

Co-Designing Multimodal Pedagogical Content Knowledge with Indonesian Teachers

Hyo-Jeong SO^{a*}, Ching Sing CHAI^b, Nur Arifah DRAJATI^c, Uma NATARAJAN^d, Hyeran LEE^a & Yue WANG^a

^a*Department of Educational Technology, Ewha Womans University, Korea*

^b*Department of Curriculum and Instruction, The Chinese University of Hong Kong, Hong Kong*

^c*Faculty of Teacher Training and Education, Universitas Sebelas Maret, Indonesia*

^d*meriSTEM Centre, National Institute of Education, Singapore*

*hyojeongso@ewha.ac.kr

Abstract: The purpose of this study was to engage Indonesian English teachers in designing lessons for multimodal learning. Given that technological pedagogical content knowledge (TPACK) is the emerging framework that accounts for teachers' professional expertise, this study attempts to address how to support the teachers to develop TPACK through the learning by design approach. In this study, 36 Indonesian high school English teachers participated in the teacher professional development (TPD) workshop, and 28 of them completed the pre-and-post surveys that measured teachers' perceived efficacy to apply TPACK for multimodal literacy. Paired-sample t-tests revealed that all seven factors changed significantly after the workshop, indicating the positive efficacy of TPD. Overall, our findings show that when TPD is designed with the co-design principles and relevant scaffolds, it can be effective for raising teachers' competency in designing technology-integrated lessons and producing positive changes in teachers' efficacy.

Keywords: TPACK, multimodal literacy, teacher professional development

1. Introduction

In the digital world, the conception of literacy has undergone fundamental changes and reviews. Literacy as one's ability to read and write, has been broadened with the ease of producing and sharing digital media and artefacts. Given the current advances in digital technology and media, students now have access to multiple modes of communicative resources, such as video, audio, images and even hybrid forms (e.g., blogs, wikis, social media), in daily life. From pedagogical perspectives, such multiple communication sources offer both opportunities and challenges. Multimodal literacy, which is the combined use of multiple communication modes, offers rich opportunities for learners to better construct and deconstruct the meaning of messages. Advocates of multimodality in education argue that it provides learners with more situated and relevant contexts for meaning-making (Kress, 2003). On the other hand, it is also challenging for learners to understand and interpret how the different modes are subtly shaping messages. Further, multimodal literacy has challenged the traditional notion of language teaching, which mainly focuses on the acquisition of linguistic knowledge and communicative skills. The multimodal approach requires substantial design efforts from teachers to re-contextualize language learning in a media-rich world.

Given that technological pedagogical content knowledge (TPACK) is the emerging framework that accounts for teachers' professional expertise (Chai, Koh & Teo, 2018), and that multimodal communication is a desirable capacity for the 21st century school and workplace (Jenkins, 2006) with potential to enhance students' language literacy, this study attempts to engage language teachers in designing lessons for multimodal learning. This study was the first part of a 6-month long professional development process where the instructors (the first and second authors) conducted a workshop for Indonesian teachers. The aim was to equip the participants with basic knowledge and experiential understanding of multimodal meaning-making and the iterative design processes that would allow them to continue the journey when they leave the workshop.

To achieve such aims within two days, a set of design principles based on the past research on TPACK and teacher professional development (TPD) was adopted. A study conducted in Indonesia indicates that while the Indonesian teachers have positive beliefs about the importance of using technology for pedagogical innovation, they do not possess strong efficacies in designing technology-integrated learning environments (Drajati, Tan, Haryati, Rochsantiningsih, & Zainnuri, 2018). Therefore, the specific design features of the workshop included epistemic and cognitive scaffolds that could help the participants improve their beliefs and efficacy to design technology-integrated lessons based on the principles of multimodal literacy. In this paper, the effects of the TPD workshop on teachers' knowledge and skills are presented in self-reported forms of surveys and interviews. The implications of co-designing pedagogical innovations as well as directions for future research are discussed.

2. Theoretical Framework

2.1 Multimodal Literacy in Education

With the digital turn, the range of technologies available for communication has grown rapidly (Mills, 2010). The emergence of various digital media calls for reconceptualization of the meaning of literacy, which has been broadened with the proliferation of multimodal texts. More than two decades ago, the New London Group (1996) published the seminal work on multiliteracy, which foregrounded the changing nature of literacy, and the profound affordances of multiple modes of communication and texts. In essence, multimodal literacy refers to the combination of multiple semiotic modes. Here, a mode is "a socially and culturally shaped resource for meaning making" (Bezemer & Kress, 2008, p.171), and a mode of meaning includes diverse representations such as visual (still and moving), audio, gestural, and spatial, other than linguistics. Multimodal literacy engages students to create multimodal texts that ensemble different modes. Multimodal literacy, however, is not merely combining different modes, but to understand similarities and differences underlying each mode. Ajayi (2009) reported the study of engaging ESL (English as Second Language) students from diverse cultural and language backgrounds to encode and decode multimodal texts and its positive impact on students' critical thinking skills.

2.2 Teacher Learning in Professional Development

Teacher learning is a developmental trajectory spanning from initial teacher education and induction to in-service training and continuous professional development. In-service teachers enter professional development programs with certain beliefs and ideas with regards to what teaching and learning is about, built on their lived experiences. One of success factors in teacher professional development is to recognize such rich existing experiences and tacit knowledge as valuable assets. The existing body of literature highlights some core features that makes TPD effective. For instance, Garet et al. (2009) argue that teachers' knowledge and skills can be enhanced when TPD is designed to focus on content knowledge, active learning (e.g., hands-on work), and coherence. Under reform initiatives, the design of TPD programs needs to consider teachers' readiness for changes, especially when promoting unfamiliar pedagogical approaches (Twining, Raffaghelli, Albion, & Knezek, 2013).

While numerous efforts toward TPD exist, the research still points to the problem of teachers lacking content-specific teaching skills. This becomes even more problematic and complex when teachers are required to integrate new types of technologies and pedagogical approaches that create tensions with their habitus, or set of disposition (Belland, 2009). In particular, with the paradigm shift toward learner-centered pedagogy, teachers are increasingly seen as designers of learning environments, and designing for pedagogical innovation has become an important competency required for teachers (Laurillard, 2013). Despite such a paradigm shift, how to scaffold teachers' developmental trajectory to become designers of learning environments is less understood. The notion of teachers as designers also carries implications to multimodal literacy in education. In a digital age where new media become rich sources for literacy and communication, teachers' role is shifting from s a mere actor of implementing

prescribed curricular to a designer of new learning experiences encompassing multimodal learning activities (Kalantzis & Cope, 2010).

2.3 TPACK and Teacher Professional Development

In this study, we adopted TPACK as an overarching framework to scaffold teacher learning about multimodal literacy. TPACK is a theory designed to account for teachers' ability to integrate technology into the curriculum (Mishra & Koehler, 2006). TPACK includes the technological knowledge (TK), pedagogical knowledge (PK) and content knowledge (CK) and the interaction of these knowledge, which include technological pedagogical knowledge (TPK), technological content knowledge (TCK) and pedagogical content knowledge (PCK). Koh, Chai, Wong and Hong (2015) postulate that teachers need to activate the various forms of TPACK to bear on the classroom pedagogical needs to design feasible lesson ideas.

To identify the relevant literature that attempted to teach in-service teachers about multimodal literacy, we used the keywords such as "multimodal", "language learning" and "teacher professional development" in the Scopus database. The search only surfaced 9 studies. Closer examination, however, revealed that none of the studies focused on developing teacher's capacities to design language learning lessons that employ multimodality as learning resources or multimodality as means for students' production of digital artefacts. Two studies that provide some relevant information for this study were conducted by Draijati et al. (2018) and Bruce and Chiu (2015). Draijati et al. (2018) surveyed Indonesian pre- and in-service English language teachers about their understanding of multimodal literacy and TPACK and concluded that both ideas were new to the teachers. Bruce and Chiu (2015) surveyed 240 America English language arts teachers who had completed at least one digital videos project with an open-ended questionnaire. The findings indicate that the teachers welcomed the learning experiences and appreciated the pedagogical affordances of digital videos. In sum, both studies seem to indicate that language teachers are keen to undertake multimodal teaching and learning.

However, without adequate design from teacher educators to enrich teachers' understanding of multimodality and TPACK, teachers may not be able to develop sufficient knowledge and skills to undertake such complex changes in teaching practices. Lee and Kim (2017) attempted to support preservice teachers in developing technology integration using the TPACK framework. Their study reveals that there were several gaps in the teachers' competencies. Their first design surfaced the preservice teachers' lack of pedagogical knowledge and their second design surfaced the problem that the actual teaching practice of their pre-service teachers continued to be teacher-centered. It took three iterative design cycles before they could achieve their pedagogical aims.

Learning by Design (LBD) has been suggested as an effective method to help teachers gain situated understanding about the complexity of technology-integrated lesson design (Koehler & Mishra, 2005). Kolodner et al. (1998) define LBD as "students encountering a design challenge and attempting a solution using only prior knowledge - individually and/or in small groups" (p.16). Similarly in TPD, the LBD approach structures teachers to work collaboratively to solve pedagogical problems through authentic design tasks. Koehler and Mishra (2005) argue that the LBD approach is effective for enhancing teachers' TPACK since the approach engages teachers to make the intricate connection among content, pedagogy and technology in every stage of design. LBD has also been applied as a pedagogy of multiliteracies. Cope and Kalantzis (2016) reported the LBD project as a reflexive pedagogy in multiliteracies with the knowledge processes including experiencing, conceptualizing, analyzing and applying. They argue that LBD is a relevant pedagogy in multiliteracies since it provide teachers with opportunities to reflect on how to achieve transformative learning for diverse students.

2.4 Research Purpose and Questions

TPACK emerges through the explicit and intentional connection among content, pedagogy and technology. Despite more than a decade of TPACK research, however, little is understood of how TPACK emerges and become solid contextualized knowledge. Whether TPACK is a new form of teacher knowledge or an integration of different knowledge types is a debatable issue. What is clear is the role of technology, which is not to merely support or extend but to transform existing practices for pedagogical innovations (Twining et al., 2013).

This study aims to address how to support teachers to develop TPACK through the LBD approach. The bulk of the time in the proposed workshop, hence, was devoted to closely work with the teachers to scaffold their design thinking process. The design of the workshop included specific scaffolding strategies in the learning-by-design approach. In view of the research gaps identified, this study examines the following research questions concerning TPACK and TPD.

- a) How do teachers' efficacy and beliefs about multimodal TPACK change after the workshop?
- b) How do the teachers perceive the impact of the TPD activities?

3. Method

3.1 Research Context and Participants

Thirty-six Indonesian high school English teachers participated in the TPD workshop for improving teaching with TPACK for multimodal literacy. The workshop was held in the Surakarta region for two days in May 2018, as the first part of a 6-month long professional development process. Twenty-eight teachers (24 female and 4 male) completed the pre-and-post workshop surveys that measured teachers' perceived efficacy to apply TPACK for multimodal literacy. Half of the participants was over 41 years old (46%), followed by 9 teachers who were below 30 years old, and 6 teachers in their 30's. The average of teaching experiences was 13.7 years. Overall, the majority of the participants can be described as experienced teachers in their 30s-40s with more than 10 years of teaching experiences. All participants joined the Facebook group that was created to facilitate the workshop activities such as resource sharing, presentations, peer feedback, and reflection.

3.2 Design Principles in Teacher Professional Development

Table 1 presents the core design principles underlying the workshop. Employing TPACK as an overarching framework coupled with the design principles of learning-by-design, the researchers activated relevant knowledge that the teachers have about curricula, school contexts and students. Such a co-design approach ensures that a relevant set of TPACK is foregrounded as epistemic resources to contextualize teachers' design (Koh et al., 2015).

Table 1

Design of the Teacher Professional Development

TPD Activities	Duration	Design Principles
Lecture <ul style="list-style-type: none"> • Multimodality & TPACK • Gamification & Social Media 	2 hours	<ul style="list-style-type: none"> • Knowledge inputs to address knowledge gaps (Sweller, 1994) • TPACK design framework to establish a shared framework for design (Chai et al. 2018) • With knowledge gaps and design framework addressed, cognitive overload during design process and activation of relevant knowledge for design can be achieved
Hands-on activities <ul style="list-style-type: none"> • Google site development • Mobile apps for language learning 	1 hour	<ul style="list-style-type: none"> • Just-in-time learning of technological tools to build technological knowledge (TK)
Group-based design	7 hours	<ul style="list-style-type: none"> • Learning-by-design (Mishra & Koehler, 2006) • Supporting reflective practices through scaffolding by worked examples and in-situ instructor scaffolding (Schön, 1987)

		<ul style="list-style-type: none"> Co-design with distributed expertise where both teachers' CK and researchers' TK and TPK are synthesized and transformed into TPACK (Koh, Chai & Lim, 2017).
Peer critique and refinement of lessons	4 hours	<ul style="list-style-type: none"> Iterative co-design (Koh et al., 2017)

The bulk of TPD was then devoted to co-design a web-based learning environment in the Google Site platform (see Figure 1) in small groups (5-6 members) with researchers' in-situ scaffolding and worked examples as another form of scaffolding. Learning how to design is essentially a process of being a cognitive apprentice and engaging in reflective practices (Schön, 1983; 1987). From the perspective of cognitive load (Pass, Renkl & Sweller, 2003), working examples and distributed expertise (i.e., working in teams) are both likely to assist in reducing the complexity of learning to design language learning lessons with multimodal expressions.

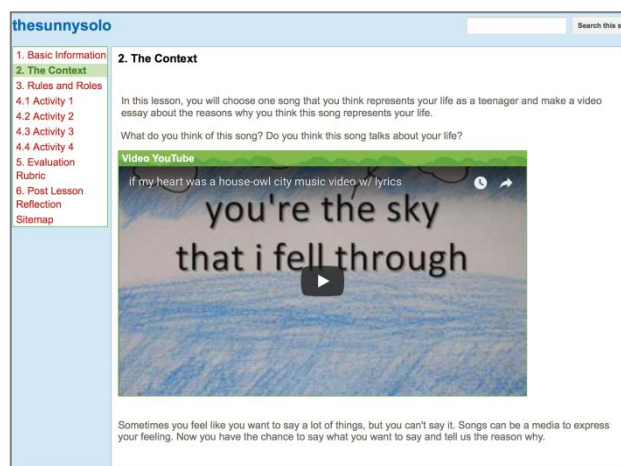


Figure 1. Example of a Google Site lesson created by the participant

In this study, we view a lesson design as a form of concretized TPACK that embodies teachers' integration of content, pedagogy, and technology, coupled with other contingent considerations such as student characteristics and classroom environments. TPACK is a form of contextualized knowledge creation as each lesson is designed for a specific class with unique and collective characteristics of diverse learners. The current TPACK research is moving towards the direction of creating lessons for specific technology, pedagogy and content areas (Chai, Koh, & Tsai, 2016). For the present study, the specific content knowledge (CK) lies in social semiotics (theory of meaning making), and multimodal media with the gamified approach as technological knowledge (TK) and technological pedagogical knowledge (TPK).

3.3 Data Collection and Analysis

To investigate teachers' perceived efficacy of TPACK for multimodal literacy, we administered the survey instrument with 40 items that were adapted from the existing instrument developed and validated by one of the authors for the purpose of this study. Table 2 shows seven factors measured in the survey with sample items and Cronbach's α values. Reflecting this study's focus on multimodal literacy, the factor 'Content Knowledge (CK)' was designed to measure teacher knowledge of social semiotics (theory of meaning making) whereas 'Pedagogical Knowledge (PK)' refers to knowledge of supporting 21st century learning dimensions (e.g., collaborative learning, self-directed learning). Items under 'Technological Knowledge' (TK) were designed to measure knowledge about digital media tools. Other factors such as TPK, TCK, and TPACK were created to measure the intersection of content, pedagogy and technological knowledge. Pedagogical Content Knowledge (PCK) was not measured since the workshop focused on the integrations of technology, and PCK does not include a technological dimension of knowledge. Instead, we included the factor 'Beliefs about the new culture of learning' to measure epistemic beliefs that teachers hold about the changing nature of teaching and

learning. The items were measured on a 7-point Likert scale (1 = strongly disagree, 7 = strongly agree). The reliability measures of each factor in Cronbach's α were in an acceptable range (all above .90). Survey data was analyzed using the SPSS, and the corresponding paired-sample t-tests were conducted to investigate statistically significant differences between the pre- and post-workshop responses.

Table 2

Factors and sample items

Factor	Number of items	Sample items	Cronbach's α
Content Knowledge (CK)	6	I have sufficient knowledge about how semiotic modes (e.g., linguistic, audio, visual, gestural and spatial) work.	.97
Pedagogical Knowledge (PK)	6	I am able to stretch my students thinking by creating challenging tasks for them.	.97
Technological Knowledge (TK)	5	I am able to use social media (e.g., Facebook, Edmodo, Twitter, etc.).	.92
Technological Pedagogical Knowledge (TPK)	5	I am able to use technology to help my students develop diverse perspectives for authentic issues.	.90
Technological Content Knowledge (TCK)	4	I can use specialized software programs created for a multimodal text analysis (e.g., video annotation tools, etc.).	.90
TPACK	7	Using appropriate technology, I can stimulate my students to read and write critically about current affairs represented in media.	.97
Beliefs about the new culture of learning	7	Today's learners should be able to remix relevant resources to publish their ideas.	.93

In addition, we conducted the focus group interview with nine teachers after the workshop to better understand their perceptions and experiences about multimodal pedagogical content knowledge and the co-design activity. The interview was semi-structured with the following guiding questions: (a) can you describe your experience in these two days?; (b) why did you decided to attend this workshop?; and (c) how is your belief about teaching language changed? The interview lasted approximately for 30 minutes and audio-recorded for transcription. The researchers analyzed the content of the transcribed data to identify emerging themes.

4. Results

4.1 Survey Data

To understand the first research question concerning whether the workshop was effective in raising the teachers' perceived efficacy in multimodal lesson design and their beliefs, paired-sample t-tests were conducted between the pre- and post-workshop survey. As documented in Table 3, all seven factors changed significantly after the workshop. In the pre-workshop survey, the mean scores of factors range from 4.51 to 6.04. The mean scores after the workshop ranges from 5.88 to 6.42 where five factors were above 6.00. Relatively large gains were observed in the factors CK (pre-workshop $M = 4.51$; post-workshop $M = 5.88$) and TCK (pre-workshop $M = 4.42$; post-workshop $M = 5.78$). On the other hand, the teachers' beliefs about the new culture of learning were already high in the pre-workshop survey, and hence showed the smallest gain. All six factors except the Belief factor showed the high effect size at .98 and higher. In general, the Cohen's d value is interpreted as a medium effect size at .5 and a larger effect size at .8 or higher (Cohen, 1992).

Table 3

Descriptive analyses and results of paired-sample t-test (N = 28)

Measured factors	Pre-workshop survey		Post- workshop survey		t-test	Cohen's d
	M	SD	M	SD		
CK	4.51	1.19	5.88	.74	6.74*	1.38
PK	5.08	1.23	6.19	.67	4.98*	1.12
TK	4.83	1.40	6.01	.80	5.28*	1.03
TPK	5.18	1.04	6.17	.54	4.96*	1.19
TCK	4.42	1.35	5.78	1.00	5.17*	1.14
TPACK	5.03	1.24	6.07	.84	4.67*	0.98
Belief	6.04	.94	6.42	.56	2.32*	0.49

* $p < .001$

4.2 FGI Data

Overall, the FGI revealed that the teachers see the workshop as relevant and they are beginning to embark on the design developmentary trajectory. They seem to recognize that developing their competencies in designing multimodal language learning is a worthy pursue and a means for personal growth. Most teachers attended the workshop as they were attracted by the novel terms TPACK and multimodal, as the teachers put it “What kinds of thing is this TPACK... it hasn’t been applied yet, so far for English teachers” (MT). “I think... I will be more familiar with.... multimodal TPACK” (CT). Some of these teachers travelled far (7-9 hours land transport) to attend the workshop. These topics were attractive because the teachers recognized that their students know more about technology and students are reporting that they are learning English because of games such as “Mobile Legends” (ST). The teachers believe that “we are teaching in the 21st century now so I need to change the way I teach my students.” (ST).

The teachers reported that they knew gamification and some technological tools, but they either use games without computers or Facebook for socialization. In other words, they seem to lack experiences in connecting technological, pedagogical or content knowledge. One teacher reported that “we got our model lesson plan from our government. When you showed us the latest one, I tell myself I have to insist on getting out of my comfort zone. It is going to be very challenging, but that’s fine” (UT). Technology does not seem to be foregrounded. While the teachers are acutely aware of the gaps between them and the students’ in terms of technological skills, their concern is about designing ‘meaningful’ learning experiences and tasks that align with the standards. The changes that the teachers experienced seem to be best captured by the following quote:

“Learning language is not merely doing what the teacher said but is about doing something meaningful. And I am trying to analyze how he (the instructor) develops his task. Several years ago, I took task-based design as my thesis. And I know what a meaningful task is. But it is quite difficult to develop such kinds of task in two days. Actually, I don’t worry about technology because I can ask my students. But what worries in my mind is how I can decide the tasks... something very different from what I always do in my teaching. I mean designing the task that it is really meaningful for the students. And relating the task with the students’ interest. I think the important thing is designing the task” (CT).

Nonetheless, the teachers also reported that they may face challenges in school because of the school infrastructure and policies such as the low bandwidth and banning the use of mobile phones in classrooms. When the researchers suggested that they could do action research to show results, one of them responded “It is not so simple. It is a culture thing”. A teacher representative in the government multiliteracy program also expressed the following concern; “the basic and the fundamental literacy for Indonesia is not really there yet. Literacy is what we need to be concerned about. I just want to be sure that the regulation about multimodality will be suitable for our students. not for creating the jumping programs.”

In sum, while the workshop was welcomed and it started the teachers in connecting relevant knowledge which was manifested in the Google Site lessons they completed at the end of the workshops, they forecasted that they would face other systemic problems.

5. Discussion and Conclusion

This study presents the specific design features of TPD informed by TPACK and teacher learning literature and the impact of the TPD on teachers' knowledge and skills in self-reported forms. It also exemplifies the design principles of TPD that aimed to promote pedagogical approaches that teachers are rather unfamiliar with. From the TPACK perspective, multimodal literacy is the intersection of content, pedagogy and technology. The teachers who participated in the workshop had to understand multimodal literacy and how digital media and technology are related to multimodal literacy in the context of language learning.

This study demonstrates one possible design of TPD, given the condition where teachers are struggling to understand new pedagogical practices, coupled with the lack of relevant internal expertise and support systems. The workshop was successful in promoting efficacies and providing the basis for the developmental trajectory. The lesson design that teacher created in the workshop was complete and workable for the classroom implementation. In particular, the co-design process with multiple scaffolds that aimed to reduce teachers' cognitive load was perceived to be important, coupled with the peer critique that promoted collegial knowledge sharing. Undoubtedly, a workshop, which is a structural approach often scheduled after school or over weekends/school breaks occurring outside of teachers' school context, is the most common format of professional development in the literature. The workshop format, however, has been also criticized as being ineffective in promoting deeper substantial changes in teachers' practices (Garet et al., 2001). While we do not argue that short-term workshops can produce deep changes, our findings show that when TPD is designed with the co-design principles and relevant scaffolds, it can be effective for raising teachers' competency in designing technology-integrated lessons and producing positive changes in teachers' efficacy, which is the first level of change needed to launch the teachers on a developmental trajectory.

Some limitations of this study should be noted. This study mainly examined the perceived beliefs and efficacy of teachers through the self-reported survey and interviews, and did not examine the actual enactment of the designed lessons. Further, the effects of professional development on student achievement were not investigated in this study. As mentioned earlier, this study was a part of the 6-month long professional development process, and we plan to continuously support the teachers' development trajectory through subsequent work, including the support of teachers' lesson enactment and the examination of student achievement, especially their digital artefacts that embody multimodal literacy practices. We also plan to administer the questionnaire again after six months in order to analyze teachers' lesson designs and to observe the enactment of designed lessons.

Acknowledgements

This research was supported by the HEAD foundation, Singapore, and the international collaboration research fund by Ewha Womans University, Korea.

References

- Ajayi, L. (2009). English as a second language learners' exploration of multimodal texts in a junior high school. *Journal of Adolescent & Adult Literacy*, 52(7), 585-595.
- Belland, B. R. (2009). Using the theory of habitus to move beyond the study of barriers to technology integration. *Computers & Education*, 52(2), 353-364.
- Bezemer, J., & Kress, G. (2008). Writing in multimodal texts: A social semiotic account of designs for learning. *Written Communication*, 25(2), 166-195.
- Bruce, D. L. & Chiu, M. M. (2015). Composing with new technology: Teacher reflections on learning digital video. *Journal of Teacher Education*, 66(3), 272-287.

- Chai, C. S., Hwee Ling Koh, J., & Teo, Y. H. (2019). Enhancing and Modeling Teachers' Design Beliefs and Efficacy of Technological Pedagogical Content Knowledge for 21st Century Quality Learning. *Journal of Educational Computing Research*, 57(2), 360-384.
- Chai, C. S., Koh, J. H. L., & Tsai, C.-C. (2016). A review of quantitative measures of Technological Pedagogical Content Knowledge (TPACK). In Mary Herring, Matthew Koehler, & Punya Mishra (Eds.), *TPACK Handbook V2.0: TPACK Research and Approaches* (pp. 97-116). New York: Routledge.
- Cohen, J. (1992). A power primer. *Psychological Bulletin*, 112(1), 155-159.
- Cope, B., & Kalantzis, M. (Eds.). (2016). *A pedagogy of multiliteracies: Learning by design*. Springer.
- Drajati, N. A., Tan, L., Haryati, S., Rochsantiningsih, D. & Zainnuri, H. (2018). Investigating English language teachers in developing TPACK and multimodal literacy. *Indonesian Journal of Applied Linguistics*, 7(3), 575-582.
- Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F., & Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal*, 38(4), 915-945.
- Jenkins, H. (2006). *Convergence culture: Where old and new media collide*. NYU press.
- Kalantzis, M., & Cope, B. (2010). The teacher as designer: Pedagogy in the new media age. *E-learning and Digital Media*, 7(3), 200-222.
- Koehler, M. J., & Mishra, P. (2005). Teachers learning technology by design. *Journal of Computing in Teacher Education*, 21(3), 94-102.
- Koh, J. H. L., Chai, C. S., Benjamin, W., & Hong, H. Y. (2015). Technological Pedagogical Content Knowledge (TPACK) and design thinking: A framework to support ICT lesson design for 21st century learning. *The Asia-Pacific Education Researcher*, 24(3), 535-543.
- Koh, J. H. L., Chai, C. S., & Lim, W. Y. (2017). Teacher professional development for TPACK-21CL: Effects on teacher ICT integration and student outcomes. *Journal of Educational Computing Research*, 55(2), 172-196.
- Kolodner, J. L., Crismond, D., Gray, J., Holbrook, J., & Puntambekar, S. (1998, December). Learning by design from theory to practice. In *Proceedings of the international conference of the learning sciences* (Vol. 98, pp. 16-22).
- Kress, G. (2003). *Literacy in the new media age*. New York, NY: Routledge.
- Laurillard, D. (2013). *Teaching as a design science: Building pedagogical patterns for learning and technology*. Routledge.
- Lee C.-J. & Kim, C. (2017). A technological pedagogical content knowledge based instructional design model: a third version implementation study in a technology integration course. *Educational Technology: Research and Development*, 65, 1627-1645.
- Mills, K. A. (2010). A review of the "digital turn" in the new literacy studies. *Review of Educational Research*, 80(2), 246-271.
- Mishler, P. & Koehler, M. J. (2006). Technological pedagogical content knowledge: a framework for teacher knowledge. *Teachers College Record*, 108(6), 1017-1054.
- New London Group. (1996). A pedagogy of multiliteracies: Designing social futures. *Harvard Education Review*, 66(1), 60-92.
- Paas, F., Renkl, A., & Sweller, J. (2003). Cognitive load theory and instructional design: Recent developments. *Educational Psychologist*, 38(1), 1-4.
- Schön, D. (1983). *The reflective practitioner: how professionals think in action*. London: Temple Smith.
- Schön, D. A. (1987). *Educating the reflective practitioner*. San Francisco: Jossey-Bass.
- Sweller, J. (1994). Cognitive load theory, learning difficulty, and instructional design. *Learning and Instruction*, 4(4), 295-312.
- Twining, P., Raffaghelli, J., Albion, P., & Knezek, D. (2013). Moving education into the digital age: the contribution of teachers' professional development. *Journal of Computer Assisted Learning*, 29(5), 426-437.