

Surveying Indonesian Teachers' Design Belief and TPACK for 21st Century Oriented Learning

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Abstract: This study validates a survey created to study Indonesia teachers' beliefs about lesson design and their technological pedagogical content knowledge (TPACK) for 21st century oriented learning. The teacher's design beliefs, which is a new perspective in understanding teachers' beliefs, consist of their view about their design disposition (DD), beliefs about the new culture of learning (BNCL), and their beliefs about 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 reveal 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 21st 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, 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 engender such learning in today's classroom demands teachers to assume the role of designer to psychologize the subject matter as real world problems that require the use of ICT as cognitive tool to help in resolving (Howland et al., 2014). Teachers' professional development and the school ICT provision, teachers' beliefs and their design capacity, however, have been identified as three level of interacting barriers that may hinder the actualization of 21st 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 designer 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 instrument that can validly measure the relevant aspect of teachers' beliefs and their 21st 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 21st century oriented learning. The teacher's design beliefs, which is a new perspective in understanding teachers' beliefs, consist of

their view 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 21st century learning (Howland, Jonassen & Marra, 2014; Voogt & Roblin, 2012). Further reviews of current research about teachers' beliefs and TPACK survey are elaborated in the following paragraphs.

1.1 Studies of Teachers' Beliefs

Teachers' beliefs are multidimensional in nature. Past research on teachers' beliefs can include their epistemological beliefs, pedagogical beliefs, beliefs about subject matter; which in the context of ICT integration have been identified as influencing teachers' decision (Ertmer, Ottenbreit-Leftwich, & Tondeur, 2014). Given the current concern about teachers' design capacity, Chai, Tan, Deng and Koh (2017) and Koh, Chai, Hong and Tsai (2015) 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 efforts 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 it should be tested in a wider context to examine its effect, especially on how it relates to the teachers' TPACK. This study adopted the survey design by Chai and Koh (in press) to study whether or not such beliefs can be identified among the Indonesian teachers.

1.2 Current Development of TPACK Survey

Previous TPACK surveys generally adopt the seven factors model (Chai, Koh & Tsai, 2016; Mishra & Koehler, 2006). 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 survey 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) has adopted the Delphi method to identified 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 21st century learning. Consequently, three distinctive yet commonly emphasized dimensions of 21st century learning were used to expand the TPACK factors (see instrument section).

Given the review above, this study 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 21st century learning oriented (21CLO) TPACK?
2. What are the relationships between the Indonesian teachers' design beliefs and their 21st century learning oriented TPACK?

2. Methods

2.1 Participants and Survey Instrument

There are 187 participants in total who have 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 area. Sixty out of 187 are male teachers. Their mean age is 30.7 years (SD=9.5). Around 50.4% of them are from the 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 21st century learning oriented TPACK (21CLO-TPACK). Demographic data collected include age, gender, teaching level and subject matter taught. The teachers' design beliefs comprise three scale namely design disposition (DD), beliefs about the new culture of learning (BNCL), and their beliefs about teachers' role as designer (TAD). DD refers to the teachers' 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 21st 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. The survey was presented in a seven-point Likert scale, ranging from 1 for strongly disagree to 7 for strongly agree. This is a newly constructed survey based on currently understanding of 21st 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 is an English-version survey and it took around 15 minutes to complete. Indonesian co-authors and education professors have reviewed the survey to make sure that the Indonesian teachers can understand each survey item. 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 Exploratory Factor Analysis (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 reliability of the survey is 0.95. Table 1 shows 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 participatory 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
Design Disposition (DD) ($\alpha=0.87$), Mean=5.36, SD=0.96		
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
Teacher as designer (TAD) ($\alpha=0.93$), Mean=6.01, SD=0.96		
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
Beliefs about New Culture of Learning (BNCL) ($\alpha=0.91$), Mean=5.93, SD=0.91		
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

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 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 explained 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 2: 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**

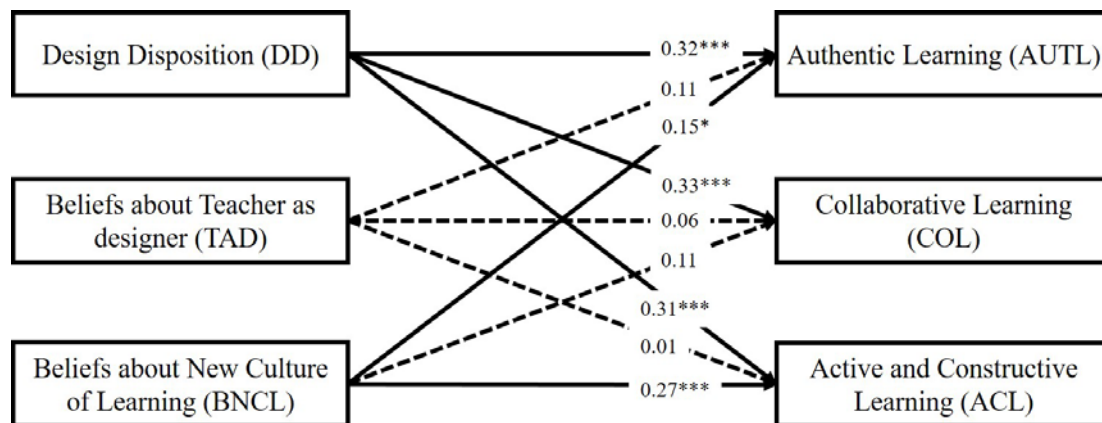


Figure 1. Path Analysis of Teachers' Design Beliefs and 21CLO-TOACK.

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 that the survey possess factorial validity and it is reliable. The survey outcomes indicate that the Indonesian teachers are inclined towards designing instruction for 21st 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 are 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 path the ways for 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 21st 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 designer for such learning. Nonetheless, the teachers do not possess strong efficacies in designing 21st century learning with technology. The Indonesia education authority 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 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 imply that it could be important to consider the teachers' design beliefs as these beliefs would shape their design. 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 conjecture that it could be helpful if the teachers could implement the designed technology-based lessons and discuss the outcomes.

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

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