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PSCP Cognitive Engagement Scale: A Scale Development Study

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ABSTRACT

This study aimed to develop and validate an instrument to measure students' cognitive engagement in teaching-learning environments. An exploratory correlational method was employed to develop the scale. 446 university pre-degree students learning English as a foreign language participated in the study. A pilot study was conducted with 117 students to explore the item and factor structure of the scale, resulting in the removal of eight items from the scale. A subsequent study with 329 students was conducted to confirm the scale's item and factor structure. Results showed that the scale demonstrated content validity, with a content validity index of .94. The scale consisted of nine items and two factors, identified as *cognitive attention* and *cognitive effort*. Convergent validity was established, as evidenced by composite reliability values of .83 and .84 for each factor, with average variance extracted of .55 and .51, respectively. Corrected item-total correlation values ranged from .54 to .71, and inter-item correlation exceeded .30. Reliability analysis revealed high internal consistency, with each factor demonstrating reliability of .83 and .85, resulting in an overall scale reliability of .89. In conclusion, the findings indicate that the developed PSCP Cognitive Engagement Scale is a valid and reliable scale for measuring cognitive engagement in learning environments.

Keywords: Cognitive engagement, scale development, factor analysis, reliability, validity.

Introduction

In contemporary teaching and learning environments, the influence of digital tools and technologies is steadily increasing. This increase has the potential to raise students' cognitive load, thereby impacting their cognitive engagement during the learning process (Henrie et al., 2015). Cognitive engagement, defined as the deliberate task-specific thinking that a student undertakes while participating in a classroom activity (Helme & Clarke, 2001), includes their cognitive attention (Kong & Hoare, 2011) and cognitive effort (Earl et al., 2023). Within this context, cognitive engagement represents the cognitive processes and energy that students invest in understanding the learning content (Finn & Zimmer, 2012).

Cognitive engagement, which reflects the investment students make in their learning processes, can significantly influence the teaching and learning experience. A review of the literature reveals that cognitive engagement not only enhances motivation (Archambault et al., 2009; Husni et al., 2022; Shukor et al., 2014) but also positively impacts academic achievement and performance (Guthrie & Carlin, 2024; Huang et al., 2019; Liu et al., 2023). Students with deep cognitive engagement actively use prior knowledge and intentionally create complex knowledge structures by integrating new information with prior knowledge (Greene, 2015). In doing so, they elaborate on the material and achieve more effective learning. Within this context, it can be stated that students who engage in deeper cognitive processing tend to demonstrate higher levels of academic success (Greene & Miller, 1996).

Cognitive engagement has been defined in similar ways by various researchers. For instance, Fredricks et al. (2004) describe cognitive engagement as the cognitive investment students make in learning, while Blumenfeld et al. (2006) define it as the willingness to put effort into learning by using cognitive and metacognitive strategies. Similarly, Greene (2015) defines cognitive engagement as the metacognitive effort individuals expend to learn effectively.

In light of the literature, this study defines cognitive engagement as students' cognitive attention directed to instructional content and their cognitive effort exerted to process and understand new information. Cognitive attention relates to how well students focus on teaching and learning activities without being affected by internal or external distractions. Cognitive effort relates to the quality and level of effort students expend to understand information even in moments when they struggle.

Researchers have identified distinct levels of cognitive engagement. For example, Blumenfeld et al. (2006) examined cognitive engagement by categorizing it into superficial and deep levels of engagement. Superficial cognitive engagement involves basic strategies, such as memorization. In contrast, deep cognitive engagement encompasses efforts to relate new information to existing knowledge and elaborate on the information for a more comprehensive understanding.

According to Chi and Wylie (2014), cognitive engagement can occur in four modes: interactive, constructive, active, and passive. In their framework, known as the ICAP theory, each type of cognitive engagement involves distinct cognitive processes and methods of acquiring knowledge. Students exhibiting passive cognitive engagement merely direct their attention to the instructional material presented to them. When they repeat or attempt to memorize the information, they demonstrate active cognitive engagement. Constructive cognitive engagement occurs when students generate new ideas that go beyond the given material, such as when they explain concepts in their own words. Finally, interactive cognitive engagement, the deepest level of engagement, occurs when students engage in substantive dialogue about the material, with each person contributing constructively to build understanding together.

The level of cognitive engagement can be observed through students' behaviors during the learning process. This level is evident in their performance during learning activities, the number of questions they ask in class, and the quality of the assignments they submit (Hew, 2016). Students with a high level of cognitive engagement strive to internalize the information and effectively employ learning strategies (Meece et al., 1988). They actively participate in the learning process and put effort into understanding the material. Such students use their cognitive systems efficiently when applying cognitive strategies or acquiring new knowledge (Guthrie & Carlin, 2024). They ask questions to deepen their understanding, persist through challenging tasks, read beyond the assigned material, and engage in research to self-regulate their learning.

As noted by Appleton et al. (2006), observing student behaviors provides only an inferential estimate of their cognitive processes. Therefore, self-report scales can be employed to measure cognitive engagement. In their study comparing data collection tools designed to assess student engagement, Fredricks and McColskey (2012) identified 11 self-report scales that measure various dimensions of engagement, such as emotional, behavioral, and social engagement. Cognitive engagement has been measured as a subdimension in six of these scales (Appleton et al., 2006; Fredricks et al., 2004; Greene & Miller, 1996; Liem & Martin, 2012; Voelkl, 1997; Yazzie-Mintz, 2007). Additionally, the construct has been addressed as a subdimension in other engagement scales found in the literature (Burch et al., 2015; Gunuc & Kuzu, 2015).

The literature highlights two measurement tools specifically developed to assess cognitive engagement (Agustini et al., 2022; Barlow et al., 2020). The first tool, developed by Agustini et al. (2022), was designed to examine the extent to which students' cognitive engagement influences their critical and creative thinking skills. This scale includes items that measure behaviors such as practicing, elaborating, and organizing information as indicators of cognitive engagement. The second tool, developed by Barlow et al. (2020), aims to measure the cognitive engagement of engineering students in class. It was designed to provide teachers with data on strategies to promote active student participation during learning sessions. The subdimensions of this scale include peer interaction, constructive notetaking, active notetaking, active processing, and passive processing.

Purpose of the Study

A review of the literature on cognitive engagement reveals its conceptualization through elements such as cognitive attention directed toward learning materials (Kong & Hoare, 2011) and cognitive effort applied through cognitive and metacognitive strategies (Greene, 2015). While existing scales measure cognitive and metacognitive strategy use, no instrument specifically measures students' cognitive attention and effort during learning. Addressing this gap, this study aimed to develop and validate an instrument to measure students' cognitive engagement by assessing their cognitive attention and effort.

To fulfill this objective, this study addressed the following research questions:

- How does the PSCP Cognitive Engagement Scale demonstrate content validity?
- How does the PSCP Cognitive Engagement Scale demonstrate construct validity?
- How does the PSCP Cognitive Engagement Scale demonstrate convergent validity?
- How does the PSCP Cognitive Engagement Scale demonstrate discriminant validity?
- How does the PSCP Cognitive Engagement Scale demonstrate item discrimination?
- How does the PSCP Cognitive Engagement Scale demonstrate internal consistency?

Method

Research Design

This study aimed to develop and validate an instrument to measure students' cognitive engagement in teaching and learning environments. For this purpose, an exploratory correlational research design was employed. This design allows researchers to examine relationships among two or more variables in their natural state without researcher manipulation (Creswell, 2015). Within this framework, the explanatory correlational design was used to investigate relationships between the observed variables (items) within the developed scale.

Participants

The target population for this study included 410,103 university students in Ankara. The sample size was determined as 385 based on a 5% margin of error and 95% confidence interval. Using proportional cluster sampling, public and private universities were treated as two distinct clusters; however, permissions were obtained from only two public universities and one private university. Consequently, the sample consisted of 450 volunteer students learning English at the Schools of Foreign Languages of these universities.

Regarding faculty distribution, the highest participation came from the Faculty of Engineering (n = 153), followed by the Faculty of Arts and Sciences (n = 80), and the Faculty of Economics and Administrative Sciences (n = 66). The gender distribution included 180 male and 265 female participants, with five choosing not to disclose their gender. Age distribution showed 334 students in the 18-19 age range, 92 in the 20-21 range, and 24 aged 22 or above. Regarding English learning duration, 128 students had studied English for one year, 147 for 2-3 years, and 80 for more than 10 years. While 344 participants reported enjoying learning English, 71 indicated they did not. 35 participants did not disclose their attitude toward English.

Following examination of participant characteristics, outlier analysis was conducted. After removing data from four participants, the final sample consisted of 446 students. Of these, 117 participated in the initial scale development study, and 329 in the confirmatory factor analysis of the draft scale.

Scale Development Process

The PSCP Cognitive Engagement Scale was developed to examine the relationships among students' psychological safety perception, social presence, cognitive engagement, and perceived learning in learning environments. The acronym PSCP, derived from the initial letters of these variables, was used to name the scale. While this study does not address these relationships directly, it presents the development process, validity, and reliability of the PSCP Cognitive Engagement Scale. The scale development process followed the stages proposed by DeVellis (2003).

Determining the Construct to Be Measured

Before developing the PSCP Cognitive Engagement Scale, the definitions of cognitive engagement in the literature were reviewed. Drawing from this literature, this study defines *cognitive engagement as students' cognitive attention directed to instructional content and their cognitive effort exerted to process and understand new information*. Based on this conceptualization, items were developed to measure students' cognitive engagement by measuring both their cognitive attention and cognitive effort in teaching-learning environments.

Generating the Item Pool

The item pool was developed through two complementary approaches: (1) adaptation of items from existing cognitive engagement measurement instruments in the literature, and (2) generation of new items based on documented characteristics of students demonstrating high cognitive engagement. This process yielded an initial pool of 96 items.

Determining the Format for Measurement

Following a review of measurement formats in the literature and considering respondent accessibility, a graded response model with five categories was adopted. Accordingly, the scale items were anchored on a continuum from Strongly Disagree (1) to Strongly Agree (5).

Reviewing the Initial Item Pool

Before the item pool was reviewed by experts, the researchers conducted a preliminary analysis to identify and remove items that: (1) were duplicated or similar to the other items in the pool, (2) aimed to measure cognitive engagement in online environments, (3) were developed for participants outside the scope of this study (such as primary school students), or (4) were likely to measure constructs unrelated to cognitive engagement. This preliminary analysis reduced the item pool to 46 items. Discussions with administrators revealed that the intensive teaching schedule of the Foreign Languages Department, where the preliminary study would be conducted, allowed limited time for the research. Consequently, an expert review methodology was chosen over pilot testing for item evaluation. The researchers and a language education specialist employed a read-aloud technique to assess item clarity and alignment with the study's objectives. This process identified 22 items that demonstrated both linguistic clarity and conceptual alignment with the research aims.

The resulting 22-item draft PSCP Cognitive Engagement Scale was then submitted for review to eight education experts: five specialists in curriculum and instruction and three in educational measurement and evaluation.

Establishing Content Validity

Content validity was evaluated through expert review using Lawshe's method (1975). Eight education experts evaluated each item using a tripartite rating scale (Essential, useful but not essential, or not necessary). Content Validity Ratios (CVR) were calculated for each item, and items failing to meet Lawshe's critical threshold of .75 were eliminated. This process resulted in the removal of three items, yielding a 19-item revised draft scale.

Administering Items to the Development Sample

The pilot study aimed to evaluate the item and factor structures of the PSCP Cognitive Engagement Scale to establish its final form. Prior to conducting the pilot study, all required ethical protocols were completed.

The ethical process in the study was as follows:

- Ethics committee approval was obtained from Hacettepe University Social Sciences and Humanities Research Ethics Committee (Date: 16.11.2023, Number: E-66777842-300-00003202071)
- Informed consent has been obtained from the participants.

Following ethical approval, data were collected online through Google Forms from 117 students learning English at a university's School of Foreign Languages.

Evaluating the Items

After developing the draft form, conducting expert review, and administering it to 117 students, analyses were conducted to examine the scale's items and structure

Examining Initial Item Performance: Initial psychometric evaluation followed DeVellis's (2003) criterion that scale reliability is contingent upon strong inter-item correlations. Analysis of the inter-item correlation matrix revealed positive correlations across all items. However, four items (Items 5, 17, 18, and 19) exhibited insufficient correlation coefficients with other scale items and were consequently noted for removal.

Assessing Item-Total Correlations: Item discrimination was assessed through corrected item-total correlations, using Büyüköztürk's (2018) criterion of .30 as the threshold for acceptable item discrimination. Corrected item-total correlations ranged from .43 (Item 17) to .79 (Item 13). Although Items 5, 17, 18, and 19 demonstrated relatively lower item-total correlations compared to other scale items, all items exceeded the recommended threshold of .30, indicating adequate discriminative properties. Based on these results, all items were retained for subsequent exploratory factor analysis.

Analyzing Item Means: Discriminative properties of the scale items were evaluated through extreme groups analysis, comparing the upper and lower 27% of scores (n = 32 per group). Independent samples t-tests revealed significant differences ($p < .001$) between groups across all items, with mean differences ranging from 1.188 to 2.031. These results provide evidence for the items' capacity to discriminate effectively between high and low levels of the measured construct.

Conducting Exploratory Factor Analysis

The suitability of data set for factor analysis was assessed using the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity in SPSS 24.0. The analysis yielded a KMO coefficient of .91, and Bartlett's Test was significant (χ^2 (55) = 752.75, $p < .001$). These results indicated the suitability of the data set for factor analysis.

Exploratory factor analysis (EFA) was conducted to examine the scale's structure and establish construct validity. Maximum Likelihood extraction method was employed. Initial analysis revealed a four-factor structure; however, Item 18 was eliminated as it loaded solely on the fourth factor.

Subsequent analysis indicated a three-factor structure. Item 5 was removed due to cross-loading, with insufficient differentiation between its loadings on the second (.46) and third factors (.49) (difference < .10). The remaining two items in the third factor were subsequently eliminated. The final EFA revealed a two-factor structure explaining 66.2% of the total variance.

Additionally, Velicer's Minimum Average Partial (MAP) test was conducted to examine the factor structure. Results suggested a three-factor solution with the smallest squared partial correlation of .024 for three factors, which aligned with the initial EFA findings. The details of the scale items and their factor loadings are presented in Table 1.

Table 1.

Item Characteristics of the Draft PSCP Cognitive Engagement Scale

Item	Mean	Corrected Item-Total Correlation	Factor Loading
1	3.71	.63	.61
2*	3.31	.56	-
3	3.98	.58	.55
4	3.51	.63	.77
5*	2.70	.43	.56
6*	3.55	.76	.48
7	3.74	.68	.71
8*	3.63	.65	.54
9	3.93	.72	.63
10	3.85	.79	.67
11	4.09	.73	.71
12	3.92	.74	.65
13*	3.52	.79	.49
14	3.68	.68	.69
15	3.60	.60	.72
16	3.50	.71	.54
17*	3.23	.43	.58
18*	3.04	.44	.64
19*	3.10	.61	.69

Following completion of item and factor analyses, eight items were removed from the scale based on the following criteria: (1) Item 2 failed to load significantly on any factor, (2) Items 5, 6, 8, and 13 showed insufficient differentiation between cross-loadings (difference < .10), (3) Items 17 and 19 remained as the only items in the third factor, and (4) Item 18 was the only item that loaded on the fourth factor.

Subsequent analyses confirmed factor loadings exceeding .50 for all remaining items. The final PSCP Cognitive Engagement Scale comprised 11 items across two factors: Factor 1 with four items and Factor 2 with seven items.

Assessing Internal Consistency Reliability

To establish reliability evidence, both Cronbach's alpha and McDonald's omega coefficients were calculated. Cronbach's alpha coefficients were .82, .91, and .92 for Factor 1, Factor 2, and the overall scale, respectively. McDonald's omega coefficients demonstrated similar reliability: .82 for *cognitive attention*, .89 for *cognitive effort*, and .91 for the overall scale. These findings from the preliminary study (N = 117) provide evidence for the internal consistency reliability of the PSCP Cognitive Engagement Scale.

Results

Data from 329 participants were collected through online survey administration to evaluate the psychometric properties of the 11-item PSCP Cognitive Engagement Scale. This section presents evidence for the scale's reliability and validity through multiple analytical approaches.

Findings on the Content Validity of the PSCP Cognitive Engagement Scale

The content validity of the PSCP Cognitive Engagement Scale was evaluated using Lawshe's method (1975). Initial psychometric analyses from the pilot study resulted in the removal of eight items that did not meet the established validity and reliability criteria as discussed in the previous section. For the remaining 11 items, three primary indices were calculated: Content Validity Ratio (CVR), Item Content Validity Index (I-CVI), and Scale Content Validity Index (S-CVI). These indices were calculated using the following formulae, where N represents the total number of subject matter experts and N_E indicates the number of experts who rated the item as *essential*: $CVR = (N_E – N / 2) / (N / 2)$, $I\text{-}CVI = N_E / N$, and $S\text{-}CVI = \sum (N_E) / N$. Table 2 presents the item-level content validity indices (CVR and I-CVI) and the aggregate scale-level content validity index (S-CVI).

Table 2.

Content Validity Ratios and Indices Based on Expert Evaluation

Item	N_E	CVR	I-CVI
1	8	1	1
2	8	1	1
3	7	.75	.88
4	8	1	1
5	8	1	1
6	8	1	1
7	7	.75	.88
8	8	1	1
9	8	1	1
10	8	1	1
11	8	1	1
N	8		
S-CVI	.95		

The content validity ratio (CVR) analysis revealed that all scale items exceeded Lawshe's (1975) critical threshold of .75 (Table 2). Furthermore, The Scale Content Validity Index (S-CVI) of .95 supported the instrument's content validity. These results provide strong empirical support for the scale's content representativeness and relevance to the intended construct.

Findings on the Construct Validity of the PSCP Cognitive Engagement Scale

A confirmatory factor analysis was conducted using Mplus

8.1 to verify the two-factor structure of the 11-item PSCP Cognitive Engagement Scale identified through exploratory factor analysis. Results are displayed in Figure 1.

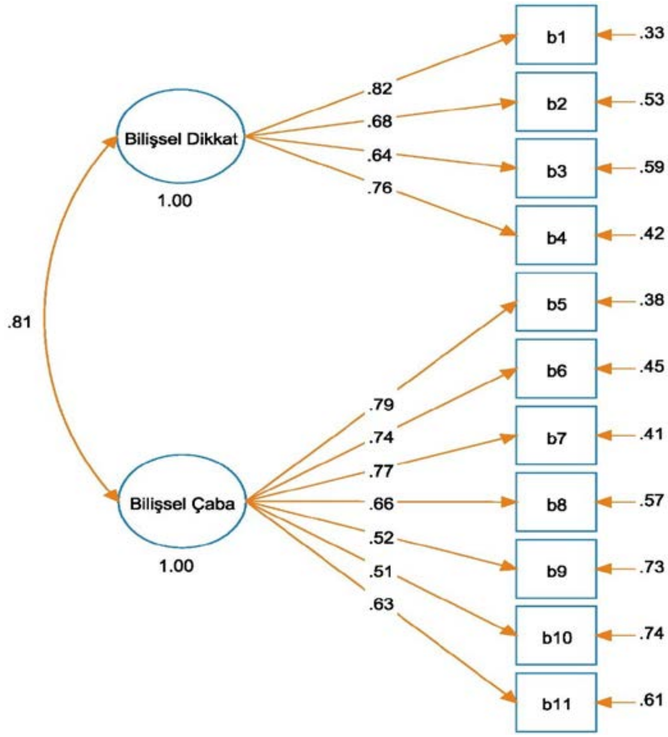

Figure 1.
Confirmatory Factor Analysis Model of the 11-Item PSCP Cognitive Engagement Scale

The confirmatory factor analysis revealed a two-factor structure (Figure 1), with Factor 1 including four items and Factor 2 including seven items. The measurement model demonstrated acceptable fit indices: X^2 / sd ≤ 4; X^2 (40) = 82.94; CFI = .97; TLI = .96; RMSEA = .06; SRMR = .04. All fit indices met the established thresholds (Kline, 2023), with CFI and TLI values exceeding .90, and both RMSEA and SRMR values falling below .08.

Following confirmation of the factor structure, Factor 1 (4 items) was identified as *cognitive attention*, while Factor 2 (7 items) was termed *cognitive effort*.

Findings on the Convergent Validity of the PSCP Cognitive Engagement Scale

To establish the convergent validity of the PSCP Cognitive Engagement Scale, we examined the item convergence within each factor and internal consistency (composite reliability). Average Variance Extracted (AVE) and Composite Reliability (CR) were calculated for both *cognitive attention* and *cognitive effort*. Initial analyses yielded AVE values of .53 and .44 for the first and second factors, respectively. Considering Hair et al.'s (2013) threshold criterion (.50), while the first factor demonstrated adequate convergence (.53 > .50), the second factor did not meet this threshold (.44 < .50). Consequently, Items 9 (λ = .51) and 10 (λ = .51), which exhibited the lowest factor loadings, were removed, and analyses were repeated. The results are presented in Table 3.

Table 3.
Convergent and Discriminant Validity Results of PSCP Cognitive Engagement Scale

	CR	AVE	√AVE
Cognitive Attention	.83	.52	.73
Cognitive Effort	.84	.53	.72

As shown in Table 3, the AVE values were calculated at .55 for the first factor and .51 for the second factor. Additionally, CR values were .83 for *cognitive attention* and .84 for *cognitive effort*. With both factors exceeding the recommended thresholds of .50 for AVE and .70 for CR (Hair et al., 2013), these results support the convergent validity of the nine-item PSCP Cognitive Engagement Scale.

Following the convergent validity analyses, the two-factor structure of the nine-item PSCP Cognitive Engagement Scale was re-examined. The confirmatory factor analysis, conducted using Mplus 8.1, yielded the model presented in Figure 2.

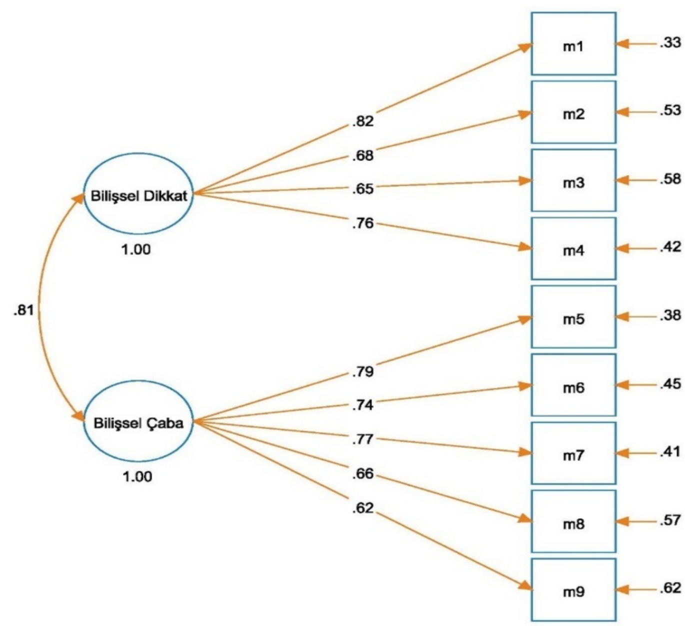

Figure 2.
Confirmatory Factor Analysis Model of The Nine-Item PSCP Cognitive Engagement Scale

Figure 2 illustrates the two-factor structure, with *cognitive attention* comprising four items and *cognitive effort* consisting of five items. The measurement model demonstrated acceptable fit indices: (X^2 / sd ≤ 4; X^2 (25) = 48.26; CFI = .98; TLI = .97; RMSEA = .05; SRMR = .03. All fit indices met the established thresholds (Kline, 2023), with

CFI and TLI values exceeding .90, and both RMSEA and SRMR values falling below .08.

Findings on the Discriminant Validity of the PSCP Cognitive Engagement Scale

To assess the discriminant validity of the PSCP Cognitive Engagement Scale, we examined the correlation between the *cognitive attention* and *cognitive effort* factors. As shown in Figure 2, the correlation between these factors was calculated at .81. According to the Fornell-Larcker Criterion, the correlation between two factors should be lower than the square root of their respective AVE values (Hair et al., 2013). However, as indicated in Table 3, the √AVE for the *cognitive attention* factor was lower than the interfactor correlation (.73 < .81). Similarly, the √AVE for the *cognitive effort* factor was also lower than the interfactor correlation (.72 < .81). These findings suggest that while the factors are related, they are not entirely independent constructs.

Hair et al. (2013) propose that examining cross-loadings provides an additional method for assessing discriminant validity. Accordingly, we analyzed both the primary factor loadings and cross-loadings for all nine items of the PSCP Cognitive Engagement Scale. The results are presented in Table 4.

Table 4.
Factor and Cross-Factor Loadings of PSCP Cognitive Engagement Scale

Item	Factor	
	Cognitive Attention	Cognitive Effort
1	.82	.42
2	.68	.28
3	.65	.17
4	.76	.41
5	.30	.79
6	.45	.74
7	.35	.77
8	.16	.66
9	.34	.62

For the *cognitive attention* factor, the cross-loadings ranged from .17 (Item 3) to .42 (Item 1). Similarly, for the *cognitive effort* factor, cross-loadings ranged from .16 (Item 8) to .45 (Item 6). Given that the difference between primary factor loadings and cross-loadings exceeded .10 for all items, these results provide evidence for the discriminant validity of the *cognitive attention* factor.

Findings on the Item Discrimination Analysis of the PSCP Cognitive Engagement Scale

To assess the item discrimination properties of the PSCP Cognitive Engagement Scale, data from 329 students were analyzed, with results presented in Table 5.

Table 5.
Item Characteristics of the PSCP Cognitive Engagement Scale

Factor	Item	Mean	Corrected Item-Total Correlation
Cognitive Attention	1. I always pay attention to what we learn in class.	3.63	.71
	2. I try to listen even when I cannot understand what the teacher is saying.	3.96	.62
	3. I pay attention to the teacher even when I find the topic boring.	3.34	.57
	4. I carefully follow instructions during class.	3.75	.67
Cognitive Effort	5. I try to understand my mistakes during class activities	4.10	.68
	6. I try to do in-class activities even when I find them difficult.	3.92	.68
	7. I make an effort to achieve my learning goals.	4.13	.68
	8. I try to connect new information with what I already know.	4.06	.54
	9. I try to discover new information about what we learn in class.	3.64	.57

Note: The items presented in Table 5 are English translations for publication purposes. All psychometric analyses and reported findings are based on the Turkish version of the scale.

As shown in Table 5, the corrected item-total correlation coefficients ranged from .54 to .71. Considering Büyüköztürk's (2018) recommended threshold of .30 for acceptable item-total correlations, these results indicate that the scale items effectively discriminate between individuals who possess and do not possess the measured construct.

Additionally, to determine the scale's discriminative properties, data from the upper 27% (n = 89) and lower 27% (n = 89) of the sample were compared using an independent samples t-test. The analysis revealed mean differences ranging from 1.45 to 1.73 across items, with all differences reaching statistical significance ($p < .001$). These findings provide evidence for the discriminative properties of the scale items.

Findings on the Internal Consistency Reliability of the PSCP Cognitive Engagement Scale

The internal consistency reliability analyses yielded Cronbach's alpha coefficients of .83 for *cognitive attention*,

.85 for *cognitive effort*, and .89 for the overall scale. Additionally, McDonald's omega coefficients were calculated at .83 for *cognitive attention*, .83 for *cognitive effort*, and .88 for the overall scale. Given that these values exceed the recommended threshold of .70 (Büyüköztürk, 2018), the results indicate high internal consistency reliability for the scale.

Discussion

This study aimed to develop and validate an instrument to measure students' cognitive engagement in teaching and learning environments. The findings regarding the validity and reliability of the PSCP Cognitive Engagement Scale are discussed in light of the relevant literature.

Content Validity of the PSCP Cognitive Engagement Scale

To establish content validity, eight educational science experts evaluated the relevance of each item in the PSCP Cognitive Engagement Scale to its content domain. The data were analyzed and interpreted using Lawshe's method (1975). The content validity index of the nine-item scale exceeded the established content validity criterion. Similar studies in the literature employing Lawshe's method (1975) with eight experts have retained items with content validity indices of .75 or higher while eliminating items falling below this threshold (e.g., Silviana et al., 2024). Therefore, the content validity of the PSCP Cognitive Engagement Scale has been demonstrated through both Lawshe's method (1975) and alignment with existing literature.

Construct Validity of the PSCP Cognitive Engagement Scale

To examine the construct validity of the PSCP Cognitive Engagement Scale, exploratory and confirmatory factor analyses were conducted sequentially. Initially, data from 117 participants were analyzed using exploratory factor analysis to determine the scale's factor structure and number. The analysis revealed an 11-item, two-factor structure explaining 66.2% of the total variance. The first factor, consisting of four items, was named *cognitive attention,* while the second factor, consisting of seven items, was termed *cognitive effort*. During the convergent validity analyses, two additional items from the *cognitive effort* factor were eliminated. Subsequently, confirmatory factor analysis was conducted using data from 329 participants to examine the structure of the nine-item PSCP Cognitive Engagement Scale. The model fit indices demonstrated good fit, confirming a two-factor structure with nine items total: four items in the first factor (*cognitive attention*) and five items in the second factor (*cognitive effort*).

The validated factor structure of *cognitive attention* and *cognitive effort* aligns with existing cognitive engagement research in the literature. Barlow et al.’s scale (2020), which includes factors such as peer interaction, constructive notetaking, active processing, active note-taking, and passive processing, shows consistency with the *cognitive attention* and *cognitive effort* factors identified in the PSCP Cognitive Engagement Scale. Furthermore, examination of Burch et al.’s (2015) scale of in-class and out-of-class cognitive engagement reveals explicit references to attention, focus, and concentration in ten out of twelve items. Therefore, the factors and items in existing scales or subscales measuring cognitive engagement in the literature provide support for the factor structure of the PSCP Cognitive Engagement Scale.

Convergent Validity of the PSCP Cognitive Engagement Scale

To examine the convergent validity of the PSCP Cognitive Engagement Scale, CR and AVE were calculated. The CR values were .83 for *cognitive attention* (Factor 1) and .84 for *cognitive effort* (Factor 2), both exceeding the threshold criterion of .70 recommended by Hair et al. (2013). Additionally, the AVE values were calculated at .55 for *cognitive attention* and .51 for *cognitive effort*. In reviewing the literature, Appleton et al. (2006) assessed convergent validity by examining interfactor correlations in their scale development study. Although they did not report specific values, they indicated that the correlations were within acceptable ranges and supported convergent validity. Similarly, for the PSCP Cognitive Engagement Scale, both the CR values and AVE values calculated from factor loadings exceeded Hair et al.'s (2013) recommended threshold of .50. These findings provide evidence for the scale's convergent validity.

Discriminant Validity of the PSCP Cognitive Engagement Scale

Analyses examining the discriminant validity of the PSCP Cognitive Engagement Scale confirmed that all items' primary factor loadings exceeded their cross-loadings. Appleton et al. (2006) reported establishing discriminant validity for their scale, noting positive correlations between factors. Similarly, examination of cross-loading values for items in the PSCP Cognitive Engagement Scale provides evidence supporting its discriminant validity.

Item Discrimination Analysis of the PSCP Cognitive Engagement Scale

Item analyses were conducted to examine the discriminative properties of the PSCP Cognitive Engagement Scale items. Results revealed corrected item-total correlation coefficients ranging from .54 to .71. In reviewing cognitive engagement scale development studies, Appleton et al. (2006) reported removing items with inter-item correlations below .10. Similarly, in the present study, inter-item correlations were examined.

Following the pilot administration, although four items showed low inter-item correlations, they were retained for exploratory factor analysis due to their high corrected item-total correlations (.56 - .64). These items were subsequently eliminated following the exploratory factor analysis. Given that the corrected item-total correlations and inter-item correlations for the final nine-item scale exceeded the recommended threshold of .30 (Büyüköztürk, 2018), these findings provide evidence for the discriminative properties of the PSCP Cognitive Engagement Scale items.

Internal Consistency Reliability of the PSCP Cognitive Engagement Scale

To establish reliability evidence for the PSCP Cognitive Engagement Scale, Cronbach's alpha coefficients were calculated. The analyses yielded coefficients of .83 for the *cognitive attention*, .85 for the *cognitive effort*, and .89 for the overall scale. These values exceed Büyüköztürk's (2018) recommended threshold of .70 for acceptable reliability, thus supporting the scale's reliability. Additionally, McDonald's omega coefficients were examined, yielding values of .83 for *cognitive attention*, .83 for *cognitive effort*, and .88 for the overall scale. The consistency between Cronbach's alpha and McDonald's omega coefficients suggests robust internal consistency, with both methods confirming the scale's internal consistency reliability. These values indicate that both the overall scale and its factors (*cognitive attention* and *cognitive effort*) demonstrate strong reliability.

Conclusion and Recommendations

This study aimed to develop and validate and instrument to measure students' cognitive engagement in teaching-learning environments. Data were collected from university students learning English as a foreign language to establish the scale's content validity, construct validity, and internal consistency reliability. Content validity evidence was established through expert evaluation following Lawshe's (1975) method. Exploratory and confirmatory factor analyses were conducted to examine construct validity. Item analysis based on corrected item-total correlations was performed to determine internal consistency reliability, and Cronbach's alpha coefficients were calculated to assess scale reliability. The research resulted in the development of a nine-item scale with two factors (*cognitive attention* and *cognitive effort*). Based on the data collected and analyses conducted, the PSCP Cognitive Engagement Scale has demonstrated to be a valid and reliable instrument to measure students' cognitive engagement levels.

While this study makes a significant contribution to the literature by introducing the validated PSCP Cognitive Engagement Scale, certain limitations should be noted. First, despite comprehensive development and analysis procedures, the scale was tested with 446 university preparatory class students learning English as a foreign language. Consequently, the scale's applicability may vary across different student groups, age ranges, and subject areas. Additionally, the scale relies on self-reported data from students. Their self-assessments of cognitive engagement may not accurately reflect actual engagement levels due to factors such as limited self-awareness. Therefore, qualitative methods such as observations and interviews could be employed alongside the scale to determine students' cognitive engagement levels more comprehensively.

Based on the findings and limitations of this study validating the PSCP Cognitive Engagement Scale, several recommendations can be proposed for future research. Given that the current study's participants were university preparatory students learning English as a foreign language, future research should validate the scale's reliability and validity with undergraduate and graduate students across different academic programs. Additionally, since the scale was administered in face-to-face teaching-learning environments, its application could be extended to measure cognitive engagement in online learning contexts. Teachers and instructional designers could use the PSCP Cognitive Engagement Scale to measure students' cognitive engagement levels and subsequently design effective teaching-learning activities based on their findings. While this research successfully developed a valid and reliable instrument for measuring students' cognitive engagement, it did not propose specific teaching-learning strategies based on the scale's findings; therefore, the scale could serve as a tool for developing strategies that enhance students' cognitive engagement. Furthermore, the scale could be complemented with qualitative methods such as observations and interviews to identify factors influencing cognitive engagement.

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