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A Structural Model of Teaching Quality Based on Cognitive Ergonomics and Psychological Awareness Mediated by Classroom Social Interaction

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ABSTRACT

Objective: The present study aimed to propose a structural model of teaching quality based on cognitive ergonomics and psychological awareness, mediated by classroom social interaction among primary school teachers in Tehran.

Methods and Materials: This applied research falls within the category of descriptive-correlational studies, specifically employing structural equation modeling (SEM) as its analytical approach. The statistical population included primary school teachers working in Tehran during the 2024–25 academic year. Using G*Power software, and considering latent and observed variables, a sample size of 245 was calculated based on a 0.05 margin of error, 95% confidence interval, and an effect size of 0.2. A stratified random sampling method was employed. Data were collected using the Seraj Teaching Quality Questionnaire (2003), Shafiei's Cognitive Ergonomics Questionnaire (2022), a researcher-developed Psychological Awareness Scale (2024), and the Teacher Interaction Scale by Lourdasmey and Kenny (2001). Data analysis was conducted using Pearson correlation and the Preacher and Hayes bootstrap macro to test the mediating role of the intermediary variables in the model.

Findings: The results confirmed the research hypothesis, indicating that cognitive ergonomics and psychological awareness have an indirect effect on teaching quality through classroom social interaction. In other words, teachers with higher cognitive ergonomics and psychological awareness enhance their teaching quality by increasing their classroom social interactions.

Conclusion: The structural model of teaching quality based on cognitive ergonomics and psychological awareness, mediated by classroom social interaction, demonstrated a good model fit among primary school teachers in Tehran.

Keywords: Teaching Quality, Cognitive Ergonomics, Psychological Awareness, Classroom Social Interaction.

Introduction

Education serves as the foundation for the development of any society and holds a unique level of importance. It is considered the core engine of transformation and the central hub for nurturing skilled and educated human resources (Guo, 2020). With the integration of innovative ideas and forward-thinking, education can accelerate a society's progressive momentum (Qiu, 2020). Among the various duties of educators and the educational system, teaching is regarded as the most technical and fundamental function, one that must be executed with expertise (Zhang & Tsai, 2021). Teaching quality is a process that brings about the most constructive and beneficial learning experience for students (Xu, 2020),

encompassing elements such as: (1) enhanced perception and ability to apply course concepts, changes in attitude, enthusiasm toward discipline, and academic environment, as well as cognitive development; and (2) improvement in specific skills such as critical writing and reading, oral communication, analysis, synthesis, and generalization (Hou, 2022).

Experts in ergonomics and human factors can contribute to the development of practical solutions to support individual performance within organizations (Gurses et al., 2020). According to the International Ergonomics Association, cognitive ergonomics is a branch of human factors science that investigates the interaction between human cognitive processes—such as perception, memory, reasoning, and motor response—and other system elements (Karwowski, 2012). In a study titled "Application of Cognitive Ergonomics in Managing Educational Issues," Papakitsos (2015) found that cognitive ergonomics contributes to guidelines and standards aimed at improving teaching and administrative practices in educational institutions (Papakitsos, 2015).

Moreover, high-level executive functioning and psychological awareness are among the significant variables associated with teaching quality (Yang, 2020; Yang & Wang, 2019). Psychological awareness includes the initiation, cessation, or monitoring of activities; flexibility in knowledge application; rational inference; abstract thinking; responding to new stimuli and conditions; sequencing of information; appropriate behavior; acquisition, maintenance, and adaptation of cognitive schemas in response to environmental demands; visualization; hypothesis testing; self-monitoring; goal-directed behavior; and inhibition of automatic responses. These capabilities affect a broad range of behaviors and life outcomes, including academic achievement, health-related behaviors, socioeconomic status, resilience, career performance, and even mortality (Baumeister et al., 2014; Breukelaar et al., 2018; Hofmann et al., 2012; Reymond et al., 2018). In their study, Barzegar Bafrouei et al. (2021) concluded that increasing psychological awareness among teachers enhances wisdom (Barzegar Bafrouei et al., 2020). Similarly, Khodaverdi Tajabadi (2022) found a significant positive relationship between cognitive awareness and teaching quality (Khodaverdi Tajabadi, 2022).

Given the observed connections between cognitive ergonomics and psychological awareness, a key question arises: What mechanisms may play a mediating role in sustaining or moderating the effects of these variables? Research indicates that classroom social interaction serves as a mediating factor (Feyzi & Dezhpasand, 2018), particularly in terms of teaching quality. Interaction is conceptualized as a basic human need with specific developmental roots, originating from the more fundamental need for attachment (Ataei, 2022). Severe disturbances in forming secure attachment during infancy—regardless of the cause—can have significant negative consequences for attachment development later in life (Tahmasebi Fard, 2021). The need for interaction is essentially a developed and differentiated expression of the biological need for human closeness. However, the intensity of this need varies among individuals (Wang & Han, 2021).

Education and teaching, without consideration for individual and instructional factors, with clearly defined quality metrics, become ambiguous. Individual, personality, and instructional traits of teachers are vital elements that require continuous effort for improvement. Nevertheless, few studies have analyzed in depth the relationships between teaching quality, cognitive ergonomics, psychological awareness, and classroom social interaction, especially at the elementary level.

Moreover, one of the key characteristics of successful organizations is the presence of capable and impactful human resources aligned with the organization's goals. In education systems, the teacher is the cornerstone of all activities, and their individual, psychological, and cognitive attributes significantly influence their performance and teaching quality. Reviewing the literature and theoretical foundations reveals that limited research has been conducted in this domain, or that existing studies have only explored two-variable relationships. Given that teaching quality is a central component of teacher evaluations in the national education system, identifying and analyzing the relationships among its components can provide valuable insights into the effectiveness of teacher evaluations. Humanities research—particularly in the field of health education—is often filled with situations where researchers explore relationships among multiple variables or seek to evaluate the overall fit of a

theoretical model using data from their target population. Therefore, this study was conducted with the primary aim of proposing a structural model of teaching quality based on cognitive ergonomics and psychological awareness, mediated by classroom social interaction, among primary school teachers in Tehran during the 2024–25 academic year.

Methods and Materials

Study Design and Participants

This study employed a naturalistic approach and was classified as descriptive-correlational research, utilizing structural equation modeling (SEM) to analyze the data. The statistical population consisted of primary school teachers working in Tehran during the 2024–2025 academic year. To determine the sample size, a regression-based model decomposition technique was employed to predict the endogenous variable by the proposed conceptual model. Using G*Power software and considering both latent and observed variables, with a significance level of 0.05, a 95% confidence interval, and an effect size of 0.2, the required sample size was calculated to be 245 participants. The sampling method was stratified random sampling.

To access the research sample, a formal visit was made to the Tehran Department of Education to discuss the research goals, procedures, and the necessary permissions. After obtaining consent from school principals, preliminary interviews were conducted with primary school teachers. Those who met the inclusion criteria and were willing to participate were informed about the confidentiality of the data and asked to complete the research questionnaires carefully and accurately.

Instruments

1) Teaching Quality Questionnaire: This questionnaire, developed by Seraj (2003), includes 20 items that measure teaching quality across four factors: Lesson Planning (items 1–5), Teaching Execution (items 6–10), Evaluation of Teaching (items 11–15), and Interpersonal Relations (items 16–20). All items are rated on a 5-point Likert scale from "very low" to "very high." The four-factor structure of this tool was confirmed by Shabani Varki and Hossein Gholizadeh

(2011). The total score ranges from 20 to 100, with scores above 60 indicating a higher level of teaching quality (Khodaverdi Tajabadi, 2022; Matlabi Nejad et al., 2023). In the present study, Cronbach's alpha for this questionnaire was 0.94.

2) Cognitive Ergonomics Questionnaire: This questionnaire, developed by Shafiei (2022), comprises 44 items that measure cognitive ergonomics across six subscales: Decision-Making Power, Workplace Learning, Creative Problem-Solving, Group Dynamics, Situational Awareness, and Proactive Work Engagement. Responses are rated on a 5-point Likert scale from "strongly disagree" (1) to "strongly agree" (5). Internal consistency reliability was assessed using Cronbach's alpha, yielding the following values: Total scale: 0.827, Decision-making: 0.667, Learning at work: 0.671, Creative problem-solving: 0.695, Group dynamics: 0.633, Situational awareness: 0.744, and Proactive engagement: 0.623. These values indicate acceptable to high reliability. In this study, Cronbach's alpha for the overall scale was 0.95.

3) Classroom Social Interaction Questionnaire: This tool is based on the Teacher Interaction Questionnaire developed by Lourdusamy and Khine (2001) to assess teacher-student interaction in the classroom. It includes 24 items across four dimensions: Leadership, Helping/Friendly Behavior, Understanding, and Responsibility/Freedom. Items are scored on a 5-point Likert scale (from "always" to "never") with values ranging from 1 to 5. According to Abdollapour and Shokri (2019), the content, face, and criterion validity of the questionnaire were evaluated as appropriate. The reported Cronbach's alpha values were: Leadership, 0.67; Helping/Friendly, 0.66; Understanding, 0.59; Responsibility/Freedom, 0.58; and Total scale, 0.83. In the present study, Cronbach's alpha for the scale was 0.93, and composite reliability was also calculated at 0.93.

4) Psychological Awareness Questionnaire: Since no existing instrument was suitable for measuring psychological awareness in teachers, a new researcher-made questionnaire was developed by psychometric principles. Following a comprehensive review of existing tools, a preliminary version containing 38 items was created and validated by a panel of five psychology experts, who confirmed the content validity. During the development and validation process, the initial 38-item

scale was administered to a sample of teachers, and exploratory factor analysis (EFA) was conducted. Based on the results, the number of items was reduced to 30, categorized into three subscales. A second-stage administration was performed, and confirmatory factor analysis (CFA) validated 26 items across the exact three dimensions. In the present study, Cronbach's alpha for the final version of the psychological awareness questionnaire was 0.94.

Data Analysis

After collecting the data, two incomplete or invalid questionnaires were excluded, leaving 243 valid questionnaires for analysis using AMOS-18 software. Statistical methods used for data analysis included Pearson correlation coefficients and the Preacher and

Hayes bootstrap macro to examine the mediating role of intermediary variables within the model.

Findings and Results

The demographic analysis revealed that 85.6% of the participants were female and 14.4% were male. In terms of educational attainment, 67.5% of participants held a bachelor's degree, 27.5% a master's degree, and 5% a doctoral degree, with the majority holding a bachelor's degree. Regarding work experience, 62.6% of participants had more than 15 years of teaching experience, while 37.4% had less than 15 years. The employment status revealed that 64.6% were officially employed, while 35.4% held contractual or temporary positions.

Table 1

Descriptive Statistics of Research Variables

Variables	Mean	SD	Skewness	Kurtosis
Teaching Quality	84.19	11.27	-0.497	-0.277
Lesson Planning	21.14	3.25	-0.799	0.179
Teaching Execution	21.29	3.05	-0.645	-0.372
Teaching Evaluation	20.67	3.36	-0.547	-0.280
Interpersonal Relationships	21.08	3.11	-0.780	-0.528
Cognitive Ergonomics	183.20	17.95	-0.045	-0.825
Decision-Making Power	19.50	2.10	-0.267	-0.018
Workplace Learning	48.46	4.97	-0.450	-0.517
Creative Problem-Solving	21.00	3.06	-0.486	-0.068
Group Dynamics	30.92	3.62	-0.528	-0.604
Situational Awareness	33.84	4.19	-0.066	-0.854
Proactive Work Engagement	29.45	3.80	-0.246	-0.685
Psychological Awareness	113.41	12.01	0.292	0.940
Psychological Awareness	47.33	5.79	0.370	-0.556
Behavioral Awareness	30.25	3.72	0.314	-0.556
Communicative Awareness	40.15	4.22	0.707	-0.409
Classroom Social Interaction	98.08	10.03	-0.263	-0.629
Leadership	27.50	2.53	-0.948	0.079
Understanding	22.79	2.22	-0.932	0.260
Helping Behavior	24.94	3.27	-0.247	-0.718
Learner Responsibility	22.83	4.02	0.030	-0.675

According to Table 1, the mean and standard deviation values for the key variables were as follows: teaching quality (M = 84.19, SD = 11.27), cognitive ergonomics (M = 183.20, SD = 17.95), psychological awareness (M = 113.41, SD = 12.01), and classroom social interaction (M = 98.08, SD = 10.03).

The skewness index indicates the degree of symmetry in the distribution of the data. Values closer to zero represent higher symmetry. Generally, if skewness and kurtosis fall within the range of ±2, the data distribution

is considered normal. As shown in Table 1, all variables and their subcomponents have skewness and kurtosis values within the range of -1 to +1, confirming the assumption of a normal distribution. An item-by-item analysis revealed that each questionnaire item aligned with its respective construct. Items with factor loadings below 0.30 were removed, and the measurement models were revised accordingly. Each measurement model was run twice: initially, the factor loadings of individual items were assessed; items with a loading below 0.30 were

excluded. Internal model fit was evaluated through composite reliability (CR) and Cronbach's alpha to assess the internal consistency of the instruments.

According to established standards, values above 0.81 are considered excellent, while values between 0.71 and 0.80 are deemed good. The reliability coefficients in this study indicated that all variables achieved excellent

internal consistency. Additionally, the univariate skewness and kurtosis of all variables remained within ±1, further supporting the assumption of normality. Multivariate kurtosis was below 10 (2.66<10), and the critical ratio was below 1.96 (1.01<1.96), confirming multivariate normality.

Table 2

Correlation Matrix of Research Variables

Variables	1	2	3	4
1. Teaching Quality	1			
2. Cognitive Ergonomics	-0.729	1		
3. Psychological Awareness	-0.667	0.664	1	
4. Classroom Social Interaction	-0.650	0.670	0.764	1

As shown in Table 2, the endogenous variable, teaching quality, has significant correlations with the

exogenous and mediating variables. All correlations were statistically significant at the p < 0.001 level.

Table 3

Model Fit Indices

CMIN	DF	P	CMIN/DF	GFI	IFI	TLI	CFI	RMSEA	PCLOSE
109.24	71	0.001	1.34	0.957	0.916	0.923	0.916	0.09	0.291

Model 1 illustrates the standardized paths and the explained variances of variables. All direct paths were statistically significant at the 0.001 level. The variance in classroom social interaction explained by cognitive ergonomics was 0.50, while the variance in teaching quality explained by cognitive ergonomics, psychological

awareness, and classroom social interaction was 0.67. The model fit indices (CFI, TLI, IFI, GFI) were close to 1. The RMSEA was 0.09, and PCLOSE = 0.291, indicating no significant misfit. Overall, the model demonstrated good fit (Table 3).

Table 4

Bootstrap Mediation Analysis of Classroom Social Interaction in the Relationship Between Cognitive Ergonomics, Psychological Awareness, and Teaching Quality

| Pathway	Data	Boot	Bias	SE	Lower Bound	Upper Bound
Cognitive Ergonomics → Teaching Quality (via Classroom Social Interaction)	-0.1134	-0.1125	-0.0009	0.0369	+0.0644	+0.1760
Psychological Awareness → Teaching Quality (via Classroom Social Interaction)	-0.3951	-0.3995	-0.0044	0.0973	+0.1945	+0.5877

In Table 4, the indirect effect of cognitive ergonomics on teaching quality through classroom social interaction was -0.1134, with a confidence interval ranging from -0.0644 to 0.1760, excluding zero. Similarly, the indirect effect of psychological awareness on teaching quality through classroom social interaction was -0.3951, with a confidence interval ranging from -0.1945 to 0.5877, excluding zero. Therefore, the null hypothesis is rejected,

confirming the research hypothesis that cognitive ergonomics and psychological awareness indirectly influence teaching quality through the mediating variable of classroom social interaction. In other words, teachers with stronger cognitive ergonomics and psychological awareness improve their teaching quality by enhancing their social interactions in the classroom.

Figure 1

Standardized model, direct path coefficients, and explained variance.
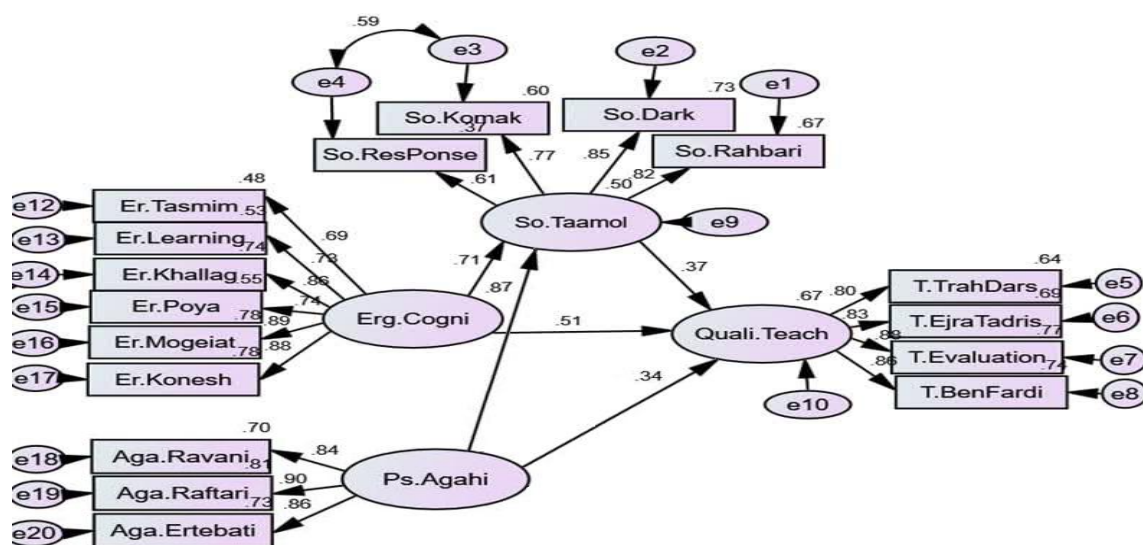
Discussion and Conclusion

The primary aim of this study was to propose and evaluate a structural model of teaching quality based on cognitive ergonomics and psychological awareness, mediated by classroom social interaction among primary school teachers in Tehran. The results confirmed the hypothesized model, providing empirical evidence for both direct and indirect relationships among the variables. Specifically, the findings indicated that cognitive ergonomics and psychological awareness have a significant influence on teaching quality, with classroom social interaction serving as a strong mediating factor.

These findings are consistent with previous research emphasizing the impact of cognitive ergonomics on professional performance. As noted by Karwowski (2012) and Papakitsos (2015), cognitive ergonomics plays a crucial role in optimizing mental processes, such as decision-making, problem-solving, and situational awareness, all of which are essential for effective teaching (Karwowski, 2012; Papakitsos, 2015). Teachers with high levels of cognitive ergonomics are better equipped to process information, adapt to dynamic classroom environments, and engage in reflective practices, ultimately enhancing instructional quality (Oluwaseun & Regina, 2020).

Moreover, the influence of psychological awareness on teaching quality aligns with prior studies (Baumeister et al., 2014; Breukelaar et al., 2018), which highlight the relevance of executive functions such as self-regulation, cognitive flexibility, and goal-directed behavior in determining professional competence. Psychological awareness enables teachers better to understand their mental states and those of their students, leading to more empathetic and effective teaching strategies (Barzegar Bafrouei et al., 2020; Khodaverdi Tajabadi, 2022).

A novel contribution of this study lies in its examination of classroom social interaction as a mediating variable. The analysis revealed that classroom interaction significantly strengthens the relationship between cognitive and psychological attributes and the quality of teaching. This supports the theoretical framework proposed by Feyzi and Dezhpasand (2018) and corroborates the developmental importance of human interaction (Feyzi & Dezhpasand, 2018), as discussed by Ataei et al. (2021) and Tahmasbi Fard and Erfani (2021). Teachers who cultivate positive social interactions in the classroom are more likely to foster a supportive learning environment (Ataei, 2022; Tahmasebi Fard, 2021), which, in turn, enhances students' academic engagement and overall learning outcomes (Wang & Han, 2021).

From a practical standpoint, the results highlight the need for educational policymakers and school administrators to prioritize teacher training programs that develop both cognitive ergonomic competencies and psychological awareness. Professional development workshops should focus not only on instructional techniques but also on cognitive strategies, emotional intelligence, and interpersonal communication skills. Additionally, creating school cultures that encourage collaboration and positive teacher-student relationships can further amplify the benefits of such interventions.

The model's good fit indices—such as CFI, TLI, IFI, and RMSEA—indicate that the theoretical framework is empirically sound and suitable for use in primary education settings. This supports the structural validity of the proposed model and reinforces its applicability in assessing and improving teaching quality in similar educational contexts. Nevertheless, some limitations must be acknowledged. The study focused exclusively on primary school teachers in Tehran, which may limit the generalizability of the findings. Future research could replicate this model across different educational levels and geographic regions to examine potential variations. Longitudinal studies are also recommended to explore the causal relationships and developmental trajectories of the identified constructs.

In conclusion, the present study offers a comprehensive model of teaching quality that integrates cognitive, psychological, and social dimensions. It demonstrates that cognitive ergonomics and psychological awareness enhance teaching quality both directly and indirectly through classroom social interaction. These findings underscore the importance of addressing the cognitive and emotional needs of teachers while fostering interactive learning environments. By leveraging these insights, education systems can develop more effective strategies for professional development, ultimately enhancing student learning experiences.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Declaration of Helsinki, which provides guidelines for ethical research involving human participants. Ethical considerations in this study included the fact that participation was entirely optional.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

All authors equally contribute to this study.

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