

# Effectiveness of a Phonics Instructional Guide on the PCK of Teaching Phonics among Pre-service EFL Teachers

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Received: October 19, 2023

Accepted: December 19, 2023

Online Published: February 5, 2024

doi:10.5430/wjel.v14n2p400

URL: <https://doi.org/10.5430/wjel.v14n2p400>

## Abstract

Previous studies have revealed that a newly compiled phonics instructional guide was able to improve the content knowledge level of pre-service EFL teachers by 23 per cent. Based on this and to further investigate how this guide indirectly impacted the pedagogical content knowledge of these teachers, a longitude and continuous quantitative study was conducted on the same sample in the same teaching college in China. In total, 140 pre-service EFL teachers were assigned to two equivalent groups as before, namely the experimental (N=70) and control groups (N=70), who conducted a trial phonics instruction and completed self-evaluation questionnaires, respectively. The trial instruction aimed to assess their pedagogical content knowledge of teaching phonics, while the self-evaluation form aimed to investigate their self-perceived competencies and efficacy in phonics instruction. The results indicated that based on the content knowledge they already possessed, the pre-service EFL teachers in the experimental group had higher levels of pedagogical content knowledge and self-perception; in comparison, those in the control group had lower pedagogical content knowledge and self-perception levels. In other words, the linear regression results demonstrated that the content knowledge of pre-service EFL teachers is a reliable predictor of their pedagogical content knowledge and self-perception levels. These findings suggest the necessity of enhancing pre-service EFL teachers' content knowledge of phonics instruction via the guide to further improve their phonics instruction competency, which forms part of their pedagogical content knowledge.

**Keywords:** pedagogical content knowledge, content knowledge, EFL teachers, correlation, phonics

## 1. Introduction

In English-speaking contexts, phonics has long been considered an essential tool in the early reading process (ILA, 2020; Papp, 2020). With mastery of phonics knowledge, learners in the context of English as a second language also are predicted to be able to achieve basic reading automaticity at word level first and then at text level (Gopal & Singh, 2020). In the EFL context, studies have yielded similar results, that phonics instruction enables English learners to read and spell English independently, at least at word level (Nasir et al., 2019). In China, English is taught and learnt as a foreign language. Phonics was included in the National Curriculum for Compulsory Education in 2011. After the introduction of this curriculum in 2011, EFL learners were initially expected to master 26 letters and the corresponding sounds the letters stand for (Zhao, 2019). In 2022, this requirement remained unchanged in the latest version of the National Curriculum for Compulsory Education. Between 2011 and 2022, numerous studies were conducted to indicate the effectiveness of phonics instruction on the English learning results of EFL learners. Almost all these results were positive, regardless of the students' educational backgrounds.

However, studies have also implied the poor implementation of phonics instructions in the compulsory education phase (Zhao, 2019; Zhong, 2020). The main reason lies in the knowledge deficiency of in-service EFL teachers, as reported in several studies conducted in China. These studies specifically investigated the status of phonics implementation and found that the subject matter content knowledge of in-service EFL teachers might be an important factor in this poor implementation (Long, 2019; Yan, 2018; Zhong, 2020; Zhong & Kang, 2020). In one of these studies, Long (2019) pointed out that during the investigation process, some new EFL teachers had been unprepared to teach phonics when they were still attending the teacher training program. In other words, pre-service EFL teachers were taught the International Phonetic Alphabet (IPA) rather than phonics. They were not taught phonics or how to teach it, and there was no standard phonics instructional guide for them to follow. In this context, Chen et al. (2022) compiled a phonics instructional guide for pre-service EFL teachers to enable them to teach phonics. The implementation and evaluation results indicated the efficacy of this type of guide in equipping pre-service EFL teachers with the required content knowledge to teach phonics. Specifically and fundamentally, the findings revealed that the CK of the pre-service EFL teachers had been improved by 23 per cent after the intervention with the phonics instructional guide. However, as indicated by Blevins (2017) and Shulman (1987), a teacher's CK is essential in teaching but cannot guarantee teaching efficacy. Furthermore, as Shulman (1987) indicated, a teacher's pedagogical content knowledge directly affects their

pedagogical decisions in class, which indirectly determines the teaching efficacy. Therefore, the main focus of this study was to investigate the PCK of pre-service EFL teachers, based on the phonics instruction CK they had already acquired, to assess the effectiveness of the newly compiled phonics instructional guide in indirectly improving their PCK. Therefore, the following research questions were developed:

**RQ 1:** How does the CK level of pre-service EFL teachers relate to their PCK level?

**RQ 2:** How effective is the guide in impacting self-perceived competencies in phonics instruction among pre-service EFL teachers?

**RQ 3:** How does pre-service EFL teachers' relate to their self-perceived competencies in phonics instruction?

## 2. Literature Review

### 2.1 CK and PCK

Shulman (1987) noted that each subject has a unique set of content, and CK is a necessary component of each subject field. EFL teachers intending to teach phonics to their students should first acquire phonics knowledge to comprehend aspects like the related terminology and decoding rules. In other words, they should at least possess CK first. Such CK can greatly affect their pedagogical judgement, pedagogical decisions, teaching abilities, and teaching confidence during pedagogical exercises (Blevins, 2017; Zhang, 2019). Shulman (1987) and Han (2011) stated that PCK enables a teacher to utilise the most effective analogies, illustrations, examples, demonstrations, and explanations to represent and formulate a certain topic within the subject to learners in a comprehensible way. In other words, a teacher's PCK decides their teaching strategy. Logically, a teacher's CK has a major impact on their PCK, and PCK derives from CK (Zhang, 2019). Despite this link, Belvins (2017) pointed out that a teacher's phonics subject matter content knowledge can affect his or her phonics implementation, which has been verified in previous studies in China (Zhong & Kang, 2021). However, a teacher's PCK is dynamic, possibly because it may be acquired from auditing the classes of other teachers or through apprenticeships, or it may be enhanced via teaching practice. Thus, in the present study, the PCK of phonics instruction among the pre-service EFL teachers may have derived from their phonics CK and their trainer's adopted approach to teaching phonics CK. Thus, drawing on the relationship between CK and PCK, the assessment of the pre-service EFL teachers was based on their CK. The key components of their CK served as a basis on which to measure their PCK. This measurement relied mainly on how the educators rated their pedagogical design and their practice of phonics instruction.

### 2.2 CK of Phonics Instruction among Pre-service EFL teachers

As stated previously, a pre-service EFL teacher's CK is the basis for his or her PCK. In terms of the CK of phonics teaching among pre-service teachers, numerous studies have been conducted on this topic in the English-speaking context. DEST (2005) found that teachers lack a firm grasp of why, how, what, and when to employ these specific strategies, which has implications for pre-service teacher education. Reports by the ILA (2019) and NRP (2000) stressed the critical nature of teachers' professional development in five areas such as word recognition strategy, fluency, vocabulary, and comprehension strategy, all of which are included in the teaching spectrum of explicit and systematic phonics instruction. Meeks and Kemp (2017) corroborated this assertion, proposing that pre-service teachers be trained with evidence-based teaching strategies (DEST, 2005; Meeks & Kemp, 2017). Furthermore, such instructional strategies should incorporate the five basic strategies: phonemic awareness, phonics, vocabulary, understanding, and fluency (Meeks & Kemp, 2017). Blevins (2017), ILA (2019), and Meeks and Kemp (2017) recommended that teachers provide systematic, explicit, and direct phonics instruction to ensure that beginners grasp the fundamental alphabetic decoding rules. These recommendations, which are equally appropriate for pre-service EFL teachers, could also be regarded as part of the phonics guide for pre-service EFL teachers included in the present study. This is because explicit and systematic decoding rules are critical for assisting the English learning of EFL beginners who lack vocabulary acquisition. However, although decoding rules are necessary for EFL beginners, the way a teacher manages phonics is equally critical (Blevins, 2017; DEST, 2005; Honan, 2015; Meeks & Kemp, 2017; ILA, 2019). The phonics subject-matter knowledge of teachers affects their pedagogical decisions (Blevins, 2017; Grossman, 1989; Han, 2011; Shulman, 1987; Zhang, 2019). Levine (2006) discovered a similar pattern among novice teachers in the United States of America. Even in China, Zhao (2019) found that novice EFL teachers lacked confidence in teaching phonics in primary schools due to their lack of knowledge about decoding rules and how to explain irregulars to their students. Zhao (2019) demonstrated that when those novice EFL teachers were pre-service EFL teachers, they had not received phonics or phonics instruction training. In other words, as described in the problem statement, they lack an instructional guide for learning phonics and teaching phonics. As a result, they are unprepared, which significantly reduces their confidence in teaching phonics (Zhao, 2019). Given this context, Chen et al. (2022) compiled a phonics instructional guide that incorporated seven knowledge dimensions: phonics-related general knowledge, knowledge of the English sound system, phonemic awareness knowledge, phonics decoding rules, phonics instruction approaches, decoding rules reinforcing approaches, and sight words instruction approaches. After the training had been conducted with the pre-service EFL teachers, a mixed method was adopted to investigate the effectiveness of the guide. Together with a quasi-experiment, the questionnaire and focus group discussion results indicated that the training with the guide had improved the CK of the pre-service EFL teachers by 23 per cent, a considerable increase. More specifically, they progressed in five dimensions, namely general knowledge, decoding rules, phonics instruction, sight words, and rules reinforcement. The progress rates for each dimension were 29 per cent, 32 per cent, 25 per cent, 37 per cent and 41 per cent, respectively. However, although the guide was verified as effective in enhancing the CK of pre-service EFL teachers, its effectiveness in enhancing their PCK has yet to be verified. As the related literature in this field is very scarce, it is hoped the present study based on previous research findings will bridge this research

gap and contribute to the body of literature in this field.

**3. Methods**

*3.1 Context, Sampling, and Participants*

This study was conducted in a teaching college in Mianyang City, Sichuan Province, P.R. China. As stated above, the current study is based on and a continuation of a previous quasi-experimental study. The participants were 172 pre-service EFL teachers enrolled on a four-year full-time bachelor’s degree program in teacher education. However, by the time this study continued, 32 of these teachers had graduated, leaving only 140 pre-service EFL teachers ranging from first-year to third-year trainees. Of these 140, 70 were still in the previously arranged experimental group and the other 70 were still in the previous control group. For the present study, to test the participants’ PCK to teach phonics, a 45-minute trial phonics instruction was assigned to each group. Before the trial, the subjects were required to submit a phonics teaching plan to the educators. After the trial, both the experimental and control group members were required to complete a self-evaluation questionnaire. Aside from the pre-service EFL teachers, eight teacher educators with a PhD or associate professor status, as well as extensive pedagogy skills, joined the study. They were divided into four groups to rate the pre-service EFL teachers’ performance in teaching phonics.

*3.2 Instruments and Data Collection*

This study adopted only a quantitative approach, which included a teaching evaluation form and a self-evaluation questionnaire. More specifically, to collect data on the PCK of the pre-service EFL teachers, the participants were required to submit a pre-designed teaching plan for a 45-minute teaching period. This teaching plan should as a minimum: i) demonstrate teaching the alphabet; ii) demonstrate teaching decoding rules; iii) demonstrate reviewing decoding rules; and iv) demonstrate teaching irregulars. The subjects were given 45 minutes to trial their teaching plan. The educators worked in pairs to rate each teaching plan and trial instruction performance. The rating standards were based on an explicit and systematic synthetic phonics instruction approach, which is commonly considered the most appropriate approach for EFL learners. The full score for the teaching plan in written form was 50 and the full score for the trial phonics instruction was 50 points. The evaluation forms were validated by all eight educators. The data obtained through this instrument were analysed and compared with the post-test scores. The aim was to measure the CK level obtained in the previous study and assess the correlation between the participants’ CK and PCK scores. This would answer primary research question 1 of this study.

The second instrument was the self-evaluation questionnaire, which was issued to participants in both groups (N<sub>e</sub>=70, N<sub>c</sub>=70) to explicitly and systematically investigate their self-perceived competencies in teaching phonics. This questionnaire was adapted from that developed by Soo and Goh (2020), which consisted of 30 items intended to identify self-evaluated competencies and confidence in teaching phonics among pre-service EFL teachers. Taking the form of a five-point Likert scale, the questionnaire was also validated by educators. To ensure the quality of the study, the questionnaire was piloted. The reliability was found to be 0.993, which represents fair reliability (McNamara, 2014). The constructive validity was also estimated using statistical software. The KMO=0.953 and P<0.001 scores indicated fair constructive validity. After all the data had been collected, the data from the experimental and control group participants were analysed and compared using an independent T-test to answer primary research question 2 of the present study. Moreover, the data obtained from this instrument was analysed and compared with the CK scores previously obtained by the pre-service EFL teachers to assess the correlation between their levels of CK and self-perceived competencies; this would answer primary research question 3.

*3.3 Data Analysis Process*

All the collected data were analysed using statistical software. To answer primary research questions 1 and 3, linear regression analysis was adopted. To answer primary research question 2, an independent T-test was employed, for which the null hypothesis was:  $\bar{X}_e = \bar{X}_c$  (e= experimental group, c= control group). The results are reported in the next section.

**4. Findings**

This section reports the results concerning the correlation between the self-perceived competencies in phonics instruction, CK, and PCK of the pre-service EFL teachers, as well as the correlation between their CK level and self-perception in phonics instruction.

*4.1 Results of Correlation between Pre-service EFL Teachers’ CK and PCK Level*

The PCK scores consisted of two parts, the score for the teaching plan and the score for the trial phonics instruction. Thus, the correlation between the CK scores and PCK scores of the trainees, the correlation between their CK and teaching plan scores, as well as the correlation between their CK and trial phonics instruction scores are reported sequentially.

Table1. Descriptive Statistics of Trainees PCK Score, CK Score, Teaching Plan Score, Trial Instruction Score (N<sub>e</sub>=70, N<sub>c</sub>=70)

	Mean	SD	Full Score
Experimental group CK	21.01(70%)	5.582	30(100%)
Experimental group PCK	77.17 (77%)	4.070	100 (100%)
Experimental group teaching Plan	41.17 (82.3%)	4.054	50(100%)
Experimental group trial	36 (72%)	1.624	50(100%)
Control group CK	13.33(44.4%)	3.342	30(100%)
Control group PCK	58.14(58.14%)	12.303	100 (100%)

Control group teaching plan	29.51(59.02%)	5.965	50(100%)
Control group trial	28.64 (57.2%)	6.385	50(100%)

Table 1 indicates that after the training with the newly compiled guide, the trainees' CK and PCK levels were all above the cutoff line (60%). Based on their improved CK, they were able to design a phonics instruction teaching plan and demonstrate effective phonics instruction. In contrast, the CK level of the control group participants was only 44 per cent of the full score and thus below the cutoff line (60%). Accordingly, the scores for their teaching plans, trial instructions, and PCK were also below the cutoff line (60%).

Table 2. Independent T-test Results of Two Groups (Ne=70, Nc=70)

	Mean for control group	Mean for experimental group	mean difference	t	df	Sig. (2-tailed)
CK	13.33	21.01	7.681	12.51	137	<0.001
Teaching plan	58.14	77.17	11.664	13.501	137	<0.001
Trial	29.51	41.17	7.362	9.346	137	<0.001
PCK	28.64	36	19.027	11.769	137	<0.001

The independent T-test results shown in table 2 indicate that since the trainees in the experimental group obtained higher scores in their CK test (mean difference=7.681, P<0.001), they performed better at designing a teaching plan for phonics instruction (mean difference=11.664, P<0.001) and demonstrating phonics instruction (mean difference=9.346, P<0.001). Thus, these trainees obtained higher PCK scores (mean difference=19.027, P<0.001).

Table 3. Correlation between CK Score and Other Scores (N=140)

	Correlation	Sig.
CK score-PCK score	0.926	<0.001
CK score-Teaching plan score	0.956	<0.001
CK score-Trial score	0.855	<0.001

Table 3 indicates that the trainees' CK was closely related to their PCK, ability to design a teaching plan for phonics instruction, and ability to demonstrate phonics instruction because the correlation index values in the table are 0.956, 0.855, 0.926, and P<0.001. As Kumar (2019) pointed out, with a correlation coefficient, the closer a score is to 1, the stronger the correlation.

Table 4. Results of Model Summary (N=140)

Model	R	R Square	Adjusted R Square	F change	Sig. F Change	Durbin-Watson
CK-PCK	0.926 <sup>a</sup>	0.857	0.856	829.345	<0.001	0.224
CK- Teaching Plan	0.956 <sup>a</sup>	0.915	0.914	1480.140	<0.001	0.418
CK-Trial	0.855 <sup>a</sup>	0.730	0.728	373.781	<0.001	0.127

a . predictors: (constant)

In table 4, the adjusted R-squared value is a statistic that measures how well an estimated model fits an observed value (Johnson & Christensen, 2019). Therefore, in table 4, based on the CK score predictor, the adjusted R-squares values are 0.926, 0.956, and 0.855, meaning the CK level of pre-service EFL teachers can effectively predict their levels of designing teaching plans, demonstrating phonics instruction, and PCK.

Table 5. Results of Regression ANOVA<sup>a</sup> (N=140)

Model		Sum of Square	df	Mean Square	F	Sig.
CK-PCK	Regression	21510.331	1	21510.331	829.345	<0.001 <sup>b</sup>
	Residual	3579.240	138	25.937		
	Total	25089.571	139			
CK- Teaching Plan	Regression	7593.953	1	7593.953	1480.140	<0.001 <sup>b</sup>
	Residual	708.018	138	5.131		
	Total	8301.971	139			
CK-Trial	Regression	3542.716	1	154.333	379.314	<0.001 <sup>b</sup>
	Residual	1307.970	138	3542.716	373.781	
	Total	4850.686	139	9.478		

a . dependent variable: PCK, Teaching Plan, Trial Instruction; b. predictors: (constant)

As reported in table 5, the ANOVA results, F= 829.345, 1480.140, and 379.314 (P<0.001) indicate linear regression relationships between the CK level of pre-service EFL teachers and their ability to design a teaching plan for phonics instruction, their ability to trial their phonics instruction, and their PCK level.

Table 6. Results of Regression Coefficients (N=140)

Model		Unstandardized Coefficient B	Standardized Coefficient Beta	t	Sig.	95% Confidence Interval for B	
						Lower Bound	Upper Bound
CK-PCK	Constant	27.692		19.003	<0.001	24.811	30.574
		2.326	0.926	28.798		2.166	2.486
CK- Teaching Plan	Constant	11.592		17.886	<0.001	10.311	12.874

		1.382	0.996	38.473	1.311	1.453
CK-Trial	Constant	16.100		18.277	<0.001	14.359
		0.944	0.855	19.333		0.847
						1.401

a. dependent variable: PCK, Teaching Plan, Trial Instruction; b. predictors: (constant)

In terms of the CK-PCK regression coefficient, the constant variable CK (B=2.326, P<0.001), 95% CI (2.166-2.486), and Constant=27.692 indicate that to predict the PCK level of pre-service EFL teachers from their CK level, the linear regression equation is:  $Y=27.692+2.326X$ .

Secondly, for the CK-Teaching Plan regression coefficient, the constant variable CK (B=1.382, P<0.001), 95% CI (1.311-1.453), and Constant=11.592 indicate that to predict the pre-service EFL teachers' ability to design a teaching plan from their CK level, the linear regression equation is:  $Y=11.592+1.382X$ .

Thirdly, for the CK-Trial regression coefficient, the constant variable CK (B=0.944, P<0.001), 95% CI (0.847-1.401), and Constant=16.100 indicate that to predict the pre-service EFL teachers' ability to demonstrate phonics instruction from their CK level, the linear regression equation is:  $Y=16.100+0.944X$ .

To summarise, based on the CK level of pre-service EFL teachers, their ability to design a teaching plan for phonics instruction, ability to demonstrate phonics instruction, and PCK level can be predicted via linear regression equations. These are:  $Y=11.592+1.382X$ ,  $Y=16.100+0.944X$ , and  $Y=27.692+2.326X$ , respectively. In addition, the R-squared values of 0.915, 0.730, and 0.857 (in table 4) indicate good predictions. Thus, the first research question was answered.

4.2 Results of Independent t-test

As mentioned above, a self-evaluation questionnaire was used to assess the pre-service EFL teachers' self-perception about implementing phonics instruction. An independent t-test was used to compare the self-perceived competencies of the experimental and control groups. Based on the null hypothesis  $\bar{X}_e=\bar{X}_c$  (e= experimental group, c= control group), the following results were obtained:

Table 7. Statistics of pre-service EFL teachers' self-perception survey (N=140)

Valid N	Frequency	percent %
Experimental group	70	50
Control group	70	50
Total	140	100

Table 8. Independent T-test Results of Each Item (N=140)

No.	Items	Mean for control group	Mean for experimental group	mean difference	t	df	Sig. (2-tailed)
1.	I understand the requirement of phonics in national curriculum.	3.14	4.30	1.157	59.932	138	<0.001
2	I understand the importance and necessity to teach phonics to EFL learners.	2.53	4.23	1.700	7.073	138	<0.001
3	I know how to instruct phonics in an explicit and systematic way.	1.59	4.73	3.143	12.610	138	<0.001
4	I know how to develop EFL learners' phonemic awareness.	1.7	4.0	2.300	39.339	138	<0.001
5	I know how to develop EFL learners' phonological awareness.	1.9	4.1	2.200	41.691	138	<0.001
6	I know how to instruct alphabet recognition.	1.81	4.27	2.457	23.426	138	<0.001
7	I know how to instruct phonics decoding rules.	1.89	3.97	2.086	23.584	138	<0.001
8	I know how to assist EFL learners to review learned decoding rules.	1.93	4.64	2.714	25.222	138	<0.001
9	I know how to explain irregular spelling words to EFL learners.	2.01	4.53	2.514	23.449	138	<0.001
10	I know how to teach consonant articulations.	1.84	4.26	2.414	23.578	138	<0.001
11	I know how to teach long vowel sounds.	1.99	4.13	2.143	22.756	138	<0.001
12	I know how to teach short vowel sounds.	1.97	4.17	2.200	23.625	138	<0.001
13	I know how to teach consonant digraphs.	1.96	4.26	2.300	25.197	138	<0.001
14	I know how to teach consonant blends.	1.86	4.23	2.371	23.565	138	<0.001
15	I know how to teach silent consonants.	1.57	4.50	2.929	34.580	138	<0.001
16	I know how to teach long vowel sounds.	1.73	4.44	2.714	26.385	138	<0.001
17	I know how to explain phonics terms to EFL learners	1.59	4.41	2.829	28.382	138	<0.001
18	I know how to teach other vowel sounds.	1.60	4.50	2.900	30.281	138	<0.001

19	I know how to teach phonograms.	1.70	4.51	2.814	29.424	138	<0.001
20	I know how to teach sight words.	1.79	4.39	2.600	23.256	138	<0.001
21	I know dos and don'ts in phonics instruction process.	1.64	4.43	2.786	33.593	138	<0.001
22	I know how to make use of decodable books to enhance the phonics instruction efficacy.	1.66	4.41	2.757	28.023	138	<0.001
23	I know games or activities to assist EFL learners to learn phonics.	1.76	4.30	2.543	25.623	138	<0.001
24	I am confident in implementing phonics instructions.	1.76	4.40	2.643	21.399	138	<0.001
25	I can identify phonics-related contents in English textbooks.	1.94	4.37	2.429	22.140	138	<0.001
26	I know how to adapt phonics instruction contents presented in the English textbooks.	1.57	4.59	3.014	33.070	138	<0.001
27	I am able to conduct phonics instruction explicitly based on the English textbooks.	1.74	4.51	2.771	28.138	138	<0.001
28	I won't adopt IPA to teach phonics-related contents any more.	1.77	4.46	2.686	23.025	138	<0.001
29	I know how to assist EFL learners to achieve reading fluency from word level to text level.	1.60	4.59	2.986	30.017	138	<0.001
30	I am able to explain phonics-related terms to EFL learners/	1.70	4.40	2.700	24.746	138	<0.001
	Total	55.23 (36.82%)	131.03 (87.3%)	75.8(50.5%)	59.932	138	<0.001

As indicated in table 7, 140 valid questionnaires were delivered and returned. Overall, the results shown in table 8 imply that the trainees in the experimental group, who had received phonics training via the newly compiled phonics instructional guide, had greater self-perception in designing a teaching plan for phonics instruction and implementing phonics instruction (the mean difference is 75.8 and  $P < 0.001$ ). This result indicates that the training with the newly compiled guide helped the pre-service EFL teachers enhance their self-perceived competencies to teach phonics by about 50 per cent. The result also implies that the null hypothesis  $\bar{X}_e = \bar{X}_c$  should be rejected. Specifically for item 24, which directly focuses on teaching confidence, the average rating of the trainees in the experimental group was 4.4 points out of a full score of 5. Meanwhile, the trainees in the control group definitely showed lower confidence because their average self-rating was only 1.76 points out of 5 ( $P < 0.001$ ). The results for item 25 indicate that the trainees in the experimental group were more capable of identifying phonics content in a textbook (the mean difference is 2.492 and  $P < 0.001$ ). Moreover, the results for item 9 indicate that those in the experimental group were more confident in explaining irregular spellings to EFL learners (the mean difference is 2.514 and  $P < 0.001$ ), which has been mentioned in the literature as a challenge to in-service EFL teachers. Thus, the second research question was answered.

#### 4.3 Results of Correlation between CK and Self-Perceived Competencies of Pre-service EFL Teachers

Linear regression was applied to answer primary research question 3: how does the CK level of pre-service EFL teachers relate to their self-perception? In this subsection, the linear regression results are reported.

Table 9. Descriptive Statistics (N=140)

	N	Mean	SD	Full Score
Self-perception	140	93.14 (62%)	7.478	150 (100%)
CK Score	140	17.24(57%)	5.582	30(100%)

Table 9 illustrates the analysis of the 140 pre-service EFL teachers' level and self-perception. Of the 140 samples, 70 were from the experimental group (N=70) and 70 were from the control group (N=70).

Table 10. Correlation between CK Score and Self-perceptions (N=140)

	Correlation	Sig.
CK Score- Self-perception Level	0.818	<0.001

The results shown in table 2 indicate a close correlation between the CK and self-perception levels of pre-service EFL teachers (correlation=0.818 and  $P < 0.001$ ).

Table 11. Model Summary<sup>b</sup> (N=140)

Model	R	R Square	Adjusted R Square	F change	Sig. F Change	Durbin-Watson
CK- Self-perception	0.818 <sup>a</sup>	0.669	0.667	279.085	<0.001	0.252

a. predictors: (constant)

b. dependent variable

In table 11, the adjusted R-squared value is a statistic that measures how well the estimated model fits an observed value (Johnson &

Christensen, 2019). Therefore, in table 11, based on the CK score predictor, the adjusted R-squared value of 0.669 indicates that the CK level of pre-service EFL teachers can effectively predict their level of self-perception for phonics instruction.

Table 12. Results of Regression ANOVA<sup>a</sup> (N=140)

Model		Sum of Square	df	Mean Square	F	Sig.
CK- Self-perception	Regression	139769.981	1	139769.981	279.085	<0.001 <sup>b</sup>
	Residual	69112.441	138	500.815		
	Total	208882.421	139			

a . dependent variable: self-perception; b. predictors: (constant):CK

As reported in table 12, the ANOVA results, F= 279.085 (P<0.001), indicate a linear regression relationship between the CK level of pre-service EFL teachers and their self-perception for phonics instruction.

Table 13. Results of Regression Coefficients (N=140)

Model		Unstandardized Coefficient B	Standardized Coefficient Beta	t	Sig	95% Confidence Interval for B
CK-Self-perception	Constant	-9.065		-1.416	<0.001	-21.727 3.596
		5.930	0.818	16.706		5.228 6.631

a . dependent variable: self-perception; b. predictors: (constant)

Table 13 shows that for the CK-Self-prediction regression coefficient, the constant variable CK (B=5.930, P<0.001), 95% CI (5.228-6.631), and Constant=-9.065 indicate that to predict pre-service EFL teachers' level of self-perception for phonics instruction from their CK level, the linear regression equation is:  $Y = -9.065 + 5.930X$ . Thus, the third research question was answered.

To conclude, the three research questions were answered comprehensively. First, the CK of pre-service EFL teachers can effectively predict their PCK level via the linear regression equation  $Y = 48.604 + 1.359X$ . Second, training via the guide can improve the self-perceived ability of pre-service EFL teachers to teach phonics by up to 50 per cent. Lastly, the CK level of such teachers can also effectively predict their self-perception for phonics instruction via a linear regression equation:  $Y = -9.065 + 5.930X$ .

### 5. Discussion

The purpose of this study was to evaluate indirectly the effectiveness of the phonics instructional guide in enhancing the PCK level of pre-service EFL teachers via the CK level they obtained as the independent variable. Thus, linear regression was conducted to determine the correlation between the CK level of these teachers and their assessed PCK level. An independent t-test was then conducted to check the mean difference between the self-perceived ability to teach phonics of the control group and that of the experimental group. Furthermore, the linear regression results showed that the CK level of the teachers could also effectively predict the level of their self-perception to teach phonics. However, some specific results need to be discussed.

The first point to address is the correlation between the CK and PCK levels of the pre-service EFL teachers. As Han (2011), Shulman (1987), and Zhang (2019) noted, teachers' CK is the foundation for developing their PCK. More specifically, Blevins (2017) and ILA (2019, 2020) noted that a teacher's CK of phonics may affect their ability to implement phonics instruction. In the present study, the linear regression results are in line with previous assertions that pre-service EFL teachers' CK can effectively predict their PCK. Although other studies such as those by Alavian (2019) and Correia and Baptista (2022) have yielded similar results, these authors did not focus on English as a foreign language study nor on pre-service EFL teachers. Clearly, there remains a scarcity of studies on the relationship between the CK and PCK of pre-service EFL teachers in China. Researchers such as Long (2019), Zhao (2019), Zhao et al. (2015), and Zhong (2020) have pointed out that neither in-service EFL teachers nor new EFL teachers are well-prepared for phonics instruction. Their studies also imply that these teachers lack CK, although their study did not mention the teachers' PCK of phonics. Therefore, although preliminary, this study has yielded a new finding and should contribute to the existing body of knowledge in this domain.

Furthermore, in this study, the pre-service EFL teachers' self-perception questionnaire results indicated that through training with the guide, they gained more confidence in teaching phonics. This study provides a solution to the problem proposed by Long (2019), Zhao (2019), and Zhong (2020): due to the absence of a phonics instructional guide and training, EFL teachers lack confidence in teaching phonics. As outlined above, the results indicate that the teachers expressed how they were able to identify phonics-related content in the English textbooks and that they would no longer teach vocabulary via the IPA. This was also mentioned by Long (2019), Zhao (2019), and Zhong (2020), who found that EFL teachers sometimes totally ignored the phonics content in textbooks or taught pronunciation using the IPA instead because they had only learned the IPA in their training. Therefore, this newly compiled phonics instructional guide essentially meets the learning needs of in-service and pre-service EFL teachers through its capacity to make them more confident in teaching phonics by improving their phonics CK. Thus, in this respect, the present study also contributes a new finding to the literature in this domain.

In addition, in the present study, the linear regression results demonstrated that the CK level of pre-service EFL teachers is a reliable predictor of their self-perceived phonics instruction competencies and confidence. This is also a new finding in this area, although several studies have focused on teachers' CK and self-perceived teaching confidence, such as those of Norton (2017) and Irwanto et al. (2022). Their studies focused on other subject areas such as STEM education, technology, or mathematics. Very few studies have focused

specifically on the CK and self-perceived competencies of pre-service teachers or EFL teachers. Zhao et al. (2015) conducted a study on the knowledge construct and self-perceived teaching abilities of Chinese EFL teachers. The results demonstrated that the teachers' knowledge and skills were significant predictors of their self-perceived teaching ability, regardless of their age and years of teaching. However, Zhao et al. (2015) focused on an in-service EFL teacher group and adopted only a questionnaire as the instrument, which was different from the approach used in the present study. In this sense, the latter contributes a new finding to the existing body of literature.

Last but not least, based on the CK level obtained by the teachers, the results showed that the correlation between CK and the ability to design a phonics teaching plan is stronger than the correlation between the teachers' levels of CK and trial instruction. The reason is that the guide used during their training included a sample lesson and guidelines for designing a systematic and explicit phonics instruction lesson. Thus, the trainees in the experimental group generally knew how to design a phonics instruction lesson plan with the CK they had already obtained. However, Blevins (2017) and ILA (2019, 2020) noted that teachers' CK of phonics may greatly impact their pedagogical strategy, pedagogical decisions, and even teaching abilities. Thus, the correlation coefficient indicated that the teachers' CK level was closely related to their PCK level, ability to plan phonics instruction teaching, and trial phonics instruction ability. Although Grossman (1989), Shulman (1987), Kaya et al. (2022), and Valencia et al. (2021) pointed out that CK indeed impacts PCK and is the prerequisite for developing PCK, it does not always guarantee a high level of PCK because the latter, as defined by Shulman (1987), is the blending or amalgamation of pedagogy and subject-matter content knowledge, which is known as CK. In other words, PCK includes what a teacher should know in order to teach and the way to teach. PCK is always dynamic and developing. Based on CK, PCK can be enhanced via avenues such as apprenticeships, internships, teaching practice, or auditing the classes of experienced teachers. Thus, even if pre-service EFL teachers possess the same phonics CK level and ability to design a phonics instruction teaching plan, they may not demonstrate a phonics instruction lecture to the same level. Therefore, the correlation between CK and trial phonics instruction was comparatively weaker than the correlation between the teachers' CK level and ability to design a lesson plan for phonics instruction.

## 6. Conclusion

In conclusion, the main purpose of this study was to investigate how effective a newly compiled phonics instructional guide was in improving pre-service EFL teachers' PCK, based on their already acquired CK of phonics. The results indicate that with the content knowledge acquired from the guide, these teachers exhibited a more satisfying PCK level than those teachers who trained with the prescribed phonology textbook in the control group. This study also suggests that the CK level of pre-service EFL teachers is a fairly reliable predictor of their levels of PCK, self-perceived competencies, and self-perceived efficacy. As most existing studies were conducted in a first-language context, a monolingual context, or other disciplines, the present study contributes to enriching the literature in the similar academic domain of EFL settings in China. Nonetheless, the sample size in this study was not large enough to generalise the results to a larger population. This may be addressed in future studies with a larger sample size. Moreover, it is hoped that the present study will encourage better ideas for investigating professional knowledge of phonics instruction among pre-service EFL teachers, in-service EFL teachers, or even educators. This would radically improve the teaching quality of English in light of the newly released English National Curriculum.

## Acknowledgments

We extend our deepest gratitude to the pre-service English as a Foreign Language (EFL) teachers and the university for their invaluable contributions to this study. The willingness of the pre-service EFL teachers to participate provided critical insights and significantly enriched the research, reflecting their commitment to language education. Likewise, the university's support, both logistically and intellectually, was instrumental in facilitating this collaborative effort. The enthusiasm and cooperation of the university staff and administration were pivotal in the successful execution of our project. This combined support from the pre-service teachers and the university has been indispensable, and we are profoundly grateful for their engagement and dedication to advancing the field of language education.

## Authors contributions

In this quantitative study, the collaborative efforts of the authors were integral to its success. Chen Min Jie spearheaded the study's conceptualization and methodology, and also managed the software aspects of data analysis. Yin Guo Jie was pivotal in data curation and took a primary role in drafting the original manuscript. Soo Ruey Shing enhanced the research with his expertise in visualisation and was key in the investigative processes. Wong Wei Lun provided vital supervision and project administration, ensuring the smooth progression and adherence to the study's objectives. Lastly, Dong Yi Ling's contributions were essential in the manuscript's review and editing, as well as in securing the necessary funding for the project. Each author's distinct contributions were fundamental in the comprehensive execution and success of this research endeavor.

## Funding

This article is a preliminary result of the following research projects:

- 1) "Empirical Study on the Improvement Path of In-Service EFL Teachers' Content Knowledge to Instruct English Early Reading in Light of National Curriculum" [Grant Number: 2022SC006] from the Chinese Society for Tao Xingzhi Studies;
- 2) "Improving EFL students' Language Abilities Via Phonics Instruction" [Grant Number: QJZD20220628] from China Basic Foreign Language Education Research & Training Center;



- 3) “A Study on the Impacts of Cross-Regional Instructional researches upon Teachers’ Professional Development in Nationality Areas” [Grant No. PDTR2017-1] from Sichuan Primary and Secondary School Teacher Development Research Center .

### Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### Informed consent

Obtained.

### Ethics approval

The Publication Ethics Committee of the Sciedu Press.

The journal’s policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

### Provenance and peer review

externally double-blind peer reviewed.

### Data availability statement

The data that support the findings of this study are available on request from the corresponding author.

### Data sharing statement

No additional data are available.

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