Journal of Education and Learning (EduLearn)
Vol. 18, No. 3, August 2024, pp. 825~832
ISSN: 2089-9823 DOI: 10.11591/edulearn.v18i3.21780

Unboxing the primary English teacher's TPACK profile: instrumental design and validation

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Article Info

Article history:

Received Jan 23, 2024
Revised Jan 25, 2024
Accepted Feb 17, 2024

Keywords:

Content knowledge
English language teaching
Instrument
Pedagogical knowledge
Primary English teacher
Technological knowledge

ABSTRACT

Numerous researchers have developed technological pedagogical content knowledge (TPACK) instruments for English language teaching; however, a valid and reliable instrument to unbox the primary English language teacher's TPACK profile from graduates of the primary school teacher education study program does not yet exist. Consequently, this study aimed to design and validate a questionnaire to unbox the primary English language teacher's TPACK profile. This study used a mixed-methods approach. First, qualitative methods were employed to verify and validate the content of each construct. The items were generated through experts' and a primary English teacher's reviews. As a quantitative method, the questionnaire was then validated through explanatory factor analysis (EFA). The result of EFA yielded a comprehensive set of 40 items: technological knowledge (TK) section (consisting of 5 items), content knowledge (CK) section (consisting of 6 items), pedagogical knowledge (PK) section (consisting of 6 items), pedagogical content knowledge (PCK) section (consisting of 5 items), technological content knowledge (TCK) section (consisting of 5 items), technological pedagogical knowledge (TPK) section (consisting of 7 items), and TPACK section (consisting of 5 items). The reliability coefficients of each construct were acceptable. In conclusion, the study obtained a fruitful questionnaire for unboxing the primary English language teacher's TPACK profile.

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1. INTRODUCTION

English language learning (henceforth ELL) at primary school is an aspiration of globalization demand [1], [2]. The failure of English subject attainment at junior or senior high schools is also a main reason for ELL implementation earlier [3]. In line with the other findings, it is confirmed that ELL started in primary school and strengthened English language skills at the junior or senior high school level [4], [5]. However, empirical studies reveal challenges of ELL at the primary level, such as English teachers who are graduates of the primary school teacher education study program and insufficient English language teaching pedagogical competence [3], [6].

Primary students include young learners [7]. Young learners have characteristics that tend to like concrete and imaginative activities [4]. Consequently, in ideal teaching, primary English teachers are not only required to have English competence but also pedagogical competence in teaching English for young learners

(henceforth EYL) [8], [9]. Besides, primary English teachers must be able to utilize technology and use an appropriate learning material [10]–[15] in facilitating and improving learning attainment [16], [17] and also accommodating EYL characteristics [18]–[20]. As a predictor of learners‘ achievement, teachers must be able to develop learning material and its use and provide it by using technology [21]. Hence, it is crucial for teachers to master technological pedagogical content knowledge (henceforth TPACK) [22], especially ELL at the primary school level [23]. TPACK is an effective framework to reflect teachers competence in preparing learning material, mastering learning methodology, and integrating technology [24], [25]. It has three main components, such as technological knowledge, content knowledge, and pedagogical knowledge [26], [27]. Further, the three main components are extended into four components, such as pedagogical content knowledge, technological content knowledge, technological pedagogical knowledge, and TPACK [28], [29].

Numerous previous studies have investigated English teachers' TPACK profile. Studies by [30], [31] revealed that TPACK is influenced by teachers' teaching experience. Further, [32], [33] reported that a training in technology-assisted learning has a significant influence towards pedagogical knowledge and English teacher competence. In addition, self-efficacy and motivation are factors in teaching practicum integrated with technology [34], [35]. The previous studies are explored the factors that influence the English teacher's TPACK profile, nonetheless, a study of TPACK profile based on teacher's educational background has not yet been conducted.

Since this current study is to unpack primary English language teachers' TPACK profiles based on their educational backgrounds, this questionnaire produced an adapted and modified questionnaire that combines the concepts of [36]–[40]. Thus, this study is expected to be able to bridge the gap that exists in previous studies about TPACK. To achieve this objective, the goal of this study to determine the reliability and validity of the TPACK in order to provide several lights on future studies that will be conducted on unpacking the TPACK profiles on primary English educators. In pursuit of this objective, the present study aimed to tackle the subsequent research question: was the questionnaire valid and reliable to unbox the primary English language teacher's TPACK profile?

2. METHOD

The researchers attempted to develop and validate a questionnaire revealing primary English language teachers' technology pedagogical content knowledge profile. To carry out this task, we created a questionnaire to gather information on primary teachers' evaluation of the seven categories of knowledge encompassed by TPACK. The process of creating an instrument involved two separate stages: development and validation [41]. Qualitative approaches were employed in the development stage to create questionnaire items. Quantitative methods were employed during the validation stage to assess the questionnaire items created in the development stage. Creswell and Clark [41] recommended that including qualitative approaches in the creation stage would enhance the instrument's validity. This is because questionaire developers would have a deeper understanding of the phenomena of interest before validating the associated items. We conducted this work in both stages of Cresswell and Clark's [41] instrument development methodology. The following approaches are further discussed in the subsequent sections.

2.1. Instrument development

The development stages of the questionnaire assessing the TPACK profile of primary English language teachers started with collecting qualitative data. This involved conducting interviews with experts and analyzing relevant literature documents. This stage aimed to comprehend the definitions of TPACK components provided by other studies, comprehend the distinctions between these constructs in the context of English learning for primary school students, and examine the methods used to assess these characteristics in previous questionnaires. The questionnaire items were derived from the data, and the valid content of each item was determined by academicians's evaluation and a cognitive interview with a representative of the intended participant.

2.1.1. Interview

The development stage started with semi-structured interviews constructed with four academicians: one from the English language education study program, one from the primary school teacher education study program, one from the Indonesian language and literature study program, and one from the informatics study program. The interview was conducted to investigate the primary English teacher competence that required to infuse technology. Academicians were selected using purposive sampling to ensure they had appropriate experience. Since the interviews were deliberately chosen, the replies from four academics gave a redundant level, indicating a sufficient sample size for gathering this qualitative data [42].

2.1.2. Literature review and document analysis

An examination of the relevant literature and documents was also a part of the development process. This included several existing TPACK instruments from national and international standards that addresses technology-enhanced ELL. Current references TPACK instruments [36]–[40] were analysed in terms of their substance, organization, item accuracy, development techniques, validity, and reliability evidences.

2.1.3. Generation of items and assessment of content validity

Following that, the qualitative data were processed to create items for each of the seven different constructs that were generated within the TPACK framework respectively. A preliminary set of items was created by analyzing the content of interviews with experts. The items in the initial stage were subsequently modified or removed after doing an examination of the terminology used in the standards and the items included in existing TPACK questionnaires. The analyses produced a total of 65 items, consisting of 10 technological knowledge (TK) items, 10 pedagogical knowledge (PK) items, 10 content knowledge (CK) items, 10 pedagogical content knowledge (PCK) items, 7 technological content knowledge (TCK) items, 8 technological pedagogical knowledge (TPK) items, and 10 TPACK items.

Afterward, four academicians scrutinized the items to enhance the content validity of the questionnaire. These academicians were given a form in which they may offer recommendations for enhancing each item. Subsequently, the researchers used the review to modify the items by incorporating illustrative instances for technological terminology, elucidating the characteristics of certain items, and abstaining from using pedagogical terminology for the TPACK domains that are unrelated to education.

A primary English language teacher was involved in a cognitive interview to offer researchers insights into how the intended participant may perceive the items. The objective of this interview was to enhance the organization and substance of issues that were perplexing or misunderstood by a member of the target participant. Since the purpose of the study was to enhance the understanding and clarity of the items rather than confirm their validity, only a single interview was necessary to pinpoint places where the wording of the items required clarification or modification. The English language instructor diligently examined and elucidated his interpretation of every element. The findings of the cognitive interview recommended implementing several modifications, including diminishing the length of the questionnaire instructions, substituting or removing unclear terminology used in some topics, and offering the questionnaire in both English and Bahasa Indonesia. The questionnaire in this study used a seven-point rating scale, ranging from 1 for 'very untrue of me', 2 for 'untrue of me', 3 for 'somewhat untrue of me', 4 for 'neutral', 5 for 'somewhat true of me', 6 for 'true of me', and 7 for 'very true of me'. This measure follows Likert-type scale response anchors related to self-reflection [43].

2.2. Instrument validation

Explanatory factor analysis (EFA), a quantitative approach, was used for validation. The validation is only done one round because the researchers meet the criteria of questionnaire validity. Fifty primary English language teachers that hold the primary school teacher education degree were asked to fulfill the TPACK survey. Beside the educational background, the teacher must have previous experience of teaching English on technology integration. Due to the phenomenon of teachers' lack of English competency from primary school education study program graduates, English subject is used as an extracurricular in most schools so that researchers get a slightly limited sample size but it is still acceptable for factor analysis tests [44]. A presentation of the findings of the validation might be found in one of the sections dealing with results.

3. RESULTS AND DISCUSSION

3.1. Validity

Within the scope of this investigation, we carried out the Kaiser-Meyer-Olkin (KMO) test as well as Bartlett's test of sphericity values. The results of these tests demonstrate that factor analysis is valid and that there are relationships between the variables. Table 1 (see in Appendix) displays the results of the survey factor. It also includes the factor loadings for each TPACK construct. Table 1 establishes that the KMO value was determined to be 0.723, with a Bartlett's test of sphericity value of 0.780 and a significant value of 0.000. According to Tabachnick and Fidell [45], if the value of tests exceeds 0.5, it indicates that there is an fundamental framework in the questionnaire and justifies the use of factor analysis for the sample size linked with the measure. In addition, the value of BTS was substantial (BTS value = 0.780, p = 0 .000), providing support for the relationships among the components that were not zero. On the other hand, it can be said that the data was valid and can be used for the further testing.

The practical factor structure of the sixty-five items was ascertained by an EFA using principal components. Utilizing the varimax rotation approach allowed for the factors that were acquired to be condensed into a more streamlined form. To determine the number of factors that were retained, the following criteria were utilized: first, the criterion proposed by Kaiser [46] to retain factors with eigenvalues greater than one;

second, factors that accounted for at least ten percent of the total extracted variance; and third, each factor had to consist of a minimum of three items. The inclusion criterion for items in the retained factor was that they must have loadings of at least 0.50 on that factor. The study generated the discovery of seven components, specifically: TK section (consisting of 5 items), CK section (consisting of 6 items), PK section (consisting of 6 items), PCK section (consisting of 5 items), TCK section (consisting of 5 items), TPK section (consisting of 7 items), and TPACK section (consisting of 5 items), as shown in Table 1.

3.2. Reliability

Through the use of Cronbach's alpha, evidence was confirmed that the TPACK instrument that was constructed could be considered internally consistent. The calculated result of TPACK constructs 'reliability coefficients is presented in the Table 2. By using Cronbach's alpha, we were able to keep evidence that the TPACK instrument that was constructed was internally consistent. The reliability coefficients for the TPACK constructs were in the range of 0.901 to 0.960 when the items for each component were scrutinized separately (Table 2 for further information). Due to the high degree of dependability associated with the items in each construct, these scores imply that the constructs are reliable. The reliability coefficients within each construct were acceptable if the value above 0.70 [47]–[49].

Table 2. Reliability coefficients of TPACK constructs

Constructs	Cronbach's alpha
TK (technological knowledge section)	0.901
CK (content knowledge section)	0.911
PK (pedagogical knowledge section)	0.902
PCK (pedagogical content knowledge section)	0.912
TCK (technological content knowledge section)	0.930
TPK (technological pedagogical knowledge section)	0.938
TPACK (technological pedagogical content knowledge section)	0.960

3.3. Discussion

This paper holds promise as a fruitful questionnaire to unbox the primary English language teacher's TPACK profile. The EFA findings confirmed the presence of a seven-factor structure. Previously, numerous researchers have had barriers in creating a TPACK survey that effectively illustrates a fundamental seven-factor structure. The inclusion of the seven-factor construct in this study may be attributed to the utilization of the questionnaire development methodology suggested by Creswell and Clark [41]. The models of Creswell and Clark [41] offer a systematic and strong approach to developing instruments by employing many methodologies. The utilization of comprehensive qualitative data to create TPACK items pertaining to the EYL may have led to the development of surveys that are conceptually well-designed. Furthermore, there are other those who have had favourable outcomes by constructing survey questions based on qualitative data. The references used are [50]–[52].

The item accuracy in the questionnaire may have played a role in the development stage of the basis seven-factor structure in this study. Each item is re-checked by the professionals in terms of EYL since the young learner's characteristic is unique [4] and the language teaching should be emphasized on acquisition not only learning the language [53]. The different nuance and atmosphere could be a tendency in how primary English language teacher observed the TPACK constructs. By utilizing comprehensive qualitative techniques such as expert interviews, analysis of established standards, and surveys, we successfully incorporated numerous elements within each TPACK construct from an EYL perspective. For instance, since the primary English teacher was graduates of primary school teacher education department, the instrument instruction or even the statements of TPACK items should be provided in two languages namely English and Bahasa Indonesia. As reported by [52], [54] qualitative approach can be employed to avoid writing items in a general manner or creating separate items for each subject area within each construct. Others reported qualitative approach in this current study is to ensure or guarantee the content validity of each item of TPACK construct and to encourage the respondent' accurate interpretation of the items [55], [56].

In addition to the qualitative method, the quantitative approach, which is based on statistical analysis, also indicated that the questionnaire is valid and reliable. To unpack the teacher's TPACK profile, this present finding yields seven constructs. Pedagogy, content, and technology are the three primary domains of knowledge that are interconnected with one another, and the interactions that take place between these three areas of knowledge are extremely important [57]. This finding aligns with previous research that utilized content validity and factor analysis survey data to assess the teacher's knowledge in seven extended factors: TK, PK, CK, PCK,

TPK, and TPACK [36], [52]. The research implies that the TPACK questionnaire may be used to examine the TPACK profile of primary English teachers in all aspects concurrently, rather than individually.

4. CONCLUSION

Unboxing the profile of primary English language teachers integrating technology into their instruction is a key goal of this project, which aims to construct and validate the questionnaire for studying the TPACK profile of elementary English teachers. As part of the implications of this study, the TPACK questionnaire that was then presented in this article was expected to enhance how primary English language educators, who are graduates of primary school teacher education study program, instruct their students by using technology.

APPENDIX

Table 1. The result of survey factor and factor loadings of TPACK constructs

Constructs	Items	Factors						
		1	2	3	4	5	6	7
Tecnological knowledge	TK1	0.861						
	TK2	0.866						
	TK3	0.758						
	TK4	0.885						
	TK10	0.771						
Content knowledge	CK1		0.728					
	CK2		0.857					
	CK3		0.882					
	CK5		0.878					
	CK9		0.726					
	CK10		0.837					
Pedagogical knowledge	PK1			0.743				
	PK2			0.675				
	PK3			0.809				
	PK4			0.828				
	PK5			0.722				
	PK10			0.707				
Pedagogical content knowledge	PCK1				0.788			
	PCK2				0.835			
	PCK3				0.857			
	PCK9				0.908			
	PCK10				0.903			
Technological content knowledge	TCK1					0.862		
	TCK3					0.915		
	TCK4					0.752		
	TCK5					0.93		
	TCK7					0.826		
Tecnological pedagogical knowledge	TPK1						0.892	
	TPK2						0.852	
	TPK3						0.731	
	TPK4						0.907	
	TPK5						0.722	
	TPK7						0.879	
	TPK8						0.796	
Technological pedagogical content knowledge	TPACK1							0.738
	TPACK2							0.852
	TPACK4							0.804
	TPACK5							0.694
	TPACK9							0.876
KMO					0.723			
Bartlett's test of sphericity					0.780			
Sig.					0.000			
Eigenvalue		9.204	5.055	4.533	4.033	3.316	2.156	1.726
Total variance (%)		23.010	12.638	11.332	10.083	8.290	5.390	4.316

ACKNOWLEDGEMENTS

The authors would like to acknowledge the financial support provided by the Direktorat Penelitian dan Pengabdian Masyarakat, Universitas Islam Riau to carry out this research.

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