a necessity both for university students and teachers (Karsenti et al., 2012).

Tertiary institutions are organizations and as such they have to be managed. The managing of an institution cannot be done without some form of communication therefore the use of ICT for management activities is very important as it makes communication more effective. Governments have also emphasized the importance of ICT in education as its use in schools is stressed in

educational policies of today. For example, Ghana's Information and Communication Technology for Accelerated Development (ICT4AD) policy has an overall goal to enable graduates from Ghanaian educational institutions – formal and non-formal – to confidently and creatively use ICT tools and resources to develop requisite skills and knowledge needed to be active participants in the global knowledge economy by 2015 (MOE, 2008). In a Ghana country report on ICT in education (Mangesi, 2007), it was indicated that access to ICTs still remains highly inadequate and unevenly distributed through Ghana, with an urban bias. Also the capacity of teachers and educators to deliver policy still remains low with many averse to adopting ICTs in the classroom or with inadequate skills. During a week-long school and conference in January 2014, which is an annual national event held by the Institute of Continuing and Distance Education (ICDE) of the University of Ghana (UG), on the theme: "Information and Communication Technology-Driven Education for Sustainable Human Development: Challenges and Prospects", the Minister of Education indicated that with the present focus on ICT to drive education, there was the need to empower institutions of higher learning to come out with sustainable solutions to offset the challenges of ICT usage. In Ghana although the importance of ICT has been emphasized it appears there is the challenge of effective ICT use and integration in our tertiary institutions. A study by Oden and Kankam (2013) on the perception of curriculum innovation needs for pedagogical and act competencies among education students in University of Cape Coast, Ghana found out that with regards to ICT competencies, most of the Education students were not familiar with the identified ICT skills needed for them to function effectively in the classroom as modern day teachers.

The integration of ICT in teaching and learning has a number of advantages to our tertiary institutions. These include technologies having the potential to make learning resources more accessible. This enables both faculty and students have a greater degree of individualization and it makes the learning process a more active one. There is the quick access to relevant information. The access to Internet substitutes can be expensive as it is difficult to obtain hardcopy of books. Also ICT gives ease of collaboration and interaction between educational and research groups improving on the content or curriculum knowledge base of academic staff. These advantages in the long term enable tertiary institutions create a congenial environment for teaching and learning as well as for administrative activities.

METHODOLOGY

The review of the relationship among ICT, curriculum content and pedagogy is done in the light of teaching and learning within tertiary institutions. Before the review of this relationship the concept of ICT and the technological environment of tertiary institutions in sub Saharan countries are described. The paper then examines ICT and its relation with curriculum content and pedagogy in the context of tertiary education. Putting these together the relationship among ICT, curriculum and pedagogy are considered underpinned by Mishra and Koehler (2006) TPACK model. Ultimately the implications of this relationship for tertiary education, administration, policy and practice are deduced.

DISCUSSION

ICT and its relation with curriculum content and pedagogy in the context of tertiary education

With the integration of ICT in tertiary institutions, technology must not only be used for curriculum content delivery but be taught and understood as a course and tool in itself. Users must learn the "how", "when" and "what" in order to integrate ICT effectively. Mostert and Quinn (2009) noted that some higher education institutions have come to realize that pedagogically sound integration of ICTs in lecturers' teaching requires more than technical support; it also needs professional development for lecturers to use ICTs in their teaching and learning. Also pedagogical integration of ICT means not only the implementation of networks and equipment, but also the use of a set of innovative technological techniques (audiovisual, information processing and telecommunications) to enhance learning at schools and in continuing education programs and for economic, social and cultural development (Karsenti et al., 2012). The implication here is that curriculum content design must be done bearing in mind the technology and pedagogy likely to be used. Curriculum cannot be developed separately as its effective delivery and understanding will be hindered. As mentioned by Mostert and Quinn (2009), it might be worthwhile to promote the idea that the curriculum design team should also include an educational technologist. This means that the existing curriculum content needs to be examined with the view of using ICT as a tool for delivery. Also pedagogy has to be reviewed so that ICT can be integrated into teaching and learning catering for the needs of both the lecturers and students. For example, one of the guiding principles for the MOE (2008) ICT policy in Ghana is that curriculum reform is necessary for ICT to be introduced and utilized effectively. When this is done there will be many advantages to both students and lecturers. According to Mondal and Mete (2012), technology facilitated learning would result in preparation of staff regarding innovative pedagogic methods, new ways of learning and interacting, easy sharing of new practices among teaching community and result in widening the

opportunities for their participation. With the sharing of new practices ultimately best practices are adopted and this promotes quality teaching and learning.

Relationship among ICT, curriculum content and pedagogy

ICT in the twentieth century has influenced the way curriculum is presented and pedagogy in our educational institutions at all levels. Although the extent of its influence varies from country to country and between various schools within countries, its existence cannot be ignored. Faculty members in tertiary institutions today need to have competencies in ICT, pedagogy as well as have mastery of their curriculum content. This means they need to know how to integrate ICT in their pedagogy to ensure that the curriculum is communicated to students in such a way that learning takes place effectively and efficiently. In this light faculty today have a threefold goal to achieve in order to be effective. These goals are to ensure they have ICT skills, secondly have mastery over the content and thirdly integrate ICT in their pedagogy.

This notion is linked to the TPACK model by Mishra and Koehler in 2006. This model emphasizes the fact that there is an inter-relationship among technology, content and pedagogy which is essential for effective teaching and learning. Technology refers to having knowledge, skills and competencies in using technologies such as software (basic and specialized software applications), hardware, projectors and Internet thus being computer literate. Content relates to being knowledgeable in ones field of study or discipline. Finally pedagogy in this case suggests the ability to understand the various methods of teaching and learning, that is being skilled in methods of teaching, assessment, knowledge of theories of learning and understanding how students learn. The TPACK model (Figure 1) shows the three main components of teachers' knowledge: technology content, and pedagogy.

One can examine the TPACK model (Figure 1) within the context of tertiary education institutions in developing countries. The three main components as explained earlier are all important for effective teaching and learning; however they are all interdependent and inter related. Having the link of technology and pedagogy gives technological pedagogical knowledge whereby faculty members have the skill of integrating technology in their teaching methods. This means faculty knowing when and how to use the appropriate technology to get maximum learning output in a classroom situation. Also determining who will use it, and what type of technology is suitable in any given situation. This is important as technologies are made for various purposes and faculty has to be able to adapt and adopt technology to suit their situation. Thus technological pedagogical knowledge requires a forward–looking, creative and open–minded seeking of technology use, not for its own sake but for the sake of advancing student learning and understanding (Koehler and Mishra, 2009).

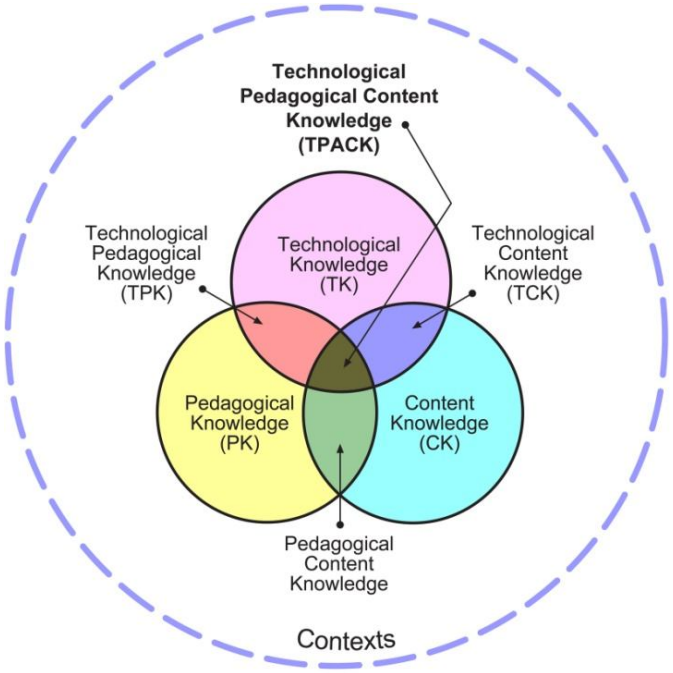

Figure 1. The TPACK framework and its knowledge components (Koehler and Mishra, 2009).

The relation between pedagogy and content gives pedagogical content knowledge as seen in Figure 1. In this instance faculty has the needed teaching skill and the knowledge in his/her area of specialization and does not make any use of technology. This situation is prevalent where there is difficulty in obtaining technology one needs or the skills to use the technology. For example in Mozambique the majority of the new higher education institutions are not using ICT facilities for educational purposes (Zeininger, 2009). However faculty find creative ways of using other instructional material to interpret content and present to learners effectively. Teachers' qualifications, experience, knowledge of subject areas and pedagogical skills influence student learning in profound ways (Vavrus et al., 2011). Therefore having knowledge of subject areas and pedagogical skills are also important in promoting quality education.

The relation between technology and content as seen in Figure 1 as 'Technological content knowledge' (TCK) is also critical. According to Koehler and Mishra (2009) teachers need to understand which specific technologies are best suited for addressing subject-matter learning in their domains and how the content dictates or perhaps even changes the technology or vice versa. This ensures that learning will be effective as the technology used are suitable and help achieve learning objectives. The use of technology and content knowledge has to be looked at together and not as separate entities. This is because they are dependent and interdependent with each other.

Combing all three to have technological pedagogical and content knowledge is the ideal situation whereby the advantage of all these sectors are put together to promote quality education.

Implications for tertiary education administration, policy and practice

The adoption of ICTs is a complex process that should be well planned for and managed. The success of ICT integration and use in tertiary education therefore needs the involvement and commitment of top management. This is because its efficient use has to have an ICT policy and strategic plan for the institutions. According to Zeininger (2009) the use of ICT facilities depends very much on the institutional culture, the existence of ICT policies and the awareness and position of the management and therefore might also have implications on the future use of educational technologies at institutional level. The use of technology is expensive but essential and so management needs to budget for it and make funds available for it. In practice also, technical support for the users in the tertiary institutions has to be available and assessable. This also involves 'out–of–hours' technical support.

Other implications are that tertiary institutions need to have secure access over wireless and wired networks via a sign on. This means a sufficient bandwidth has to be available and management has to work out a sustainable online payment of institutional bills for technology. In order that students have effective and efficient use of ICT a student portal interface that creates seamless tailored information environment has to be made available. To be able to manage student records administrators need access to aggregated student records to manage data fields, course administration processes online with appropriate delegation to students, lecturers and departments. Academic staff will need support for desktop video conferencing and tools for managing collaborative distributed research activities. Also when institutions secure file store for research data and documents accessible within and beyond the institution technological pedagogical content knowledge improves.

In the implementation of ICT policies there are challenges. As Evoh (2007) states that despite the recognized role of Information and Communication Technologies (ICTs) in improving the quality and quantity of education, ICTs remain a low priority in most educational systems in Africa. Challenges faced by tertiary institutions in sub Saharan countries include unreliable electricity supply, difficulties in obtaining funds for Internet and an adequate broad band, having appropriate software licenses and support staff. A study by Ferrell and Shafika (2007) summarizes the typical implementation constraints faced by African countries by noting that: Access to a reliable supply of electricity is a general problem but is particularly severe in rural areas because of the difficulty of connecting to national electricity grids. There is a general lack of human resources capacity to provide ICT training and equipment servicing, and there is also a lag between availability of ICT infrastructure and the ability of agrarian societies to integrate it to benefit national development. Administration needs to be asking more questions and thinking of innovative ways of using what is available. For instance how can we make use of mobile phones or emails to support teaching and learning? In what ways can the curriculum be developed bearing in mind the use of technology and the 'fit' into the world of work? How can we make use of collaborations with international institutions to our advantage to improve the skills of staff?

CONCLUSION

ICT, curriculum content and pedagogy have a bond that cannot be separated if academic performance and other supporting administrative activities are to be effective and efficient in tertiary institutions in sub Saharan countries. As skills for the knowledge economy are built at the tertiary education level, improving tertiary education systems should be high on sub Sahara Africa's development agenda (World Bank, 2013). This means our perception of ICT, curriculum content and pedagogy must be reviewed. The challenges are there but there are also opportunities to make use of available resources with innovative ideas and the commitment to get things done. ICT in itself is not a solution to all issues related to teaching and learning but it can enhance and improve it. The implication for administration, policy and practice is that, firstly, data infrastructure must improve. That is administration has to strategically plan for and budget for the acquisition of hardware, platforms comprising cabling system, fixed and wireless networks, servers, projectors, routers, printers and application software. These are the necessary tools needed for ICT integration. Secondly, knowledge infrastructure which comprises technical staff to manage and maintain network, trainers, end-user technical and application support staff, other users has to be enhanced through sustainable training programmes. These skills and competencies have to be available to ensure the effective use of ICT. Thirdly, tertiary institutions must have management infrastructure. This means institutional ICT strategies and policies must exist and be implemented. An ICT coordinating unit that reports directly to top management has to be established so that management is aware of technologies needed to budget and support its acquisition This unit will also serve as link between academic staff, students and management so that all needs are accommodated. Management is important for the successful integration of ICT because without its support adequate funding and relevant policies for ICT use and integration will not available in the tertiary institutions.

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