

# THF Working Paper

Working Papers Series No.1/2017

---

## Surveying Indonesian Teachers' Design Beliefs and TPACK for 21st century oriented Learning

**Chai, C.S., Joyce, H.W.K., Natarajan, U, et al.**

*National Institute of Education, Nanyang  
Technological University, Singapore*

[chingsing.chai@nie.edu.sg](mailto:chingsing.chai@nie.edu.sg)



The  
HEAD  
Foundation

## **Surveying Indonesian Teachers' Design Beliefs and TPACK for 21st century oriented Learning**

**Ching Sing CHAI<sup>a\*</sup>, Joyce Hwee Ling KOH<sup>a\*</sup>, Uma Natarajan<sup>b</sup>, Pei-Shan Tsai<sup>c</sup>,  
Murni Ramli<sup>d</sup> & Ari Widodo<sup>e</sup>**

<sup>a</sup>*National Institute of Education, Nanyang Technological University, Singapore*

<sup>b</sup>*Head Foundation, Singapore*

<sup>c</sup>*Affiliation C, University C, Taiwan*

<sup>d</sup>*Faculty of Teacher Training and Education, Sebelas Maret University  
Indonesia*

<sup>e</sup>*Fakultas Pendidikan Matematika dan Ilmu Pengetahuan Alam, Universitas  
Pendidikan Indonesia, Indonesia*

[\\*chingsing.chai@nie.edu.sg](mailto:*chingsing.chai@nie.edu.sg)

**Abstract:** This study validates a survey created to examine Indonesian teachers' beliefs about lesson design and their technological pedagogical content knowledge (TPACK) for 21<sup>st</sup> century oriented learning. The survey on design beliefs, which is a new perspective in understanding teacher beliefs, consists of their views about their design disposition (DD), about the new culture of learning (BNCL), and about the teacher's role as designer (TAD). The TPACK survey, which is also newly created, examines the teachers' efficacy about their knowledge of using technology for active and constructive learning, authentic learning and collaborative learning instead of adopting the seven factors TPACK model. Exploratory factor analysis and reliability analysis reveals that the six factors survey is valid and reliable. In addition, all factors are significantly correlated. Path analysis reveals that two of the teachers' design beliefs (DD and BNCL) predict the teachers' TPACK for 21<sup>st</sup> century oriented learning. The results imply that it is likely necessary to consider teachers' design beliefs when teacher educators plan to foster teachers' TPACK.

**Keywords:** Technological Pedagogical Content Knowledge, TPACK.

Teachers' beliefs, Professional development

## 1. Introduction

Twenty first century oriented learning is undergirded by the meaningful use of technology to engage students in solving authentic real world problems through active/constructive learning in collaborative classroom (Dede, 2010; Howland, Jonassen & Marra, 2014; Voogt & Roblin, 2012). To achieve such learning in today's classrooms, teachers need to assume the role of designers to psychologize the subject matter as real world problems that require the use of ICT as cognitive tools to help in resolving them (Howland et al., 2014). Teachers' professional development and the school ICT provision, teachers' beliefs and their design capacity, however, have been identified as three levels of interacting barriers that may hinder the actualization of 21<sup>st</sup> century oriented learning with ICT (Tsai & Chai, 2012; Voogt, Erstad, Dede, & Mishra, 2013). A current direction to help to address the problem of developing teachers as designers is to develop teachers' technological pedagogical content knowledge (TPACK) through learning by design (Howland et al., 2014; Voogt et al., 2013). To facilitate effort in this direction, it seems appropriate to develop instruments that can validly measure the relevant aspects of teachers' beliefs and their 21<sup>st</sup> century oriented TPACK.

This study validates a survey created to study Indonesia teachers' beliefs about lesson design and their technological pedagogical content knowledge (TPACK) for 21<sup>st</sup> century oriented learning. The teacher's design beliefs, which is a new perspective in understanding teachers' beliefs, consists of their views about their design disposition (DD), beliefs about the new culture of learning (BNCL), and their beliefs about teacher's role as designer (TAD) (see Koh, Chai, Tsai, 2015; Chai...2017; Chai & Koh, in press). The TPACK survey, which is also newly created, examines the teachers' efficacy about their knowledge of using technology for active and constructive learning, authentic learning and collaborative learning. These dimension of learning are essential for 21<sup>st</sup> century learning (Voogt & Roblin, 2012; Howland,

Jonassen & Marra, 2014). Further review of current research about teachers' beliefs and the TPACK survey are elaborated in the following paragraphs.

### *1.1 Studies of Teachers' Beliefs*

Teachers' beliefs with regard to education and ICT in education are multidimensional in nature. Previous research on teachers' beliefs have highlighted their epistemological beliefs, pedagogical beliefs, beliefs about subject matter; which, in the context of ICT integration have been identified as influencing teachers' decisions (Ertmer, Ottenbreit-Leftwich, & Tondeur, 2014). Given the current concern about teachers' design capacity, Koh, Chai, Hong and Tsai (2015) and Chai, Tan, Deng and Koh (2017) have identified some facets of teachers' beliefs including their design disposition, beliefs about new culture of learning (see Thomas & Brown, 2011) and their beliefs about themselves as designers (Chai & Koh, in press). The cumulative research effort of this group of researchers have gradually build a constellation of teachers' design beliefs that have reportedly influence the teachers' design work. However, studies of teachers' design beliefs are just emerging and needs to be tested in a wider and more varied context to examine its effect, especially on how it relates to the teachers' TPACK. This study adopted the survey designed by Chai and Koh (in press) to study whether or not such beliefs can be identified among Indonesian teachers.

### *1.2 Current development of the TPACK survey*

Previous TPACK surveys generally adopted the seven factors model (Mishra & Koehler, 2006; Chai, Koh & Tsai, 2016). While Chai et al.'s (2016) review indicates that earlier research generally fails to establish the seven factor model (see e.g. Archambault & Crippen, 2010), Chai et al. (2016) have concluded that most current surveys are able to measure the seven factors model validly. Nonetheless, Chai et al. (2016) suggest that each factor can be further expanded to include distinguishable sub-factors. For example, Yeh, Hsu, Wu, Hwang, and Lin (2014) adopted the Delphi method to identify an alternative TPACK-practical framework that generated eight

different dimensions of TPACK for Taiwanese science teachers. In other words, TPACK factors can be perceived differently under different sociocultural and pedagogical contexts. This study attempts to focus on the final TPACK factor that synthesizes teachers' technological knowledge, pedagogical knowledge, content knowledge and its overlapping constructs (i.e. technological content knowledge, pedagogical content knowledge and technological pedagogical knowledge). It does not adopt the seven factors model. Instead, it hypothesized that the final TPACK can be further factorized with different pedagogical emphasis denoting more refined form of knowledge that teachers may need to master to design and implement ICT-oriented 21<sup>st</sup> century learning. Consequently, three distinctive yet commonly emphasized dimensions of 21<sup>st</sup> century learning were used to expand the TPACK factors (see instrument section).

Given the issues raised in the review above, this paper attempts to answer the following research questions:

1. Is the instrument valid and reliable for the purpose of surveying Indonesian teachers' design beliefs and their 21<sup>st</sup> century learning oriented (21CLO) TPACK?
2. What are the relationships between the Indonesian teachers' design beliefs and their 21<sup>st</sup> century learning oriented TPACK?

## **2. Methods**

### *2.1 Participants and Survey Instrument*

A total of 187 participants, who were all teachers, volunteered for this study. These teachers have different profiles: preservice K-12 teachers (54), practicing K-12 teachers (66) and university teachers (67). The teachers are from Solo, Jakarta and Bandung in Indonesia.. Sixty out of 187 are male teachers. Their mean age is 30.7 years (SD=9.5). Around 50.4% of them are mathematics, science or technology teachers while the rest are language, religious studies, and social studies teachers.

The survey instrument comprises of three parts: demographic, teachers' design beliefs and the 21<sup>st</sup> century learning oriented TPACK (21CLO-TPACK). Demographic data collected include age, gender, teaching level and subject matter taught. The teachers' design beliefs comprises three scales, namely, design disposition (DD), beliefs about the new culture of learning (BNCL), and their beliefs about teacher's role as designer (TAD). DD refers to the teacher's assessment of their comfort level about ill-defined situations that calls for design thinking to resolve. BNCL refers to the teachers beliefs about whether today's learners should be engaged in creating digital artifacts as a means to learn. TAD refers to the teachers' acceptance of their role as designer for 21<sup>st</sup> century classrooms. The survey is adopted from a recently validated instrument (Chai & Koh, in press). The 21CLO-TPACK also comprises of three scales: TPACK for active and constructive learning (ACL), authentic learning (AUTL) and collaborative learning. This is a newly constructed survey based on currently understanding of 21<sup>st</sup> century learning. All items were subjected to review by three education professors for the assessment of face validity.

## *2.2 Data Collection and Analysis*

The participants were invited to participate in the survey through e-mail by the Indonesian co-authors of this paper. The survey took around 15 minutes to complete. The data were cleaned and subjected to exploratory factor analysis (EFA), Cronbach Alpha's analysis and the means of the validated scales were computed. Pearson correlation was then conducted followed by path analysis.

## **3. Findings**

### *3.1 Results of EFA and Reliabilities analysis*

Exploratory factor analysis employing principal axis factoring with direct Oblimin rotation was conducted. Six factors were extracted and items with factor loading greater than 0.5 were retained. Ten items with cross loading and insufficient factor loadings were removed. The overall Alpha reliabilities of the survey is 0.95. Table 1 below documents the final survey items and reports the outcome of EFA with factor

loadings, alpha reliabilities, mean scores of the factors and the standard deviation. In addition, the survey indicates that the Indonesian teachers hold strong beliefs that teachers should be designers and students learning should be driven by creating digital artifacts in a participatory learning culture. While they generally possess design disposition, their efficacies of 21CLO-TPACK should be enhanced.

**Table 1: Outcome of EFA and Reliabilities Analysis**

TPACK Active and Constructive Learning (ACL) ( $\alpha=0.91$ ), Mean=5.15, SD=1.03	Factor Loadings
1. I know how to choose appropriate technologies based on the topics I am teaching for students to perform student-centered inquiry.	.894
2. I am competent in helping my students to critically synthesize information from various web-based resources for content learning.	.800
3. I can facilitate students' ongoing effort in designing solutions with technology using their content knowledge.	.773
4. I am able to use technology to stimulate my students' higher order thinking about the subject matter.	.739
TPACK Authentic Learning (AUTL) ( $\alpha=0.92$ ), Mean=5.04, SD=1.09	
1. I can arouse students' interest in solving real world problems using subject related software.	.889
2. I am competent in searching for online video resources to initiate real world problem solving related to the subject matter.	.722
3. I can use technologies to scaffold students' in solving complex problems arising from the topics that I teach.	.707
4. I can engage students in learning the subject matter using the ICT tools that subject matter experts use.	.660
TPACK Collaborative Learning (COL) ( $\alpha=0.93$ ) , Mean=4.81, SD=1.13	
1. I can engage students in substantial peer critiquing work through collaborative software.	.883
2. I am competent in prompting students to talk deeply about the content knowledge in online platforms.	.856

3. I can facilitate students' co-construction of subject matter representations when they are working in small groups around a computer.	.854
4. I can formulate in-depth discussion topics about the content knowledge for students' online discussion.	.694
<hr/>	
Design Disposition (DD) ( $\alpha=0.87$ ) , Mean=5.36, SD=0.96	
<hr/>	
1. I am comfortable with occasional failures from trying out new approaches for teaching.	.924
2. I am comfortable to explore conflicting ideas.	.740
3. I am comfortable to deviate from established practices.	.696
4. I am constantly seeking to turn constraints into opportunities.	.648
<hr/>	
Teacher as designer (TAD) ( $\alpha=0.93$ ) , Mean=6.01, SD=0.96	
<hr/>	
1. Working like designer is part of the teacher's duty.	.928
2. Teachers should devote substantial time to design lesson.	.907
3. It is my responsibility to master the skills of designing lessons.	.759
<hr/>	
Beliefs about New Culture of Learning (BNCL) ( $\alpha=0.91$ ) , Mean=5.93, SD=0.91	
<hr/>	
1. Students should be able to choose relevant digital resources for self-initiated learning	.897
2. Remeshing digital resources responsibly is a good way to learn.	.854
3. Today's learners should be able to remix relevant resources to publish their ideas.	.799
4. Managing personal online learning resources is a desirable skill.	.797
5. Producing creative digital works is a meaningful task	.761
6. Online collaboration should be part of students' personal competencies.	.737
<hr/>	

### 3.2 Correlation and Path Analysis

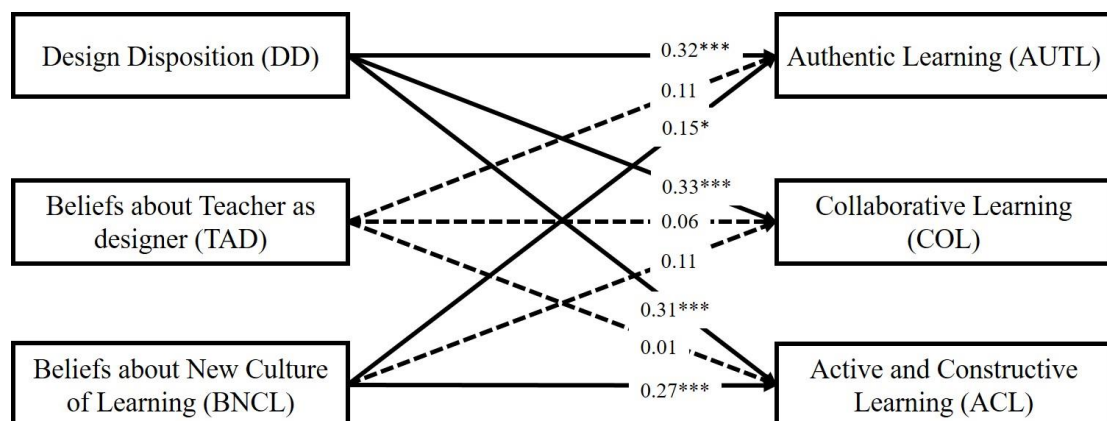
Pearson correlations were generated between the six factors. In general, all six factors were significantly correlated with Pearson correlation coefficients ranging from 0.74 to 0.29. Table 2 below documents the correlations. To investigate the roles that teachers' design beliefs play in their 21CLO-TPACK, this study used the path



analysis technique to examine the relationships among these variables. The teachers' design beliefs factors were considered as predictors, while the 21CLO-TPACK factors were viewed as outcomes variables. The results revealed that several significant relations among the factors in teachers' design beliefs and those in the 21CLO-TPACK, as shown in Figure 1. First of all, DD significantly explain all of the 21CLO-TPACK factors, including AUTL ( $\beta = 0.32, p < 0.001$ ), COL ( $\beta = 0.33, p < 0.001$ ), and ACL ( $\beta = 0.31, p < 0.001$ ). The teachers who hold stronger beliefs about design disposition (DD) would possess stronger efficacy in AUTL, COL and ACL. In addition, BNCL played a positive role in AUTL ( $\beta = 0.15, p < 0.05$ ) and ACL ( $\beta = 0.27, p < 0.001$ ). This finding indicated that the teachers who are more inclined towards new culture of learning (BNCL) would have stronger efficacies for AUTL and ACL. Teacher as designer is however only positively correlated to the teachers' 21CLO-TPACK without predictive relationships.

**Table 1: Pearson Correlations**

	AUTL	ACL	CoL	BNCL	DD
ACL	.729**				
CoL	.741**	.633**			
BNCL	.377**	.426**	.297**		
DD	.451**	.449**	.395**	.484**	
TAD	.371**	.339**	.286**	.620**	.515**



**Figure 1. Path Analysis of Teachers' Design Beliefs and 21CLO-TOACK.**

#### **4. Discussion and Conclusion**

This study aims to validate a survey instrument that is partly adopted (Chai & Koh, in press) and partly created to examine Indonesian teachers' design beliefs and their 21CLO-TPACK. The findings show that the survey instrument possesses factorial validity and it is reliable. The survey outcomes indicate that the Indonesian teachers are inclined towards designing instruction for 21<sup>st</sup> century learning mediated through participatory co-creation of digital artifacts (Thomas & Brown, 2011). The study therefore contributes first towards the cross-cultural validation of the teachers' design beliefs. Teachers' design beliefs is emerging to be an area of concern when teachers are engaged in designing technology-based instruction (Ertmer et al., 2014; Tsai & Chai, 2012) and the cross-cultural validation may assist future cross-cultural research in this area. In addition, the establishment of the 21CLO-TPACK survey may contribute to more specific assessment of teachers' efficacies to integrate technology for 21<sup>st</sup> century oriented learning (Chai et al., 2016). As indicated in the findings of this study, the Indonesian teachers possess strong beliefs that education with technology should move towards the new culture of learning and teachers should be the designers for such learning. Nonetheless, the teachers do not possess strong efficacies in designing 21<sup>st</sup> century learning with technology. The Ministry of Education officials should devote time and effort to facilitate teacher professional development in this area. Perhaps scaffolding the teachers to learn by design supported by the scaffolded TPACK lesson design model as reported by Chai and Koh (in press) could be an effective way to enhance the teachers' 21CLO-TPACK.

We have conducted several t-tests and ANOVA to further examine the results base on the participants' demographic. However, there is generally a lack of significant difference between genders and the levels they teach. The only differences detected so far is that the mathematics, science and technology teachers (generally the hard disciplines) possess stronger AUTL then the language, social studies and religious studies teachers ( $t=2.11$ ,  $p<0.05$ ).

Further analysis of the relationships between the teachers' design beliefs and their 21CLO-TPACK indicates that the Indonesian teachers' design beliefs and their

21CLO-TPACK are correlated and the teachers' design beliefs could generally predict their 21CLO-TPACK with the exception of TAD. This further implies that it could be important to consider the teachers' design beliefs as these beliefs would shape their lesson designs. One possible way to address the issues of teachers' design beliefs is to explicitly discuss the beliefs before and after the teachers design technology-based lessons. We hypothesize that it could be helpful if the teachers could implement the designed technology-based lessons and then discuss the outcomes.

There are some limitations to the current study. Firstly, the study adopted the convenience sampling technique which require the findings to be viewed with caution. Future research could adopt sampling strategies that are statistically more powerful. In addition, not all 21<sup>st</sup> century learning practices were included in the survey. For example, self-directed learning which is also frequently mentioned in 21<sup>st</sup> century learning framework (Voogt & Roblin, 2012) was not included. Future research should consider including this dimension for the 21CLO-TPACK.

### **Acknowledgements**

We would like to thank the Head Foundation and all participating Indonesia Institutes of Education for supporting this research.

### **References**

- Archambault, L. M., & Barnett, J. H. (2010). Revisiting technological pedagogical content knowledge: Exploring the TPACK framework. *Computers & Education*, 55(4), 1656-1662.
- Chai, C. S. & Ko, J. H. L. (in press). Changing teachers' TPACK and design beliefs through the Scaffolded TPACK Lesson Design Model (STLDM). *Learning: Research and Practice*.

- Chai, C. S., Koh, J. H. L., & Tsai, C. C. (2016). A review of the quantitative measures of Technological Pedagogical Content Knowledge (TPACK). *Handbook of Technological Pedagogical Content Knowledge (TPACK) for Educators*, 87-106.
- Chai, C. S., Tan, L., Deng, F., & Koh, J. H. L. (2017). Examining pre-service teachers' design capacities for web-based 21st century new culture of learning. *Australasian Journal of Educational Technology*, 33(1), 1-20. <https://doi.org/10.14742/ajet.3013>
- Dede, C. (2010). Comparing Frameworks for 21st Century Skills. In Bellanca, J. & Brandt, R. (Eds.) *21st century skills, Rethinking How Students Learn*. (pp. 51 – 75). Solution Tree Press.
- Ertmer, P. A., Ottenbreit-Leftwich, A. T., & Tondeur, J. (2014). Teachers' beliefs and uses of technology to support 21st-century teaching and learning. In H. Fives and M. G. Gill (eds.). *International handbook of research on teacher beliefs*. (pp 403-418). New York, NY: Routledge.
- Howland, J. L., Jonassen, D. H., & Marra, R. M. (2014). *Meaningful learning with technology*. (4<sup>th</sup> ed.) Essex, UK: Pearson.
- Koh, J. H. L., Chai, C. S., Hong, H. Y., & Tsai, C. C. (2015). A survey to examine teachers' perceptions of design dispositions, lesson design practices, and their relationships with technological pedagogical content knowledge (TPACK). *Asia-Pacific Journal of Teacher Education*, 43(5), 378-391.
- Thomas, D. & Brown, J. S. (2011) *A new culture of learning: Cultivating the imagination for a world of constant change*. Lexington, Ky: CreateSpace.
- Tsai, C. C., & Chai, C. S. (2012). The “third”-order barrier for technology-integration instruction: Implications for teacher education. *Australasian Journal of Educational Technology*, 28, 1057-1060.
- Yeh, Y. F., Hsu, Y. S., Wu, H. K., Hwang, F. K., & Lin, T. C. (2014). Developing and validating technological pedagogical content knowledge-practical (TPACK-practical) through the Delphi survey technique. *British Journal of Educational Technology*, 45(4), 707-722.
- Voogt, J. & Roblin, N. P. (2012). A comparative analysis of international frameworks for 21st century competences: Implications for national curriculum policies. *Journal of Curriculum Studies* 44, 299-321.

Voogt, J., Erstad, O., Dede, C., & Mishra, P. (2013a). Challenges to learning and schooling in the digital networked world of the 21st century. *Journal of computer assisted learning*, 29(5), 403-413.

Voogt, J., Fisser, P., Pareja Roblin, N., Tondeur, J., & van Braak, J. (2013b). Technological pedagogical content knowledge—a review of the literature. *Journal of Computer Assisted Learning*, 29(2), 109-121.

**Note**

*The HEAD Foundation Working Paper Series© are preliminary papers subject to further revisions, and are circulated to solicit comments and suggestions for improvements. The Working Papers are unedited and unreviewed. The views and opinions expressed are those of the author(s) and do not necessarily reflect those of The HEAD Foundation. No part of the article may be cited without permission from the author(s).*