Designing a PBL Teacher Training Program for the Development of TPACK Competencies of Primary School Science Teachers in Urban Areas of Uganda

Pearl Ingrid Mugala
KyungHee University
ingridsure@gmail.com

Inae Kang
KyungHee University
iakang@khu.ac.kr

Abstract: It has become widely accepted that in order to successfully integrate technology in education, teachers require a special kind of knowledge. This knowledge set has been conceptualized as an intricate meshing of Technological Pedagogical and Content Knowledge. In Uganda, much of the effort to integrate technology in schools has focused on instrumentation and basic computer skills training. Several researches link the low success of Uganda's efforts to integrate technology to teachers having inadequate knowledge on how to use technology for pedagogy. This study therefore set out to design a program by which teacher training can develop the Technological Pedagogical and Content Knowledge of Primary school science teachers in particular so as to enhance efforts towards technology integration in education in Uganda. Using a scoping literature review method, this research found a viable link between the tenets of Problem-Based Learning and the instructional needs of teachers as they develop Technological Pedagogical and Content Knowledge. This research also found several aspects of learner centred teacher professional development activities that foster Technological Pedagogical and Content Knowledge development such as content specificity, focus on pedagogy, teacher owned processes, collaboration, modelling, practice and design. As such this research used the Problem based learning model of instruction weaved with the key aspects of learner-centred professional development that foster development of Technological Pedagogical and Content Knowledge to design a content specific teacher training program for primary school teachers in Uganda.

Key words: Problem-Based Learning, Technology Integration in education, TPACK (Technological Pedagogical and Content Knowledge) development

INTRODUCTION

Nowadays, technology is seen to have the potential to reinvent approaches to learning and collaboration, shrink long-standing equity and accessibility gaps in the education system and adapt learning experiences to meet the needs of learners. (NETP Update, 2017)

THEORETICAL BACKGROUND

Technology integration in education

Williams (2003) described technology integration in education as the means of using any Information and Communications technology (ICT) tool to assist teaching and learning. Studies have shown that teacher readiness is a vital component of successful integration of ICTs in school. (Jimoyiannis & Komis, 2007) For effective technology integration, teachers should not only be able to use ICT in order to support traditional instructional methods but also to innovate in instruction. (Jimoyiannis & Komis, 2007) Puentedura (2006) conceptualized technology integration in schools in the Substitution, Augmentation, Modification and Redefinition (SAMR) model where the goal for 21st century technology mediated learning is represented by R-Redefinition.

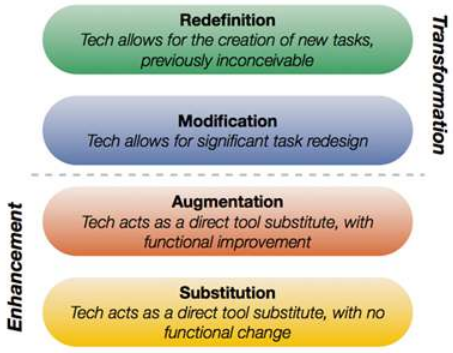

Figure 1.Technology integration defined in SAMR (Puentedura, 2006)

In Uganda, while efforts have been made to provide instrumentation (ESSAPR report, 2016-2017) the success rate of integration - that is the active use of ICTs for instructional purposes - is low. (Andema, et al. 2013; Markon 2013; Nyenje, 2017) Teachers

were found to have little confidence in the use of ICTs for pedagogical purposes or to think that the content in teacher training programs was not pertinent to the curriculum they teach (Andema, et al., 2013; Markon, 2013)

TPACK

Mishra & Koehler (2006) argue that TPACK is the basis of effective teaching with technology. A teacher with Technological pedagogical and Content knowledge understands the representation of concepts with technology; understands the pedagogical techniques that use constructive ways to teach his/her particular subject matter; understands how technology can ease the challenges students face in learning certain subject content; understands how students learn and can use technologies to develop new ways of learning or strengthen old methods. (Koehler & Mishra 2009) In other words, TPACK is not about possessing computer skills per se but about the possession of a high awareness of the affordances that emerging technology tools have to offer in transforming instruction and learning. (Tarling & Ng'ambi, 2016) Kihoza et al. (2016) elaborated on how TPACK might enhance the integration of ICTS based on the SAMR model and found that TPACK promoted Redefinition integration efforts while TPK, TCK and PCK supported Modification in integration.

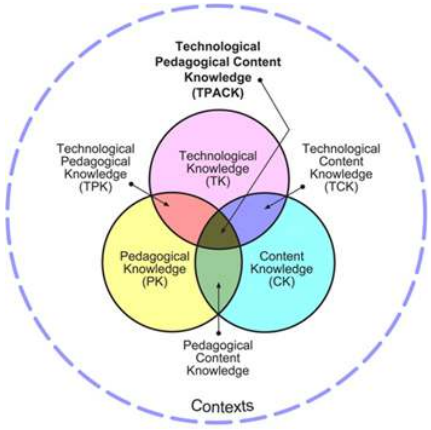

Figure 2.TPACK knowledge domains (Mishra & Koehler, 2006)

PBL

Problem-based learning is a student-centred, inquiry-based instructional model in which learners engage with authentic, ill-structured problem that requires further research (Jonassen & Hung, 2008). The fundamental characteristics of PBL have been defined as follows: first, learning occurs in small groups where students are presented with an open-ended, ill-structured scenario/ problem; secondly, the instructor's role transforms from that of imparting knowledge to that of facilitating learning; third, PBL places emphasis is on self-directed learning; and lastly students are engaged in a problem-solving process (Hmelo-Silver, 2004; Schmidt, Rotgans, & Yew, 2011).

PBL instructional design method in Hong (2009) as seen below in Figure 3 was used in the design of the PBL program in this research paper.

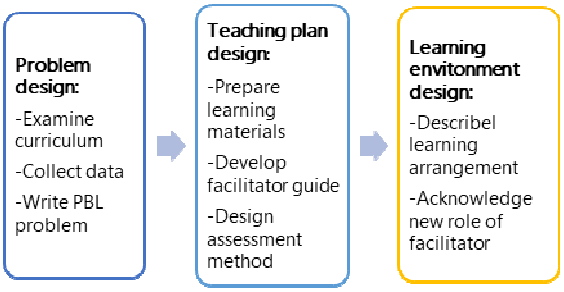

Figure 3.PBL instructional design (Hong, 2009)

PBL and TPACK

Through a literature review, this research found that many of the strategies that had been found effective in the development of teachers' TPACK in other researches are also made provision for in the tenets of Problem based learning. (See Table 1)

Table 1.Strategies for developing TPACK and what PBL offers

Figures and tables

Figure captions and table titles should be the 10-point size and centered ("caption" in the Styles menu of this document). In the figure captions and table titles, the first letter of the first word should be capitalized. Figures and tables must be numbered separately.

The captions of figures are placed below the figures; however, the table titles are to appear above the tables. The body text of table is "table text" in the Styles menu of this document). Table heads (and subheads if needed) are in boldface and left-justified.

Table 1. Table type styles.

TPACK developing strategies	What PBL offers
Activity based learning in the TPACK development program Blocher, et al., 2011)	Learning by doing students actively engage in the learning process (Kang, 2007; Hong, 2009)
Teachers TPACK develops when TPACK development activities include collaboration (Papanikolau et al., 2014)	Collaboration in groups to solve problems (Hmelo- Silver, 2004)

TPACK develops when teachers are allowed to critically reflect and question their practices in integrating technology (Angeli & Valanides, 2009)	Reflection is a critical component of Problem based learning. (Hmel-Silver, 2004)
Involvement in authentic teaching and learning tasks involving technology (Tondeur et al., 2016; Wetzel et al., 2014)	PBL majors greatly on situating learning in authentic tasks (Harris, 2016; Hong, 2009; Kang, 2007)
Sufficient scaffolding during teacher training on integrating technology(Chai & Koh, 2017; Goktas et al., 2009)	Instructors in PBL are scaffolding agents, acting as guides and gradually fading out as the learner gains confidence (Hong, 2009)
Learner-centred Professional development activities (Koh, et al., 2014)	PBL is a learner-centred instructional model. (Hmelo- Silver, 2004; Kang, 2007)
Learner centred assessment consisting of peer assessment (Dawson, 2007), Self-assessment and Expert assessment (Angeli & Valanides, 2009)	In PBL assessment occurs in as a threefold process: Facilitator assessment, Peer assessment and Self-assessment (Elizondo-Montemayor, 2004)

This research therefore concluded that PBL has the potential to provide an effective model for teacher training programs intending to develop teachers' TPACK.

Another aspect found to be vital for the development of TPACK was content specificity in the training process, to enhance teacher understandings of content representation possible with various technologies. (Angeli & Valanides, 2009)

RESEARCH METHODS

This research employed two methods. The first was a scoping review for exploratory purposes to identify the principles that could inform the process of design for a learner-centred TPACK development program. This review set out to determine vital aspects of PBL and Learner-centred teacher training programs that make them effective in developing participating teachers' TPACK as per the literature. Then, expert consultations and formative evaluation processes were also used during the instructional design process.

RESEARCH RESULT

By incorporating the findings of the literature review, that is the aspects of effective learner-centred teacher training programs that successfully enhance TPACK development, this research paper designed a content specific teacher training program based on PBL to develop the TPACK competencies of Primary School teachers of Uganda.

Table 2.Outline of Teacher training program

Title of Problem	**Making a broth for Akoth and Obbo**	
Target	Primary school science teachers in Urban Uganda	
Duration of program	15 contract hours 3 weeks	
Program description	The problem is designed around the life of Akoth a seven year old girl suffering from some side effects of malnutrition. The task is to identify the factors that lead to her condition and design a balanced diet brochure to help Akoth's guardian better attend to Akoth's dietary needs.	
	Pre-program TPACK level determination	
Learning cycles of program	PBL learning process	-Activate prior knowledge -Determine learning objectives -Engage in self-directed learning and collaborate on a brochure -Present result and evaluate Reflection journals
	PBL design process	-Choose a topic -Determine learning goals -Determine technology to use -Design a technology enhanced PBL classroom experience -Present program -Assessment - Reflection journals

	Evaluation	Overall assessment Post program: TPACK evaluation

CONCLUSION

In conclusion, this paper acknowledges that there are other factors that contribute to the successful integration of technologies in education other that the TPACK competencies of teachers.

One limitation of this study is that the program was not implemented. Hopefully this research paper will spur Ugandan Scholars to seek out more pragmatic and learner centred strategies to enhance teacher capacities in teaching with technologies.

REFERENCES

Andema, S., Kendrick, M. & Norton, B., (2013). Digital literacy in Ugandan teacher education: Insights from a case study. *Reading & Writing 4(1)*, 27-28

Angeli, C., & Valanides, N. (2009). Epistemological and methodological issues for the conceptualization, development, and assessment of ICT-TPCK: Advances in technological pedagogical content knowledge (TPCK*). Computers & Education 52*(1) 154–168

Blocher, J. M., Armfield, S. W., Sujo–Montes, L., Tucker, G., & Willis, E. (2011). Contextually based professional development. *Computers in the Schools, 28*(2), 158-169

Chai, C. S. & Koh, J. H. L. (2017) Changing teachers' TPACK and design beliefs through the Scaffolded TPACK Lesson Design Model (STLDM), Learning: *Research and Practice, 3(2),* 114-129

Dawson, K (2007). The role of teacher inquiry in helping prospective teachers untangle the complexities of technology use in classrooms. *Journal of Computing in Teacher Education, 24(1)*, 5-14.

Elizondo-Montemayor, L. L. (2004) *Formative and Summative Assessment of the Problem-Based Learning Tutorial Session Using a Criterion Referenced System.* Retrieved on May, 17 2018 from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.557.1290&rep=rep1&type=pdf

Goktas, Y., Yildirim, S. &Yildirim, Z. (2009).Main barriers and possible enablers of ICT integration into preservice teacher education programs. *Educational Technology & Society, 12(1),* 193-204.

Harris, J. (2016). In-service teachers' TPACK development: Trends, models, and trajectories. In M. Herring, M. Koehler, & P. Mishra (Eds.), *Handbook of technological pedagogical content knowledge for educators (2nd ed.)* (pp. 191-205). New York, NY: Routledge.

Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review, 16*(3), 235-266.

Hong, H. (2009). Design and implementation of a PBL-based Museum education program- The case study of Kyung Hee University National History Museum. *Art education review, 34,* 1-38.

Jimoyiannis, A., & Komis, V. (2007). Examining teachers' beliefs about ICT in education: implications of a teacher preparation programme. *Teacher Development, 11*(2), 149-173

Jonassen, D. H., & Hung, W. (2008). All Problems are Not Equal: Implications for Problem-Based Learning.Interdisciplinary. *Journal of Problem-Based Learning, 2(2*).

Kihoza, P., Zlotnikova, I., Bada. J. & Kalegele. K. (2016). Classroom ICT integration in Tanzania: Opportunities and challenges from the perspectives of TPACK and SAMR models. *International Journal of Education and Development using Information and Communication Technology (IJEDICT*), 12, (1), 107-128

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

Koh, J. H. L., Chai, C. S., Tay, L. Y. (2014) TPACK-in-action: Unpacking the contextual influences of teachers' construction of Technological Pedagogical Content Knowledge (TPACK). *Computers & Education, 78*, 1–10.

Markon, A. G. (2013). *Perspectives on ICT adoption in Ugandan school*. Retrieved on April, 4, 2018 from http://www.mtu.edu/peacecorps/programs/science-education/pdfs/tony-markon-thesis-final.pdf

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for integrating technology in teacher knowledge. *Teachers College Record, 108* (6), 1017-1054.

National Education Technology Plan (NETP) Update (2017). Reimagining the role of technology in Education. Retrieved on February, 15, 2018 from https://tech.ed.gov/files/2017/01/NETP17.pdf

Nyenje, A., (2017). *Education reform dynamics and quality of primary education in selected areas of Uganda*. Retrieved on April 19, 2018 from http://hdl.handle.net/10570/5897

Papanikolaou, K., Gouli, E., Makri, K., (2014). Designing Pre-service Teacher Training based on a Combination of TPACK and Communities of Inquiry. *Procedia - Social and Behavioral Sciences, 116*, 3437-3442

Puentedura, R. (2006). *Transformation, technology, and education. Strengthening Your District through Technology workshops, Maine, US*. Retrieved on April, 20, 2018 from http://hippasus.com/resources/tte/part1.html

Schmidt, H. G., Rotgans, J. I., & Yew, E. H. J. (2011). The process of problem-based learning: What works and why. *Medical Education, 45*(8), 792–806

Tarling, I. & Ng'ambi, D. (2016), Teachers pedagogical change framework: a diagnostic tool for changing teachers' uses of emerging technologies. *British Journal of Education Technology, 47*(3) 554-572

Tondeur, J., Roblin, N. P., Van Braak, J., Voogt, J. & Prestridge S. (2016) Preparing beginning teachers for technology integration in education: ready for take-off? *Technology, Pedagogy and Education, 26*(2), 157-177

Uganda Ministry of Education and Sports (2017). *Education and Sports sector Performance Report (ESSAPR)*

2016-2017 Retrieved on March 16, 2018 from http://www.education.go.ug

Wetzel, K., Buss, R., Foulger, T. S., & Lindsey, L.A. (2014). Infusing educational technology in teaching methods courses: Successes and dilemma. *Journal of Digital Learning in Teacher Education, 30*(3), 89–103.

Williams, M. D. (2003). Technology integration in education. In S. C. Tan & F. L. Wong (Eds.), *Teaching and learning with technology: An Asia pacific perspective*, (pp 17-31) Singapore: Prentice Hall.