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EVALUATING PROFESSIONAL KNOWLEDGE FOR TEACHING ENVIRONMENTAL ISSUES IN VIETNAMESE ELEMENTARY SCHOOLS

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Abstract. *The significance of environmental education has become more evident, driven by global concerns surrounding climate change. In Vietnam, a country facing significant environmental challenges, developing environmental knowledge of elementary school teachers is crucial. This study aimed to validate a questionnaire for assessing professional knowledge of elementary school teachers in teaching environmental issues, originally designed in the Korean context. Recognizing the need for adaptation to the Vietnamese educational system, language, and local environmental issues, the initial 39-item questionnaire underwent a validation process. A total of 86 elementary school teachers participated in the construct validity and reliability, while eight qualified professionals evaluated the content validity. The results indicated that content validity indices for each item ranged from .88 to 1.00, and a scale-content validity index was .90. Exploratory factor analysis confirmed construct validity, organizing the 27 items into seven dimensions. The Cronbach's α coefficient was .86, which confirmed the questionnaire demonstrated a high level of reliability. Therefore, it is a reliable instrument for assessing elementary school teachers' professional knowledge in teaching environmental issues, which is relevant in the Vietnamese context. The validated instrument supports the development of professional development programs and contributes to the broader goal of enhancing environmental education in Vietnam.*

Keywords: *elementary teachers, environmental education, instrument development, professional knowledge*

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Introduction

The urgency of addressing environmental issues through education has become more evident. Education plays a vital role in equipping the next generation with the knowledge and skills needed to tackle pressing environmental challenges. As societies increasingly recognize the interconnectedness of human actions and environmental health, it becomes essential for educational systems to integrate comprehensive environmental education. Such integration addresses the global concerns about climate change, resource depletion, and ecological deterioration, as well as fosters a deeper understanding and commitment to sustainable practices among students, who are future stewards of the planet (Taboada-González & Aguilar-Virgen, 2024; Varela-Candamio et al., 2018).

Within the Vietnamese setting, a nation characterized by its remarkable natural landscapes and cultural diversity, there recently emerged a compelling concern about environmental challenges (Chau et al., 2020; World Bank, 2022). These issues involve a range of complex obstacles, such as deforestation, pollution, and the inexorable advancement of urbanization (Hoang et al., 2022; Ho et al., 2021). Vietnam is currently experiencing significant impacts from climate change and natural disasters, resulting in serious consequences for the health of the country's citizens (Huong et al., 2022; World Bank, 2022). Considering the ways to reduce the risks associated with natural environmental contamination, it is crucial for Vietnam to prioritize the development of environmental knowledge among all its citizens, with a special emphasis on elementary students (Hoang & Kato, 2016; Mashaba et al., 2022). Students are coming of age in an era characterized by human-induced global warming and grave environmental threats (Heck, 2015). Thus, they hold a pivotal role as the future generation of a nation, exerting considerable influence on sustainable development in society. Their attitudes, actions, and decisions will define their nations' long-term prosperity and ecological sustainability (Tayci & Uysal, 2012).

The purpose of enhancing environmental knowledge among elementary students emphasizes the role of elementary teachers as facilitators of environmental education (Sukma et al., 2020). The effectiveness of elementary teachers is crucial because they establish the foundation for a child's lifelong

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learning (Heck, 2015; Hoang & Kato, 2016). Elementary school teachers are critical to developing students' intelligence and providing them with the understanding to build a sustainable life (Timm & Bartha, 2021). Therefore, it becomes paramount to equip elementary school teachers with the professional knowledge essential for effectively imparting environmental education to their students.

Hence, it is important to have a reliable and valid instrument for evaluating the professional knowledge of elementary school teachers in Vietnam. This guarantees that elementary school teachers across Vietnam are well-prepared and possess the requisite professional knowledge. Some studies in the literature have confirmed the relevance of elementary school teachers' competencies to content knowledge and pedagogical content knowledge in the Vietnamese context (Nguyen, 2001; Thao et al., 2022). However, the existing evaluation instruments may not comprehensively address the distinctive challenges and demands of the Vietnamese elementary education landscape. While evaluating existing international literature, this study encountered a questionnaire by Lee et al. (2018) related to teacher knowledge for environmental education in elementary schools, specifically designed in the context of Korea. Notably, an interdisciplinary approach to environmental education is observed to be a commonality between Korea and Vietnam. Encouraged by this alignment, this study aspires to apply the Korean questionnaire to assess teacher knowledge within the Vietnamese context.

Education in Vietnam is undergoing ongoing reforms, including national curriculum, textbooks, educational approaches, and assessments (Nguyen et al., 2022). This requires teachers to not only possess pedagogical skills but also an insight into teaching content, contexts, classroom management, learning objectives, and the flexibility to adapt to their students' ever-changing needs (Pham et al., 2023). As a result, validating an instrument developed to measure elementary school teachers' professional knowledge for teaching environmental issues in Vietnam is worthwhile. This study aimed to close the gap between the Korean original questionnaire and the Vietnamese version, as well as ensure its suitability, reliability, and validity in measuring elementary school teachers' professional knowledge in teaching environmental issues in Vietnamese elementary education.

Theoretical Framework: Professional Knowledge

The concept of "professional knowledge" reflects a complicated foundation that teachers need in order to effectively engage in the process of teaching (Fischer et al., 2012). In 1986, Shulman published the first theoretical framework that is extremely valuable in enhancing the professional knowledge of teachers (Neumann et al., 2019). Shulman initiated the exploration of teacher professional knowledge, identifying various knowledge bases like content and general pedagogical knowledge (Neumann et al., 2019; Shulman, 19876). Subsequently, in 1987, the framework was broadened by including seven essential elements. These include content knowledge (CK); general pedagogical knowledge (GPK); curriculum knowledge (CmK); pedagogical content knowledge (PCK); learners and their characteristics knowledge (LCK); educational contexts knowledge; and educational ends, purposes, and values knowledge (PVK).

In their attempts to model professional knowledge, scholars have reached differing opinions regarding these seven components. Grossman (1990) presented four components: knowledge about students; knowledge about curriculum; knowledge about teaching strategies; and beliefs about the purposes for teaching a subject at different grades. Teaching is the act of combining content knowledge, context knowledge, and pedagogical knowledge (Gess-Newsome, 1999). Professional knowledge includes four components: general misconceptions of students, curriculum-specific knowledge, teaching strategies knowledge, and teaching objectives knowledge (Carlsen, 1999). Furthermore, knowledge of the subject area, understanding of the context and goals of instruction, strategies for representing ideas in the classroom, and familiarity with students are all components of professional knowledge (Jang et al., 2009; Tuan et al., 2000). Moreover, assessment knowledge is an important element of teachers' professional knowledge (De Jong, 2009).

Until now, there has been ongoing discourse regarding what constitutes professional knowledge and how to assess and integrate it (Young & Muller, 2010). This study adopts the comprehensive view of professional knowledge developed by Lee et al. (2018) as teachers' professional knowledge in environmental education, including seven components: (1) content knowledge; (2) general pedagogical knowledge; (3) curriculum knowledge; (4) learners and their characteristics knowledge; (5) educational contexts knowledge; (6) educational ends, purposes and values knowledge; and (7) assessment knowledge.

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Measuring Professional Knowledge in the Field of Environmental Education

In international literature, there is evidence that professional knowledge has been explored across various fields such as mathematics, science, history, and literature (Mishra, 2020; Neumann et al., 2019; Tuithof et al., 2021; Van Sledright, 2014). However, when it comes to the field of environmental education, the research landscape is relatively limited (Lee et al., 2018; Yolcu et al., 2022). Notably, most studies in environmental education have primarily focused on the secondary education level (Abdullah & Halim, 2012).

Within the Vietnamese educational context, it is important to highlight that there is no distinct curriculum to instruct environmental education for elementary school students (Ministry of Education and Training [MOET], 2018). Consequently, teachers are tasked with the challenging role of integrating environmental concerns—covering aspects like natural resource conservation, ecosystems, habitat preservation, and pollution—into various subjects (Tran et al., 2020). This integration approach often results in the professional knowledge required for effective environmental education being overlooked (Danh, 2021).

Nevertheless, there have been some studies concerning teachers' knowledge of environmental education. For example, the work of Nguyen (2001) indicated that Vietnamese elementary teachers not only lack comprehensive knowledge of environmental issues, conservation, and environmental education but also struggle to apply theoretical knowledge to their local contexts. While there have been studies addressing teacher competencies, especially related to two kinds of knowledge (content and pedagogy), most of these focus on secondary or higher education levels (Kieu, 2016; Nguyen, 2018). Moreover, these studies tend to lack coverage of all seven components outlined in Shulman's (1987) or Lee et al.'s (2018) frameworks of professional knowledge.

Furthermore, it was mentioned that interviews and observations are the main methods used to evaluate teachers' professional knowledge. One common limitation observed in these studies is the lack of developed assessment tools designed to evaluate teachers' knowledge of teaching environmental issues, particularly at the elementary level (Thao et al., 2022).

Research Aim and Research Questions

The field of teacher knowledge, particularly professional knowledge, has been extensively explored in the existing body of literature (Chan & Yung, 2018). While there has been a growing emphasis on teacher knowledge in various research studies conducted in Vietnam, there is a noticeable lack of attention given to the field of environmental education. Based on the literature review, several previously validated instruments were examined, leading to the selection of the Elementary School Teachers' Environmental Pedagogical Content Knowledge questionnaire (Lee et al., 2018) to evaluate the teacher's professional knowledge regarding teaching environmental issues in Vietnam.

1. How do experts assess the content validity of the Elementary School Teachers' Environmental Pedagogical Content Knowledge questionnaire in the Vietnamese context?
2. Can the factor structure, as measured by the Elementary School Teachers' Environmental Pedagogical Content Knowledge questionnaire, be confirmed in the Vietnamese context?
3. To what extent do the factors in the Elementary School Teachers' Environmental Pedagogical Content Knowledge questionnaire demonstrate reliability in the Vietnamese context?

Research Methodology

General Background

The research was conducted over a three-month period from August to October 2023. A quantitative research approach was chosen to provide a systematic means of evaluating the questionnaire of teachers' professional knowledge in environmental education. The study utilized a theoretical framework grounded in Pedagogical Content Knowledge (PCK), which highlights the integration of subject matter knowledge and pedagogical strategies necessary for effective teaching. This framework is essential in the context of environmental education, where teachers must not only understand environmental concepts but also know how to convey these concepts to students in an engaging and meaningful way.

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Participants

Drawing on the findings of prior research, content validity assessments are commonly conducted with the involvement of seven or more experts (Parsian & Dunning, 2009). However, Yusof (2019) proposed that a panel of five to ten experts for content validity assessment is generally sufficient, and the inclusion of more than ten experts might prove unnecessary. Considering these considerations, eight professionals affiliated with universities were invited to participate. Each of these experts had specialized knowledge in the fields of educational measurement (2 experts), elementary education (3 experts), and environmental education (3 experts).

A convenience sample of one hundred elementary school teachers in the southern region of Vietnam was contacted and invited to participate in the study. There were 86 participants who responded, accounting for 86.00% of the total number of invitees. The participant group was composed of 61 females (70.93%) and 25 males (29.07%), aligning with the gender distribution observed in Vietnamese elementary education sources (Nguyen, 2020). Table 1 illustrates a comprehensive summary of the participants.

Table 1
The Detailed Information of the Participants

Gender	Experts		Elementary school teachers	
	n	%	*n*	%
Female	4	50.00	61	70.93
Male	4	50.00	25	29.07
Total	8	100.00	86	100.00

Instrument and Procedures

In this study, the "Elementary School Teachers' Environmental Pedagogical Content Knowledge" questionnaire (Lee et al., 2018) was employed with the permission of the authors. This questionnaire is designed to assess seven latent constructs related to elementary school teachers' professional knowledge in teaching environmental issues. It comprises a total of 39 items distributed across the following categories: 5 items for Content Knowledge, 5 items for General Pedagogical Knowledge, 4 items for Curriculum Knowledge, 5 items for Learners and Their Characteristics Knowledge, 6 items for Educational Contexts Knowledge, 8 items for Educational Ends, Purposes, and Values Knowledge, and 6 items for Assessment Knowledge. Participants were asked to express their degree of agreement with these statements using a 5-point Likert scale, which ranged from "strongly disagree" to "strongly agree" (see Table 2).

Table 2
Information of the Elementary School Teachers' Environmental Pedagogical Content Knowledge Questionnaire

Dimension	Sample item	Number of Items
CK	I know the inquiry process that a learner should have in environmental education.	1-5
CmK	I understand the government-proposed environmental education standards for different grade levels of schools.	6-9
LCK	I understand a lot of obstacles that students face when trying to adopt pro-environmental behavior.	10-14
GPK	I understand strategies that can be used in the classroom to make environmental concepts more accessible to students.	15-19
ECK	I understand the need to carry out environmental education in connection with social environmental education institutions (e.g., NGOs, local government, and business enterprises).	20-25
PVK	I understand that a goal which considers the students' long-term behavioral changes is necessary for environmental education.	26-33
AK	I know how to assess affective domains such as attitude and belief towards the environment.	34-39

Note. CK - Content Knowledge, GPK - General Pedagogical Knowledge, CmK - Curriculum Knowledge, LCK - Learners and Their Characteristics Knowledge, ECK - Educational Contexts Knowledge, PVK - Educational Ends, Purposes, and Values Knowledge, AK - Assessment Knowledge

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The original questionnaire was written in English. Therefore, the authors of this study conducted the translation process from an English questionnaire into Vietnamese to facilitate data collection. An English lecturer at the English Department, University of Education in Vietnam then back-translated this version into English to ensure its accuracy. After a thorough validation of the translation's accuracy and linguistic equivalence, the Vietnamese version of the questionnaire underwent a pilot test with a committee of experts and elementary school teachers to assess the validity and reliability of the questionnaire items.

In addition, a committee of experts utilized an additional evaluation tool known as the content validity form. This form enabled experts to assess the relevance and clarity of each item in relation to the study's objectives. This assessment was executed on a rating scale ranging from 1 (indicating "not relevant" or "not clear") to 4 (indicating "highly relevant" or "highly clear"). Moreover, there was a section for experts to provide suggestions and comments on each item, further enhancing the comprehensiveness of their evaluation.

Data Collection

In the first round, the data collection process commenced in early August 2023 with the dispatch of formal invitations to eight university experts. These invitations allowed the experts to choose between an in-person or virtual approach. Three of the eight experts chose the in-person method, while the other six chose the virtual option.

To facilitate the in-person meeting, a three-hour expert panel meeting was scheduled. During this session, the researcher guided the content validation process. On the other hand, experts were given an online content validation form as part of the virtual approach. To help with the content validation process, specific instructions were given in this context.

In the second round, email invitations were extended to a sample of 100 elementary school teachers in September 2023. They were gently reminded of the invitation two weeks later. This strategy was implemented to encourage their participation in the study. By October 2023, this study collected responses from 86 teachers, who had willingly taken part in our research. To protect the privacy of participants, their personal information would be handled with confidentiality and used only for research purposes.

Data Analysis

To address the first question, the item-level content validity index (I-CVI) for every questionnaire item was calculated. The I-CVI values for each item were then averaged to calculate a scale-level content validity index based on the average method (S-CVI/Ave). In this context, and with the participation of eight experts, the minimally acceptable scores for I-CVI and S-CVI/Ave were established as .78 and .83, respectively (Polit et al., 2007).

To resolve the second question, data analysis was carried out using SPSS Statistics version 29. Extraction using Principal Component Analysis and rotation using Varimax were two of the data analysis methods used in exploratory factor analysis (EFA). These analytic procedures were instrumental in examining the construct validity of the research instrument.

To answer the third question, this study continued to utilize SPSS Statistics version 29 to calculate Cronbach's Alpha coefficient. The following reliability levels are established by the interpretation of Cronbach's Alpha coefficient: invalid (.00 to .53), low (.54), moderate (.60 to .65), good (.66 to .71), excellent (.72 to .99), and perfect (1.00) (Creswell, 2010).

Research Results

Content Validity

In alignment with prior research, items with an I-CVI value exceeding .79 were considered appropriate and retained. Moreover, items scoring within the range of .70 to .79 required modifications, guided by the recommendations provided by the panel of experts. Additionally, items scoring below .70 were removed as advised by Rodrigues et al. (2017). Results from the evaluation performed by eight specialists should not have an S-CVI value lower than .83, as per the standards laid out in the literature (Polit & Beck, 2006; Polit et al., 2007). Table 3 displays the content validity of the instrument in this study.

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Table 3
The Content Validity Index of the Instrument with Experts (N = 8)

Factor	Item	Expert Agreement*	I-CVI	S-CVI/Ave	Interpretation
CK	CK1	6/8	.75	.88	Need to revise
	CK2	7/8	.88		Accepted
	CK3	8/8	1.00		Accepted
	CK4	6/8	.75		Need to revise
	CK5	8/8	1.00		Accepted
CmK	CmK1	8/8	1.00	.94	Accepted
	CmK2	8/8	1.00		Accepted
	CmK3	6/8	.75		Need to revise
	CmK4	8/8	1.00		Accepted
LCK	LCK1	6/8	.75	.90	Need to revise
	LCK2	8/8	1.00		Accepted
	LCK3	7/8	.88		Accepted
	LCK4	7/8	.88		Accepted
	LCK5	8/8	1.00		Accepted
GPK	GPK1	8/8	1.00	.95	Accepted
	GPK2	8/8	1.00		Accepted
	GPK3	6/8	.75		Need to revise
	GPK4	8/8	1.00		Accepted
	GPK5	8/8	1.00		Accepted
ECK	ECK1	6/8	.75	.88	Need to revise
	ECK2	7/8	.88		Accepted
	ECK3	6/8	.75		Need to revise
	ECK4	7/8	.88		Accepted
	ECK5	8/8	1.00		Accepted
	ECK6	8/8	1.00		Accepted
PVK	PVK1	7/8	.88	.88	Accepted
	PVK2	8/8	1.00		Accepted
	PVK3	8/8	1.00		Accepted
	PVK4	8/8	1.00		Accepted
	PVK5	7/8	.88		Accepted
	PVK6	6/8	.75		Need to revise
	PVK7	6/8	.75		Need to revise
	PVK8	6/8	.75		Need to revise
AK	AK1	8/8	1.00	.84	Accepted
	AK2	8/8	1.00		Accepted
	AK3	8/8	1.00		Accepted
	AK4	6/8	.75		Need to revise
	AK5	5/8	.63		Need to remove
	AK6	5/8	.63		Need to remove
Total				.90	

*Note. * The number of experts provides a score of 3 or 4 divided by the total number of experts*

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Table 3 presents the outcomes of the content assessment conducted by the experts on each item within the "Elementary School Teachers' Environmental Pedagogical Content Knowledge" questionnaire. The total scale-content validity index stands at .89, indicating the overall appropriateness of the entire questionnaire. Out of the 39 items examined, 26 items demonstrated acceptability and suitability, with I-CVI scores ranging from .88 to 1.00.

Moreover, considerable discussion centered on the clarity and comprehensibility of certain questions. Items about "Content knowledge" (CK1, CK4), "Curriculum knowledge" (CmK3), "Learners and their characteristics knowledge" (LCK1), "General pedagogical knowledge" (GPK3), "Educational contexts knowledge" (ECK1, ECK3), "Educational ends, purposes, and values knowledge" (PVK6, PVK7, PVK8), and "Assessment knowledge" (AK4) obtained a CVI score of .75. These specific items necessitated revisions, as advised by the expert panels, to align more effectively with the Vietnamese context. For example, the term "preconceptions" (original item LCK1) proved to be challenging for comprehension. Consequently, this item was rephrased as "prior knowledge" to enhance clarity and understanding. Also, in alignment with the Vietnamese Educational Curriculum, which outlines three general competencies, the ability to learn independently, to communicate and collaborate with others effectively, and to solve problems creatively (MOET, 2018), revisions were made to the original item PVK8.

Nonetheless, two items (AK5 and AK6) were removed from the instrument because they were inconsistent with the assessment context in Vietnam. This modification was necessitated by the fact that environmental education is not presented as a single program in the Vietnamese Education Curriculum but rather is incorporated with other subjects. In addition, during the evaluation process, the panel of experts suggested reordering the item sequence within specific factors, such as "Content knowledge" and "Educational contexts knowledge", to enhance the logical structure of the questionnaire. Finally, 26 items were accepted, 11 items were revised, and two items were removed for the new version of the instrument, called "Professional Knowledge for Teaching Environmental Issues" (PK-TEI) with 37 items.

Construct Validity

In order to determine whether the PK-TEI questionnaire was construct valid, an EFA was carried out. The commonality values of all items in the questionnaire are above .72, hence there were no items to be removed from further steps of factor analysis (Costello & Osborne, 2005). After checking with elementary school teachers, the factor loading and item description for each of the 37 items included in the EFA is presented in Table 4.

Table 4
Exploratory Factor Analysis Results of PK-TEI Questionnaire in the Vietnamese Context (n = 86)

Factor	Item	1	2	3	4	5	6	7	Percentage of variance
CK	CK1						.82		9.59
	CK3						.83		
	CK4						.76		
CmK	CmK1							.76	7.78
	CmK2							.93	
	CmK4							.62	
LCK	LCK1		.92						13.69
	LCK2		.90						
	LCK4		.95						
	LCK5		.89						
GPK	GPK1			.71					12.25
	GPK3			.88					
	GPK4			.87					
	GPK5			.81					
ECK	ECK3					.94			10.84
	ECK5					.90			
	ECK6					.94			

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Factor	Item	1	2	3	4	5	6	7	Percentage of variance
PVK	PVK1	.88							18.83
	PVK2	.87							
	PVK3	.88							
	PVK4	.71							
	PVK7	.87							
	PVK8	.79							
AK	AK1				.83				11.91
	AK2				.78				
	AK3				.72				
	AK4				.88				
Total									84.89

In Table 4, the results of the EFA based on the Principal Component Analysis extraction method and Varimax rotation method extracted seven factors of the PK-TEI questionnaire with eigenvalues greater than 1. In addition, some items were excluded because of small factor loadings (less than ± .30) and cross-loading, certain items were deleted. At last, this study kept 27 items from the PK-TEI survey; these items are highly consistent with the authors' and experts' predicted domain recommendations.

Particularly, the first construct, "Educational Ends, Purposes, and Value Knowledge", explained 18.83% of the variance and included 6 items with standardized factor loadings between .71 and .88. The second construct, "Learners and Their Characteristics Knowledge", explained 13.69% of the variance and included 4 items with standardized factor loadings ranging from .89 to .95. The third construct, "General Pedagogical Knowledge", explained 12.25% of the variance and included 4 items with standardized factor loadings between .71 and .88. The fourth construct, "Assessment Knowledge", explained 11.91% of the variance and included 4 items with standardized factor loadings between .72 and .88. The fifth construct, "Educational Contexts Knowledge", explained 10.84% of the variance and included 3 items with standardized factor loadings ranging from .90 to .94. The sixth construct, "Content Knowledge", explained 9.59% of the variance and included 3 items with standardized factor loadings between .76 and .83. The seventh construct, "Curriculum Knowledge", explained 7.78% of the variance and included 3 items with standardized factor loadings between .62 and .93.

Internal Reliability

The PK-TEI questionnaire's reliability was tested using internal consistency reliability on a sample of 27 items. Table 5 displays the domain-specific results based on the seven factors.

Table 5
Reliability of the PK-TEI Questionnaire (n = 86)

Factor	Domain	Number of items	**Cronbach's α**
CK	CK1, CK3, CK4	3 items	.87
CmK	CmK1, CmK2, CmK4	3 items	.78
LCK	LCK1, LCK2, LCK4, LCK5	4 items	.96
GPK	GPK1, GPK3, GPK4, GPK5	4 items	.89
ECK	CK3, ECK5, ECK6	3 items	.95
PVK	PVK1, PVK2, PVK3, PVK4, PVK7, PVK8	6 items	.95
AK	AK1, AK2, AK3, AK4	4 items	.92
Total		27 items	.86

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As shown in Table 5, the PK-TEI questionnaire had 27 items and a Cronbach's Alpha value of α = .86. This value shows that the overall instrument has a high degree of internal reliability (Creswell, 2010). In detail, four subscales got excellent levels of internal reliability. The "Learners and their characteristics knowledge" subscale consisted of 4 items (α = .96), the "Educational contexts knowledge" subscale consisted of 3 items (α = .95), the "Educational ends, purposes and values knowledge" subscale consisted of 6 items (α = .95), and the "Assessment knowledge" subscale consisted of 4 items (α = .92). Moreover, the three remaining subscales got good levels of internal reliability. For example, the "Content knowledge" subscale consisted of 3 items (α = .87), the "Curriculum knowledge" subscale consisted of 3 items (α = .78), and the "General pedagogical knowledge" subscale consisted of 4 items (α = .89).

No items were removed from the reliability analysis based on these results. This led to the validation of the final version of the PK-TEI questionnaire, which comprises 27 items and covers seven primary factors: (1) content knowledge with three items; (2) curriculum knowledge with three items; (3) learners and their characteristics knowledge with four items; (4) general pedagogical knowledge with four items; (5) educational contexts knowledge with three items; (6) educational ends, purposes and values knowledge with six items; and (7) assessment knowledge with four items.

Discussion

To date, there has been a notable absence of studies in Vietnam that employ fully validated questionnaires to assess professional knowledge in environmental education (Thao et al., 2022). In response to this research gap, the main aim of this study was to adapt and validate an instrument that enables the evaluation of elementary school teachers' professional knowledge in teaching environmental issues within the Vietnamese educational context. This process involved not only validating the existing questionnaire but also making necessary modifications to ensure its relevance and effectiveness for the specific educational and environmental context of Vietnam.

This study has provided substantial evidence supporting the content validity of the questionnaire, originally developed by Lee et al. (2018) within the context of South Korean education. In their earlier work, the initial validation of the questionnaire was conducted by a panel of ten experts, all operating within the framework of the Korean educational system, which led to the confirmation of 39 items. However, our study encountered certain challenges during the evaluation process, primarily in terms of modifying items that would offer clear and comprehensive information to our respondents. The expert panel involved in this study raised concerns about the clarity of specific items. To enhance the quality of the questionnaire's content, it needs to consider the educational context, particularly within the framework of the Educational Curriculum reform in Vietnam (MOET, 2018). As a result, we faced the demanding decision to eliminate two items and modify eleven others based on the feedback provided by the experts. These adjustments underscore the notable distinctions between the educational contexts of Vietnam and Korea.

Regarding construct validity, an EFA was performed, and seven factors were identified: "content knowledge", "general pedagogical knowledge", "curriculum knowledge", "learners and their characteristics knowledge", "educational contexts knowledge", "educational ends, purposes, and values knowledge", and "assessment knowledge". These elements are highly consistent with the original questionnaire's predicted domains (Lee et al., 2018). However, it is essential to note a difference between our study and previous ones: the questionnaire was reduced to 27 items following the EFA. With a Cronbach's Alpha coefficient of .86, the questionnaire also demonstrated a high degree of reliability. This indicates that the instrument's items are internally consistent and reliably measure the intended constructs.

In comparison with international studies, the findings of this study align well with the general trends observed in the validation of educational assessment tools. For instance, a study by Hill et al. (2008), the development and validation of a measure for teacher knowledge in the United States similarly faced the necessity of refining items to improve clarity and contextual relevance. Moreover, the reduction of items after EFA is a common step in the validation process, as evidenced by research conducted by Howard (2015), which also involved modifications to ensure the relevance and reliability of the instrument across different educational contexts.

Further, the adaptation and validation process outlined in this study mirrors similar efforts in other cultural and educational settings. For example, a study by Lee et al. (2022) on the validation of an instrument to assess students' perceptions of flipped classroom experience in Monash University Malaysia School of Pharmacy also highlighted the importance of contextual adaptations to align the instrument with local educational practices. This comparison underlines the global relevance of our approach and the necessity of cultural and contextual considerations in the validation of educational assessment tools.

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It is important to note that while this study did make some noteworthy contributions, it did have several limitations. A primary limitation is the relatively small sample size of elementary school teachers ($n = 86$). Because of this limited sample size, this study was unable to perform Confirmatory Factor Analysis (CFA) and Structural Equation Modeling (SEM). CFA and SEM require a large sample size to ensure reliable results as suggested by Byrne (2006) and Hair et al. (2019). The current sample size was sufficient for exploratory factor analysis (EFA) but does not meet the recommended threshold for conducting CFA and SEM. Therefore, expanding the sample size would enhance the generalizability of findings concerning elementary school teachers' professional knowledge in environmental education. Furthermore, it's essential to recognize the potential selection bias due to the purposeful selection of experts and the convenient sampling of elementary school teachers. This bias may have contributed to the high coefficients of validity and reliability observed in the questionnaire. Therefore, further studies should employ different approaches to provide additional validation for the instrument, such as CFA and SEM to confirm the factor structure and assess the model's fit.

Conclusions and Implications

This study effectively validated the instrument of Lee et al. (2018) in the Vietnamese context, thereby addressing the critical need for an instrument to assess elementary school teachers' professional knowledge of teaching environmental issues. Content validity, construct validity, and internal reliability were all part of the validation procedure that aimed to guarantee the reliability and validity of the questionnaire.

The revised questionnaire, which consists of 27 items organized into seven constructs, provides a comprehensive and well-structured instrument for assessing the professional knowledge of Vietnamese elementary school teachers. This instrument is useful for guiding teacher training programs and curriculum development to improve the successful implementation of environmental education in elementary schools. The seven constructs identified—content knowledge, general pedagogical knowledge, curriculum knowledge, learners and their characteristics knowledge, educational contexts knowledge, educational ends, purposes and values knowledge, and assessment knowledge—cover critical areas essential for effective environmental education.

Although the study's primary objective was to check the questionnaire in the Vietnamese context, its implications extend beyond Vietnam. Other countries seeking to assess and improve the environmental professional knowledge of elementary school teachers can adopt and adapt this instrument to fit their educational contexts. The need for a culturally and contextually relevant tool for evaluating teachers' knowledge in environmental education is universal, given the global challenges of climate change, resource depletion, and ecological deterioration.

Recognizing the critical role that elementary school teachers play in developing environmental consciousness in their students, the results stress the importance of investing in their professional development as environmental education facilitators. By equipping teachers with the necessary knowledge and skills, they can effectively integrate environmental education into their teaching practices, thereby fostering a new generation of environmentally conscious citizens. This research contributes to ongoing global efforts to strengthen environmental education in elementary schools and supports the broader objective of promoting sustainable development through education.

Moreover, the validated instrument supports educational policymakers and curriculum developers in identifying specific areas where teachers may need additional training or resources. This targeted approach can lead to more effective and meaningful professional development programs, ultimately enhancing the quality of environmental education delivered to students.

This study not only provides a validated tool for assessing elementary school teachers' professional knowledge in Vietnam but also offers a model for similar efforts in other countries. The findings underscore the necessity of culturally and contextually relevant instruments in educational research and highlight the global importance of empowering teachers to address environmental issues through education.

Declaration of Interest

The authors declare no conflict of interest.

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