An exploratory study on the questionnaire measuring EFL teachers' attitudes towards information and communication technology (ICT) integration in primary school classrooms

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DOI: 10.14232/edulingua.2023.1.3

This study aimed to examine the reliability and robustness of a questionnaire developed based on the Teachers' Attitudes Towards Computers (TAC) Questionnaire (version 6) by Christensen and Knezek (2009) to measure EFL primary school teachers' attitudes towards ICT use in teaching practice in Vietnam. Exploratory Factor Analysis (EFA) was conducted on a pilot study sample (n = 202) to refine the factor model. The identified factor structure was then used to collect data for the main study (n = 598). Cronbach's alpha and McDonald's omega coefficients were computed to evaluate the internal consistency of the newly identified factors in both the pilot study and main study samples. The findings revealed consistent reliability in the factor structure across the samples, reinforcing the robustness of the questionnaire and its reliability for future use. Implications for both researchers and educational organizations are also presented in this study.

Keywords: validation, reliability, teachers' attitudes, EFA, ICT use

1. Introduction

Information and Communication Technology (ICT) has had a powerful impact on education over the past few decades. ICT-enhanced teaching and learning has continued to flourish since the Covid-19 pandemic. However, the effectiveness of ICT use in teaching is determined by several factors (Al-Zaidiyeen et al., 2010) and teachers decide whether to integrate ICT, the extent to which ICT penetrates their teaching, and how it is implemented in their practice. Numerous studies have proven that teachers' attitudes towards ICT use greatly influence ICT adoption (Albirini, 2006; Celik & Yesilyurt, 2013; Scherer et al., 2018). Despite the wealth of research on teachers' attitudes towards ICT use in teaching practice, the number of systematic studies in the same field in the Vietnamese educational landscape has been relatively limited. Based on a thorough review by the researcher, no study has been conducted on EFL teachers' attitudes towards ICT use in teaching practice at the primary school level in the Vietnamese research context. Therefore, it is necessary for researchers to shift their focus to this topic, and a

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reliable instrument for measuring teachers' attitudes towards ICT use in teaching is urgently needed.

The Teachers' Attitudes Towards Computers (TAC) Questionnaire (version 6) developed by Christensen and Knezek (2009) was selectively adapted with multiple changes by the researcher because of its comprehensiveness, reliability, and validity. Specifically, it was constructed based on 14 previously developed and widely used questionnaires and has undergone several rounds of development and refinement with large samples over the years (see Christensen & Knezek, 2009). Owing to the fast-paced development of ICT in general and ICT in education in particular, this instrument somewhat displays its outdatedness to some extent. For instance, it focused on teachers' attitudes towards the use of computers, which was popular at that time, but no longer the case after nearly twenty years.

Changes made to the original questionnaire were associated with the replacement of several phrases and one construct called *E-mail*, which was considered inappropriate for application in the targeted research context, and the exclusion of one irrelevant construct. Therefore, it is essential to examine the factor structure underlying the modified questionnaire and its reliability and robustness to ensure its ability to measure the relevant aspects of teachers' attitudes towards the use of ICT in EFL teaching within the research context of Vietnam. Based on these objectives, this study proposes the following hypotheses:

Hypothesis 1: There are changes in the factor structure of the adjusted questionnaire as a result of running an exploratory factor analysis using the pilot sample compared to the original one.

Hypothesis 2: The reliability coefficients, including Cronbach's alpha and McDonald's Omega, for the identified constructs based on both the pilot sample and the main data are statistically significant, indicating significant internal consistency and robustness within the identified questionnaire.

After formulating these hypotheses and specifying the parameters for examination, attention was turned to the research questions guiding the examination of the factor structure, reliability, and robustness of the identified questionnaire over time. This study seeks to answer the following two research questions.

Research Question 1: What changes are observed in the factor structure of the adjusted questionnaire based on the pilot sample compared to the original one?

Research Question 2: To what extent does the identified questionnaire demonstrate reliability and robustness over time based on both the pilot and main samples?

In summary, this introduction provides an overview of the significance of ICT use in education, the role of EFL teachers' attitudes towards ICT use in teaching practice, the need to develop an instrument measuring EFL teachers' attitudes towards it, checking its reliability and robustness over time, and positing hypotheses and research questions accordingly. In the following section, I will delve into the existing literature to contextualize my study within the broader research landscape and examine relevant studies and theories.

2. Literature review

After being modified and examined for reliability and robustness over time, the instrument was later employed in the main study, which aimed to examine primary school teachers' attitudes towards the use of ICT in EFL teaching in an underprivileged area in Vietnam. This research is part of a larger study, followed by an examination of teachers' actual use of ICT in their pedagogical practices. Taking these aims into account, this section will first delve into theories depicting the correlation between teachers' attitudes *toward*s ICT use and their adoption in teaching practices; second, I review relevant previously developed instruments measuring teachers' attitudes, and finally go deeper into TAC version 6.

2.1 Attitudes: Definition, theoretical and empirical background

Attitudes are defined as "a relatively enduring organization of beliefs, feelings and behavioral tendencies towards socially significant objects, groups, events or symbols" (Vaughan & Hogg, 2005, p. 154). Over the decades, attitudes have been recognized as "central to behavioral intentions and usage behaviors" in theories explaining the acceptance and adoption of technology (Dwivedi et al., 2019, p. 719). It has emerged as a pivotal factor influencing individuals' behaviors within traditionally established models. In the Theory of Reasoned Action developed by Ajzen and Fishbein in 1975, *attitudes*, together with *subjective norm,* contribute to the formation of behavioral intentions, consequently impacting actual behaviors. Similarly, the Theory of Planned Behavior (TPB; Ajzen, 1991) asserts that *attitudes,* coupled with *subjective norm* and *perceived behavioral control,* play a crucial role in predicting and explaining individuals' behaviors. Five years later, Taylor and Todd (1995) extended the TPB by introducing the decomposed Theory of Planned Behaviour (DTPB). This model aims to clarify user behaviors by examining the associations between *beliefs, attitudes, intention,* and *behaviour.* Attitudes play a central role in predicting individuals' usage behaviors.

It is worth noting that in some other frameworks, attitudes still exert their influence on technology adoption but under various construct names. The Social Cognitive Theory (SCT), extended to the context of information technology utilization by Compeau and Higgins (1995), is an example. *Affect*, representing the positive feelings an individual experiences when using computers, and *anxiety,* reflecting the negative emotions one may encounter during computer use*,* grouped into *affective factors,* exhibit a direct impact on *usage.* Another theoretical framework, namely the Model of PC Utilization (MPCU; Thompson et al., 1991), also consists of the construct *affect towards use,* which refers to "feelings of joy, elation, or pleasure, or depression, disgust, displeasure, or hate associated by an individual with a particular act" (p. 127).

Over time, theories aiming to elucidate technology usage behavior have received substantial attention from researchers and undergone continuous development. Notably, attitudes have consistently proven their role as predictors of actual utilization in practical settings. In 2001, Ajzen conducted a comprehensive examination of the role of attitudes within the TPB framework and investigated the relationship between attitudes and behavior in multiple prior studies. The research results reaffirmed the significant exploratory and predictive capabilities of attitudes in elucidating and forecasting behavior. Similarly, Teo et al. (2016) validated their extended TPB, identifying that attitudes towards computer use had the most

substantial positive impact on the intention to use technology, which consequently drove individuals to take specific actions. Despite their doubts on the role of affective attitude constructs in predicting the adoption of Information Systems (IS), Yang and Yoo (2004) shed light on the significance of *cognitive attitude* as a critical factor in explaining it within their study, extending Davis's (1989) Technological Acceptance Model (TAM).

Previous empirical studies have demonstrated that teachers' attitudes correlate with their decisions on the use of ICT in their teaching practices. For instance, a study in the Syrian context by Albirini (2006) emphasized that teachers had positive attitudes towards computers, leading them to make decisions about using computers in in-class teaching. This finding aligns with those of Yan and Piper (2003). Other studies (Teo & Bang Lee, 2010; Tondeur et al., 2008) shifted their focus to teachers' attitudes towards the use of technology, not the technology or computers themselves, and came to a similar conclusion that teachers' attitudes served as a significant predictor of their intention to utilize technology in pedagogical practices. Therefore, measuring teachers' attitudes is an indispensable step in predicting their integration of technology into teaching (Myers & Halpin, 2002), particularly for researchers, educational policymakers, and administrators.

2.2 Measurement of teachers' attitudes

Many instruments have been developed to measure teachers' attitudes towards technology and its use in teaching. Some focused on teachers' attitudes towards technology itself, and the term *computers* was used to refer to technology in their instruments (e.g., Albirini, 2006; Teo et al., 2007). Others emphasized teachers' attitudes towards the use of technology, but the use mentioned in the questionnaire was still restricted to *Computers* (e.g., Al-Zaidiyeen et al., 2010). Nevertheless, the continuous development of technology in education, specifically in EFL teaching, has led to the introduction of novel instructional opportunities integrated with new technological advancements (Murray, 2007). As a result, it is likely that teachers' attitudes towards ICT use in their pedagogical practices may change over time. Consequently, it is critical to re-examine the instruments employed to gauge teachers' attitudes in this field and to clarify ICT use within these instruments.

Attitudes themselves are multidimensional constructs (Teo, 2008) that are measured diversely based on different sets of dimensions. Nevertheless, the existing body of literature has recorded a considerable number of studies in which instruments gauging attitudes as a unidimensional construct were employed. A prime illustration is found in Al-Zaidiyeen et al. (2010), who adopted the 15-item questionnaire developed by Albirini (2006) to investigate teachers' attitudes and their utilization of technology in classroom teaching within the Jordanian research context. Similarly, Sang et al. (2010) conducted a study titled "*Student teachers' thinking processes and ICT integration: Predictors of prospective teaching behaviors with educational technology*", employing the Attitudes towards Computers in Education Scale (ACE), comprising eight items designed by Braak (2001). Another instance is found in the study carried out by Al-Emran et al. (2016), where attitudes towards the integration of mobile learning in higher education were measured as a unidimensional construct using a set of ten items designed by the authors. However, it is worth noting that Yang and Yoo (2004) revealed that while cognitive attitudes play a critical role in predicting ICT use, the influence of affective attitudes remains uncertain. Taking the research objective of examining the reliability and

robustness of the adapted questionnaire for further investigations into EFL teachers' attitudes towards ICT use and their actual use in pedagogical practices into account, the researcher deliberately considered choosing the questionnaire to be adapted in this study, ensuring that attitudes was treated as a multidimensional construct and comprised separate affective and cognitive attitudinal dimensions.

2.3 Questionnaire adaptation: Examining factor structure, reliability, and robustness

The TAC questionnaire version 6, developed by Christensen and Knezek (2009) based on 14 previous instruments (see Christensen & Knezek, 2009), gauges various dimensions of attitudes towards computer use, including enjoyment, anxiety, avoidance, e-mail, negative impact, productivity, and semantic perception of computers. It has undergone two significant refinements and was utilized to collect data over various time spans: 1995–1997, 1998–1999, 1999–2000, 2003, 2006, and 2008, confirming its consistently high psychometric attributes (Christensen & Knezek, 2009). Nevertheless, Christensen and Knezek (2009) cautioned that its robustness in maintaining stability in diverse international contexts should be scrutinized in further investigations. This underscores the importance of conducting the present study to examine the reliability and robustness of the questionnaire, especially after undergoing a number of major adjustments before and after running factor analysis.

To minimize the number of variables and subsequently explore the underlying factor structure, factor analysis is recommended (Pallant, 2010). This process involves taking a substantial number of variables and condensing them by simultaneously proposing the potential exclusion of certain variables and the underlying factor model. Several considerations should be taken into account before conducting the factor analysis. One such consideration is sample size, which is an aspect with limited consensus. Tabachnick and Fidell (2007) advocated for a minimum of 300 cases, but acknowledged that a smaller sample size, such as 150 cases, could be acceptable if certain marker variables in the solution exhibited high loadings. However, Nunnally (1978) proposed a ratio of 10 to 1, indicating that one item requires ten cases. In a recent study, Sürücü et al. (2022) proposed that 200 cases should be regarded as the lower threshold, suggesting that a sample size greater than 200 would be deemed sufficient. Other considerations worth examining include the intercorrelations among items, with numerous values equal to or exceeding .3 (Tabachnick & Fidell, 2007), Kaiser-Meyer-Olkin (KMO) coefficients greater than .6 (Kaiser, 1970, 1974), and the statistical significance of Bartlett's test of sphericity ($p > .05$; Pallant, 2010).

For item removal, the following criteria were applied. First, items with communality values lower than .5 were eliminated (Hair et al., 2019b). Second, items with loadings lower than .4 were also excluded (Howard, 2016). Third, items loaded on two factors or more with the difference between the primary and alternative factor loadings below .2 were dropped out (Howard, 2016). Finally, the items were removed based on the researchers' judgment regarding content validity. Concerning the determination of factors to be retained, it is recommended that their eigenvalues, indicating the extent to which they explain the total variance, should be 1.0 or above. (Pallant, 2010).

Calculating Cronbach's alpha values is an indispensable step after determining the factor model to inspect its reliability, with values greater than .6 considered acceptable in an exploratory study (Hair et al., 2019b). Similarly, Straub et al. (2004) noted that Cronbach's

Alpha and McDonald's Omega must surpass .6 in the post-analysis stage. Hair et al. (2019b) also emphasized that a well-constructed scale should exhibit reliability, indicating consistent scores across repeated applications on different samples.

This section is dedicated to reviewing references regarding the inspection of reliability and robustness, concluding the literature review, and setting the stage for the upcoming method section. The subsequent section presents an in-depth description of the participants, the development of the instrument assessing EFL teachers' attitudes towards ICT use in pedagogical practices at the primary school level, the procedure of data collection, and data analysis.

3. Methods

3.1 Participants

The pilot study sample consisted of 202 EFL primary schoolteachers in Vietnam. The average age of the sample was M = 33.46 (SD = 6.23). Female teachers accounted for the highest proportion at 80.2%, while male teachers made up a small percentage of 8.4%, and the rest (11.4 %) reported not preferring to say. Most teachers obtained a bachelor's degree (63.9%). 21.8% of the participants acquired an associate's degree, nearly double the figure for those who gained a master's degree (9.3%). Only one participant (equivalent to 5%) completed a doctoral degree. Data were collected in 2021 through convenience sampling using an online platform. The data were initially used to obtain preliminary results regarding EFL primary school teachers' attitudes towards the use of ICT in teaching practice and the influence of demographic characteristics on their attitudes. Second, it was used to develop a reliable questionnaire to measure teachers' attitudes towards ICT use.

The data for the main study were collected from 598 EFL teachers from different primary schools in the Central Highlands of Vietnam, a mountainous area with numerous ethnic minority groups living together. The age distribution varied across the different groups. Specifically, the majority of the participants fell within the age group of 31-35 years (45.5%), followed by those age groups of 26-30 years (21.6%), 40 years and above (16.2%), 36-40 years (13.4%) and 20-25 years (3.3%). There were 41 male participants (6.9%), 514 female participants (86%), and 43 participants preferred not to say (7.2%). In terms of the highest degree, a significant percentage of teachers held a Bachelor's degree (69.6%). 14.9% obtained a master's degree, nearly the same as the figure for those who acquired a degree of association (14%). A small percentage of participants completed a doctoral degree (1.5%).

3. 2 Instrument

In this section, the researcher presents justifications for changes made to the original questionnaire and details the adjustments made to enhance the instrument's appropriateness and effectiveness. The instrument is described in detail.

The questionnaire to measure teachers' attitudes towards the use of ICT was mainly adapted from TAC version 6 (Christensen & Knezek, 2009). The original consists of 51 items under nine constructs: *Interest, Comfort, Accommodation, Interaction (E-mail), Concern,*

Utility, Perception, Absorption, and *Significance.* To tailor the questionnaire to the research goals of exploring teachers' attitudes toward ICT in EFL teaching in the Vietnamese context and to examine the impact of demographic characteristics on their attitudes, TAC version 6 underwent a thorough examination by the researcher and two experts in the same fields. As a result, several adjustments were made, which are presented in this section.

It is worth noting that the terms *factor* and *construct* are used interchangeably throughout this study. With the clear idea of developing and checking the reliability of the questionnaire developed based on TAC version 6 in mind, I carefully read each item to detect any potential issues and brainstorm their solutions. First, I selected several items from the previous version of TAC version 6, which might be potential items for factors in the questionnaire used in the Vietnam research context based on my own judgment to enrich the item pool (e.g., *I like using technologies in my teaching at school* under the factor *Interest*, and the item *I find it challenging to learn about technologies* under the factor *Comfort*). This is known as the first step in the process of developing and piloting questionnaires (Dörnyei, 2007). Next, I replaced the term *computers* with the term *technology* instead of ICT, which denotes "a diverse set of technological tools and resources used to communicate, and to create, disseminate, store, and manage information" '(UNDP, 2001, p. 2). For example, the item *A job using computers would be very interesting* is transformed into *A job using technology is interesting to me.*

For the second step, referred to as the "initial piloting of the item pool," I collaborated closely with an expert. We carefully reviewed all the items multiple times. During this stage, we identified and agreed upon certain issues, such as complicated language (e.g., *Computers intimidate me*), double-barreled questions (e.g., *Working with a computer makes me feel tense and uncomfortable; I think that working with computers would be enjoyable and stimulating*), and the irrelevance of the factor called *Interaction (E-mail)*.

Our approach involved rewording items with complex language and splitting double-barreled items into two single items, which can be easily understood by EFL primary school teachers at B2 level and above. For the construct *Interaction (E-mail)*, we shared the perspective that email was an unpopular means of interaction between teachers and students at the primary school level. Therefore, measuring EFL primary school teachers' attitudes towards the use of e-mails might not yield in-depth and valuable data (e.g., *The use of Email helps provide a better learning experience*, *The use of electronic mail (E-mail) makes the student feel more involved*).

It is worth noting that the pilot study was conducted during the Covid-19 pandemic, when online teaching and learning experienced a surge on various online platforms and became the sole option to maintain educational activities over the social distancing period. Accordingly, the interaction between the teachers and students was maintained online. As a consequence, we arrived at the decision to substitute the factor *Interaction (E-mail)* with *Online Interaction,* which focused on measuring teachers' attitudes towards online interaction; for example, *Online environment helps to increase students' talking time,* and *Online classrooms require less teachers' preparation than face-to-face ones.*

Afterwards, I sought the input of another expert to review the questionnaire, and she suggested excluding the factor *Perception*. This factor comprised five pairs of extreme adjectives positioned at the two ends of the spectrum (e.g., pleasant and unpleasant) and was measured using 7-point Likert scale. It would be challenging to run relevant statistical analyses, compare or combine the responses, and interpret the results, as the other factors of the questionnaire were measured using a 5-point Likert scale. I concur with her regarding these

concerns. Furthermore, this factor aimed to measure how teachers felt about computers, utilizing adjectives such as *comfortable, likable, pleasant, exciting,* which were somewhat covered by other factors, such as *comfort* and *interest*. Finally, as previously mentioned, this questionnaire was developed and validated for use in a smaller study within a larger research project. In this broader study, I conducted interviews with teachers to gain an in-depth understanding of their attitudes towards the use of ICT in EFL teaching and its actual implementation in teaching practice. In my judgment, the decision to eliminate this factor does not result in data loss or violation of theories.

After completing these steps, the final version of the questionnaire consisted of 62 content questions distributed across eight constructs: *Interest, Comfort, Accommodation, Online Interaction, Concern, Utility, Absorption,* and *Significance*. All items under these eight factors were rated on a 5-point Likert scale, ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The developed questionnaire is presented in Appendix 1. In addition, the original version, or TAC version 6, is presented in the Appendix section under Appendix 2.

The questionnaire used in the main study was obtained from an EFA conducted on a pilot study sample. It consisted of 51 items under seven constructs, including *Significance, Comfort, Interest, Online Interaction, Concern, Absorption,* and *Negative Impact on Society* and 14 questions regarding information background.

3. 3 Procedure

Prior to data collection for the pilot study, the questionnaire was created on an online platform (Google form) and sent to two teachers to verbalize their thoughts during the completion of the questionnaire, known as the think-aloud protocol. They showed different understandings of the phrase *learning difficulties*, both of which were accepted in this study. Therefore, no further changes were made after this step. Afterwards, the link to access the questionnaire was sent to my colleagues through private messages on social media, and they were also asked to spread it to their colleagues. The link was posted on pages for EFL primary teachers in Vietnam.

As for the main study, the questionnaire was also created on an online platform (Google Form). E-mail addresses were collected to check for repeated responses from the same respondents. It was posted on various pages for primary EFL school teachers. However, only EFL teachers from primary schools in the Central Highlands of Vietnam were asked to administer the questionnaire because of the research scope. In addition, the link was shared on social media accounts such as Facebook and Zalo, which are widely used in the Vietnamese context. They were also distributed to my colleagues via email and through private messages. Finally, with the valuable support of five officers currently working in five Provincial Departments of Education and Training and responsible for the EFL sector at the primary school level, the questionnaire access link was sent to all primary schools in five provinces in the Central Highlands. This effort contributed significantly to maximizing the response rate of the questionnaire.

3. 4 Data analysis

EFA was conducted using the Statistical Package for Social Sciences (SPSS) version 26. The approach for determining the number of factors to extract was Kaiser’s criterion, or the

eigenvalue rule, in which only factors with an eigenvalue equal to or greater than 1.0 were retained for further examination (Pallant, 2010). Principal component analysis was chosen as the extraction method because of its ability to generate a more structured and interpretable model (Hair et al., 2019). The Varimax method was chosen, as it was suggested to be the most used by Hair et al. (2019). Factor loadings were categorized as weak (<.4), moderate (.4 to .6), or strong (> .6; Kline, 2014). In this study, only items with factor loadings equal to or greater than .5 were displayed.

Cronbach's alpha (α) and McDonald's omega (ω) were then calculated for each new factor of the specified factor model resulting from the EFA, using the pilot study sample and the main study sample. These values must be above .60 to ensure the reliability of the factor structure (Straub et al., 2004).

4. Results and discussion

To test Hypothesis 1, an EFA was conducted to examine the underlying factor structure of the pilot study data. The sample size (n = 202) was adequate to run the EFA, satisfying the threshold recommended by Sürücü et al. (2022). An examination of the correlation matrix revealed many coefficients of .3 and above (Tabachnick & Fidell, 2007). The Kaiser-Meyer-Olkin (KMO) was .87, greater than the threshold of .6 (Kaiser, 1970, 1974), and Bartlett's test of sphericity was statistically significant (p <.05; Pallant, 2010), confirming the suitability of the correlation matrix for factor analysis.

After several rounds of eliminating items based on the aforementioned criteria in the literature review section and rerunning the EFA with principal component analysis and the varimax method, a seven-factor model was revealed, with eigenvalues greater than 1, explaining a total of 62.16 percent of the variance. Eleven items were removed: COM3, COM6, ACC2, ACC4, ACC5, ONIN7, UT1, UT7, AB5, AB6, and AB7.

The Kaiser-Meyer-Olkin Measure of Sampling Adequacy was .88, and Bartlett's test of sphericity was significant (p <.05), indicating that the factor analysis was appropriate. The correlation matrix table was also examined and numerous coefficients above .3 were found (Tabachnick & Fidell, 2007). None of the items had a communality value below .5. Table 1 presents a rotated matrix with seven constructs.

For Hypothesis 2, Cronbach's alpha and McDonald's omega values were calculated to examine the internal consistency of new constructs using samples from the pilot study and the main study. The results showed that all new constructs had internal consistency. In the pilot study sample, Cronbach's alpha and McDonald's omega coefficients ranged from .7 to .9 (see Table 2). For the main study sample, they fell between .6 and .9 (see Table 2). These findings support Hypothesis 2, providing evidence for the questionnaire's reliability and robustness.

The EFA results suggest a seven-factor model that displays several variances from the questionnaire developed in the previous stage (see Table 1). Thus, Hypothesis 1 was supported, indicating alterations in factor structure. According to Hair et al. (2019b), once the factor solution is obtained, the researcher labels or names the factors. The label or name of a factor represents its variable loading. They also emphasized that variables with stronger loadings had a greater impact on determining the factor name.

Table 1. Factor Loadings for retained items in the Seven-Factor Model

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9
SIG6	.795								
SIG3	.780								
SIG5	.774								
SIG4	.747								
SIG1	.738								
UT5	.726								
SIG2	.718								
UT3	.717								
UT2	.679								
UT4	.678								
UT6	.658								
UT8	.578								
COM9		.842							
COM8		.829							
COM5		.807							
COM7		.802							
COM2		.769							
COM1		.725							
ACC1		.713							
COM4		.666							
ACC6		.639							
ACC3		.570							
I6			.768						
I7			.764						
I2			.760						
I3			.746						
I5			.715						
I1			.713						
I4			.684						
ONIN5				.824					
ONIN3				.786					
ONIN6				.772					
ONIN9				.756					
ONIN10				.740					
ONIN8				.664					
ONIN2				.537					
ONIN4				.524					
CON5					.807				
CON4					.803				
CON7					.662				
CON6					.634				
CON9					.511				
AB3						.758			
AB1						.750			
AB4						.654			
AB2						.601			

ONIN1							.649		
CON2							.648		
CON1							.630		
CON8							.542		
CON3							.509		

Note. Factor loadings represent the strength and direction of the relationship between each item and corresponding factor in the model. SIG, UT, COM, ACC, I, ONIN, CON, and AB represent the *Significance, Utility, Comfort, Accommodation, Interest, Online Interaction,* and *Absorption*, respectively.

Table 2 Cronbach's Alpha and McDonald's Omega Coefficients for Retained Items in the Seven-Factor Model: Pilot Study Sample and Main Study Sample

Factors	**Items**	**Standard item code**	**Pilot Study Sample**		**Main Study Sample**	
			α	**ω**	**α**	**ω**
Significance	12	SIG1, SIG2, SIG3, SIG4, SIG5, SIG6, UT2, UT3, UT4, UT5, UT6, UT8	.933	.933	.923	.923
Comfort	10	COM1, COM2, COM4, COM5, COM7, COM8, COM9, ACC1, ACC3, ACC6	.901	.926	.909	.918
Interest	7	I1, I2, I3, I4, I5, I6, I7	.913	.914	.877	.877
Online Interaction	8	ONIN2, ONIN3, ONIN4, ONIN5, ONIN6, ONIN8, ONIN9, ONIN10	.883	.887	.812	.830
Concern	5	CON4, CON5, CON6, CON7, CON9	.846	.847	.787	.793
Absorption	4	AB1, AB2, AB3, AB4	.830	.832	.690	.697
Negative Impact on Society	5	ONIN1, CON1, CON2, CON3, CON8	.723	.723	.604	.605

With these guidelines in mind, the first and second factors were named *Significance* and *Comfort,* respectively. To be more specific, the first new factor in Table 1 consists of 12 items from two former constructs: *Significance* and *Utility*; however, the *Significance* items had much higher factor loadings than the *Utility* items. The second factor in Table 1 was given the name *Comfort* as *Comfort* not only revealed greater factor loadings, but also outnumbered *Accommodation* items.

Subsequently, no change was found in the third construct in the new factor solution (see Table 1) in terms of the number of items and the items themselves compared with the original *Interest* construct. As a result, the factor name *Interest* remains unchanged. Similarly, all *Online*

Interaction items, except for ONIN7, which was removed in the previous step, were found to load on one factor, with loadings ranging from .52 to .82. Hence, the label *Online Interaction* remained unchanged.

One of the significant changes was that the items under the original construct *Concern* were split into two groups. A thorough examination of these items revealed that one group consisted of statements measuring concerns about the negative impact of technology use on teachers or students (e.g., *Using technologies prevents me from being creative*, and *If I use technologies, I become addicted to them*), while the other comprised items measuring concerns about the impact on society in general (e.g., *Technologies are changing the world rapidly* and *Technologies can take away people's jobs*). It is clear that this distinction was minor. However, I accepted this solution and gave them the labels *Concern* and *Negative Impact on Society*. In fact, *Negative Impact on Society* was not a new factor name, as it was used in the previous version of TAC version 6 (see Christensen & Knezek, 2009). In other words, the fifth factor of the seven-factor model was named *Concern,* including five items, CON4, CON5, CON6, CON7, and CON9 and *Negative Impact on Society* was the seventh factor with five items, ONIN1, CON1, CON2, CON3, and CON8 (see Table 1).

Finally, the sixth construct of the solution, containing four items (AB1, AB2, AB3, and AB4) with factor loadings between .60 and .75, was assigned the name *Absorption* as it was in the original scale.

The reliability coefficients calculated using the pilot study sample and the main study sample were consistent. Specifically, Cronbach's Alpha and McDonald's omega values, ranging from an acceptable to an excellent level, suggested that the internal consistencies of these factors also fell within the acceptable to excellent level (see Table 2; Straub et al., 2004). Therefore, it can be concluded that the items under these factors within the specified factor model reliably measure their underlying factors. Additionally, this consistency not only demonstrated a degree of robustness in the identified factors across various samples but also supported the generalizability of the questionnaire.

The validated questionnaire for measuring EFL primary school teachers' attitudes towards ICT use in their teaching practice offers significant practical implications for both researchers and educational organizations. Researchers, educational policymakers, and administrators can use this instrument as a reliable tool to assess teachers' attitudes towards the integration of technologies in educational settings. Subsequently, it can help elucidate the actual use of ICT by teachers in pedagogical practices, offering valuable insights for decision makers in tailoring or suggesting development or training programs that aim to foster more effective and sustainable utilization of ICT in classroom teaching.

Apart from the promising results regarding the reliability and generalizability of the questionnaire developed based on TAC version 6, this study, as well as the measure, is not without limitations. First, the majority of participants in both the pilot and main studies were female EFL teachers, leading to a major gender imbalance. This issue may affect the generalizability of the study's findings to settings with different gender compositions. Second, the study was conducted in a given context, namely EFL teaching at the primary school level in Vietnam. Further use of the measure at different levels or in different contexts should be considered to examine its applicability. Hopefully, more studies will be carried out to test the reliability and validity of the questionnaire in various populations in different contexts of English teaching and learning. However, with the promising results found in this study, the

questionnaire, which was developed based on TAC version 6 (Christensen & Knezek, 2009) and later underwent several rounds of refinement, adjustment, and development, is undoubtedly recommended for future use.

5. Conclusion

This study aimed to develop and check the reliability of a questionnaire developed based on TAC version 6 (Christensen & Knezek, 2009). The original was built in 2009 and needs to be re-examined for the research purpose of investigating teachers' attitudes towards ICT utilization in EFL teaching due to the fast-paced advancement of technologies and changes in ICT integration over time, especially after the Covid-19 pandemic. A new seven-factor model was revealed after running the EFA using the pilot study data. Compared to the adjusted version of the questionnaire before EFA, items under two factors *Utility* and *Accommodation* were merged into other factors, and one new factor emerged, namely *Negative Impact on Society*, with most items originally coming from the *Concern* factor. Evidence of internal consistency in the newly identified factors was found in both the pilot study and the main study, leading to the conclusion that the questionnaire developed based on TAC version 6 showed a degree of stability and robustness across samples and gained reliability for future use.

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Appendix 1

Questionnaire

Thank you for participating in this study.

My name is Vuong Thi Hoan. I am a doctoral student at the Faculty of Humanities, Eötvös Loránd University, Hungary. I am doing a piece of research on teachers' attitudes towards the use of Information Communication Technology (ICT) in language teaching. Therefore, this questionnaire aims to ask teachers at primary schools in Vietnam for information about their background and attitudes towards ICT use in language teaching. If you have any question, please do not hesitate to contact me at hoanvuong@student.elte.hu

The questionnaire should be completed by you only. It should take about 15-20 minutes to complete.

This is not a test so there are no "right" or "wrong" answers. I am interested in your personal opinion. Please give your answers sincerely. If you do not know an answer precisely, your best estimate will be adequate for the purposes of the study.

Your answers will be kept confidential. No blank in the questionnaire requires your name fulfillment. They will be combined with answers from other teachers to calculate totals and averages in which no single teacher can be identified.

Thank you very much for your help.

Teachers' attitudes towards ICT use

Part 1

Instruction: select one level of agreement that best describes how you feel

1: strongly disagree 2: disagree 3: undecided 4: agree 5: strongly agree

1	A job using technologies is interesting to me.	1	2	3	4	5
2	I want to learn about technologies which I can use in my teaching.	1	2	3	4	5
3	I can explore a lot of interesting things when I use technologies in my teaching	1	2	3	4	5
4	I like using technologies in my teaching at school.	1	2	3	4	5
5	I think that working with technologies is enjoyable.	1	2	3	4	5
6	I find it exciting to learn about technologies.	1	2	3	4	5
7	I think that working with technologies is stimulating.	1	2	3	4	5

Part 2

Instruction: select one level of agreement that best describes how you feel
1: strongly disagree 2: disagree 3: undecided 4: agree 5: strongly agree

1	I feel anxious when I use technologies.	1	2	3	4	5
2	Working with technologies makes me feel frightened.	1	2	3	4	5
3	I find it challenging to learn about technologies.	1	2	3	4	5
4	Some technologies can be difficult to understand.	1	2	3	4	5
5	Working with technologies makes me feel worried.	1	2	3	4	5
6	I do not feel confident when it comes to working with technologies.	1	2	3	4	5
7	I feel anxious even when I think of using technologies.	1	2	3	4	5
8	Using technologies can be annoying.	1	2	3	4	5
9	Working with technologies makes me feel nervous.	1	2	3	4	5

Part 3

Instruction: select one level of agreement that best describes how you feel
1: strongly disagree 2: disagree 3: undecided 4: agree 5: strongly agree

1	I prefer not to take a job where I have to work with technology.	1	2	3	4	5
2	I don't use technologies in my teaching if I don't have to.	1	2	3	4	5
3	I can't think of any way to use technologies in my teaching.	1	2	3	4	5
4	I probably never use some technologies.	1	2	3	4	5
5	Learning about technologies is a waste of time.	1	2	3	4	5
6	I see the technologies as something I rarely use in my daily life.	1	2	3	4	5

Part 4

Instruction: select one level of agreement that best describes how you feel
1: strongly disagree 2: disagree 3: undecided 4: agree 5: strongly agree

1	I prefer online instruction.	1	2	3	4	5
2	Online environment helps to increase students' talking time.	1	2	3	4	5
3	Online instruction helps students understand the content easily.	1	2	3	4	5
4	Online classrooms require less teachers' preparation than face-to-face ones.	1	2	3	4	5
5	Online environment helps to increase the quality of interaction between teachers and students.	1	2	3	4	5
6	On-line environment makes it easy to communicate with students in class	1	2	3	4	5
7	Online communication is less stressful for the students than face-to-face one.	1	2	3	4	5
8	Students feel comfortable to answer questions presented in online classes.	1	2	3	4	5
9	Online environment provides a good teaching experience.	1	2	3	4	5
10	Online instruction is more efficient than in-person one.	1	2	3	4	5

Part 5						
Instruction: select one level of agreement that best describes how you feel 1: strongly disagree 2: disagree 3: undecided 4: agree 5: strongly agree						
1	Technologies are changing the world too rapidly.	1	2	3	4	5
2	Technologies have the potential to control our lives.	1	2	3	4	5
3	Technologies can take away people's jobs.	1	2	3	4	5
4	Using technologies prevents me from being creative	1	2	3	4	5
5	Technologies isolate people by preventing social interactions among user	1	2	3	4	5
6	If I use technologies, I become addicted to them.	1	2	3	4	5
7	The use of technologies in teaching distracts students' attraction.	1	2	3	4	5
8	Some teachers rely too much on technologies.	1	2	3	4	5
9	Working with technologies makes me feel isolated from other people	1	2	3	4	5
Part 6						
Instruction: select one level of agreement that best describes how you feel 1: strongly disagree 2: disagree 3: undecided 4: agree 5: strongly agree						
1	Technologies could help learners with learning difficulties understand	1	2	3	4	5
2	Technologies help me with teaching activities.	1	2	3	4	5
3	Technologies improve the overall quality of life.	1	2	3	4	5
4	Technologies are necessary tools in educational settings.	1	2	3	4	5
5	Technologies help to improve education.	1	2	3	4	5
6	Technologies can increase my productivity.	1	2	3	4	5
7	Using technologies helps me to be a good teacher.	1	2	3	4	5
8	Technologies can be useful instructional aids in almost all subject areas.	1	2	3	4	5
Part 7						
Instruction: select one level of agreement that best describes how you feel 1: strongly disagree 2: disagree 3: undecided 4: agree 5: strongly agree						
1	I like reading about technologies.	1	2	3	4	5
2	I always try to use technologies in my teaching as much as I can.	1	2	3	4	5
3	I like to talk to others about technologies	1	2	3	4	5
4	When there is a technological problem that I can't immediately solve, I stick with it until I have the answer.	1	2	3	4	5
5	It is fun to figure out how technologies work.	1	2	3	4	5
6	I don't like the challenge of solving problems with technologies.	1	2	3	4	5
7	If a technological problem is left unsolved in a class, I continue to think about it afterward.	1	2	3	4	5
Part 8						
Instruction: select one level of agreement that best describes how you feel 1: strongly disagree 2: disagree 3: undecided 4: agree 5: strongly agree						
1	Technologies can encourage creativity in students.	1	2	3	4	5
2	All students should have an opportunity to learn with	1	2	3	4	5

	technologies at school.					
3	Having technological skills helps one get a good job.	1	2	3	4	5
4	It is important for students to learn with technologies in order to be informed citizens.	1	2	3	4	5
5	Technologies can provide students with different methods of learning.	1	2	3	4	5
6	Students should understand the role technologies play in society.	1	2	3	4	5

Background information

1. What gender do you identify as?
   - ☐ Male
   - ☐ Female
   - ☐ Prefer not to answer
2. What is your age?
3. What is the highest degree or level of education you have completed?
   - ☐ Degree of Associate
   - ☐ Degree of Bachelor
   - ☐ Degree of Master
   - ☐ Degree of Doctor of Philosophy or higher
4. What is your current employment status?
   - ☐ A contract teacher
   - ☐ A permanent teacher
5. What type of school are you teaching at?
   - ☐ A private school
   - ☐ A public school
6. Where is your school located?
   - ☐ North Vietnam
   - ☐ Central Vietnam
   - ☐ South Vietnam
   - ☐ Central Highlands, Vietnam
7. Please specify your school district
   - ☐ Rural
   - ☐ Urban
8. I am teaching at
   - ☐ 1st grade
   - ☐ 2nd grade
   - ☐ 3rd grade
   - ☐ 4th grade
   - ☐ 5th grade
9. How many years of teaching experience do you have?

10. Have you ever attended any training courses on technology use in language teaching organized by the Department of Education and training?

☐ Yes

☐ No

11. Have you ever attended any online training courses on technology use in language teaching?

☐ Yes

☐ No

12. Do you want to add any comments on technology use?

Appendix 2

Teachers' Attitudes Toward Computers (Christensen & Knezek, 2009)

This questionnaire is derived from well-validated portions of several attitudinal surveys that have been used with teachers in the past. We will use your responses to help develop a profile of how teachers view technology. Please complete all items, even if you feel that some are redundant. This should require about 10 minutes of your time. Usually, it is best to respond with your first impression without giving a question much thought. Your answers will remain confidential.

ID: Group:	Use the ID assigned to you or if there is no assigned ID, use the last four digits of your social security #				
Part 1 Instructions: Select one level of agreement for each statement to indicate how you feel. SD = Strongly Disagree, D = Disagree, U = Undecided, A = Agree, SA = Strongly Agree					
	SD	D	U	A	SA
1. I think that working with computers would be enjoyable and stimulating. (186)	1	2	3	4	5
2. I want to learn a lot about computers. (103)	1	2	3	4	5
3. The challenge of learning about computers is exciting. (211)	1	2	3	4	5
4. I like learning on a computer. (181)	1	2	3	4	5
5. I can learn many things when I use a computer. (9)	1	2	3	4	5
Part 2 Instructions: Select one level of agreement for each statement to indicate how you feel. SD = Strongly Disagree, D = Disagree, U = Undecided, A = Agree, SA = Strongly Agree					
	SD	D	U	A	SA
1. I get a sinking feeling when I think of trying to use a computer. (263)	1	2	3	4	5
2. Working with a computer makes me feel tense and uncomfortable. (230)	1	2	3	4	5
3. Working with a computer makes me nervous. (17)	1	2	3	4	5
4. Computers intimidate me. (227)	1	2	3	4	5
5. Using a computer is very frustrating. (18)	1	2	3	4	5
Part 3 Instructions: Select one level of agreement for each statement to indicate how you feel.					

SD = Strongly Disagree, D = Disagree, U = Undecided, A = Agree, SA = Strongly Agree					
	SD	D	U	A	SA
1. If I had a computer at my disposal, I would try to get rid of it. (150)	1	2	3	4	5
2. Studying about computers is a waste of time. (192)	1	2	3	4	5
3. I can't think of any way that I will use computers in my career. (74)	1	2	3	4	5
4. I will probably never learn to use a computer. (154)	1	2	3	4	5
5. I see the computer as something I will rarely use in my daily life. (123)	1	2	3	4	5
Part 4 Instructions: Select one level of agreement for each statement to indicate how you feel. SD = Strongly Disagree, D = Disagree, U = Undecided, A = Agree, SA = Strongly Agree					
	SD	D	U	A	SA
1. The use of electronic mail (E-mail) makes the student feel more involved. (282)	1	2	3	4	5
2. The use of E-mail helps provide a better learning experience. (284)	1	2	3	4	5
3. The use of E-mail makes a class more interesting. (281)	1	2	3	4	5
4. The use of E-mail helps the student learn more. (283)	1	2	3	4	5
5. The use of E-mail increases motivation for class. (280)	1	2	3	4	5
Part 5 Instructions: Select one level of agreement for each statement to indicate how you feel. SD = Strongly Disagree, D = Disagree, U = Undecided, A = Agree, SA = Strongly Agree					
	SD	D	U	A	SA
1. Computers are changing the world too rapidly. (142)	1	2	3	4	5
2. I am afraid that if I begin to use computers I will become dependent upon them. (215)	1	2	3	4	5
3. Computers dehumanize society by treating everyone as a number. (138)	1	2	3	4	5
4. Our country relies too much on computers. (135)	1	2	3	4	5
5. Computers isolate people by inhibiting normal social interactions among users. (144)	1	2	3	4	5
6. Use of computers in education almost always reduces the personal treatment of students. (176)	1	2	3	4	5
7. Computers have the potential to control our lives. (134)	1	2	3	4	5
8. Working with computers makes me feel isolated from other people. (241)	1	2	3	4	5
Part 6 Instructions: Select one level of agreement for each statement to indicate how you feel. SD = Strongly Disagree, D = Disagree, U = Undecided, A = Agree, SA = Strongly Agree					
1. Computers could increase my productivity. (202)	SD	D	U	A	SA
2. Computers can help me learn. (204)	1	2	3	4	5
3. Computers are necessary tools in both educational and work settings. (226)	1	2	3	4	5
4. Computers can be useful instructional aids in almost all subject areas. (175)	1	2	3	4	5
5. Computers improve the overall quality of life. (207)	1	2	3	4	5

6. If there was a computer in my classroom it would help me to be a better teacher. (163)								1	2	3	4	5
7. Computers could enhance remedial instruction. (168)								1	2	3	4	5
8. Computers will improve education. (162)								1	2	3	4	5
Part 7 Instructions: Choose one location between each adjective pair to indicate how you feel about computers.												
Computers are:												
1. unpleasant	1	2	3	4	5	6	7	pleasant	(44)			
2. suffocating	1	2	3	4	5	6	7	fresh	(50)			
3. dull	1	2	3	4	5	6	7	exciting	(49)			
4. unlikable	1	2	3	4	5	6	7	likeable	(41)			
5. uncomfortable	1	2	3	4	5	6	7	comfortable	(46)			
Part 8 Instructions: Select one level of agreement for each statement to indicate how you feel. SD = Strongly Disagree, D = Disagree, U = Undecided, A = Agree, SA = Strongly Agree												
								SD	D	U	A	SA
1. I like to talk to others about computers. (98)								1	2	3	4	5
2. It is fun to figure out how computers work. (193)								1	2	3	4	5
3. If a problem is left unsolved in a computer class, I continue to think about it afterward. (85)								1	2	3	4	5
4. I like reading about computers. (100)								1	2	3	4	5
5. The challenge of solving problems with computers does not appeal to me. (57)								1	2	3	4	5
6. When there is a problem with a computer that I can't immediately solve, I stick with it until I have the answer. (69)								1	2	3	4	5
Part 9 Instructions: Select one level of agreement for each statement to indicate how you feel. SD = Strongly Disagree, D = Disagree, U = Undecided, A = Agree, SA = Strongly Agree												
1. It is important for students to learn about computers in order to be informed citizens. (96)								SD	D	U	A	SA
2. All students should have an opportunity to learn about computers at school. (95)								1	2	3	4	5
3. Students should understand the role computers play in society. (172)								1	2	3	4	5
4. Having computer skills helps one get better jobs. (97)								1	2	3	4	5
5. Computers could stimulate creativity in students. (199)								1	2	3	4	5

Thank you for your time.