Chapter 5
Digital Technologies and Emerging Educational Objectives: The Need for Transformational Changes in Teacher Education and Training

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Abstract The institutionalisation of information technology in human society has necessitated the emergence of new educational goals and objectives. This study identifies the emerging educational goal and objectives of the twenty-first century and examines the challenging role of higher education in the information age. This article introduces four models that can guide and fast-track the integration of new knowledge domains in the curriculum structure and the development of new instructional and pedagogical designs in higher education to facilitate the attainment of the educational goal and objectives of the twenty-first century. The article also introduces a structural model of providing the foundation needed for higher education in the twenty-first century in the present information and technology-driven world of globalisation. Based on existing studies, this article considers the role of teacher education as being critical in addressing the various challenges associated with the transformational changes needed for higher education in the twenty-first century.

5.1 Introduction

The world is currently witnessing remarkable development in Computer, Internet and Digital Communication Technologies (CIDCT). This development has over the years increased human interaction with the computer (Teo 2008), the Internet and other digital communication technologies (Garba 2014) in all aspects of human activities (Umar and Maswan 2007). The increasing use of these technologies

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(CIDCT) has made communication between individuals, groups, communities, organisations and institutions easier, faster and more convenient (Luppicini and Haghi 2013), thus no longer making distance and time a barrier to communication and interaction the world over (Onasanya et al. 2010). This development has facilitated the global flow and access to information at any point in time. The global integration and institutionalised use of the computer, the Internet and digital communication technology in human society has ushered in the 'information age', which is characterised by 'globalisation' and gradual transformation of the world into a global village (Roy 2009; Webster 1995).

With these developments, surviving the challenges of living in an emerging information age that is knowledge driven and technology oriented, every member of the global community needs to have information literacy (IL), the ability to search, access and use information as a base for knowledge construction, decision-making and problem-solving (ALA 1998; Bruce 1999; Corrall 2008; Mutch 1997), and technological literacy (TL)—the basic knowledge and ability to use the computer, the Internet and other digital communication technologies in the search, access, use, processing and dissemination of information (Dakers 2006; Keller 2010). The two emerging educational needs (IL and TL) have increased the number of basic literacy domains from five to seven (i.e. reading ability and skills, writing ability and skills, numerical literacy and skills, basic science literacy and skills, language and communication skills, information literacy and skills and technological literacy and skills). This has necessitated a redefinition of the 'basic literacy' concept in the information age of the twenty-first century.

Blending the seven literacy domains in redefining the basic literacy concept has led to the emergence of 'ICT literacy skills and competence' as a concept that defines the new standard for basic literacy in the twenty-first century. Basic literacy in the present information age is therefore not restricted to reading, writing, numeracy, science and language development (ACL 2000). The five are blended with information and technology literacy to represent ICT literacy skills and competence—the ability to read and write, use numbers and appreciate scientific knowledge, use technology and information and use of language in communication. Knowledge of information and technological skills have now become additional knowledge domains of basic education. The education industry is now faced with a new challenge (Cisco 2008), which is to help learners acquire (at the school level) the basic knowledge and skills of using technology and information in addition to reading, writing, numeracy, science and language use (Moore 2002) as the basic foundation for higher education in the twenty-first century (Pont 2001) and, consequently, introduce new (twenty-first century) educational goals and objectives at all levels of learning.

This development has far-reaching implications in educational practices at all levels of learning. It implies the need for adjustment in the curriculum structure, instructional designs, learning objectives, pedagogical approaches and methods of assessment and evaluation of learning outcome, if educational practices are to be redirected towards achieving the educational goals and their emerging objectives in the twenty-first century.

5.2 Integrating the Twenty-First-Century Educational Goals and Objectives in Higher Education

Preparing learners towards becoming 'global citizens' who can properly fit into the globalised world of the information age, which is technology and knowledge driven, is the overall goal of education in the twenty-first century (UNESCO 2014). Although global citizenship is a multidimensional concept that is accorded a different interpretation and meaning by scholars (Lane et al. 2013), the conception of the term global citizen within the context of this work is the alignment of technology and information literacy as the foundational bases of acquiring global knowledge and gaining an understanding of the world as a single community. Therefore, preparing learners towards becoming global citizens refers to the process of building information and technological competencies alongside professional development among learners for active participation in addressing global issues while contributing to global peace and development in their professional capabilities. Hence, the curriculum structure and educational activities in higher education need to be redirected towards the achievement of this goal (Murray and Perez 2014). Learners seeking higher education should possess the basic foundation upon which the desired twenty-first-century goal-oriented higher education can be built and developed. Consequently, basic education has to be properly structured to provide the foundation needed to achieve the twenty-first-century educational goal in higher education.

5.2.1 Building the Desired Foundation for Twenty-First-Century Higher Education

To provide the foundation needed for twenty-first-century higher education, basic education (primary and secondary education) has to be directed towards providing functional literacy (permanent ICT literacy skills). The curriculum structure and learning activities at this level of education should be directed towards developing the ability of learners to read, write, use numbers (numeracy), appreciate science, speak (language and communication), use the computer and the Internet and use of information (Braslavsky 2001). The model in Fig. 5.1 shows the desired structure of basic education in the twenty-first century as a foundation for twenty-first-century higher education in the information age.

Basic education, as shown in the model, is to provide learners with functional ICT literacy (Panel 2007) as a foundation for higher education. The subject to be taught should reflect the development of the four knowledge domains in achieving the seven educational objectives listed in the model (structure). To achieve the listed objectives, computer and information science need to be introduced as new subjects in the school curriculum (for technology and information literacy domains) in
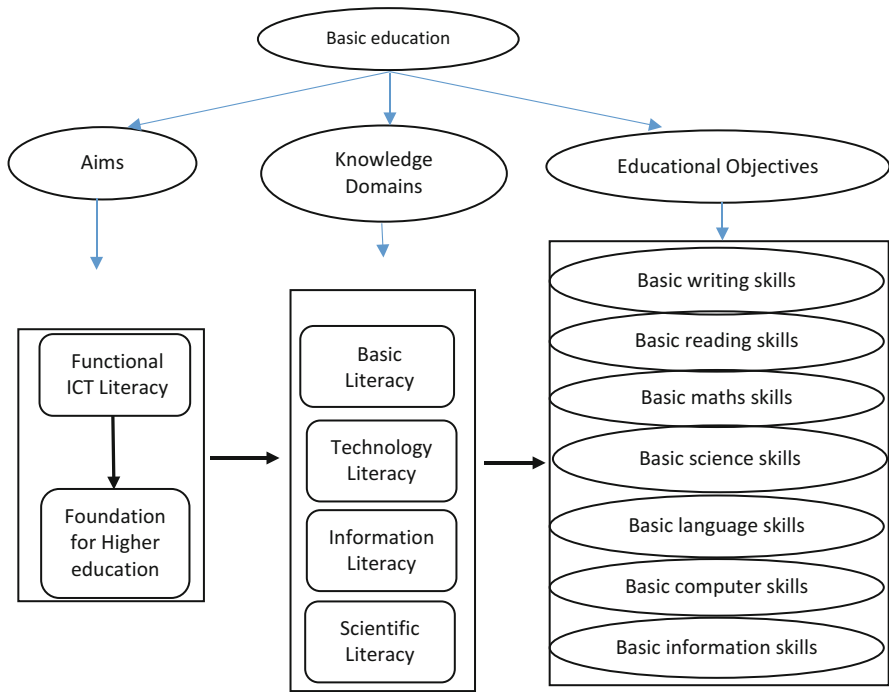
Fig. 5.1 Twenty-first-century structure of basic education

addition to the existing conventional subjects. This is done in most countries (and incorporated into the basic education policy). However, the level of implementation and the success stories differ among nations (Boyer and Moore 2014). In most of the third world nations of Africa and Asia, a large number of students are completing their basic education without acquiring the desired functional information and technological literacy (Garba 2014; Yusuf 2005). This is because schoolteachers lack the ICT literacy skills and competence needed for teaching the newly introduced computer and information literacy-related subjects (Yusuf 2005), particularly the rural and suburban areas where access to the ICT infrastructure is a major issue. This situation is responsible for the existing wide gap in ICT literacy skills and competence among the members of the global community. Not even 30 % of the total world population of approximately seven (7) billion people have the desired ICT literacy skills and competence (Rao 2009). Achieving the identified objectives of basic education provides the foundational base needed for twenty-first-century higher education. The structure of higher education should therefore build on the foundation provided in basic education programmes for the development of twenty-first-century skills among learners as a necessary requirement of becoming global citizens of the information age.

5.2.2   Building the Twenty-First-Century Higher Education Structure

The goal of higher education in the twenty-first century centres on the professional development of learners in their respective areas of specialisation and the development of twenty-first-century skills, as indicated in Fig. 5.2.

The model presents two major aims and six objectives in twenty-first-century higher education. Therefore, educational activities in institutions of higher learning should be directed towards the development of a sound knowledge and deeper understanding of the relevant concept, principles and theories of knowledge in areas of choice for specialisation among learners; sound knowledge of information and communication technology (ICT), its application in professional practices and personal living; skills of inquiry, independent and lifelong learning; problem-solving and decision-making skills; and ability to collaborate and work in a team. Achieving these emerging twenty-first-century learning objectives in higher education requires
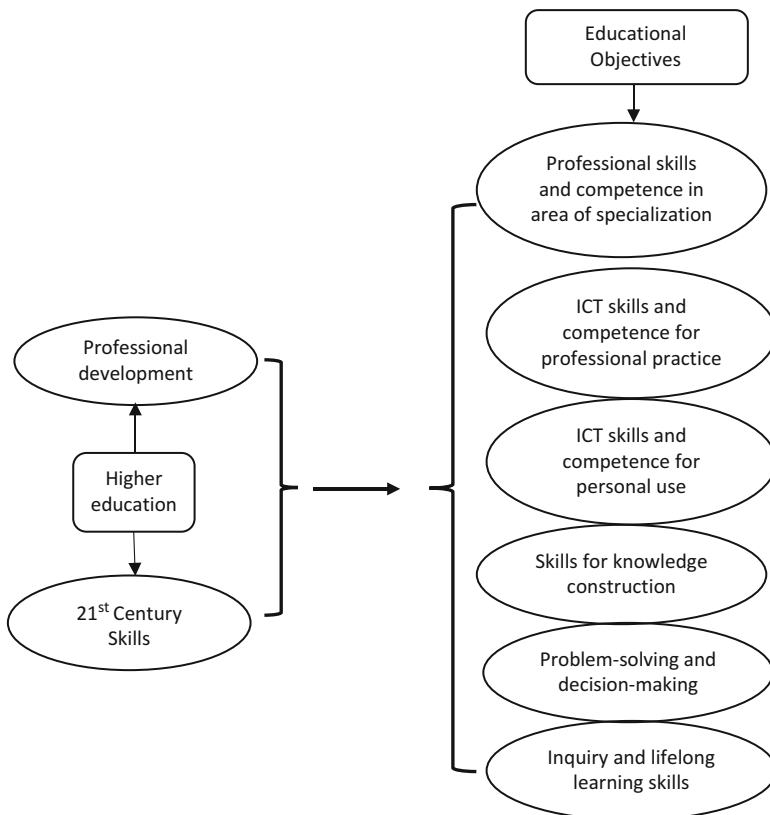

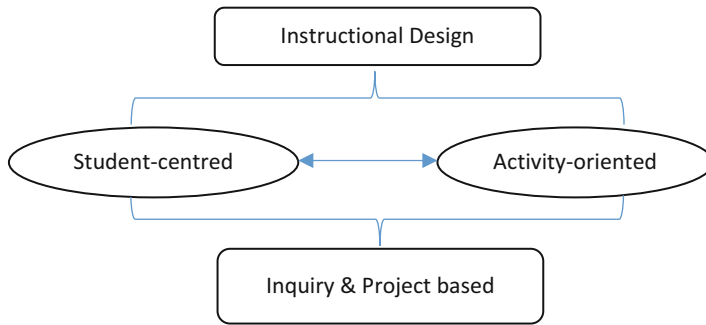**Fig. 5.2** The basic structure of twenty-first-century higher education

Fig. 5.3 Pattern of instructional design for twenty-first-century higher education

a full integration of ICT in the teaching-learning process, while the teaching-learning process has to be student centred and activity and inquiry oriented directed towards knowledge construction and problem-solving. Figure 5.3 shows the desired pattern of instructional design for teaching and learning in twenty-first-century higher education.

The diagram in Fig. 5.3 shows a changing pattern of instruction for higher education. Learning instruction has to be student centred. In such a learning environment, the role of the instructor (lecturer) or faculty member has to change from that of a knowledge provider (and a source of information for learning content) to that of a mentor and facilitator. Thus, instead of providing information and transmitting content knowledge, the faculty member facilitates and guides learners towards the exploration of information for subject content knowledge. In addition, the role of learners would have to change from that of passive listeners to that of active engagement in exploring information and building knowledge. This approach to instructional design makes teaching and learning more interactive, project based and inquiry oriented. The use of information technology in this approach is necessary in facilitating the role of the learner and faculty member. Figure 5.4 provides a general guide to how pedagogical approaches can be blended with technology to facilitate teaching and learning in the instructional design described in Fig. 5.3.

Information and learning content, technology and the GPM learning interaction are at the core centre of the pedagogical approach. Both learners and course instructors have to engage the use of relevant digital technological gadgets in the exploration of information and learning materials in line with the course curriculum structure. Web 2.0 accessed through the Internet becomes the major source of information for learning materials in the use of this approach. Thus, instead of the instructor providing the information and learning materials, learners are mentored and urged to use technology and Internet resources to explore information that would help them in understanding the course content. The course instructor has to employ the use of blended pedagogy (integrating more than one teaching method and technique in a single instruction) in creating a desired classroom-learning environment for inquiry-based learning activities.
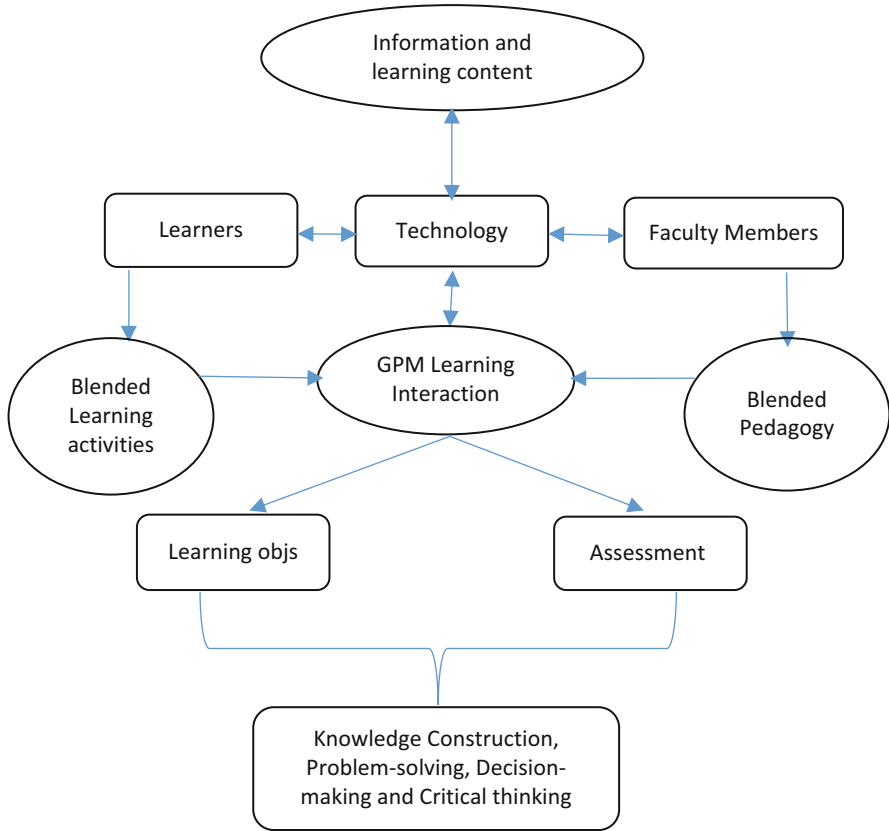
Fig. 5.4 Pedagogical approach to instruction for twenty-first-century higher education

The teaching-learning interaction can be structured into the giving, prompting and making stages (Hammond and Manfra 2009). The instruction may start with 'giving', in which instructors can integrate the use of the lecture method with a demonstration to introduce issues, situations and phenomenon to be investigated or the project to be undertaken in the course. By blending a number of pedagogical designs with a questioning approach, the course instructor could establish the need for inquiry and then prompt and motivate the learners into the (web) inquiry process at the second stage. The learning activities at this stage are centred on the learners' involvement in the exploration of information using the computer and the Internet in establishing a deeper understanding of the issues, phenomenon, situation and project introduced to the class at the 'giving' stage. At the last stage, 'making', learners are to be engaged in the study of the information and materials gathered at the intermediate stage to build and construe knowledge. Learners are to apply the knowledge they have construed in:

(a) Building a deeper meaning and understanding of the facts, concepts, theories, principles and procedures relating to issues under their investigation
(b) Providing a proper explanation to situations and phenomena relating to the issues they are investigating
(c) Solving problems raised or introduced at the giving stage or identified in the study process
(d) Taking suitable decisions regarding the project they are working on individually and in groups

An assessment of the learning outcome in this approach has to shift from the conventional cognitive evaluation of content learning (through paper-pencil exams) to a more comprehensive evaluation system that can assess the acquisition and development of twenty-first-century skills.

In the three-stage GPM learning process, both the course instructor (using blended pedagogy and technology) and the learners (using blended learning activities and technology) are actively involved in the teaching-learning process that is activity oriented and inquiry based (Hammond and Manfra 2009). The course instructor works in the process as a mentor and a facilitator, while the learners' activities are centred on the exploration of information and the study of learning materials to build and construe knowledge for problem-solving and decision-making. The process promotes independent and lifelong learning skills; inquiry and problem-solving skills; collaboration, teamwork, leadership and decision-making skills; and the improvement of information and technological skills among learners, thus potentially facilitating the attainment of the twenty-first-century educational objectives identified in Fig. 5.2.

5.2.3   The Challenges

A number of peculiar issues that vary from institution to institution and from country to country have made the attainment of twenty-first-century educational goals and objectives a challenge to many institutions of higher learning. Such challenging issues include:

(a) Lack of proper understanding of the changing trends in educational goals and objectives by policymakers, administrators and some of the academics
(b) Unwillingness of some academics to effectively integrate ICT in their pedagogical practices due to either item 1 (a) above, 3 (c) or 4 (d) below or even both
(c) Lack of sound knowledge, skills and competence in the use and application of ICT in educational practices on the side of both academics and administration staff in some of the institutions of higher education
(d) Poor ICT infrastructure and Internet connectivity
(e) Lack of a universally accepted theoretical, conceptual frameworks and models for ICT integration in educational practices
(f) Lack of a universally accepted framework for the development of a twenty-first-century curriculum structure that can accommodate the emerging twenty-first-

century educational objectives and instructional designs and pedagogical approaches at both the subject discipline level and institutional level

The above issues are not universally applicable to all the institutions of higher learning. Some are at the stage of understanding the emerging twenty-first-century educational goals and objectives and trying to establish the need for its integration. Others are at the stage of making provision for ICT infrastructure and Internet connectivity, professional development of academic and nonacademic staff towards ICT skills and competence and encouraging the integration of ICT in administration, teaching and learning (and the shift towards the use of student-centred pedagogy). Few institutions are at the stage of exploring (researching) how best the emerging twenty-first-century educational goals and objectives can be integrated into the curriculum structure and assessment system in terms of the subject disciplines and institutional level; the development of new instructional designs can facilitate the integration of technology and development of twenty-first century skills. The current developments in higher education in relation to the issues listed above suggest five possible transformational stages in building a twenty-first-century learning environment for higher education that includes the following in hierarchical order:

(a) Identifying and understanding the changing role of higher education and emerging educational objectives relevant to the present information age for twenty-first-century learners
(b) Providing an ICT infrastructure and access to the Internet and modern digital technological gadgets for teaching and learning
(c) Providing intensive training of academics on ICT skills and their applications in teaching and learning
(d) Ensuring effective integration of relevant technology as they emerge in the teaching-learning process by:

   1. Restructuring the existing curriculum framework to accommodate new domains (information and technological knowledge and skills) as they relate to the respective subject disciplines in higher education
   2. Creating new instructional designs and models that can facilitate the integration of modern technology in the teaching-learning process for the respective subject disciplines
   3. Creating new pedagogical designs that promote the use of relevant technologies in inquiry- and project-based learning
   4. Redesigning the existing learning outcomes to reflect knowledge construction, problem-solving and decision-making (thus, accommodating the emerging twenty-first-century learning objectives)
   5. Redesigning the method and system of evaluating the learning outcome to reflect the assessment of inquiry skills, knowledge construction, problem-solving skills, decision-making skills, independent learning skills, lifelong learning skills and higher-order thinking skills (accommodating the twenty-first-century skills for surviving the challenge of living in the present information age)

6. Utilising the potential of cloud-computing technology and MOOCs as complementing resources in teaching, learning and assessment

(e) Establishing and institutionalising the twenty-first-century learning environment
(f) Establishing and consolidating good practices suitable for teaching and learning in the twenty-first-century learning environment for twenty-first-century learners in higher education

Considering the issues identified earlier and the transformational stages involved in building a twenty-first-century learning environment for higher education, the role of academics is critical (Garba et al. 2013). To a large extent, the success or otherwise of building and sustaining a twenty-first-century learning environment is dependent on educators—academic staff (and teachers at the school level). Going through the stages of transformational development for building the desired twenty-first-century higher education structure requires the services of academic staff (and teachers at the school level) with sound knowledge, skills and training in handling the challenges of teaching and learning in the twenty-first-century learning environment. Thus, is teacher education and training directed towards producing the desired twenty-first-century academics?

5.3 Coping with the Challenges Ahead: The Role of Teacher Education and Training

Teacher education and training is expected to produce a new breed of academics (educators, teachers and faculty members) for twenty-first-century teaching and learning at all levels of education (Oakley 2008). Such a desired new breed of academics (at all levels) should be able to blend pedagogy with technology in redirecting the process of teaching and learning subject content (Webb et al. 2011) concerning the development of twenty-first-century skills among learners. This has been the major challenge of teacher education and the training industry in the information age (NIES 2009), a challenge that is well recognised and appreciated by teacher educators the world over (Teo 2008). Addressing this challenge is critical and education must be directed at all levels towards achieving the emerging educational goals and objectives of education and in the development of twenty-first-century skills among learners. Over the years, this concern has encouraged a series of research studies that focus on how teacher education and training can best be transformed. Some of the research findings have reported the need for ICT to be integrated in teacher education and teacher training (Jung 2005) and for teacher educators to model the use of the relevant digital technology in their professional practices (Parker 1997). This has prompted the government of many countries to make various efforts in providing the needed ICT infrastructure in public teacher training institutions. Yet, even with the facilities provided, teacher educators in most institutions hardly use technology in their teaching, and graduate teachers hardly acquire the competency needed for ICT integration in teaching and learning either

as teachers or as faculty members (Garba 2014). This development has shifted the concern of stakeholders to 'how ICT can be integrated in teacher education and training' and how teacher educators can be encouraged to model the use of technology for twenty-first-century teaching and learning.

With more research findings being reported, it is becoming clearer that providing ICT facilities and its simple usage (mostly power point presentation) in teaching within the context of teacher education and training is not enough to produce the desired academics for twenty-first-century education. Perhaps, for ICT to be deeply rooted in teacher education and training, the curriculum structure, pedagogical approach, learning outcome and objectives of teacher education need to be restructured to reflect the twenty-first-century educational objectives. Thus, the framework to guide the transformation of teacher education becomes the issue of concern. However, recently, the work of Mishra and Koehler in, 2006 and 2009 provides a major breakthrough. Their work provides a framework that can guide the meaningful transformation of teacher education and training for twenty-first-century teacher education. The framework introduces 'knowledge of technology' as a core curriculum component in teacher education, consequently adding four new knowledge domains to the existing three domains established in the framework of Shulman (1986) to create seven TPACK domains of teacher education (Koehler and Mishra, 2009). Most researchers and education practitioners consider the framework as providing the general framework needed in restructuring teacher education curriculum. The popularity of the framework has motivated a series of further studies investigating and examining the framework from different dimensions. Some of the studies investigated:

1. How knowledge of some of the domains can be assessed and evaluated and have identified validated instruments that can be used in measuring some of the domains (Archambault and Crippen 2009; Schmidt et al. 2010)
2. How knowledge of the domains can help faculty members and schoolteachers integrate technology in their teaching
3. The effect of some of the domains on preservice teachers in specific subject areas (Landra 2010)
4. The effect of the framework on the instructional designs for specific subject disciplines and some specific pedagogical approaches (Chai et al. 2010)

Despite the volume of existing studies on TPACK theory and framework, currently, there is no report of any teacher training institution or faculty of education that has fully integrated the framework in its curriculum structure, instructional designs and pedagogical practices. Thus, the research findings on how best the framework can be integrated in its full form into the existing teacher education and training curriculum structure are limited. Therefore, much work is needed in exploring the integration of the seven knowledge domains in the existing curriculum structure of each subject discipline within the context of teacher education and training. Further studies would also be needed in examining the application of the knowledge domains in lesson planning, classroom instructional designs and pedagogical approaches for the development of twenty-first-century skills among learners and the attainment of twenty-first-century educational objectives.

5.4 Conclusion

Digital technology has caused the emergence of new educational objectives for twenty-first-century teaching and learning. Although some higher educational institutions in many countries have responded, or are in the midst of preparing a strategy to deal with this new phenomenon, it is clear that transformational changes in teacher education and training should be at the core of the planning strategy. For teacher education and training institutions to live up to their expectations in producing the desired academics capable of providing the training needed in building the desired foundation for twenty-first-century higher education at the basic level, a comprehensive strategic plan for the full integration of the TPACK framework into their curriculum structure, instructional design and pedagogical approach is needed. Further efforts will have to be undertaken in this direction, as new findings and knowledge emerge based on future innovative studies. With learners having a proper foundation built at their basic educational level and a new structure initiated based on the models provided in Figs. 5.2, 5.3 and 5.4, the transformation of higher education for the attainment of twenty-first-century higher education may be a logical conclusion.

References

ACL. (2000). *Information literacy standard and competence for higher education*. New York: American College and Research Libraries. Retrieved January 5, 2015, from http://www.org/ala/mgrps/divs/acrl/standards/standards.pdf.

ALA. (1998). *Presidential committee on information literacy*. Final Report. Chicago.

Archambault, L., & Crippen, K. (2009). Examining TPACK among K-12 online distance educators in the United States. *Contemporary Issues in Technology and Teacher Education (CITE Journal), 9*(1), 71–86.

Boyer, R. S., & Moore, J. S. (2014). *A computational logic handbook: Formerly notes and reports in computer science and applied mathematics*. Elsevier: San Diego, CA.

Braslavsky, C. (2001). *Basic education in the twenty-first century and challenges of secondary education*. Paris: UNESCO. Retrieved January 6, 2015, from www.be.unesco.org/publications/prospects/…/editorial-117e.pdf.

Bruce, S. (1999). Workplace experience of information literacy. *International Journal of Information Management, 19*(1), 33–47.

Chai, C. S., Koh, J. H., & Tsai, C. C. (2010). Facilitating pre-service teachers development of technological pedagogical content knowledge (TPACK). *Journal of Educational Technology and Society, 13*(4), 63–73.

Cisco. (2008). *Equipping every learner for the 21st century: A white paper*. California: CISCO. Retrieved January 6, 2015, from www.cisco.com/web/about/citizenship/socio-economic/docs/GlobalEdWP.pdf.

Corrall, S. (2008). Information Literacy Strategy Development in Higher Education: An Exploratory Study. *International Journal of Information Management*, 26–37. doi:10.1016/j.ijinfomgt2007.07.002

Dakers, J. R. (2006). *Defining technological literacy: Toward an epistemological framework*. New York: Macmillan.

Garba, S. A. (2014). The impact of ICT course on pre-service teachers' acquisition of ICT literacy skills and competence in Nigeria. *International Journal of Modern Education Research, 1*(2), 37–42.

Garba, S. A., Kaur, T. R., & Yusuf, N. M. (2013). Integrating technology in teacher education curriculum and pedagogical: The effect of web-based technology resources on pre-service teachers achievement in teacher education and training. In *2013 international conference on information science and technology application (ICISTA-13)* (pp. 060–077). Macau-China: Atlantis Press. France, Paris.

Hammond, T. C., & Manfra, M. M. (2009). Giving, prompting and making: Aligning technology and pedagogy within TPACK for social studies instructions. *Journal of Contemporary Issues in Technology and Social Studies Teacher Education, 9*(2), 160–185.

Jung, I. (2005). ICT-pedagogy integration in teacher training: Application cases worldwide. *Educational Technology and Society, 8*(2), 94–104.

Keller, H. (2010). Technological literacy: The key to education reform. *Journal for Educational Technology and Change*, 23–35. Retrieved from http://etcjournal.com/2010/08/22/technological-literacy-the-key-to-education-reform-2/

Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge? *Contemporary Issues in Technology and Teacher Education, 9*(1), 60–70.

Landra, G. A. (2010). *Creating and validating an instrument to measure middle school mathematics teachers' technological pedagogical content knowledge (TPACK)*. Knoxville: University of Tennessee, Knoxville.

Lane, P., Krystina, R. S., Lee, S., Daniel, W., Rachel, P., & Michael, A. T. (2013). The importance of global citizenship to higher education: The role of short-term study abroad. *British Journal of Education, Society and Behavioural Sciences, 3*, 1–14. Retrieved January 6, 2015, from http://discoverabroad.uga.edu/wp-content/upload2014/…/perry-et-al-2013.pdf.

Luppicini, R., & Haghi, A. K. (2013). *Education for digital world: Present realities and future possibilities*. Canada: Apple Academic Press.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record, 108*, 1017–1054.

Moore, P. (2002). *An analysis of information literacy education worldwide*. New York: UNESCO. Retrieved January 6th, 2015, from http://portal.unesco.org/…/33e3dd652a107b3be6d64fd67ae898f5information….

Murray, M. C., & Pérez, J. (2014). Unraveling the digital literacy paradox: How higher education fails at the fourth literacy. *Issues in Informing Science and Information Technology, 11*, 85–100.

Mutch, A. (1997). Information literacy: An exploration. *International Journal of Information Management, 17*, 377–386. doi:10.1016/S0268(97)00017-0.

NIES. (2009). *A teacher education model for 21st century*. Singapore: National Institute of Education, Singapore. Retrieved January 7, 2015, from www.nie.edu.sg/files/spcs/TE21_Executive%20Summary_101109.pdf.

Oakley, C. (2008). *Preparing future teachers for 21st century learning: Partnership that enhances the capacity of pre-service education.* Australia: Intel Education. Retrieved January 7, 2015, from http://download.intel.com/education/…/EnhancingPre-Svc_WhitePaper.pdf

Onasanya, S. A., Shehu, R. A., Oduwaiye, O. R., & Shehu, L. A. (2010). Higher institutions lecturers' attitudes towards integration of ICT into teaching and research in Nigeria. *Research Journal of Information Technology, 2*, 1–10. Retrieved March 2012

Panel. (2007). *Digital transformation: A framework for ICT literacy.* New York: ETS. Retrieved January 6, 2015, from www.ets.org/Media/Tests/Information_and…Literacy/ictreport.pdf

Parker, D. R. (1997). Increasing faculty use of technology in teaching and teacher education. *Journal of Technology and Teacher Education 5*, (2/3), 11–24.

Pont, B. (2001). *Competencies for the knowledge economy.* Paris: OECD. Retrieved January 6, 2015, from http://www.oecd.org/dataoecd/42/25/1842070.pdf

Rao, S. S. (2009). Role of ICT in India rural communities. *Journal of Community Informatics, 5*(1), 313–429. Retrieved January 6, 2015, from http://www.ci-journal.net/index.php/ciej/article/view/313/429

Roy, S. (2009). *Globalisation, ICT and developing nations: Challenges in the information age*. India: SAGE.

Schmidt, D. A., Baran, E., Thompson, A. D., Koehler, M. J., Mishra, P., & Shin, T. (2010). The development and validation of an assessment instrument for pre-service teachers. *Journal of Research on Technology in Education, 42*(2), 123–149.

Shulman, L. (1986). Those who understand: Knowledge growth in teaching. *Educational Review, 15*(2), 4–14.

Shulman, L. (1987). Knowledge and teaching. *Harvard Education Review, 57*(2), 1–21.

Teo, T. (2008). Pre-service teachers attitude toward computer use: A Singapore survey. *Australian Journal of Educational Technology, 24*(4), 413–424.

Umar, I. N., & Maswan, S. (2007). The effect of web-based inquiry guided approach on students achievement. *Journal of Computers, 2*(5), 38–43.

UNESCO. (2014). *Global citizenship education: Preparing learners for the challenges of the 21st century*. Paris: UNESCO. Retrieved January 6, 2015, from http://unesdoc.unesco.org/images/0022/00227729E.pdf

Webb, M., Cox, M., Davis, N., & Voogt, J. (2011). Twenty first century pedagogy for technology enhanced learning. In *Society for information technology & teacher education international conference 2011* (pp. 3390–3397). Nashville: AACE.

Webster, F. (1995). *Information and the idea of information society: Theories of the information society*. London: Routledge.

Yusuf, M. A. (2005). Information and communication skills (ICT) and education. *International Education Journal*, 316–321.