International Journal of Multidisciplinary Research and Development
Online ISSN: 2349-4182, Print ISSN: 2349-5979; Impact Factor: RJIF 5.72
Received: 14-07-2020; Accepted: 28-07-2020; Published: 15-08-2020
www.allsubjectjournal.com
Volume 7; Issue 8; 2020; Page No. 122-126

A critical analysis of the TPACK model from instructional design perspective

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Abstract
The position of the letter "T" in the TPACK Model does not align itself with dictates of instructional design models common in literature. Also, the exalted position of the letter "A" to an uppercase status leaves every new user with the impression that it is an element of the model. Thus, the paper sues for a reversed model, the PCTK or PCaTK that addresses these overt observations. The paper also explored on the place of acronyms in aiding learning while utilizing the same common instructional design models to effectively anchor the discourse. However, in line with this proposition and in consideration of the immeasurable role of the model, its 7 – component structure form a sizeable portion of the paper. Hence in line with the paper, they are labeled as; PK, CK, TK, PCK, PTK, CTK and PCTK/PCaTK, with preference placed on pedagogy rather than technology in terms of placement and usage.

Keywords: analysis, knowledge, changer, postulants, acronym, reversed

Introduction

Technology knowledge, pedagogical knowledge and content knowledge are the three broad sets on which the TPACK model is borne (Shulman, 1986; Mishra & Koehler, 2006) [25, 18]. The other subsets from the overlapping of these broad ones gave rise to the other four components namely; technology content knowledge (TCK); technology pedagogy knowledge (TPK), pedagogy content knowledge (PCK) and technology pedagogy content knowledge (TPACK) (Lin, Tsai, Chai & lee, 2012; Chai, koh & Tsai, 2010) [6, 15]. A succinct look at the various elements of this model, displays the unquantifiable niche the model plays in the place of technology in the technology classroom of today.

If the letter A in the TPACK suggests *and*, and not an element, therein lies the concern of the paper. While T-technology, P-pedagogy, C- content, then it is obvious that a-*and*, a conjunction is not necessarily an element of the TPACK acronym. This will be corroborated by a display of other acronyms common in the process or tool component instructional design.

Instructional design generally is concerned with the science and art of facilitating learning. The primary focus then is learning, from shallow to deep learning, by brining learning theories, teaching theories, methodologies, and other aspects of education to bear. The idea is acknowledging their role in promoting learning. Ideally, when what is to be taught is settled, the place of technology integration is given a worthy consideration. In other words, technology does not look for what to do; we rather look for technology, realizing that it has a vital role to play in accomplishing a given task for us. The emphasis placed on pedagogy should influence the label and descriptions of the components of the reversed PCTK in entire discourse.

The PCTK model option

The PCTK option only represents the initial letters of the words that make up this reversed version of the TPACK. The model obliterates the ambiguity and confusion associated with a model that shows 5-elements, even though it is a 4-element one. A model is meant to aid memorization, comprehension and promote recall and not to create any form of illusion. It is a way to synthesize complex and detailed task in such a manner that aids learning. It is very relevant in attainment of instructional objectives, irrespective of the class and sub-class. A model can be represented by a simple acronym, hence the untold place of an acronym in an instructional system.

In instructional design system, the place of acronyms is corroborated by their presence in the instructional process. The ADDIE household name is a typical example. ADDIE, simply represents; analysis, design, development and evaluation. It is a 5- element model with 5-elements, not less or more. The ASSURE model is another one that obeys this simple order. The 6-element model represents: analysis; statement of objectives; selection of media; utilization of media, request learner performance and evaluation (Heinich, Molenda, Russell & Smaldino 1999) [11]. In line with this reasoning is also the PIE model (Newly Stepich, Lehman & Russell, 2000) [21]. This 3-element model is represented by; P-plan, I-implementation and E-evaluation. The story is not different of the SAM or successive approximation model (Allen & Sites, 2012) [1]. If there is one thing that is common with these models, it has to do with the specifics of the elements that make up their acronyms. These acronyms are distinct and very definitive, and so pose no challenge in associating various elements with what they represent. This is a sure way of presenting on acronym, which the TPACK is flawed with.

In Information Communication Technology, (ICT) is a household acronym. And in recognition of the invaluable place of acronyms in aiding memory and recall, such acronyms in the ICT world have come to stay. Hyper Text Transfer Protocol (HTTP), Hyper Media Transfer Protocol (HMTP), Personal Identification Number (PIN), learning Management System (LMS), Internet Service Providers (ISP), Internet Protocol (IP), File Transfer Protocol (FTP),

are typical examples, amongst others. Also,in internet network, Local Area Network (LAN), Wide Area Network (WAN), Personal Area Network (PAN), Campus Area Network (CAN). Metropolitan Area Network (MAN) and wireless local area network (WLAN), are common acronyms. The list is inexhaustible, a confirmation of the indispensable and untold role of acronyms in human life in general and learning in particular.

From the Instructional design point of view, pedagogy rather than technology occupies the front seat in the instructional process. In the Gerlach and Ely (1980) [10] model, specification of content, objectives, assessment of entering behaviours come first before determination of strategy where resources (technology) inclusive is housed. Even the Morrison, Ross and Kemp (1994) [19] model, places media or other resources consideration after addressing students' readiness level, instructional objectives and strategies. In the ISD model by Braden (1996) [4], instructional materials (technology), occur at the 12th position in the 15th component model. The model appreciates the place of needs assessment, goals, students' analysis, writing of performance objective, amongst others before technology. In the Heinich, *et al*., (1999) [11] model, analyzes learners and statement of objectives come before selection of media and materials (technology). The planning phase of Newby, *et al*., (2000) [21] model, it considered gathering information about the learner, content and setting first, before looking out for how technology can assist in creating effective and motivational learning. This is not different from the Dick, Carey and Carey (2001) [7] model. The model considered needs assessment, instructional learner analysis, performance objectives, assessment and strategies before technology. These observations on the positioning of media (technology) in the instructional process are virtually the same among instructional designers as corroborated by the various models under review.

Instructional designers who are protagonists of this school of TPACK model seem to align themselves with the educational technology 1 & 2 approach of the field. It was an approach that saw the field as technology (hardware and their corresponding software) in education. It is obvious that the field is far from technology in education or else it becomes an all comers affair, after all every person can use technology to learn. It is in the pursuit of this delimitation that the focus is shifting to pedagogy; the art and science of facilitating learning by bringing all instructional design elements to bear, then technology consideration, integration and utilization. This is the focus of the concept of technology of education where emphasis is placed on the various processes and theories and their invaluable role in promoting learning and enhancing students' performance. It is these processes and theories which invariably influence design, development, integration and utilization of instructional media or technology.

Lastly, technology (instructional media) selection criteria are topical issues in instructional design. They fall under the theme that sets and spells out basic considerations to be taken before instructional media selection and integration. Media selection criteria include; objectives of instruction, content or task, learners' age, interest and emotion, teachers' technical knowhow, availability or improvisation tendencies. Others include environmental factors, such as power and steady source of power, network presence and the presence of hardware with corresponding software (Romiszoweski, 1981; Williams, 1999) [27]. The fact remains that if there are selection criteria spelt out while considering technology in any instructional process; it then suggests that placing technology before such criteria is synonymous to the placement of a cart before a horse

The 7 – elements of the PCTK model

The reversed model would reflect on the position designate of the elements that form its constituent parts. From the 3 – broad elements; pedagogy knowledge, content knowledge and technology knowledge, the usual sets and subsets configuration formed are presented thus.

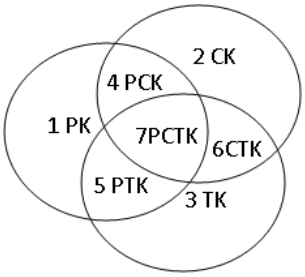

Fig 1: PCTK elements and relationships

The figure above presents the naming and arrangement of the elements of the PCTK model and in the fashion they would be discussed under the headlines below.

Pedagogical Knowledge: The provision of pedagogical knowledge is courtesy the field of education. Education is the profession that prides in the training and equipping of educators with requisite knowledge that would guarantee learning. It is a profession that explores the various kills, techniques and methodologies which aid and promote learning. Art of teaching, classroom management, child psychology, learning theories, amongst others are requisite knowledge from the pedagogical point of view. The overall essence is the definition of teaching as a profession where relevant skills, knowledge and aptitude play very distinction roles.

PK represents the kind of knowledge that is required to; identify the true nature of the learner and learners' general and specific characteristics, general characteristics in terms of the background, socio-economic status, cultural and religious inclinations while specific characteristics would include; input competence, entry behavior and individual learning preferences or styles. This is the essence of what is aptly labeled as audience analysis and its place in facilitating learning is an invaluable asset (Williams, 1999) [28].

PK also involves richness and versatility in statement of learning objectives. PK avoids the educator to be abreast of the domains of instructional objectives; cognitive, affective and the psychomotor, and their sub categories inclusive. The use of the right verbs and parameters to be met by a well stated objectives, that is; audience, behavior, condition and degree (ABCD) on one hand, or the (SMART) format; specific measurable, attainable, relevance and time lag are typical of PK (Arshavskiy, 2013).

PK is the kind of knowledge which focuses on the methodologies, strategies and teaching skills required for learning to take place. Demonstration, discussion, didactic dramatization, inquiry and project are typical of such methods. Concept-mapping, collaborative, contextual, brainstorming are common strategies, while set induction,

reinforcement, punishment, stimulus variations, questioning skills, non-verbal communication, skill of closure are common teaching skills ushered by PK (Mangal & Mangal, 2009; Williams, 2015) [27].

Knowledge of instructional plan is what PK bequeaths its beneficiaries. An instructional plan is influenced by both the processes, theories and physical resources factor of every design. This PK acquaints the educator with such instructional processes that effective plan can be anchored. The ASSURE (audience, statement of objective, selection of material/media, utilization, require learner performance); PIE (plan, implement and evaluate); ADDIE (analysis, design, development, implement and evaluate), are common examples (Gerach & Ely, 1980; Heinich, *et al* 1999) [10].

Also, learning is enhanced when knowledge of the various learning theories and the psychological bases of those learning theories are ascertained. PK makes it possible for place of such theories as; behaviourism, cognitivism, constructivism, connectivism, communication theories, amongst others and their

Content Knowledge (CK): This is the place where the subject matter experts (SMEs) are distinct and pronounced (Schraagen, 2009; Diezmann & Walter, 2015) [24, 8]. SMEs are postulants, very rich in subject matter content, or content knowledge of their areas of specialty. Holders of single honours (BSc, BA) conveniently fall into this category in the Nigeria context. These SMEs generally have an in dept knowledge of the contents of the subject in which they are majors. They are subject matter experts without pedagogical training, hence their contribution in a course design is key (Carter & Berliner 1987: Albert, 2006) [5, 2]. Cognizance of the deficiency associated with being an SME and to function in the education sector, a kind of blended policy came into existence where pedagogical knowledge and content knowledge were provided via a single platform. Faculties of education and education related institutions today serve this singular purpose by producing teachers rich in the pedagogical and content knowledge. It is this hybrid form of knowledge that has given the field its current worth, stand and rating. Educators today are not only rich in the art of teaching but also serve as SMEs. This is the premise under which we have such honours as; B.Ed, B.Sc.(Ed) and the like. The emphasis is showcasing the presence of Siamese twin; pedagogy and content which must coexist if education should serve it purpose.

To check and correct this error especially for migrant teachers or new entrants into the field of teaching, a post graduate diploma programme in education is in place. Prospective teachers are required to have a 1-yr mandatory training in the art and science of teaching to be able to migrate into a new field of their choice. Such a 1-yr programme is meant to address the PK obviously absent in their initial training.

ALL teachers training institutions however address this abnormally ab-initio by combining contents and pedagogical knowledge at the same time of career development. To ensure that there is a balance of both, CK is addressed by experts in content areas while PK is handled by educators versed in such knowledge. The subject of CK or SMEs and its inevitable place in learning are corroborated by several works (Hashwel, 1987; Schraagen, 2009; Rotgans & Schmidt, 2011) [12, 24, 23].

Technology Knowledge: Knowledge of devices, tools and materials that support teaching and learning fall under this category. Their immeasurable place in today's world has made knowledge about them a must even among educators who initially saw technology as a surrogate. Not at all, they can ever be the teacher's surrogate rather ease and compliment their role in facilitating learning.

Technology knowledge is a vast subject. However, no matter how broad it is, basic knowledge of technology is necessary. TK makes one to be technology literate, able to speak and use the language of technology, appreciate the inevitable place of technology and its application in diverse learning environment. In line with this thought, Evan, Martin and Poatsy (2010) [9] maintain TK makes us to acknowledge why technology is necessary, ushers us into the computer and internet environment, conversant with application software, system software (operating system, utility programs and file management), networking, recruit and mobile computing. TK in the understanding of Morrison and Lowther (2010) [20] also lend credit to the preceding position. According to the authors TK makes one to be able to use digital tools in today's classroom. The authors also acknowledged the place of application software; productivity, research, communication, problem solving and educational, make exploration of technology smoother, easier and appreciating. Ability to explore the World Wide Web (WWW) is also a sure evidence of TK. Such knowledge makes it easy for teachers and students to be able to surf the web so as to gain from the numerous benefits it offers. TK also cover knowledge of internet tools, multimedia in the web, using the web for teaching and learning, knowledge and use of Open educational resources (OERs), Learning management systems (LMS) including internet networking. In the words of lever-Duffy and McDonald (2011) [14], such knowledge of traditional and digital technologies is very vital in teaching and learning in the present age. The two authors also added that there are issues which accompany TK. They identified such ones as; legal issues (copyright and fair use, privacy, acceptance and software piracy; social issues (cyber bullying & online social interaction); and ethical issues (freedom of speech, privacy & academic dishonesty).

TK therefore is an uncompromising one in the technology age of today. Thus the belief is true that a technology non-compliment teacher would definitely be left behind in the technology- driven learning environment of the 21st century, which has given students a new status of digital natives, netizens and internet savvies.

Pedagogy Content Knowledge (PCK): This is the product of PK and CK, a subset of the two overlapping elements. If PCK is an amalgam of PK and CK, it means it has to do with knowledge that merges content to be taught with how best it is to be taught, deploring the art and science of teaching. PCK like PK is one of the elements that gave the field its professional status, because of the presence of P. while non-professionals are only rich CK; professional teachers are rich in PCK, making them the right SMEs for the profession. PCK thus is critical to understanding effective teaching as it makes transformation of knowledge smoother and represents a unique domain of teacher knowledge (Magnuson, Krajcik & Booko, 1999; Krauss, Brunner, Kunter & Bayunert, 2008).

Pedagogy Technology Knowledge (PTK): This hybrid of P and T knowledge corroborates the influence of the elements on each other. Pedagogical inputs should guide technology/media choice, integration and utilization to

enhance learning. In this wise, the influence they have on each other will be more obvious. How can the objectives of lesson be achieved, audience diverse learning preferences be addressed and effective delivery be made using the right technology? Issues like these make this union between P and T a strong and inseparable one. PTK is crucial as it influences teachers' experiences in deciding technology integrated in pedagogy; and wise use of technology for educational purposes (So & Kim, 2009) [26]. The tie that exists between P and T has made it obligatory that no meaningful teaching can be done without the interpretation of one form of technology or the other. After all, the numerous gains of technology in our modern-day life in general and education, to be specific learning cannot be under estimated. This is also a major factor that has changed the sage on stage role of the teacher to facilitator of learning, the learner occupying the centre stage.

Content Technology Knowledge (CTK): This is the product of CK and TK, or the outcome of the amalgam of the two. Once content is outlined, the next kind of knowledge outside P has to do with T, hence CTK. Such knowledge is rightly expressed in the NTeQ technology integration model of Morrison and Lowther (2010) [20]. In the 9-element model, an element requires specification of technology (computer) function that will match content. Therefore, CTK is a key sub element of PCTK in cognizance of the very bond that exists between CK and TK. Therefore, if instructional content must be delivered with minimal stress but desired comfort and meaningfulness, the invaluable place of CTK must ne acknowledged.

Pedagogy Content Technology Knowledge (PCTK): This re-emphasizes the position of the paper and the proper manner in which the elements should be positioned, that is, pedagogy before technology and content before technology. Also, the A element is letter is underplayed as it is only a conjunction and not an element; and even if it must be placed before the third element, then PCaTK could be an alternative. PCTK represents crucial and inevitable model in the learning environment of the present age. Our classrooms have become digital, flipped and the flying type. The role of both the teacher and the learner has changed automatically as such the PCTK model remains the only viable and available option in making teaching and learning desired results-oriented tasks.

Conclusion

The proper placement of the element pedagogy before any other elements, contest and technology based on instructional design models in literature is what this paper sought to achieve. Also, there is the need for a model that settles for an acronym to be strict in ensuring that such acronym does not misrepresent a model. These are the two observations this paper tried to resolve. The essence is to ensure that the purpose of an acronym representing a model does not infringe on the learning that it is supposed to serve.

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