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EFL teachers' pedagogical beliefs, pedagogical content knowledge, and instructional material use: a scale development and validation

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ABSTRACT

Teachers' pedagogical beliefs (PB) and knowledge base of teaching play a prominent role in determining their instructional practices, including instructional material use (MU). Instructional materials provide students with information and facilitate learning, allowing meaningful learning. However, teachers' MU likely affects the effectiveness of their teaching, and the decision on their MU relies on their PB and their knowledge base of teaching, which includes pedagogical knowledge (PK), content knowledge (CK), and pedagogical content knowledge (PCK). Although some studies have investigated how teachers' PCK affects their pedagogical beliefs, studies, which investigate the interrelationship between teachers' PB, PCK, and MU, are absent. Consequently, there is yet an instrument that measures the interplay of these essential factors in English language teaching (ELT). Therefore, this study aimed to adapt and validate the EFL teachers' PB, PCK, and MU. Two hundred sixty in-service secondary school English teachers in Indonesia participated in the study. The validated version of EFL teachers' PB, PCK, and MU (EFLT-PBPCKMU) had six factors and 25 items measuring teachers' PB, PCK, and MU using the 5-point Likert scale. The EFLT-PBPCKMU scale had satisfactory psychometric characteristics and model fits, as demonstrated by exploratory and confirmatory factor analysis results.

IMPACT STATEMENT

The scale of EFL teachers' pedagogical beliefs, pedagogical content knowledge, and instructional material use measures the effect of pedagogical beliefs and pedagogical content knowledge of EFL teachers on their material use approach. The scale can be adapted to measure teachers' material use approach in another field so that stakeholders can plan future directions for teachers' development programs particularly on material use, to maximize the effects of the materials on students' learning and knowledge acquisition. Furthermore, the development and adaptation processes provide researchers with a framework for developing or adapting a reliable and valid scale based on psychometric analyses.

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1. Introduction

The national standard principles of the Indonesian secondary curriculum emphasize students as the central focus of the learning process, with teachers acting as facilitators to enhance learning activities (Kemendikbud, 2013). The principle adopts constructivist beliefs, focusing on creating a stimulating, challenging, and individually adapted learning environment that supports students' knowledge construction (OECD, 2009). However, studies show that Indonesian teachers have both transmissive and constructivist beliefs (Armin & Siregar, 2021; Inayati & Emaliana, 2017), indicating that their teaching practices do not

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fully meet the national standard. Therefore, investigating factors influencing teachers' instructional practices is crucial to meeting the national standard.

Teachers' instructional practice, mainly how they teach materials, significantly impacts students' learning, motivation (Masuhara, 2022), and teachers' professional development (Shawer, 2010). Teachers' approaches to how they teach materials fall into transmissive (fidelity) and constructivist (adaptation and enactment) approaches (Çeliker-Ercan & Çubukçu, 2023; Masuhara, 2022; Shawer, 2010). The fidelity approach refers to teachers' adherence to curriculum materials; in contrast, adaptation and enactment approaches refer to material modifications made to meet students' needs (Masuhara, 2022; Shawer, 2010). It is argued that adaptation and enactment approaches to curriculum materials are ways to meet a specific group's needs since teachers who adapt or make their materials have more control to meet student needs and achieve educational goals (Bell & Gower, 2011; Harwood, 2010). Conversely, close adherence to curriculum materials makes a teacher a passive knowledge transmitter who follows preconceived objectives and content, which cannot suffice students' differences, affecting their learning motivation (Masuhara, 2022; Shawer, 2010). However, their MU decision is influenced by their professional competence, which includes PK, CK, PCK, and PB (Blömeke & Delaney, 2012). Teachers' PB functioning as a filter to their instructional practices directs them to use and implement a transmissive approach, constructivist approach, or both approaches in their teaching practices (Habte et al., 2021; Lörincz, 2023; Tran-Thanh, 2021). Therefore, teachers with constructivist beliefs may implement student-centered curricula (Ertmer et al., 2012), directing them to adapt or develop instructional materials (Shawer, 2010); in contrast, teachers with transmissive beliefs may follow the curriculum materials without any modifications. Nevertheless, their pedagogical beliefs may be congruent or not congruent with their practices depending on factors such as teaching environment, knowledge about students, pedagogical knowledge, and content knowledge acquired during pre-service training (Gao & Cui, 2024; Habte et al., 2021; Tan & Matsuda, 2020). Hence, teachers CK, PK, and PB likely predict how teachers use instructional materials.

Owing to teachers' professional competence covering their PCK and PB, and these two components influence their instructional practices, including how they use instructional materials, it is substantial to have empirical evidence that shows the interrelationships among these components. Pajares (1992) points out that it is essential to investigate the relationships between teacher beliefs, teacher practices, teacher knowledge, and student outcomes. Tomlinson (2022) also suggests investigating how teachers use material in their teaching practice and finding factors that influence their practices. Even though there have been several studies investigating the relationship between teachers' pedagogical beliefs and TPACK (Wu et al., 2022) and teachers' beliefs and materials fidelity (Pourhaji et al., 2023), teachers' beliefs and practices (Gao & Cui, 2024; Habte et al., 2021; Lörincz, 2023), studies investigating interrelationships among PB, PCK, and MU for ESL/EFL are overlooked. Accordingly, there is a need to develop a new instrument that can collect data on the interplay of teachers' PB, PCK, and instructional MU. Therefore, the objectives of this study are twofold: 1) Develop an instrument to collect data on interrelationships among teachers' PB, PCK, and MU by adapting the available teachers' PB, PCK, and MU questionnaires, and 2) evaluate the validity and reliability of the developed instrument by using data collected from English teachers at higher level of secondary school in Indonesia. The validated questionnaire may provide insights into the interplay between teachers' PB and their PCK on their instructional MU and provide implications for EFL teachers' professional development programs.

2. Literature review

2.1. The concept of the interrelationship between teachers' PB, PCK, and MU

Blömeke and Delaney (2012) classify teachers' professional competence into cognitive abilities and affective-motivational characteristics, which include general PK, CK, and PCK, as well as professional beliefs about teaching and learning and the subject content that determine their instructional practices, including how they use instructional materials (Shulman, 1986, 1987). Furthermore, Tran-Thanh (2021) found that teachers' pedagogical competence and beliefs affected their pedagogical practices. PCK involves the interactions of CK and pedagogical strategies in teachers' minds and teachers' understanding about learning difficulties that affect how they teach materials (Shulman, 1987), thereby promoting students understanding (Hartati

et al., 2019). The traditional view of teachers' pedagogical beliefs is centralized to knowledge transmitters, where the teacher's central role is transferring the knowledge; in contrast, the constructivist approach to teachers' pedagogical beliefs focuses on the learner's active construction of knowledge. Teachers who hold traditional beliefs may use instructional materials based on curriculum and focus on the traditional approach to teaching; those who hold constructivist beliefs tend to enact student-centered curricula (Ertmer et al., 2012), directing them to adapt or even develop instructional materials (Shawer, 2010). Instructional materials have significant roles in assisting teachers and students in language learning (Cunningsworth, 1995; Osikomaiya, 2020; Sun, 2010) as they provide exposure to the language, as a means of information, as a stimulus for other activities, and as a means of teacher education (Mishan & Timmis, 2015). Therefore, teachers' PB and PCK may determine how they use instructional materials. Figure 1 shows the concept of the interrelationship between teachers' PB, PCK, and MU.

2.2. Teachers pedagogical beliefs

Teachers' PB refers to specific teaching strategies and the appropriate theoretical drive underlying teacher actions (Schutz et al., 2020). These beliefs are formed and developed through information acquired through interactions (Schutz et al., 2020), which later likely influence one's thinking and decision-making (Bandura, 1997). Concerning teachers' beliefs, their actions and decision-making regarding instruction and practice depend on their beliefs (Schutz et al., 2020).

Provided teachers' PB have significant roles in teachers' instructional practices, many studies have investigated the relationships among teachers' PB and their Technological Pedagogical Content Knowledge (TPACK), focusing on two types of PB: learner-centered PB and teacher-centered PB. Wu et al. (2022) found that teachers with strong learner-centered and teacher-centered PB have better confidence in implementing their TPACK. Other studies investigated the effect of teachers' professional development programs on teachers' PB development and change. Lim and Chan (2007) attempted to shift pre-service teachers' traditional PB (teacher-centered) to constructivist beliefs (learner-centered) by providing pre-service teachers with a microlesson series experience. Although their beliefs remain the same, the microlessons enhance their confidence in designing multimedia-based learning and extend their knowledge of technology utilization to facilitate and enhance teaching and learning processes.

In contrast, teachers' PB changed from traditional to constructivist after experiencing project-based learning, which provided supportive policy and long-term experience at the institutional level (Nxasana et al., 2023). Previous studies on teachers' PB focused on how their PB influences their TPACK implementation and the effect of teachers' professional development programs on teachers' PB change and development. However, an investigation on how PCK and their PB can influence teachers' instructional materials use is overlooked.

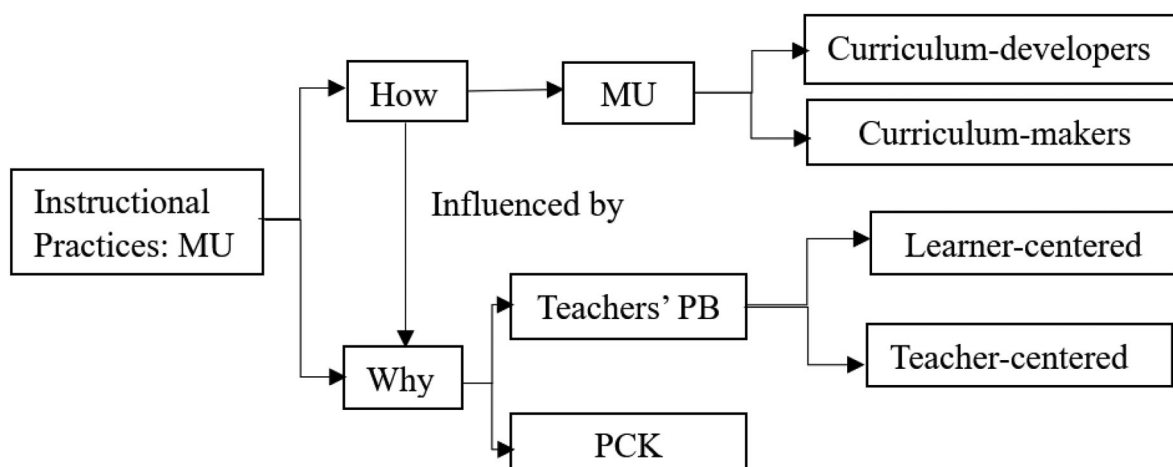


Figure 1. The concept of the interrelationship between teachers' PB, PCK, and MU. Adapted from Blömeke and Delaney (2012), Tomlinson and Masuhara (2018), and Shulman (1986, 1987).

2.3. Materials use in language classroom

Studies on MU investigate how teachers and students use instructional materials in the classroom and the factors affecting teachers' actions. Instructional MU refers to "the ways that teachers and students actually employ, interact with, and engage with materials within classroom contexts" (Guerrettaz et al., 2022, p. 547). Shawer (2010) classifies teachers' MU into curriculum-transmitter, curriculum-developer, and curriculum-maker based on teachers' approach to curriculum materials. The curriculum approach is central to curriculum knowledge, change, and teachers' roles. According to the curriculum-transmission approach (fidelity), the role of the teacher is as a knowledge transmitter who follows pre-determined objectives, contents, and activities, resulting in superficial learning (Shawer, 2010). Teachers who follow this approach use materials closely related to what is in the curriculum, such as what is in a textbook or a teacher's guide. In contrast to curriculum fidelity, curriculum-development approach (adaptation), users make modifications to curriculum materials to fit classroom context (Shawer, 2010) by adding or deleting texts or activities, replacing, reordering the sequences, modifying or supplementing activities (Masuhara, 2022). Teachers who implement a curriculum-making approach (enactment) construct their materials based on their students' needs and teachers' teaching experiences.

It is argued that teachers' approach to curriculum influences how they use the materials, resulting in the quality of students' learning and motivation and teachers' professional development (Shawer, 2010). A close adherence to curriculum materials makes a teacher a passive knowledge transmitter who follows preconceived objectives and content, which cannot suffice students' individual differences, affecting their learning motivation. Conversely, teachers who adapt curriculum materials or make their materials have more control to satisfy students' needs and achieve educational goals, which likely positively affects students' motivation and learning (Masuhara, 2022). Furthermore, Harwood (2010) asserts that material adaptation is prominent since pre-prepared materials fail to fulfil students' needs. Therefore, adapting and supplementing materials are ways to meet a specific group's needs (Bell & Gower, 2011). Teachers' decision to follow or adapt the curriculum materials depends on their teaching experience (Idowu, 2010), knowledge about students, class size, knowledge about the curriculum, instructional strategies (Chen et al., 2020), teachers' beliefs (Masuhara, 2022) and school authorities (Masuhara, 2022). However, Shawer (2010) claims that institutional control, experience, and gender do not affect teachers' approach to curriculum materials. Therefore, this present study seeks to find empirical evidence on the influences of teachers' PB and PCK on their MU as their beliefs act as filters to their classroom practice decisions (Cephe & Yalcin, 2015), and their PCK expertise may also influence how they use the materials.

2.4. Teachers' pedagogical content knowledge

Pedagogical content knowledge (PCK) refers to "subject matter knowledge for teaching," which is the way teachers formulate and represent a subject that is apprehensible to students (Shulman, 1986, p. 6). This knowledge involves the interactions of content knowledge and pedagogical strategies in teachers' minds and teachers' understanding of learning difficulties that affect how they teach materials (Shulman, 1987).

Studies on PCK investigated its relationships with teachers' instructional practices, including technology integration, instructional materials design, and teachers' professional development. PCK is strongly associated with teachers' instructional planning activities, especially knowledge about students' intellectual engagement and technology integration standards (Harris & Hofer, 2011). In terms of teachers PCK and TPACK development, instructional materials design activities, like training and experiences, are the determinant factors that affect the development of this knowledge (Ergüleç et al., 2022; Harris & Hofer, 2011; Pompea & Walker, 2017). Owing to the influence of PCK in teachers' instructional practices, we assume that PCK also influences teachers' decisions on how they use materials.

2.5. Instruments for measuring teachers' PB, PCK, and MU

Studies investigating teachers' PB mostly utilize qualitative approaches to measure teachers' PB change or development through interview, observation, and document analysis (see, for example, Chen et al.,

2021; Ertmer et al., 2012). Nevertheless, some researchers have made attempts to examine the relationships between teachers' PB, technology use, and TPACK (Lai et al., 2022; Liu et al., 2017).

The teachers' PB scale in Liu et al. (2017) study comprises two factors (constructivist PB and transmissive PB), with five items for each. A total number of two hundred and two EFL teachers rated the items on a five-point Likert scale, which resulted in a good internal consistency reliability for their constructivist PB (.820) and transmissive PB (.871) factors. Similarly, the Lai et al. (2022) study classified teachers' PB into educator-oriented identity belief factor with three items and constructivist conception of teaching factor with seven items. Responses from 280 EFL teachers on the items measured using a 6-point Likert scale showed that educator-oriented identity belief (.920) and constructivist conception of teaching (.940) have high internal consistency reliability values. The teachers' PB scale in Wu et al. (2022) study consists of two factors (learner-centered pedagogy and teacher-centered pedagogy) with eight items. Responses from 211 secondary school teachers on the items using 7-point Likert scale showed that the items had high factor loadings ranging from 0.73 - 0.94.

Schmidt et al. (2009) developed a TPACK assessment tool for pre-service teachers' knowledge of teaching and technology, which consists of 8 factors. Each factor (technology knowledge, content knowledge, pedagogy knowledge, pedagogical content knowledge, technological pedagogical content knowledge, technological content knowledge (literacy), and technological pedagogical content knowledge has good internal consistency, which is 0.86, 0.83, 0.87, 0.87, 0.93, 0.86, 0.89 respectively. However, reporting the internal consistency reliability of each scale is insufficient for reporting the adapted instruments' reliability and validity. For the current study, we only adapted factors related to PCK.

MU studies assess how and why teachers use their instructional materials in their classrooms on the basis of interviews and document analysis. Shawer (2010), for example, interviewed 10 EFL college teachers on how they use curriculum materials. The results showed that the teachers' use of curriculum materials falls into three categories: curriculum developers, curriculum makers, and curriculum transmitters identified from each excerpt provided by the teachers. Based on these results, we developed a teachers' MU questionnaire comprising two factors: curriculum developers with five items and curriculum-makers with four items. The items were developed based on the excerpts identified in Shawer's study, as interview results may serve as a source for developing questionnaire items (Jayachandran et al., 2023).

The following research questions guided the validation and the development of the EFLT-PBPCKMU:

1. What is the factor structure of the EFLT-PBPCKMU?
2. Is the EFLT-PBPCKMU a psychometrically reliable and valid instrument for teachers' PB, PCK, and MU?

3. Method

3.1. Adaptation of the instrument

EFLT-PBPCKMU adaptation is based on the concepts and theories of PCK (Schmidt et al., 2009), teachers' PB (Wu et al., 2022), and MU (Shawer, 2010). Initially, factors and items in each questionnaire were reviewed to ensure the instruments fit the current study context, which focuses on reading in English language teaching and learning. The irrelevant items and factors were removed, for example, items related to content other than literacy (social studies, mathematics, and science). Meanwhile, for the teachers' PB questionnaire, we included all the items under two factors, which were learner-centered pedagogy and teacher-centered pedagogy. For the material use questionnaire, the factors were curriculum developers and curriculum makers. The adaptation of the instruments yields to the finalized factors and items.

The adapted PCK questionnaire has two factors: content knowledge (CK) with three items and pedagogical knowledge (PK) with seven items. Teachers' PB questionnaire has two factors: teacher-centered pedagogy and learner-centered pedagogy, with four items for each factor. The materials use questionnaire encompasses curriculum developers ($n = 5$) and curriculum makers ($n = 4$).

After reviewing each questionnaire, we constructed our teachers' EFLT-PBPCKMU into five parts: instruction, PCK questions, teachers' PB questions, MU questions, and demographic questions that include gender, age range, teaching experience, and educational background. Finally, before distributing the questionnaire, two experts evaluated the content validity of the instruments. The questionnaire

Table 1. The adapted EFLT-PBPCCKMU scales and items.

Scales and Items	References
PCK	Adapted from Schmidt et al. (2009)
Content Knowledge:	
1. I have sufficient knowledge about reading comprehension in English.	
2. I can comprehend English texts with ease.	
3. I have various ways and strategies for developing my understanding of texts written in English.	
Pedagogical Knowledge:	
4. I know how to assess student performance in a classroom.	
5. I can adapt my teaching based-upon what students currently understand or do not understand.	
6. I can adapt my teaching style to different learners.	
7. I can assess students learning in multiple ways.	
8. I can use a wide range of teaching approaches in a classroom setting.	
9. I am familiar with students' common understandings and misconceptions.	
10. I know how to organize and maintain classroom management.	
Teachers' Pedagogical Beliefs	Adapted from Wu et al. (2022)
Learner-Centered Pedagogy:	
11. A good teacher should help students to think actively to build knowledge.	
12. A teacher should greatly encourage students to explore, discuss, and express their opinions.	
13. Effective teaching should encourage students to engage in more discussion and practice.	
14. Teaching should be flexible to meet the needs of students' individual differences and learning processes.	
Teacher-Centered Pedagogy:	
15. Learning is mainly through repetitive practice and drills.	
16. A teacher should have full control over students' learning.	
17. The main task of teachers is to transmit knowledge to students.	
18. Authoritarian teaching (a teacher who has total control of the classroom) is the best practice in a class.	
Instructional Material Use	Adapted from Shawer (2010)
Curriculum Developers:	
19. I develop the content of the textbook by adding material from other sources.	
20. I use some parts of the textbook and add other activities and/or materials to suit my students' needs.	
21. I skip some parts of the textbook that are not necessary.	
22. I create new activities that are different from those available in the textbook.	
Curriculum-makers:	
23. I design my teaching program and write my materials based on needs analysis.	
24. I select the topics in consultation with my students.	
25. I arrange the topics based on my students' prior knowledge.	
26. I change the focus of the course based on how the students reacted, what did not work, and what was successful.	

items were adapted from reliable and valid scales; therefore, two experts are considered enough to check if the content fits the intended goals and to identify language-related problems. If the questionnaire items were constructed by domain experts or adapted from a literature review of an existing questionnaire, the content validity is satisfied (Sauro & Lewis, 2016). Table 1 presents the teachers' EFLT-PBPCCKMU factors, items, and references.

3.2. Context and participants

The national standard principles of the Indonesian secondary curriculum put the students as the central of the learning process, which aims to provide active and meaningful learning experiences (Kemendikbud, 2013), thereby situating the roles of teachers as learning facilitators who are responsible for enhancing learning activities. This principle adopts constructivist beliefs, which are "associated with more frequent use of practices that aim at creating and stimulating, challenging and individually adapted learning environment supportive of students' construction of knowledge" (TALIS, 2009, p. 118). Despite the standard national principles of adopting a constructivist approach to the educational system in Indonesia, studies on teachers' pedagogical beliefs revealed that teachers in Indonesia have both transmission and constructivist beliefs for their teaching (Armin & Siregar, 2021; Inayati & Emaliana, 2017). Teachers' teaching approach is likely affected by their pedagogical beliefs (transmissive or constructivist beliefs, or both) and their PCK, which are applied in their instructional MU.

Two hundred sixty-seven in-service secondary school English teachers in Indonesia completed the online questionnaire between July 19 and October 14, 2023, by responding to statements on a 5-point

Table 2. The demographic information of the samples.

Demographic Information	Sample (n = 260)	
	n	Percentage
<i>Gender:</i>		
Male	68	26.3
Female	189	73
<i>Age range:</i>		
< 30	27	10.4
31-40	82	31.7
41-50	15	5.8
50 +	133	51.4
<i>Teaching experience:</i>		
< 5 years	29	11.2
5-10 years	47	18.1
> 10 years	181	69.9
<i>Educational background:</i>		
Bachelor	157	60.6
Master	98	37.8
PhD/Dr	2	0.8

Likert scale ranging from “strongly disagree” to “strongly agree”, and “never” to “always” that best describes their situation. The introduction part of the questionnaire provided information on participation consent so that the teachers were aware that they gave their consent to participate in the study by completing the questionnaire. We did not include incomplete responses, thereby leaving 260 samples included in the analysis. Table 2 presents the demographic information of the samples.

3.3. Data analysis

The study used Mplus 8 Edition and IBM SPSS Statistics Version 25 for data analysis. The exploratory factor analysis (EFA) was used to generate potential factors for MU, while the Kaiser-Meyer-Olkin (KMO) test assessed sampling adequacy (Shrestha, 2021). The confirmatory factor analysis (CFA) evaluated model fit using multiple indices, including the chi-square test (χ^2), Tucker-Lewis index (TLI), goodness-of-fit index (GFI), comparative fit index (CFI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR) (Alavi et al., 2020; Hooper et al., 2008; Hu & Bentler, 1999).

KMO values equal to or larger than 0.6 are acceptable for performing factor analysis, values between 0.7 and 0.79 are middling, and values equal to or larger than 0.8 indicate adequate sampling (Shrestha, 2021). The chi-square test is prominent in determining the overall model fit, in which values near zero indicate a good model fit (Hooper et al., 2008). A CFI value equal to and greater than 0.90 indicates an acceptable good fit of a model, and a value equal to or greater than 0.95 indicates a good fit model (Hooper et al., 2008; Hu & Bentler, 1999). TLI values equal to or greater than 0.90 are considered good, and values greater than 0.95 indicate a very good fit (Hu & Bentler, 1999). GFI value is acceptable at 0.90 (Hooper et al., 2008). RMSEA cut-off points between 0.05 and 0.10 are a fair fit (Hooper et al., 2008). SRMR cut-off points equal to 0.08 are considered acceptable fit, and a good fit value is below 0.05 (Hooper et al., 2008).

Cronbach’s alpha was utilized to test the internal consistency reliability of each factor of the instruments through the SPSS 25 application. Cronbach’s alpha values equal to or greater than 0.70 are considered acceptable (Cohen et al., 2018). The convergent validity, which is useful “to measure the level of correlation of multiple indicators of the same construct (Shrestha, 2021), was also measured by using Composite Reliability (CR) and Average Variance Extracted (AVE). An AVE value of more than or equal to 0.5 indicates convergent validity, while an acceptable value of CR is between 0.6 and 0.7 (Shrestha, 2021).

4. Results

4.1. Content validity results

Two experts on English language teaching evaluated the EFLT-BPCKMU scale in terms of the language accuracy and item relatedness to the intended goals. The experts’ comments and suggestions were used to revise the scale, as presented in Table 3.

Table 3. Experts' comments and suggestions on the EFLT-BPCKMU scale.

Parts	Items	Comments and suggestions
Instruction	Participants' consent to participate in the survey	Simplifying the language use into "Thank you agreeing to fill in this questionnaire. Your answer will be coded and used confidentially."
PCK item	I have sufficient knowledge about reading English texts. I can read English texts with ease.	Clarify the knowledge required for reading. Clarify what types of reading texts.
Teachers' PB item	A teacher who has total control of the classroom is the best way to teach	Language-related error: "A teacher is not a way to teach."
MU item	I create new activities that are different from those available in the textbooks	"Two ways of supplementing textbooks: borrow tasks/activities from other sources or develop new tasks based on authentic materials."

Table 4. Variance explained by identified factors of teachers' MU.

Factor	Initial Eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %	Total
1	3.134	44.764	44.764	3.134	44.764	44.764	2.734
2	1.111	15.866	60.630		15.866	60.630	2.436
3	0.702	10.028	70.659	1.111			

Table 5. Factor matrix after removing the low-loading item of MU.

Factors	Items	Factors	
		1	2
Material Developer	I develop the content of the textbook by adding material from other sources	.875	
	I use some parts of the textbook and add other activities and/or materials to suit my students' needs	.649	
	I create new activities that are different from those available in the textbook	.742	
	I design my teaching program and write my materials based on a need analysis	.751	
Material Maker	I select the topics in consultation with my students		.800
	I arrange the topics based on my students' prior knowledge		.817
	I change the focus of the course based on how the students reacted, what did not work, and what was successful		.758

The experts' comments and suggestions were used to revise the EFLT-BPCKMU scale. Revisions related to language accuracy were made in the instruction part, particularly related to participants' consent, where the language was simplified. The other language-related problem was on the item about teachers' PB, which was revised into "Authoritarian teaching (a teacher who has total control of the classroom) is the best practice in a class." The experts suggested clarifying the content knowledge required for teachers and the types of reading texts. Therefore, "read" was replaced with "comprehension" to clarify the content knowledge necessary for the teachers. The types of texts that explains the PCK construct were provided in the instruction part.

4.2. EFA results

Two hundred sixty responses were randomly split for MU EFA analyses using the principal component analysis and the Promax rotation with Kaiser normalization. One item (I skip some parts of the textbook that are not necessary) was deleted due to a low loading (0.304) below 0.50. The second round of EFA identified two factors (maker and developer) with eigenvalues greater than one, explaining 60.63% of the variance, as presented in Table 4.

The MU final items were seven items with two factors. The first factor includes items MU6, MU7, and MU8 about Material Maker. The second factor consists of items MU1, MU2, MU4, and MU5 about Material Developer. The factor matrix after removing the low-loading item is presented in Table 5.

4.3. CFA results

Performing multiple indices to assess model fit is prominent in addition to the chi-square test of CFA (Alavi et al., 2020). The KMO of PCK, PB, and MU was 0.897, 0.779, and 0.792, respectively, adequate for factor analysis. The results of the CFA showed a good model fit for teachers' PCK scales (chi-square =

60.453; $df = 34$; $p < 0.01$; CFI = 0.958; TLI = 0.945; RMSEA = 0.064; and SRMR = 0.047). The results of the CFA with model modification indices (LCP2 with LCP1) (Field, 2013) showed a good model fit for teachers' PB scale (chi-square = 32.100; $df = 18$; $p < 0.05$; CFI = 0.975; TLI = 0.960; RMSEA = 0.063, and SRMR = 0.067). MU analysis results showed a good model fit (chi-square = 23.120; $df = 13$; $p > 0.05$; CFI = 0.953; TLI = 0.924; RMSEA = 0.079, and SRMR = 0.047). However, the chi-square values of the three scales did not show a model fit because the chi-square is sensitive to sample size (West et al., 2012). However, the multiple indices results confirm a good model-data fit for PCK, PB, and MU scales (Hooper et al., 2008). Multiple fit indices of chi-square, RMSEA, CFI, and SRMSR can provide "a more holistic view of goodness of fit" (Alavi et al., 2020, p. 2210). All the factors and the items had significant factor loadings above 0.40 for PCK and PB and above 0.50 for MU, as presented in Figures 1–4.

4.4. Reliability

The Cronbach's alpha values of teachers' PCK ($\alpha = 0.865$), CK ($\alpha = 0.690$) and PK ($\alpha = 0.848$), PB ($\alpha = 0.704$), learner-centered pedagogy (LCP) ($\alpha = 0.876$), teacher-centered Pedagogy (TCP) ($\alpha = 0.641$), MU ($\alpha = 0.797$), developer ($\alpha = 0.695$), and maker ($\alpha = 0.699$) were acceptable. The final EFLT-PBPCKMU had six factors with 25 total items, measuring teachers' PCK, PB, and MU. The factors are CK, PK, LCP, TCP, material developer, and material maker, as presented in Table 6.

4.5. Discriminant validity

We also calculate the convergent validity by using the Average Variance Extracted (AVE) of EFLT-PBPCKMU. The AVE value of PCK was $0.45 < 0.50$, and the composite reliability (CR) of PCK was $0.89 > 0.60$, meaning that convergent validity had been established (Hair et al., 2014). The AVE value of each factor CK and PK was 0.43 and 0.46, respectively. The CR of CK and PK were 0.69 and 0.85, respectively. The AVE value of teachers' PB was $0.46 < 0.50$; the CR was $0.87 > 0.60$, confirming the instrument's

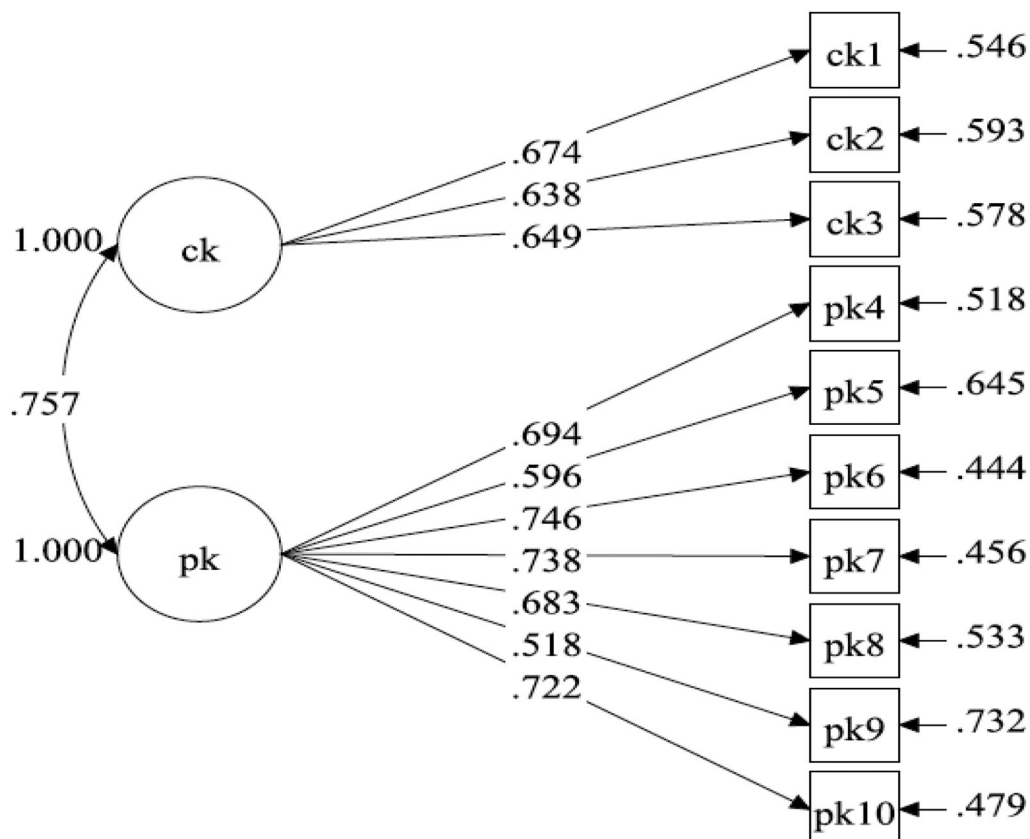


Figure 2. Standardized factor loading of the PCK questionnaire.

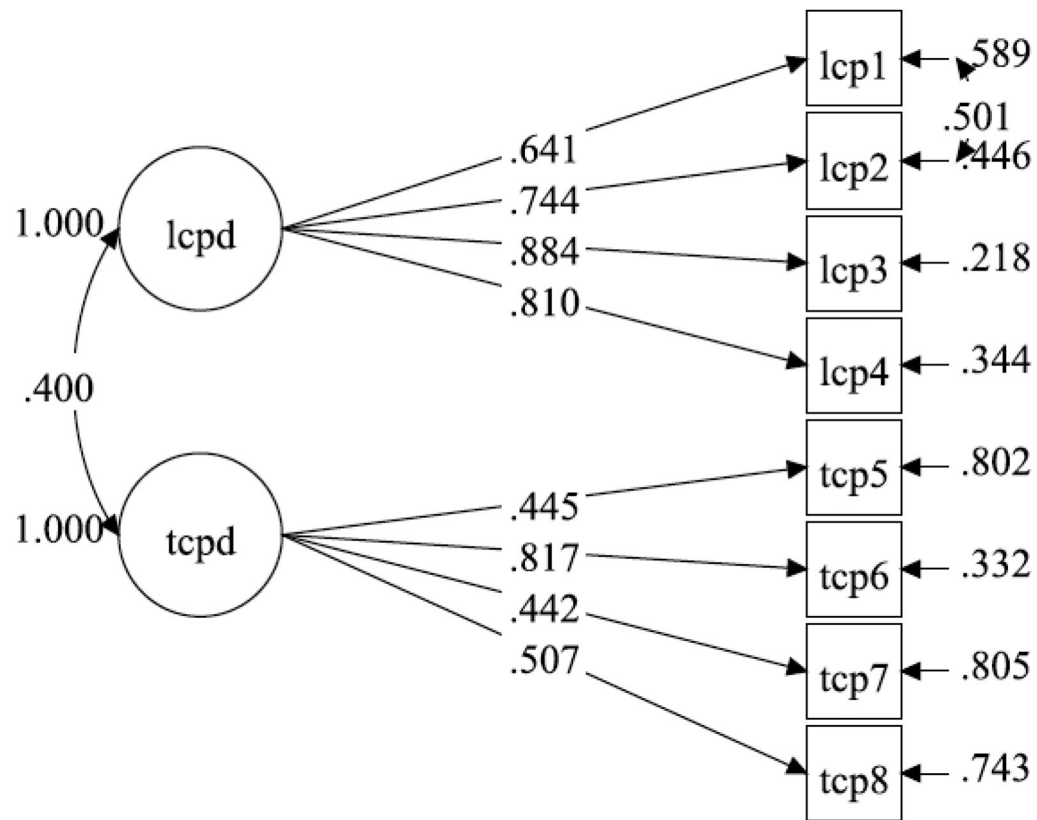


Figure 3. Standardized factor loading of PB questionnaire.

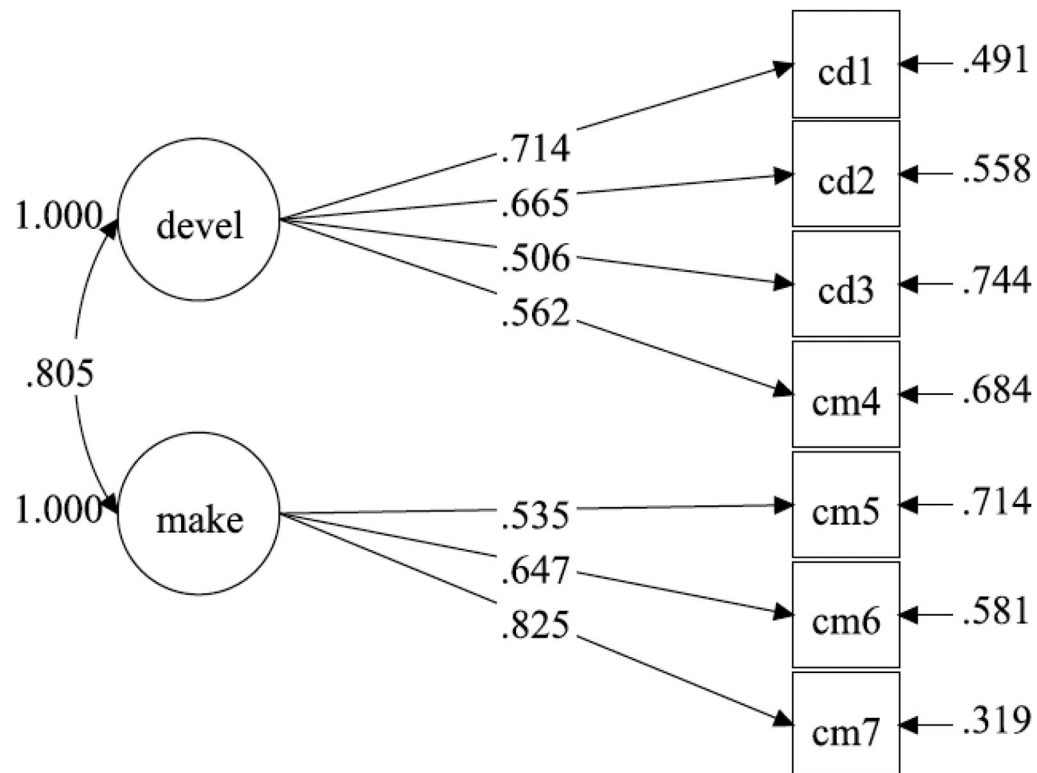


Figure 4. Standardized factor loading of material use questionnaire.

Table 6. The validated EFLT-PBPCKMU scale.

	Factors	Items
PCK	Content Knowledge	1. I have sufficient knowledge about reading comprehension in English. 2. I can comprehend English texts with ease. 3. I have various ways and strategies for developing my understanding of texts written in English.
	Pedagogical Knowledge	4. I know how to assess student's performance in a classroom. 5. I can adapt my teaching based on what students currently understand or do not understand. 6. I can adapt my teaching style to different learners. 7. I can assess student learning in multiple ways. 8. I can use a wide range of teaching approaches in a classroom setting. 9. I am familiar with students' common understandings and misconceptions. 10. I know how to organize and maintain classroom management.
PB	Learner-centered Pedagogy	11. A good teacher should help students to think actively to build knowledge. 12. A teacher should greatly encourage students to explore, discuss, and express their opinions. 13. Effective teaching should encourage students to engage in more discussion and practice. 14. Teaching should be flexible to meet the needs of students' individual differences and learning processes.
	Teacher-centred Pedagogy	15. Learning is mainly through repetitive practice and drills. 16. A teacher should have full control over students' learning. 17. The main task of teachers is to transmit knowledge to students. 18. Authoritarian teaching (a teacher who has total control of the classroom) is the best practice in a class.
MU	Material Developer	19. I develop the content of the textbook by adding material from other sources. 20. I use some parts of the textbook and add other activities and/or materials to suit my students' needs. 21. I create new activities that are different from those available in the textbook.
	Material Maker	22. I design my teaching program and write my materials based on a need analysis. 23. I select topics in consultation with my students. 24. I arrange topics based on my students' prior knowledge. 25. I change the focus of the course based on how the students reacted, what did not work, and what was successful.

convergent validity. The AVE for each factor, LCP and TCP, was 0.60 and 0.33, respectively, and the CR of LCP was 0.85 and of TCP was 0.64. The AVE value of MU was $0.41 < 0.50$; the CR value was $0.83 > 0.60$. The AVE value of the material developer was 0.38, and that of the material maker was 0.46, with CR values of each was 0.70 and 0.71, respectively. Even though the AVE values of the factors were below 0.50, the CR values of all the factors were higher than 0.60, meaning that convergent validity had been established (Fornell & Larcker, 1981).

5. Discussions and implications

Numerous studies have examined the impact of teachers' PCK and their PB (Alghamdi, 2021; Diehm & Hendricks, 2021) on their instructional practices. Therefore, some scales were constructed and evaluated to assess the roles of teachers' PCK, TPACK, and PB on teachers' teaching practice in terms of language-related assessment implementation (Wang et al., 2020), teaching approach (Lőrincz, 2023), and technology application (Gao & Cui, 2024). However, research has yet to explore how PCK and PB may affect teachers' MU. Instructional materials have significant roles in language learning (Osikomaiya, 2020; Sun, 2010). Instructional materials provide both teachers and students exposure and information about the language (Karatepe & Civelek, 2021), as a stimulus for other activities, and a means of teacher education (Mishan & Timmis, 2015). However, the effectiveness of the materials depends on teachers' approach to how they use the materials, which affects students' learning and motivation (Shawer, 2010). Accordingly, teachers' MU may positively impact teaching effectiveness, which may be influenced by their PB and PCK. Therefore, this study addressed the gap between the theoretical conceptualization of the interrelationships between teachers' PCK, PB, and MU and the construct of the EFLT-PBPCKMU scale.

EFLT-PBPCKMU development and validation aimed to measure the interrelationships between teachers' PB, PCK, and material use. The validated EFLT-PBPCKMU had six factors with 25 total items. The factors are content knowledge, pedagogical knowledge, learner-centered pedagogy, teacher-centered pedagogy, material developer, and material maker. Results confirmed that the EFLT-PBPCKMU was a valid and reliable instrument for assessing upper-secondary English teachers' PB, PCK, and material use and measuring the interrelationships among the variables.

The EFA of the MU generated two factors: material developer and material maker. One item, "I skip some parts of the textbook that are not necessary," was removed due to a low loading below 0.50. Three out of four items were loaded in the material-maker factor, whereas four items were loaded in the material-developer factor. The item "I design my teaching program and write my materials based on a need analysis" was loaded in the material-developer factor instead of the maker factor. This result contradicts Shower's findings (2010), in which he classified the process of designing teaching programs and writing materials based on a need analysis into the material maker instead of the material developer. This difference might happen because the teachers in the current study consider writing materials based on their student's needs as an act of developing or adapting their teaching materials (Azizah et al., 2021).

The CFA of teachers' PCK and PB confirmed the previous factors of teachers' PCK (Schmidt et al., 2009) and PB (Wu et al., 2022) scales were valid with modified items. Factors 1 and 2 about teachers' PCK aimed to measure teachers' CK and PK. Multiple indices results confirmed that the instrument has a good model fit, implying that the adapted instrument is valid for predicting EFL teachers' CK and PK. These results are in accordance with the previous teachers' CK and PK development and validation scales, where the multiple analysis results also showed that the instruments were valid and reliable for assessing teachers' CK and PK (Schmidt et al., 2009). PCK involves the interactions of content knowledge and pedagogical strategies in teachers' minds and teachers' understanding of learning difficulties that affect how they teach materials (Shulman, 1987), promoting students understanding (Hartati et al., 2019). Accordingly, these two factors would predict how teachers use instructional materials in their classroom as their pedagogical competence (Tran-Thanh, 2021), their PK, including their instructional strategies (Chen et al., 2020), influence their teaching practice (Shulman, 1986, 1987).

PB scale had two prominent factors in determining teachers' teaching approach to their instructional practices: learner-centered or teacher-centered. The results of multiple indices implied that the instrument is eligible to determine teachers' teaching approaches. These results align with the results of Wu's study et al. (2022), which showed a model fit of the teachers' pedagogical beliefs instrument comprising teacher-centered and learner-centered pedagogy. Since teachers' actions and decision-making regarding instruction and practice depend on their beliefs (Schutz et al., 2020), including how they use instructional materials in their teaching (Masuhara, 2022), this instrument is useful to estimate teachers' ways of using them. Finally, the adapted and validated EFLT-PBPCKMU had six factors and 25 items with good reliability and validity evidence. The adapted and validated EFLT-PBPCKMU scale helps discover how teachers use the materials in terms of adapting (curriculum-developer) or creating (curriculum-maker) materials, which are predicted by their learner-centered or teacher-centered beliefs and their PK and CK.

6. Conclusion

The current study developed and validated the scale to measure the interrelationships between teachers' PCK and PB on teachers' MU, which focused on examining the roles of internal factors such as teachers' PB, PK, and CK on their MU approach in ELT. The final factor structure of the EFLT-PBPCKMU was six factors with 25 items. The factors are content knowledge, pedagogical knowledge, learner-centered pedagogy, teacher-centered pedagogy, material developer, and material maker. The EFLT-PBPCKMU had a good model fit and was psychometrically valid and reliable. Accordingly, the instrument can gauge data on the interplay between PCK, PB, and teachers' MU. It provides implications for in-service teachers' instructional practice and professional development programs, mainly related to their PCK, PB, and MU. The scale can measure the effects of teachers' PCK and PB on predicting teachers' MU approaches, which is helpful to give directions for in-service teachers on how to use instructional materials effectively by noticing their pedagogical beliefs and their instructional practices and enhancing their pedagogical content knowledge. The development and validation of the EFLT-PBPCKMU scale allows for further investigation of the interrelationships among PCK, PB, and MU, which contribute to the constructivist theory of learning, particularly in terms of instructional material use approach and teachers' pedagogical beliefs. However, this study is limited to the teachers' MU; further scale development and validation to measure how students use instructional materials is also essential to discover how it affects learning and material evaluation and development.

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Institutional Review Board statement

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board (or Ethics Committee) of the Regional and Institutional Review Board of the Doctoral School of Education, University of Szeged (Reference number: 3/2023, date of approval: 22 March 2023).

Informed consent statement

Informed consent was obtained from all subjects involved in the study.

Disclosure statement

"The authors declare no conflict of interest." "The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results."

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Data availability statement

The data presented in this study are available on DOI: 10.17632/4m6g24y8vm.1

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