ICT-enhanced Teacher Development Model

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Foreword

The UNESCO International Institute for Capacity Building in Africa (IICBA), the only Category 1 Institute in Africa, has been working to build the capacities of teacher education institutions in Africa in such areas as curriculum, management, research, ICT and ODL. IICBA has been implementing its interventions in African Member States through face-to-face training workshops at national and sub-regional levels, conducting research on teacher issues, publishing and disseminating best practices. Through these interventions and based on relevant literature, IICBA recognized, in its most recent Strategic Plan for 2011-2015, the major challenges facing teacher development in Africa to be inadequacies in number and quality of teachers, deficient training curriculum, poor quality management and leadership, inadequacies in pedagogical research and difficult working conditions.

Meeting the challenges confronting teacher development in Africa requires well thought-out approaches that benefit Member States maximally. These approaches should also reflect the current thinking in the fields or domains they are dealing with. One such approach is IICBA’s ICT-enhanced Teacher Development Model, known for short as ICTeTD Model.

The ICTeTD Model is grounded in the belief that teaching has its own unique knowledge base, which, in the 21st century, is the technological pedagogical content knowledge (TPCK). While it is not unusual now to find ICT courses in teacher
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education programs in Africa, ICTeTD is grounded in IICBA’s strong belief that professional teacher development should not only go beyond programs that merely focus on training teachers in the operation of computers and ICT literacy per se, but should plan to work actively towards enabling African teachers to master ICT as an effective tool to improve teaching and learning.

ICTeTD regards ICT as a real opportunity for teachers of all phases and subjects to rethink fundamental pedagogical issues alongside the approaches to learning that students need to apply in classrooms. ICTeTD is not simply about re-versioning traditional teaching. Rather, it deals with the need for Member States to transform their teaching force into a technology literate and innovative worker. ICTeTD recognizes that for teachers to use ICT effectively and innovatively, they need to understand in greater depth the content of the subject matter they teach, the subject related pedagogy, and the interactions of all these in a given context.

It is thus believed that the Model will serve as guide for IICBA’s interventions in African teacher education systems in the area of ICT integration in education. The usefulness of the Model in informing IICBA’s decisions in relation to the implementation of its ICT in education projects in order to meet the targets is evident—the Institute shall make sure that the latest research developments in the knowledge base of teaching and teachers are addressed by Africa’s teacher education institutions.

Arnaldo Nhavoto
Director

1. Introduction

Societies in the 21st Century expect all children to be prepared to think critically, solve problems and be creative. The achievement of this expectation rests, first and foremost, upon the development of a highly qualified and committed teaching force (Darling-Hammond, 1995). In other words, the knowledge, skills, abilities, and commitments of teachers prepared today will shape and inform what is possible for the future generation of students.

Teacher development has been conceptualized in different ways, and reviewing those conceptions is beyond the scope of this work. This paper, however, adapted the description of teacher development by Bell and Gilbert (1996) as a process in which social, personal, and professional development is occurring, and one in which development in one aspect cannot proceed unless the other aspects develop too. Social development refers to working with, and relating to, other teachers and students to reconstruct the socially agreed knowledge about being a teacher of a given discipline. By personal development is meant attending to feelings about the change process, about being a teacher and about the education of the teacher’s discipline, and reconstructing one’s own knowledge about being a teacher of that discipline or subject area. Professional development deals with changing concepts and beliefs about education in that discipline and changing classroom activities. These three aspects are interactive and interdependent.
ICT-enhanced teacher development (ICTeTD) is therefore conceptualized in this model as the process in which ICT enhances the social, personal and professional development of teachers, and as one in which the enhancement of development in one aspect cannot happen unless the other aspects develop as well. ICTeTD is regarded as context-dependent since social, personal and professional development of teachers as well as their use of information and communication technologies are influenced by the context in which the teachers are operating.

2. Why ICT-enhanced teacher development?

About a decade ago, UNESCO recognized ICTs as a major factor in shaping the new global economy and producing rapid changes in society. It also recognized that ICTs have the potential to transform the nature of education—where and how learning takes place and the roles of students and teachers in the learning process. More specifically, UNESCO (2002) argued that:

... For education to reap the full benefits of ICTs in learning, it is essential that pre-service and in-service teachers have basic ICT skills and competencies. Teacher education institutions and programmes must provide the leadership for pre-service and in-service teachers and model the new pedagogies and tools for learning. They must also provide leadership in determining how the new technologies can best be used in the context of the culture, needs, and economic conditions within their country. ... Teacher education institutions also need to develop strategies and plans to enhance the teaching-learning process within teacher education programmes and to assure that all future teachers are well prepared to use the new tools for learning.” (p.13)

The UNESCO International Institute for Capacity Building in Africa (IICBA) has also been putting the development of ICTs in teacher education institutions as its key strategic priorities for Africa. With the advent of ICTs and the development of a knowledge-based society, IICBA firmly believes that teacher’s role needs to be redefined in a way that meets the demands of 21st century
education. To this end, IICBA looks beyond professional teacher development programs that merely focus on training teachers in the operation of computers and ICT literacy per se, and plans to work actively towards enabling African teachers to master ICT as an effective tool to improve teaching and learning and actually integrate their skills in day-to-day classroom instruction and beyond. Thus, the issue is no longer whether teachers should integrate technology in their existing practices, but how to use technology to transform their teaching with technology and create new opportunities for learning.

Research works (Angeli and Valannides, 2009; PanAfrican Research Agenda on the Pedagogical Integration of ICTs 2011) in the field of educational technology have also shown that in spite of the many efforts that researchers and educators put over the years in preparing teachers in the educational uses of technology, teachers still lack the skills and knowledge needed to be able to teach with technology successfully. These researchers and their reviews have attributed the failure to adequately prepare teachers to teach with technology to the following reasons:

- **The emphasis of educational technology courses on the acquisition of technical skills.** Although computing skills are important, skills-based courses are not enough for preparing teachers to teach with technology, because they are usually taught in isolation from a subject-specific context.

- **The lack of a subject-specific pedagogical focus in many technology preparation programs.** Even in those programs where subject applications are discussed, matters of how technology interacts with the content and content-specific pedagogy are not sufficiently explored. As a consequence, the programs fail to adequately prepare teachers in the direction of establishing pedagogical connections between the affordances of technology and the teaching of a particular content domain.

- **The lack of national policy for teacher training in the pedagogical integration of ICT and the lack of theory and conceptual frameworks to inform and guide research and actions in the area of teaching with technology.** Without some theoretical framework about teaching with technology, we may never see the larger picture that could give our everyday classroom efforts direction and meaning.

- **Lack of incentive plans for teachers.** Schools should set up incentive programs to encourage and facilitate the pedagogical integration of ICT in teaching (promotions of teachers, low-interest loans to teachers so that they buy equipments, etc.)

- **Absence of techno-pedagogical resource banks specific to our education systems.** Teachers don’t have time to search for and assess the vast quantity of resources available on the Internet. It may therefore be useful to select and compile the most relevant techno-pedagogical resources so that teachers can use them easily to improve their teaching

It is for the above-mentioned major reasons that UNESCO-IICBA stresses the need for ICT-enhanced teacher development in the 21st century Africa.
3. The conceptual model

In the most generic sense, the term conceptual model refers to models which are represented by concepts, or related concepts which are formed after a conceptualization process in the mind. It is an abstract (visual) representation of the problem domain and serves to enhance understanding of its complexity. A conceptual model also provides a basis for communication among the academic and technical members of the domain under consideration.

The domain of the ICT-enhanced teacher development model (ICTeTD) is technology use in teaching, with teaching being understood more broadly to involve all the activities of a teacher of specific subject such as lesson planning, classroom instruction, assessment/evaluation, curriculum review and development. The ICTeTD model is conceptual in the sense that it provides a visual representation of the concepts/knowledge bases from which teachers draw during their teaching. The ICTeTD model is thus expected to serve as the guide for the preparation of pre-and in-service teachers for the 21st century. When conceptual models specifically deal with the known and the knowable, they are referred to as epistemological models. In other words, the ICTeTD model is an epistemological model in that it deals with the knowledge base for teaching and teachers in the 21st century.
3.1. Earlier models of the knowledge base for teaching

Shulman (1987) introduced the concept of pedagogical content knowledge (PCK) as the ways content, pedagogy, and knowledge of learners are blended into an understanding about how particular topics to be taught are represented and adapted to learners’ characteristics, interests, and abilities. According to Shulman, any act of teaching is cyclic. A teacher must first comprehend the material to be taught, that is, grasp the relevant content knowledge (CK). This must then be transformed, by the use of pedagogical-content knowledge, into a form in which it can be taught. The actual teaching then takes place, accompanied and followed by an evaluation of the effectiveness of that instruction in fostering student learning. The teacher then reflects on the significance of that evaluation for teaching when the particular cycle is entered again. So PCK goes beyond the knowledge of subject matter per se to the dimension of subject matter knowledge for teaching.

PCK is considered as an amalgam of content and pedagogy and can be represented as in figure 1.

**Figure 1. Diagrammatic representation of PCK**

Whereas Shulman’s concept of PCK received wide acceptance in the field of teacher education in the last two decades, ICTs have also made tremendous progress at the same period of time. As Mishra and Koehler (2006) put it “though Shulman’s approach still holds true, what has changed since the 1980s is that technologies have come to the forefront of educational discourse primarily because of the availability of a range of new, primarily digital, technologies and requirements for learning how to apply them to teaching” (p. 1023).

Mishra and Koehler (2006) thus proposed the necessity for the integration of technology with PCK and named the resulting amalgam knowledge technological pedagogical knowledge (TPCK), as presented in figure 2.

**Figure 2. Framework of TPCK**
The authors further argued that the TPCK framework “emphasizes the connections, interactions, affordances, and constraints between and among content, pedagogy, and technology. In this model, knowledge about content (C), pedagogy (P), and technology (T) is central for developing good teaching. However, rather than treating these as separate bodies of knowledge, this model additionally emphasizes the complex interplay of these three bodies of knowledge” (p. 1025).

While recognizing the importance of the TPCK framework (Figure 2), Angeli and Valanides (2009) argued that it is not clear from the framework...whether TPCK is a distinct form of knowledge or whether growth in TPCK simply means growth in any of the related constructs (i.e., Pedagogical content knowledge, Technological content knowledge, Technological pedagogical knowledge, or even the initial elements of Pedagogy, Content, and Technology). Furthermore, the boundaries between some components of TPCK, such as, for example, what they define as Technological content knowledge and Technological pedagogical knowledge, are fuzzy indicating a weakness in accurate knowledge categorization or discrimination, and, consequently, a lack of precision in the framework. (p. 157).

Angeli and Valanides (2009) further stated that, although the TPCK framework recognizes the mutually reinforcing relationships between all three elements taken together, “the framework does not make explicit the connections among content, pedagogy, and technology” (p. 157). They thus introduced what they called the ICT-TPCK model as shown in figure 3.

3.2. The ICT-enhanced teacher development model

I, the author of this booklet on ICT-enhanced teacher development (ICTeTD) model, fully agree with the views of Angeli and Valanides (2009) regarding the weaknesses of the TPCK framework (figure 2). In particular, I believe that excellence in any one of the ‘component areas of TPCK’ does not enable a teacher to handle teaching-learning situations from a TPCK perspective primarily because TPCK is a collection of neither its three ‘component areas’ (T, P, and C) nor of its bi-dimensional amalgams (PCK, TPK, and TCK). In other words, TPCK is a distinct transformed knowledge area and needs to be developed by teachers as such.
But I find it difficult to accept Angeli and Valanides’ (2009) suggested new framework of ICT-TPCK (figure 3). As presented in figure 3, ICT is one of the five components that formed the ICT-TPCK framework, the other four being Pedagogy, Content, Context and Learners. But in the name “ICT-TPCK”, technology appears to be counted twice. TPCK as a distinct construct already includes the technology and hence there is little convincing argument to introduce another technology (that is ICT) into it. Furthermore, it is not clear why P (pedagogy) and C (content) in the TPCK segment of ICT-TPCK appeared as contributing knowledge areas (ovals) and T (technology) has no corresponding contribution. It is also not clear why Learners and Context appear in the framework as equal contributors (knowledge areas) but ignored in the ICT-TPCK nomenclature. Even if Angeli and Valanides (2009) argued that TPCK is a distinct construct, with which I fully agree, their framework (figure 3) fails to show that epistemological position.

I thus suggest that, rather than ICT-TPCK (figure 3), the tetrahedral framework of TPCK (figure 4) describes better the distinct construct nature of TPCK. It also conveys the transformed nature of TPCK from its constituent content knowledge, pedagogical knowledge and technological knowledge. The tetrahedral framework recognizes and indicates the progressive, transformed and dynamic nature of TPCK. Furthermore, the entire knowledge base for teachers is imbedded within a context. Since this framework deals not only with the knowledge base of teaching, but also with the development of teachers, I refer to it as the ICT-enhanced teacher development (ICTeTD) model.

In figure 4, TK (technological knowledge) and PK (pedagogical knowledge) are in the plane of the page whereas CK (content knowledge) is outward (towards the reader) of this page. All the three knowledge areas are at the same level of (have equal importance to) forming the pyramid. The pyramid is made of ‘fleshes’ of TPCK (technological pedagogical content knowledge), a transformed knowledge through proper interactions of CK, PK and TK.
The triangular face on the right side of figure 4 and formed by its base CK and PK represents PCK (pedagogical content knowledge), that on the left side formed by CK and TK represents TCK (technological content knowledge), and the back face formed by TK and PK represents TPK (technological pedagogical knowledge). The triangular face formed by CK, PK and TK is the base of the pyramid and represents the basic level of TPCK. In going towards the top of the pyramid, each triangular plane parallel to the base of the pyramid represents a certain degree of progressively higher continuum of TPCK developed by teachers. Teachers in this tetrahedral model of ICTeTD progress from the initial stage of being aware of TPCK through to being creative and innovative TPCK professionals (that is, from the bottom of the pyramid through to the top of it). Note that the arrows pointing upwards from the three corners of the pyramid indicate the progressive development of TPCK, and not its individual components of CK, PK and TK.

The continuum of transformed knowledge (TPCK) in figure 4 is categorized into four interrelated stages of development, namely emerging TPCK, applying TPCK, infusing TPCK and transforming TPCK. It should be understood that each stage in the figure represents a continuum of triangular faces/planes of the pyramid parallel to its base, and that the space between successive stages is added merely for visibility of the three dimensional model.

Emerging TPCK represents an initial stage of TPCK development by teachers. Teachers at this stage are beginning to be aware of the nature and importance of TPCK in their social, personal and professional development.

Applying TPCK is characterized by teachers who started to use TPCK-based programs/lessons developed by others. Teachers at this stage also start engaging themselves in discourses among themselves about what it means to be a teacher of TPCK-based curriculum, about their feelings and students’ feelings while experiencing the TPCK-based curriculum, etc.

Infusing TPCK represents a stage of TPCK development by teachers who started to modify, adapt and initiate their own TPCK-based materials/lessons/modules for diverse group of learners. Teachers at this stage have the capability to mentor/advise other teachers about the what and how of TPCK-based educational programs. They can also comfortably adapt themselves to new situations in those programs. They can design and carryout TPCK-based inquiry/research activities to solve personal and institutional problems.

Transforming TPCK is the highest stage of social, personal and professional development of 21st century teachers. Teachers at this stage are creative and innovative in that they not only develop new and appropriate TPCK programs for their institutions but also theorize about the nature and methodologies of TPCK.

All these progressively higher levels of teacher development are imbedded within a given context, represented as a cone surrounding the pyramid. Context is understood here as involving the cultural, political, psychological, and related factors that influence teacher development.
References


Appendix

Descriptions of basic concepts

1. Content Knowledge (CK)

Content knowledge (CK) is knowledge about the actual subject matter that is to be learned or taught (Mishra and Koehler, 2006). Teachers must know the subject they teach. Unfortunately, subject matter courses in teacher preparation programs tend to be remote from classroom teaching. Ball, et al. (2008) further argued that:

Disciplinary knowledge has the tendency to be oriented in directions other than teaching, toward the discipline—history courses toward knowledge and methods for doing history and science courses toward knowledge and methods for doing science. Although there are exceptions, the overwhelming majority of subject matter courses for teachers, and teacher education courses in general, are viewed by teachers, policy makers, and society at large as having little bearing on the day-to-day realities of teaching and little effect on the improvement of teaching and learning. (p. 404)
2. Pedagogical Knowledge (PK)

Pedagogical knowledge (PK) is deep knowledge about the processes and practices or methods of teaching and learning and how it encompasses, among other things, overall educational purposes, values, and aims (Mishra and Koehler, 2006). It also includes knowledge of different theories about learning, learning styles, planning, management and evaluation.

3. Pedagogical Content Knowledge (PCK)

Pedagogical content knowledge (PCK) is knowledge about how to combine pedagogy and content effectively, as conceptualized by Shulman. It includes knowing what teaching approaches fit the content and knowing how elements of the content can be arranged for better teaching (Mishra and Koehler, 2006). PCK is also concerned with the a) representation and formulation of concepts, pedagogical techniques, knowledge of what makes concepts difficult or easy to learn, knowledge of students’ prior knowledge, and theories of epistemology, b) knowledge of teaching strategies that incorporate appropriate conceptual representations in order to address learner difficulties and misconceptions and foster meaningful understanding, c) knowledge of what the students bring to the learning situation, knowledge that might be either facilitative or dysfunctional for the particular learning task at hand.

In the context of language teaching, for instance, van Olphen (2008) argues how PCK is often relegated to methods courses instead of being incorporated throughout teacher preparation courses. To this end, (a) theories of teaching, (b) teaching skills, (c) pedagogical reasoning, and (d) contextual knowledge are proposed as integral parts of teachers’ PCK as they provide second language teacher education with an agenda that promotes and strengthens the teachers’ engagement in the exploration of knowledge, beliefs, attitudes, and thinking as they inform their teaching endeavors.

4. Technology Knowledge (TK)

Technology knowledge (TK), within the context of technology integration in schools, appears to most often refer to digital technologies such as laptops, the Internet, and software applications. TK does however go beyond digital literacy to having knowledge of how to change the purpose of existing technologies (e.g. wikis) so that they can be used in a technology enhanced learning environment. It involves knowledge about standard technologies, such as books, chalk and blackboard, and more advanced technologies, such as the Internet and digital video (Mishra and Koehler, 2006). In the case of digital technologies, this includes knowledge of operating systems and computer hardware, and the ability to use standard sets of software tools such as word processors, spreadsheets, browsers, and e-mail. TK includes knowledge of how to install and remove peripheral devices, install and remove software programs, and create and archive documents. Since technology is continually changing, the nature of TK needs to shift with time as well.
5. Technological Content Knowledge (TCK)

Technological content knowledge (TCK) is knowledge about the manner in which technology and content are reciprocally related. Although technology constrains the kinds of representations possible, newer technologies often afford newer and more varied representations and greater flexibility in navigating across these representations (Mishra and Koehler, 2006). TCK also refers to knowledge about how technology may be used to provide new ways of teaching content. For example, digital animation makes it possible for students to conceptualize how electrons are shared between atoms when chemical compounds are formed.

6. Technological Pedagogical Knowledge (TPK)

Technological pedagogical knowledge (TPK) is knowledge of the existence, components, and capabilities of various technologies as they are used in teaching and learning settings, and conversely, knowing how teaching might change as the result of using particular technologies. This might include an understanding that a range of tools exists for a particular task, the ability to choose a tool based on its fitness, strategies for using the tool’s affordances, and knowledge of pedagogical strategies and the ability to apply those strategies for use of technologies. This includes knowledge of tools for maintaining class records, attendance, and grading, and knowledge of generic technology-based ideas such as WebQuests, discussion boards, and chat rooms (Mishra and Koehler, 2006). TPK also refers to the affordances and constraints of technology as an enabler of different teaching approaches. For example, online collaboration tools may facilitate social learning for geographically separated learners.

7. Technological Pedagogical Content Knowledge (TPCK)

Technological pedagogical content knowledge (TPCK) is a framework to understand and describe the kinds of knowledge needed by a teacher for effective pedagogical practice in a technology enhanced learning environment. It is an emergent form of knowledge that goes beyond all three components (content, pedagogy, and technology). This knowledge is different from knowledge of a disciplinary or technology expert and also from the general pedagogical knowledge shared by teachers across disciplines. TPCK is the basis of good teaching with technology and requires an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students’ prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge and to develop new epistemologies or strengthen old ones (Mishra and Koehler, 2006).
For instance, consider a Spanish writing class in which the students have to write and edit an essay about cross-cultural differences between holidays in the U.S. and in Spain (van Olphen, 2008). Writing the essay in Spanish (stylistics, syntax, cultural differences—i.e., content) drives the types of representations to be used (analysis of Spanish writing samples, semantic maps, visual representations of how to structure writing in Spanish, editing exercises—i.e., pedagogy), plus the necessary technologies to influence them. In this case, the Internet, web-based resources, Microsoft Word and its “track changes” tool, wikis, or even blogs would fit the purpose for interactively creating, developing, and writing the essay. If the teacher had not had all these technologies at hand, she/he would have to implement other ways of representing content. Obviously, this change when representing knowledge would also generate an adaptation or modification at the pedagogical level. Also consider the case of making requests in a second language and within a different culture. When situations like this one are analyzed within the context of a second or third language, language teachers need to possess a high degree of both linguistic and cultural awareness (CK). The next step is to be able to teach this concept in ways that enable students not only to see these cultural linguistic differences (e.g., the use of certain verbal tenses such as conditional over simple present) but also to learn how to use their target language (e.g., Spanish, French) within that context (PCK). When deciding about the best way to represent knowledge, teachers may integrate technology to present this content (teachers’ technological content knowledge) while supporting and enhancing students’ learning experiences. Therefore, it is necessary that teachers know about technology as well as how to integrate it in a pedagogically thoughtful way in this particular content area.

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