Comparing the Effect Size of School Level Support on Teachers' Technology Integration

Eloho Ifinedo [0000-0003-0755-0905]

Faculty of Information Technology, University of Jyvaskyla, Finland.
eloho.e.ifinedo@student.jyu.fi

Abstract. Teachers are expected to lead the innovative use of Information Communication and Technology (ICT) at the classroom level of context. However, research literature shows that a number of factors influence their ICT pedagogical practices. Therefore, the present study investigates the influence of school level support on teacher educators' technology integration. A mixed method is used to collect data through three focused interviews (N= 19) and self-completion survey (N=136). The data collected is analysed both qualitatively and quantitatively. The result shows support for the model hypothesized and suggests that the ICT pedagogical practices of the teacher educators do not predict their technology integration. Also, there was evidence that the school level context influenced teachers' ICT competence, which is necessary for successful technology integration.

Keywords: ICT competence, ICT pedagogical practices, technological pedagogical content knowledge (TPACK), technology integration, teacher educators.

1 Introduction

The spread of digital technologies across the world attest to the significant role that Information Communication and Technology (ICT) plays in our everyday life. Different sectors of every economy have recognized the possibilities that technology avails. In the education sector for example, ICT has the potential to reform the classroom experience towards developing students' future skill sets [1]. Nevertheless, literature shows continuous discussions surrounding the relationship between the various factors influencing users, from personal characteristics to other external factors [2,3,4]. While the process of successfully integrating ICT in the classroom remains a struggle, teachers are expected to play a prominent role [5]. Therefore, the aim of this study is to investigate the influence of the school context on teachers' technology integration. Specifically, two research questions are answered in this study:

How do the study constructs predict the teachers' technology integration?

What is the influence of the school level context on these constructs?

2 The Theoretical Model

The Technological Pedagogical Content Knowledge (TPACK) framework developed by [6] provides a theoretical basis for understanding how teachers successfully integrate technology in their classrooms. The TPACK framework follows from [7]'s model that depicts the integration of the knowledge constructs (pedagogy and content, PCK) that teachers require to teach. Accordingly, TPACK consists of the interrelationships between and among the three primary knowledge constructs that teachers require for teaching with technology: content (CK), pedagogy (PK), and technology (TK). Although the framework also takes cognizance of the context within which the teachers' knowledge constructs are situated, context is not explicated in many TPACK related studies [8]. However, some studies argue that the context within the TPACK framework is not adequately delineated nor robust [9,10]. Of the context levels enumerated in a number of studies, the support from the institution or school-level context has been highlighted as one crucial level that directly impacts the teachers' decision to use ICT in the classroom [3,8-11].

On this basis, the present study will compare the impact of school level support on teachers' technology integration. Four main constructs are considered in the hypothesized model of this study, namely: Technology integration, teachers' ICT competence, their knowledge for integrating technology and ICT pedagogical practices. These constructs, which are founded on the TPACK framework and previous studies are discussed next.

2.1 Teachers' Technology Integration (TTI)

The technology Integration of teachers is the focus of this study. Integration of technology has become necessary in the nowadays digital era and thus, in the learning environments, teachers are expected to effectively apply technology in their teaching of subjects. To understand this integration process for teachers, the TPACK framework was conceptualized [6] and has been applied in diverse studies [12].

2.2 Teachers' ICT Competence (TIC)

Teachers' ICT competence is one main factor necessary for successful integration of technology [13-15]. In addition, these studies have shown the positive and direct influence of teachers' technological knowledge (TK) on their technology integration (TPACK).

2.3 Teachers' Knowledge for Integrating Technology (TKIT)

[16] define the teachers' knowledge for technology integration as a combination of TCK and TPK, an adaptation from the TPACK model. In the same study, the teachers' knowledge for integrating technology was positively associated with the technology integration. Implying therefore, that teachers who are good at integrating technology consider themselves to be flexible and highly skilled such that they can make

sound pedagogical choices while selecting appropriate technologies that are suitable for their specific teaching subjects [17].

2.4 Teachers' ICT Pedagogical Practices (TIPP)

Computer or ICT experience (which results from practice with ICT tools) is positively associated with teachers' technology integration according to prior studies [15,18]. In other words, teacher's ICT integration practice which involve decisions on appropriate ICT tool and frequency of use, substantially influences their technology integration [17].

3 Methodology

Convenience sampling technique was used in the selection of three public colleges of education from the southern part of Nigeria. Thereafter, a mixed method was applied in the collection of data from Teacher Educators (or TEs) of various classroom subjects.

3.1 Qualitative Data

First, focused interview [19] was used to collect data qualitatively, which was analysed using open, focused and theoretical coding [20]. Altogether, there were nineteen TEs in the three focused interviews conducted (seven females and twelve males). For both school one and two, a group of six TEs were present while school three consisted of seven TEs.

3.2 Quantitative Data

A paper based self-completion survey was used to collect data from 136 teacher educators. Subsequently, a partial least square - structural equation modelling (PLS-SEM) approach [21,22] was used to develop the study's model depicting the relationships among the factors considered for TEs' technology integration. Consequently, the data analysis through the application of WarpPLS 6.0 software [23] provided results on the structural and measurement model.

The questions used to measure the items of the constructs of the study were derived from previous on teachers' technology integration studies. Measures for teachers' technology integration, teachers' ICT competence, their knowledge for integrating technology were derived from the design by [24], which used five scale Likert (from strongly disagree to strongly agree). Measures for ICT pedagogical practices were derived from the study by [25] using a four-point scale Likert ranging from never to almost always, which evaluates how often they used ICT and for which classroom tasks.

The assessment for Common method bias (CMB) [26] among the constructs of the study using the full variance inflation factors (VIF) analysis [27] showed that they ranged between 1.07 and 3.12. Consequently, the data collected is not suggestive of CMB since the VIFs are below 3.3 threshold.

4 Result

4.1 Result of Qualitative Data Analysis

In summary, the analysis of the nineteen TEs' responses show that in school one, the TEs perceived that their school was in support of their technology integration through the provision of laptops, IT support and free access to a digital library where they and their students could access relevant course information for assignment completion. In school two, the TEs complained about poor school infrastructure (e.g., no internet access) and thus, they perceived that their school did not promote technology integration. Although the school had computer laboratories, there were only a few functional computers (about 2 or 3) which could not cater for their class size. The case of school three appeared to be a mixture of the others. The TEs in school three acknowledged that previously, the school organized regular staff trainings in the use of ICT and that there were school policies in place that made such trainings a condition for obtaining job promotions. However, at the time of the interview, such traditions had waned.

4.2 Result of Quantitative Data Analysis

The Measurement Model. The reliability and validity of the constructs along with their measures are examined in the measurement model. Reliability is assessed using the Cronbach Alpha coefficient, Composite Reliability Coefficient and the ability for items to load on their theoretically assigned constructs. For reliability, values higher than 0.70 are recommended [21,22]. For validity, an indicator's loading should load more strongly on its own construct than on its cross loadings and the average variance extracted should be higher than 0.50 [22]. Table 1 shows that the model satisfied these conditions.

Table 1. Composite Reliability, Cronbach Alphas, Average Variance Extracted and Inter-construct correlations.

	CAC	CRC	AVE	TIC	TKIT	TIPP	TTI
TIC	0.817	0.868	0.525	**0.724**	0.603	0.162	0.588
TKIT	0.916	0.935	0.706	0.603	**0.840**	0.209	0.809
TIPP	0.865	0.896	0.552	0.162	0.209	**0.743**	0.257
TTI	0.880	0.926	0.806	0.588	0.809	0.257	**0.898**

Note: CAC = Cronbach Alphas Coefficient, CRC = Composite Reliability Coefficient, AVE = Average Variance Extracted. The off-diagonal elements depict the correlations among constructs while the bold fonts in the leading diagonals are the square roots of AVEs.

The Structural Model. The Goodness of Fit [28] was 0.69, which is large in terms of the effect size [29]. Figure 1, shows the result of the hypothesized model. The regression coefficients for the model are $R^2 = 0.69$ and $Q^2 = 0.69$. Two of the three exogenous variables predicted the endogenous variable in the model.

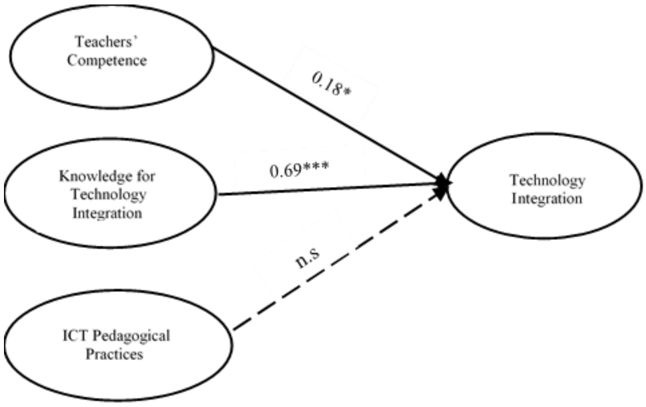

Fig. 1. The PLS-SEM Result of the Hypothesized Model.
Note: *** = significant at p < 0.001, *= significant at p<0.05, n. s= not significant

4.3 Comparing the Teachers' Technology Integration of the Schools.

A summary of the study's model for each school is presented in Table 2. Common to all three schools is that TIPP was not significantly associated with the TEs' TTI.

Table 2. Comparison of result for the schools.

School	Perceived School Support	TIC	TKIT	TIPP	TTI
1	Laptops, e-library, internet access, IT support	β=0.31; p<0.05 Effect size: 0.21	β=0.63; p<0.001 Effect size: 0.51	β=0.01; p=0.48 (n.s) Effect size: 0.004	R^2=0.72
2!	No	β=0.04; p=0.39 (n.s) Effect size: 0.017	β=0.82; p< 0.001 Effect size:0.72	β=0.11; p< 0.21 (n.s) Effect size:0.04	R^2=0.78
3	No free access to computer laboratory Waned staff ICT training	β=0.25; p<0.05 Effect size:0.17	β=0.62; p<0.001 Effect size:0.49	β=0.05; p=0.36 (n.s) Effect size:0.019	R^2=0.68

Note: β = path coefficient, p= p-value, R^2= R-squared value, n. s= not significant, 2! = reliability and validity problems identified.

In addition, a closer inspection of the school 2 model result shows the existence of reliability and validity problems. For instance, the AVE for TIC was lower than the 0.50 benchmark (0.43); the TKIT loaded more strongly on its cross loading with TTI than on itself; the VIFs for TKIT and TTI were 4.2 and 4.4 individually; One of the items measuring the TIC construct loaded poorly.

5 Discussion

This study investigates the influence of the school level context on TE's technology integration by comparing the effect sizes of the main constructs of the study. Hypothetically, the study's model was supported.

In response to the first research question, both constructs of TE's ICT competence and their knowledge for integrating technology were significantly associated with their technology integration (β=0.18, $p<0.05$; β=0.69, $p<0.001$ respectively). Support for this finding is offered in previous studies [13-16] albeit, the study by [4] shows a significant but indirect influence. Surprisingly, the construct TE's ICT pedagogical practices, was not significantly associated with their technology integration and contrary result was obtained in past research [18]. However, a possible explanation for the observed non-significant relationship is that, the sample consisted majorly of older TEs who are above 40 years of age and 66% having over ten years teaching experience which implies they may be less confident at determining effective ICT pedagogical practices. [4,14-16] highlight similar teacher characteristics as factors both directly and indirectly influencing teachers' technology integration.

In relation to the second research question, the result shows considerable difference between the schools. School two, shows that the TEs' competence did not predict their technology integration unlike the other schools. This result suggests that the lack of school support triggers a non-significant relationship with TE's ICT competence. Past research offers credence to the fact that school support influences TEs ICT competence, readiness and their technology integration practice [1-4, 9-11].

5.1 Limitations and future research

The generalization of the result should be made with caution as the study sample consisted of TEs of three schools situated in the southern part of Nigeria. Future research can consider impact of school support within private schools, other levels of education (e.g., universities) or system level support on teachers' technology integration. In addition, ICT pedagogical practices that are considered effective such that they actually predict the technology integration of teachers can be examined more thoroughly.

5.2 Conclusion

As developments in ICT continue to positively influence learning environments, much is expected from teachers in advancing technology integration. Using a mixed method, this paper showed that considerable difference exists on TEs' technology integration when their perception of school support is compared. Theoretically, the model of the study was proven useful, as such, the study adds to the literature on technology integration of TEs and the school level influence. The TPACK framework provided to a large extent the basis for this study. Practically, the study showed the need for TEs to align their ICT pedagogical practices to their technology integration. To fill this gap, professional development for teachers can be designed as previous studies have reiterated [4,11].

References

1. Fraillon, J., Ainley, J., Schulz, W., Friedman, T., & Gebhardt, E. (2014). *Preparing for life in a digital age. The IEA International Computer and Information Literacy Study.* International Report. SpringerOpen.
2. Ertmer, P. A. (1999). Addressing first- and second-order barriers to change: Strategies for technology integration. *Educational Technology Research and Development*, 47(7), 47–61.
3. Drent, M., & Meelissen, M. (2008). Which factors obstruct or stimulate teacher educators to use ICT innovatively? *Computers & Education*, 51, 187–199.
4. Inan, F. A., & Lowther, D. L. (2010). Factors affecting technology integration in K-12 classrooms: A path model. *Educational Technology Research and Development, 58*(2), 137–154.
5. Solheim, K., Ertesvåg, S. K., & Dalhaug Berg, G. (2018). How teachers can improve their classroom interaction with students: New findings from teachers themselves, *Journal of Educational Change*, 19(4), 511-538. doi: 10.1007/s10833-018-9333-4.
6. Koehler, M. J., & Mishra, P. (2006). Technological Pedagogical Content Knowledge: A framework for teacher knowledge. *Teachers College Record, 108*(6), 1017–1054.
7. Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform, *Harvard Educational Review*, 57(1), 1-22.
8. Rosenberg, J. M., & Koehler, M. J. (2015). Context and technological pedagogical content knowledge (TPACK): A systematic review, *Journal of Research on Technology in Education*, 47(3), 186-210, doi: 10.1080/15391523.2015.1052663.
9. Porras-Hernández, L. H., & Salinas-Amescua, B. (2013). Strengthening TPACK: A broader notion of context and the use of teacher's narratives to reveal knowledge construction, *Journal of Educational Computing Research*, 48(2), 223-244.
10. 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.
11. Buabeng-Andoh, C. (2012). Factors influencing teachers' adoption and integration of information and communication technology into teaching: A review of the literature. *International Journal of Education and Development using ICT*, *8*(1).
12. Phillips, M.(2017). Processes of practice and identity shaping teachers' TPACK enactment in a community of practice, *Education and Information Technologies*, 22(4),1771-1796
13. Koh, J. H. L, Chai, C. S., & Tsai, C.C. (2013). Examining practicing teachers' perceptions of technological pedagogical content knowledge (TPACK) pathways: a structural equation modeling approach. *Instructional Science, 41*(4), 793–809.
14. Nelson, M. J., Voithofer, R., & Cheng, S.-H. (2019). Mediating factors that influence the technology integration practices of teacher educators. *Computers & Education, 128*, 330-344.

15. Buabeng-Andoh, C. (2012). An Exploration of Teachers' Skills, Perceptions and Practices of ICT in Teaching and Learning in the Ghanaian Second-Cycle Schools. *Contemporary Educational Technology, 3*(1), 36–49.
16. Taimalu, M., & Luik, P. (2019). The impact of beliefs and knowledge on the integration of technology among teacher educators: A path analysis. *Teaching and Teacher Education, 79*, 101–110. https://doi.org/10.1016/j.tate.2018.12.012.
17. Chai, C. S., Koh, J. H. L., Tsai, C.-C., & Tan, L. L. W. (2011). Modeling primary school pre-service teachers' Technological Pedagogical Content Knowledge (TPACK) for meaningful learning with information and communication technology (ICT). *Computers & Education, 57*(1), 1184–1193. https://doi.org/10.1016/j.compedu.2011.01.007.
18. Chuang, H.-H., Weng, C.-Y., & Huang, F.-C. (2015). A structure equation model among factors of teachers' technology integration practice and their TPCK. *Computers & Education, 86*, 182-191. https://doi.org/10.1016/j.compedu.2015.03.016.
19. Bryman, A., Bell, E, Mills, A.J., & Yue, A.R. (2011). *Business Research Methods*. (1st ed.) Toronto: Oxford University Press.
20. Thornberg, R., & Charmaz, K. (2013). Grounded Theory and Theoretical Coding. In Flick, U. *The SAGE Handbook of Qualitative Data Analysis* (153-169).
21. Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). Pls-sem: Indeed a silver bullet. *Journal of Marketing Theory and Practice*, 19(2),139–152.
22. Lowry, P. B., & Gaskin, J. (2014). Partial least squares (pls) structural equation modeling (sem) for building and testing behavioral causal theory: When to choose it and how to use it. *IEEE transactions on professional communication*, 57(2),123–146.
23. Kock, N. (2017). Warppls user manual: Version 6.0. *ScriptWarp Systems: Laredo*, TX, USA.
24. Schmidt, D. A., Baran, E., Thompson, A. D., Mishra, P., Koehler, M. J., & Shin, T. S. (2009). Technological pedagogical content knowledge (tpack) the development and validation of an assessment instrument for preservice teachers. *Journal of research on Technology in Education*, 42, 123–149.
25. Kenttälä, V., Kankaanranta, M., & Neittaanmäki, P. (2017). Tieto-ja viestintätekniikka Keski-Suomen peruskouluissa vuonna 2016. *Informaatioteknologian tiedekunnan julkaisuja/Jyväskylän yliopisto*, (2017, 34).
26. Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of applied psychology*, 88(5),879.
27. Kock, N. (2015). Common method bias in pls-sem: A full collinearity assessment approach. *International Journal of e-Collaboration* (IJeC), 11(4),1–10.
28. Tenenhaus, M., Vinzi, V. E., Chatelin, Y.-M., & Lauro, C. (2005). PLS path modeling. *Computational statistics & data analysis*, 48(1),159–205.
29. Akter, S., D'Ambra, J., & Ray, P. (2011). An evaluation of pls based complex models: the roles of power analysis, predictive relevance and gof index. *Proceedings of the 17th Americas Conference on Information Systems (AMCIS2011)* (pp. 1-7). Detroit, USA: Association for Information Systems.