Teachers Cloud-based Content Creation in light of the TPACK Framework: Implications for Teacher Education

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With the advent ubiquitous computing, cloud-based content creation is becoming more popular and readily accessible. In Malaysia the government equipped 10,000 public primary and secondary schools with 4G Internet connectivity and a cloud-based learning environment called the Frog VLE. This study investigated the alignment and compatibility the TPACK framework to teachers' learning designs. A rubric was developed, based on the TPACK framework, and after feedback from an expert panel, 152 cloud-based sites were analysed. Results show that most areas were somewhat aligned with the TPACK framework while three areas were fully aligned and one area was minimally aligned. The fully aligned areas were use of links, design navigation flow and design functionality. The minimally aligned area was interactivity. This research finding can potentially inform teacher education as if specifically taught this can empower teachers when creating cloud-based content.

Keywords: learning design, TPACK, teacher education, cloud-based content

Introduction

With Internet speeds and access increasing cloud-based computing is becoming more common. Cloud-based computing is an "expandable, on demand service and tools that are served to the user via the Internet from specialised data centres" (Johnson, Adams Becker, Estrada & Freeman, 2014, p. 36). This study focused on cloud-based content created by Malaysian teachers as part of the 1BestariNet project which has equipped over 10,000 primary and secondary government schools with 4G Internet connectivity and a cloud-based learning environment called Frog VLE. By investigating the alignment and compatibility of the TPACK framework to teachers' learning designs it becomes possible to then give some insight of cloud-based content creation to pre-service teachers. This paper will shed light on these implications for teacher education. The research question developed was to what extent are cloud-created learning designs produced by teachers' compatible with the TPACK framework? This paper further discusses the implications of cloud-based learning design for teacher education.

Literature Review

As we know, TPACK is an increasingly common way of representing what teachers know about various technologies and how it applies to their teaching (Koehler & Mishra, 2005) while learning designs refer to a variety of ways that student learning experiences can be designed, generally using different digital technologies. Specifically, learning design is described as a 'framework' to make explicit the conceptual and practical underpinnings of "a sequence of educational activities" in an online environment (Dalziel, 2008). Oliver (1999) suggests that a learning design comprises of three key elements which are the tasks the learner is required to complete, the resources that support the learners to complete the task and the support mechanisms that exist from the teacher implementing the lesson. Digital technologies and in particular cloud-based learning resources have been evaluated from several perspectives (ie. Dinh et al., 2013). For the purpose of this research, following items, which are in accordance with TPACK and the Learning Design framework, have been selected to investigate the alignment of cloud-based learning resources.

One item is the learning outcome and according to Hernández, Gütl, and Amado-Salvatierra (2014), the learning outcome of designed cloud-based learning resources should be clearly specified. Additionally, the instruction and guideline on how learners should interact with content should be clearly provided (Mikroyannidis, 2012). Several studies in the field of online and cloud-based learning have highlighted the importance of including interactive activities to give learners a chance to provide input and modify the information (i.e. Masud & Huang, 2012; McGee & Reis, 2012). The logical

alignment of such activities with the learning outcomes is significant in learning design (Oliver, Harper, Wills, Agostinho, & Hedberg, 2007). Similarly, learning tools should potentially stimulate a high level of learner engagement. These learning tools could include learning games, feedback and reflection tools (Lin, Wen, Jou, & Wu, 2014), or quizzes (Gusev & Armenski, 2014). Use of such interactive and engaging learning material should provide a balance between the use of multimodal materials and tools to accommodate multiple learning preferences (Chang, Chen, & Hsu, 2012).

In the process of design, available tools and media in any digital learning system should suit content and learners' needs (Thomas, 2011). As highlighted by Kop and Carrol (2011), in using additional links, the relevancy of the resources is at the most importance while all links remain functional. The visual design and consistency of the provided content is another important aspect highlighted by Sánchez-Franco et al. (2013). Finally, the navigation flow and transition between all components of designed resource shall remain clear and logical (Boyatt & Sinclair, 2012). A combined perspective of all of these items to view cloud-based designs in virtual learning environments provides good boundaries of potential guidelines for teachers to create digital content in light of the TPACK framework.

Methodology and Results

A rubric consisting of ten items was used to evaluate 152 cloud-based learning designs (CBLD) that were created by teachers in a virtual learning environment (VLE). Prior to the rubric being used it was evaluated by an expert panel and then changes were implemented (Campbell, Al Harthi & Karimi, 2015). Initial rubric reliability was measured through the internal consistency using Cronbach's alpha coefficient, which was .74, indicating an acceptable reliability (George & Mallery, 2003). After taking comments on board and further discussion the rubric was changed from 12 items to 10 items and two raters were employed to evaluate the 152 learning designs. Rubric items included:

1. Purpose and Objectives
2. Instructions and Guidelines
3. Interactivity
4. Engagement
5. Learning styles
6. Tools and Media
7. Links
8. Visual Consistency
9. Navigation Flow
10. Functionality

To test the research question on the level of alignment of the learning designs with the TPACK framework, the following criteria was used:

Table 1: Criteria for Rubric Scores Interpretation

6. Score Categories	7. Interpretation of Scores
8. 1-1.75	9. Not aligned
10. 1.76-2.5	11. Minimally aligned
12. 2.6-3.25	13. Somewhat aligned
14. 3.26-4	15. Fully aligned

Based on these criteria, Table 2 shows that only three rubric items were found to be fully aligned with the TPACK framework across the 152 sites. These are the use of links, design navigation flow and design functionality. Only one rubric item was found to be minimally aligned with TPACK framework, which is the use of interactivity in the learning designs. The rest of the rubric items were found to be somewhat aligned with the TPACK framework. This was determined by the raters who both scored each site which determined the final score of whether overall the sites were aligned with TPACK and how much.

Table 2: Rubric Item Alignment with the TPACK framework

16. Rubric Item	17. Mean	18. Std.	19. How aligned are the

		Deviation	CBLD?
1. Learning Outcomes	20. 2.632	21. 1.3747	22. Somewhat aligned
2. Instructions & Guidelines	23. 2.704	24. 1.1384	25. Somewhat aligned
3. Interactivity	26. 2.309	27. 1.2247	28. Minimally aligned
4. Engagement	29. 2.803	30. .9281	31. Somewhat aligned
5. Learning Preferences	32. 3.079	33. .7850	34. Somewhat aligned
6. Tools & Media	35. 2.941	36. 1.1053	37. Somewhat aligned
7. Links	38. 3.355	39. 1.1983	40. Fully aligned
8. Visual Consistency	41. 3.184	42. .8721	43. Somewhat aligned
9. Navigation Flow	44. 3.855	45. .5801	46. Fully aligned
10.Functionality	47. 3.730	48. .5635	49. Fully aligned

To follow up with the previous analysis, a one sample *t* test was used. Test results showed that the difference in rubric item rating between the current sample of learning designs and the theoretical mean (2.5) were statistically significant for all rubric items, except learning outcome and interactivity at .05 significance level.

Table 1: Descriptive Statistics and Results for a One Sample *t* Test

50. Rubric Item	*51. t*	52. df	53. Sig. (2-tailed)	54. Mean Difference	55. 95% Confidence Interval of the Difference	
					56. Lower	57. Upper
1. Learning Outcomes	58. 1.180	59. 151	60. .240	61. .1316	62. -.089	63. .352
2. Instructions & Guidelines	64. 2.209	65. 151	66. .029	67. .2039	68. .022	69. .386
3. Interactivity	70. -1.921	71. 151	72. .057	73. -.1908	74. -.387	75. .005
4. Engagement	76. 4.020	77. 151	78. .000	79. .3026	80. .154	81. .451
5. Learning Preferences	82. 9.093	83. 151	84. .000	85. .5789	86. .453	87. .705
6. Tools & Media	88. 4.917	89. 151	90. .000	91. .4408	92. .264	93. .618
7. Links	94. 8.800	95. 151	96. .000	97. .8553	98. .663	99. 1.047
8. Visual Consistency	100. 9.673	101. 151	102. .000	103. .6842	104. .544	105. .824
9. Navigation Flow	106. 28.803	107. 151	108. .000	109. 1.3553	110. 1.262	111. 1.448
10.Functionality	112. 26.919	113. 151	114. .000	115. 1.2303	116. 1.140	117. 1.321

N=152; Test Value = 2.5

Discussion and Conclusion

From the results there are three areas that are fully aligned with TPACK. These are the use of links, the design of the navigation flow and the functionality design. As suggested in the literature review these are all important areas in site design and possibly most time and effort went into the design of these areas. Generally, from the 152 sties investigated the rest of the rubric items are somewhat aligned with TPACK. While the use of interactivity in the sites was minimally alighted with the TPACK framework. From the T-Test results neither the learning outcomes nor interactivity were statistically significant. This may mean that the teachers did not have enough knowledge and skills to design these areas well enough in the cloud-based environment.

Interactivity is one area where the sites are minimally alighted. This is an area where some sites benefit from learning design and time in creation, while for other sites it may not be needed. Possibility teachers need to think about this in more detail to ensure the optimal amount of interactivity is used in the site and then its relationship to TPACK may be increased.

Implications for pre-service teachers

This study highlights several important factors for teacher education students. These include that some areas of cloud-based learning design that are easier to relate to TPACK and some are more difficult. Those that are easier to relate to the TPACK framework include the use of links, navigation flow and functionality of the sites. More importantly when creating cloud-based learning design teacher education students should work on learning outcomes, instructions and guidelines, engagement, learning preferences as well as tools and media and visual consistency. Teacher education students may benefit from great understanding of interactivity when creating cloud-based learning designs. Thus, in teacher education, interactivity of cloud-based learning designs would benefit from a greater focus in teacher education programs. The other area is in learning outcomes as although somewhat aligned in this study to TPACK the area was not statistically significant. In conclusion, implications from this small-scale analysis suggest that teacher education programs need to reconceptualise design components in new ways that are more compatible with the virtual cloud environment.

References

Dalziel, J. (2008). Learning Design: Sharing pedagogical know-how. In T. Iiyoshi & M. S. V. Kumar (Eds.), *Opening up education: The collective advancement of education through open technology, open content, and open knowledge.* (pp. 375 - 387). Cambridge, Mass: MIT Press.

Campbell, C., Al Harthi, A. & Karimi, A. (2015). Evaluation of the Learning Designs of Cloud-based Content using the TPACK Framework. In S. Carliner, C. Fulford & N. Ostashewski (Eds.), *Proceedings of EdMedia: World Conference on Educational Media and Technology 2015* (pp. 302-309). Association for the Advancement of Computing in Education (AACE).

Boyatt, R., & Sinclair, J. (2012). Navigating the educational cloud. In*Workshop on Learning Technology for Education in Cloud (LTEC'12)* (pp. 179-191). Springer Berlin Heidelberg.

Chang, C. S., Chen, T. S., & Hsu, H. L. (2012). The Implications of Learning Cloud for Education: From the Perspectives of Learners. In *Wireless, Mobile and Ubiquitous Technology in Education (WMUTE), 2012 IEEE Seventh International Conference on* (pp. 157-161). IEEE.

Conole, G. (2010). *Learning design - Making practice explicit*. Paper presented at the ConnectEd 2010: 2nd International conference on Design Education, Sydney, Australia. http://cloudworks.ac.uk/cloud/view/4001

Dalziel, J. (2008). Learning Design: Sharing pedagogical know-how. In T. Iiyoshi & M. S. V. Kumar (Eds.), *Opening up education: The collective advancement of education through open technology, open content, and open knowledge.* (pp. 375 - 387). Cambridge, Mass: MIT Press.

Dinh, H. T., Lee, C., Niyato, D., & Wang, P. (2013). A survey of mobile cloud computing: architecture, applications, and approaches. *Wireless communications and mobile computing*, *13*(18), 1587-1611. https://doi.org/10.1002/wcm.1203

George, D., & Mallery, P. (2003). *SPSS for Windows step by step: A simple guide and reference*. 11.0 update (4th ed.). Boston: Allyn & Bacon.

Gusev, M., & Armenski, G. (2014). E-Assessment Systems and Online Learning with Adaptive Testing. In *E-Learning Paradigms and Applications* (pp. 229-249). Springer Berlin Heidelberg.

Hernández, R., Gütl, C., & Amado-Salvatierra, H. R. (2014). Cloud learning activities orchestration for MOOC environments. In *Learning Technology for Education in Cloud. MOOC and Big Data* (pp. 25-36). Springer International Publishing. https://doi.org/10.1007/978-3-319-10671-7_3

Johnson, L., Adams Becker, S., Estrada, V., and Freeman, A. (2014). *NMC Horizon Report: 2014 K-12 Edition.* Austin, Texas: The New Media Consortium.

Koehler, M. J., & Mishra, P. (2005). What happens when teachers design educational technology? The development of technological pedagogical content knowledge. *Journal of Educational Computing Research, 32*(2), 131-152. https://doi.org/10.2190/0EW7-01WB-BKHL-QDYV

Kop, R., & Carroll, F. (2011). Cloud computing and creativity: Learning on a massive open online course. *European Journal of Open, Distance and E-Learning*.

Lin, Y. T., Wen, M. L., Jou, M., & Wu, D. W. (2014). A cloud-based learning environment for developing student reflection abilities. *Computers in Human Behavior*, *32*, 244-252. https://doi.org/10.1016/j.chb.2013.12.014

Masud, M. A. H., & Huang, X. (2012). An e-learning system architecture based on cloud computing. S*ystem*, *10*(11).

CP:50

McGee, P., & Reis, A. (2012). Blended Course Design: A Synthesis of Best Practices. *Journal of Asynchronous Learning Networks*, *16*(4), 7-22.
Mikroyannidis, A. (2012). A semantic framework for cloud learning environments. *Cloud Computing for Teaching and Learning: Strategies for Design and Implementation*, 17-31.
Oliver, R. (1999). Exploring strategies for on-line teaching and learning. *Distance Education, 20*(2), 240 - 254.
Oliver, R., Harper, B., Wills, S., Agostinho, S., & Hedberg, J. (2007). Describing ICT-based learning designs that promote quality learning outcomes. *Rethinking pedagogy for a digital age: Designing and delivering elearning*, 64-80.
Sánchez-Franco, M. J., Villarejo-Ramos, Á. F., Peral-Peral, B., Buitrago-Esquinas, E. M., & Roldán, J. L. (2013). Users' Perception of Visual Design and the Usefulness of a Web-based Educational Tool. *Procedia-Social and Behavioral Sciences*, *93*, 1916-1921.
Thomas, P. Y. (2011). Cloud computing: A potential paradigm for practising the scholarship of teaching and learning. *The Electronic Library*, *29*(2), 214-224.
Wang, W. Y. C., Rashid, A., & Chuang, H. (2011). Toward the trend of cloud computing. *Journal of Electronic Commerce Research, 12*(4), 238-242.

Campbell, C., Al-Harthi, A., & Karimi, A. (2015). Teachers Cloud-based Content Creation in light of the TPACK Framework: Implications for Teacher Education. In T. Reiners, B.R. von Konsky, D. Gibson, V. Chang, L. Irving, & K. Clarke (Eds.), *Globally connected, digitally enabled*. Proceedings ascilite 2015 in Perth (pp. 399-403). https://doi.org/10.14742/apubs.2015.948