



Developing and Validating a Cognitive Competency Model for School Principals

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Abstract

The present exploratory mixed-methods research, grounded in metaphorical realism, aimed to develop and validate a Cognitive Competency Model for School Principals. In the qualitative phase, 25 cognitive education specialists were selected through purposive sampling for semi-structured interviews. Data were analyzed using Glaser's grounded theory method, employing open, selective, and theoretical coding to extract key cognitive dimensions related to educational leadership. To ensure credibility, the researchers applied expert validation and iterative refinement of the categories and concepts. In the quantitative phase, a Delphi technique supported by a questionnaire was used to validate the identified categories and concepts. Out of 25 experts in the field of cognitive education, 23 participated in the survey. The collected data were analyzed using a one-sample t-test to determine the level of expert agreement. The analysis confirmed the significance of all dimensions ($p < 0.01$). The finalized Cognitive Competency Model for School Principals includes 13 components: Metacognition, Mental Representation, Self-awareness, Psychological Capital, Linguistic Abilities, Neuroscience of Emotions, Social Cognition, Comprehensive and Systematic Approach, Neuro Leadership, Neurocognitive Principles of Learning, Multiple Intelligences, Perceptual and Mental Ability, and Cognitive-Organizational Readiness. Developing these competencies can enhance school principals' cognitive efficiency and leadership performance.

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Introduction:

Modern educational organizations operate in a complex environment influenced by political, economic, technological, social, and environmental changes, requiring them to be prepared to adapt and thrive for ongoing success (Peters, 2021). The world is characterized by intense competition, rapid technological development, volatile changes in customer demand, stringent regulations, and other related factors (Darmawan, 2024). As reported by the United Nations (2020) and the OECD (2020), 2020 was marked by the global outbreak of COVID-19, disrupting normality at all levels. More than 188 countries and about 1.7 billion students and their families were affected (Arar et al., 2024; Reimers & Schleicher, 2020). It has significantly impacted teaching, learning, and the educational organization (Vanlommel et al., 2024). According to the ambidexterity theory, the success of schools primarily depends on their leaders and how they manage the tension (Pietsch, 2022). School principals play a pivotal role in ensuring that students have access to high-quality educational opportunities (Levin et al., 2020). The school principal plays a crucial role in effectively communicating and upholding the institution's mission, vision, and core values both within the school community and beyond, with a heightened focus on fostering student success and well-being (Lambert & Bouchamma, 2019). Ambon et al. (2025) indicate the significance of leadership competencies in effectively managing a school. Also, it has been said that there is a significant correlation between educators' job satisfaction and the leadership competencies demonstrated by school principals (Beladas & Callo, 2023).

According to Pourkarimi and Azizi (2025), developing human capital and investing in individual improvement enhance organizational competitiveness in a turbulent environment. Investing in staff competency development enhances productivity and cultivates an environment that promotes creativity (Rudihartati, 2025). Human resource competency is crucial for improving employee performance, as it plays a significant role in achieving an organization's objectives, goals, vision, and mission (Lumbanraja et al., 2024; Wibowo et al., 2025).

According to Olofsson et al. (2020), competence encompasses various abilities, including task methods, problem-solving skills, and critical engagement. Boyatzis and Cavanagh (2018) identified cognitive competencies as a critical factor influencing leadership, career success, and management effectiveness. An effective leader must recognize the brain as a catalyst for human actions, allowing them to influence their followers' brains and align with their own (Boyatzis et

al., 2006). Exceptional leaders are those whose actions significantly enhance positive mental processes (Ahmadi, 2018). According to Cardenas (2009), the cognitive competencies of the organization and its members enhance efficiency and generate value for the organization. Thus, neurological management is a component of neuroscience (Cruz-Ávila & González-Romo, 2018) that consistently alters the actions of organizations and aims to meet objectives (Zak, 2018). Cognition encompasses all aspects of the "brain realm," including thought processes, memory, focus, learning, psychological outlook, and, most significantly, enthusiasm. Therefore, when discussing cognition or the mind, it also pertains to the brain. The brain and mind are interconnected (Blakemore & Frith, 2015). The field of cognitive science in management uncovers the intricate mental processes and algorithms that govern the management realm (Abili et al., 2020). Cognitive neuroscience seeks to uncover the biological underpinnings of human cognition, aiming to elucidate how mental processes emerge from the intricate information-processing mechanisms of the brain (Sloman, Patterson, & Barbey, 2021).

Although leadership and competency studies have received growing attention in educational contexts, a closer examination of previous research reveals a notable gap. Most studies have approached the topic either quantitatively, focusing on measuring behavioral or emotional traits, or qualitatively, emphasizing descriptive interpretations of leadership experiences. Few studies, however, have developed integrative models that examine the cognitive foundations of effective school leadership, particularly from a neurocognitive perspective. Existing quantitative instruments often fail to capture the depth of mental processes such as cognitive flexibility, metacognition, and neural adaptability, while qualitative research has provided limited insight into how principals perceive, interpret, and make decisions under conditions of uncertainty.

This methodological imbalance constrains the development of a comprehensive, evidence-based understanding of school principals' cognitive competencies. Traditional competency frameworks tend to emphasize managerial or emotional intelligence skills, leaving the cognitive dimensions of leadership largely unexplored. Moreover, existing educational management models predominantly focus on behavioral and instructional aspects, rarely incorporating insights from cognitive science or neuroscience. Consequently, there is insufficient understanding of how principals process, interpret, and apply knowledge in complex and dynamic educational environments.

To address these theoretical and methodological gaps, the present study employs an exploratory mixed-methods approach, combining qualitative and quantitative data to construct and validate a Cognitive Competency Model for School Principals. By integrating both methodological perspectives, this study aims to provide a more holistic and nuanced understanding of the cognitive processes underlying effective school leadership. Understanding and enhancing these cognitive competencies can guide policymakers and training institutions in designing evidence-based professional development programs that strengthen principals' decision-making, adaptability, and cognitive readiness in response to future educational challenges.

Theoretical Background

Cognitive management is crucial for managers in educational environments, as it entails processing information and educational frameworks to identify and implement effective educational processes (Levina et al., 2020). Principals' work demands significant cognitive capacity to effectively exercise judgment, make decisions, solve problems, and learn and process new information in their daily school operations (Wang, 2025).

Cognitive competencies refer to a set of competencies that encompass general and independent cognitive activities, including knowledge and skills in goal setting, planning, analysis, reflection, self-esteem, and quality, which enhance an individual's ability to understand and respond to personal and social needs (Salt-Haus, 2016). In other words, the term cognitive competencies of managers refers to the knowledge-based competencies that assist educational managers in achieving the goals of the educational organization from the perspective of brain-based capabilities. Competence is a structured integration of knowledge, skills, and capabilities synergistically combined with fundamental network elements to efficiently address specific tasks (Kassymova et al., 2020).

According to Ambon's systematic review (2025), the Crucial leadership competencies of school heads in effective school management are divided into three themes, which are: i) principals' leadership and professional development, ii) challenges and coping strategies in school leadership, and iii) leadership styles and cultural considerations. School leaders' competencies in the management area encompass five spheres: strategic management, teaching and learning, process administration, managing human resource development, ensuring and managing structure, processes, and resources, as well as strategic partnership and collaboration (Bairauskienė, 2024). Shet (2024)

categorized employee competencies as cognitive (cognitive flexibility, agility mindset, and personal ambidexterity), cross-cultural (cross-cultural intelligence and cross-cultural collaboration), analytical (creativity and complex problem-solving), and personal effectiveness competencies (personal resilience, continuous learning, and adaptive mindset). Cognitive science is a multidisciplinary domain dedicated to exploring the structural and functional aspects of the mind, particularly its mechanisms for processing information, examining the brain's role in emotion, attention, consciousness, language, perception, learning, memory, and executive functioning, integrating insights from various fields to deepen our understanding of cognitive processes (Ream & Tourgeman, 2021; Talkhabi, 2018).

Gkintoni, Halkiopoulou, and Antonopoulou (2022) emphasize the importance of incorporating neuroscience into addressing challenges in educational leadership. Neuro Management is pivotal in bridging the gap between scientific discoveries in neuroscience and their practical application in effective leadership strategies (Kouravand, 2024). Neuroleadership is introduced by Ruiz-Rodríguez et al. (2023) as a novel approach to understanding management. Neuroleadership is typically defined as the application of neuroscience findings to leadership (Gocen, 2021). The Neuroleadership process allows leaders to guide their followers in making decisions that align with a shared direction. At the same time, leaders and followers can adapt their mindsets to the context (Guarnier & Chimenti, 2024). Over time, growing research has demonstrated that cognitive abilities are crucial in shaping a leader's effectiveness (Mumford et al., 2017). Cognitive activity enables the accumulation of information and the mastery of cognitive methods, contributing to intellectual development and the acquisition of professional competence (Dilshod, 2024).

Cognitive neuroscience has developed as a scientific discipline dedicated to understanding how cognitive processes are realized through the brain's neural mechanisms (van Bree, 2023). Cognitive neuroscience aims to elucidate the intricate relationships between the mind, brain, and behavior (Mougenot & Matheson, 2024). Contemporary neuroscientific theories of human intelligence encompass both spatially localized frameworks, such as the Lateral Prefrontal Cortex Theory, the Parieto-Frontal Integration Theory, and the Multiple Demand Theory, as well as more recent global perspectives, including the Process Overlap Theory and the Network Neuroscience Theory (Anderson & Barbey, 2023).

Metacognition: Cognitive actions are higher-level functions of the cognitive system that refer to a set of

cognitive abilities (Nami, 2021). In other words, metacognition refers to the study of human cognitive actions.

Mental representation refers to internal cognitive symbols that reflect the external world (Morgan, 2014; Hosseinali Zadeh Zavaradi, 2021). In other words, mental representation refers to our mental image of various phenomena, not necessarily obtained through empirical senses. For example, a mental image that a person conjures of a space they have not been present in is one of the predominant methods in explaining and describing the nature of ideas and concepts.

Self-awareness refers to an individual's perception of themselves and the feelings that result from this perception (Nikofard & Salahi, 2021). In other words, self-awareness predicts our satisfaction with ourselves and our lives (Yahya Zadeh Jalouda et al., 2018). In the author's view, self-awareness refers to an individual's accurate understanding of themselves and their identity, thereby enhancing their ability to clearly and accurately comprehend their strengths and weaknesses.

- Psychological Capital: Psychological capital refers to individuals' positive mental state for development and progress, characterized by having self-confidence (efficacy) to make the necessary efforts for success in challenging tasks; fostering a positive sense (optimism) regarding current and future success; commitment to goals and, if necessary, navigating paths towards those goals for success; maintaining well-being and resilience to achieve success when problems and human limitations arise (Stratman & Yusuf-Morgan, 2019). The author believes that psychological capital is an invaluable internal and mental resource that individuals utilize to maintain stability and resilience in the face of crises and stressful situations. Therefore, they are less affected by daily events and consequently achieve higher psychological well-being.

Linguistic Abilities refer to an individual's ability to establish communication skills and understand how to represent, process, and comprehend information in the mind (Nili-Pour & Mir-Pour, 2003).

Neuropsychology is a branch of human medicine that addresses nervous system disorders. This means it deals explicitly with diagnosing, treating, and preventing diseases of the nervous system, including disorders of the peripheral, central, and autonomic nervous systems (Ghafarkhi et al., 2019). In other words, the neuropsychology of emotions involves identifying the processes and influential sources of emotions and behavioral reactions responsible for controlling, evaluating, and altering an individual's emotional responses in the pursuit of their goals, as well as any forms and roles of the individual in the face of

psychological disorders such as depression, anxiety, and physical symptoms of vulnerability.

Comprehensive and Systemic Perspective: Systems thinking is a cognitive process based on analysis (decomposition) and synthesis to understand a subject fully within its surrounding environment. This type of thinking seeks to comprehend the whole system and its components, the relationships between the components and the whole, and the relationships between the whole and its environment (Aghaei Fishani et al., 2011). In other words, the systemic perspective refers to understanding the whole, the components, and the relationships among them. In a simpler view, it can be divided into four parts: input, output, process, and feedback.

Neuroscience-Based Leadership: Neuroleadership refers to the understanding of the brain and its functions (mind) and the perception of decision-making processes, to improve the quality of organizational leaders' decisions (Baker et al., 2011). Neuroscience-based leadership lays the groundwork for leadership research and enhances the performance of individuals and organizations through understanding how the human brain operates; thus, the goal of NeuroLeadership is to assist organizations in recognizing their capabilities by understanding the brain processes and mental activities at individual, team, and organizational levels (Shakari et al., 2022). In other words, neuroscience-based leadership, also known as NeuroLeadership, refers to the application of knowledge from brain science to enhance effective management and leadership.

- Multiple Intelligences is the ability to solve problems or perform daily activities resulting in life outcomes within a specific cultural context or community. Multiple intelligences refer to a set of several intelligences, including verbal intelligence, logical-mathematical intelligence, musical intelligence, spatial intelligence, bodily-kinesthetic intelligence, intrapersonal intelligence, interpersonal intelligence, naturalistic intelligence, and existential intelligence (Salahi & Ghamasari, 2020). According to the author, multiple intelligences is an educational theory that acknowledges individual differences among people and recognizes the strengths and weaknesses of each individual based on their mental capabilities in problem-solving. Various classifications of types of intelligence have been presented; however, Gardner first introduced this theory. In the author's view, Multiple intelligences positively impact various areas, including career counseling, talent identification, educational planning, recruitment, and academic guidance.

Cognitive readiness refers to the mental preparedness (including skills, knowledge, abilities, and motivations) needed to achieve and maintain appropriate performance in a complex and unpredictable environment ([Morrison & Fletcher, 2002](#)). In the author's view, cognitive readiness refers to an individual's belief and mental assurance in their ability to perform a task.

Various experts and researchers have observed and proposed different categories and components in the literature review on cognitive competencies, with some focusing on cognitive competencies in a limited and specific manner. Additionally, this study uniquely identifies competencies among school managers that have not been previously addressed. According to Brito-Gonzales et al. ([2017](#)), brain-based management refers to the neural processes related to decision-making, personal development, organizational intelligence (also known as team intelligence), and human resource management, encompassing selection, training, interaction, and group leadership. Neuro-management is a branch of neuroscience ([Cruz-Avila & Gonzalez, 2018](#)) that continuously modifies organizational actions and strives to achieve goals (Zak, 2018).

Boyatzis ([2009](#)) categorized and outlined six distinct categories of cognitive competencies, along with their components:

—Organizational competencies

—Systemic thinking: the ability to view situations as a series of cause-and-effect events and comprehend the movement of information, individuals, or materials within the organization and in society.

—Pattern recognition: seeing seemingly random themes or patterns on occasion;

—Emotional intelligence competencies

—Emotional self-awareness: knowing your emotions and recognizing their impact;

—Self-management qualifications

—Emotional restraint: restraining emotions and disturbing motivations for the benefit of others;

—Adaptability: flexibility in adapting to changing conditions and managing ambiguity;

—Achievement orientation: motivation to improve performance and have standards of excellence;

—Positive outlook: having a positive outlook on people, events, and more in the future;

—Social Intelligence Competencies

—Social Awareness Competencies

—Empathy: Understanding the emotions, perspectives, and interpretations of others and actively showing interest in them;

—Organizational Awareness: Reading the flows, decision-making networks, and policies at the organizational level;

—Relationship Management Skills

—Inspirational Leadership: Guiding and motivating with an appealing vision;

—Influence: Using a wide range of tactics for persuasion;

—Coaching: Developing others' abilities through feedback and guidance;

—Conflict Management: Constructively resolving conflicts;

—Teamwork: Collaboration and team building.

Krishnamoorthy, Cardenas, and Kumar ([2007](#)) suggest that cognitive competence integrates technological tools with appropriate cultural perspectives, leading to a robust learning environment that fosters innovation and simplifies problem-solving. Cognitive competence encompasses integrating technology, cognitive tools, organizational expertise, and knowledge repositories, complemented by cultural influences and emotional intelligence. This cohesive framework facilitates the efficient application of knowledge to address complex organizational challenges ([Kelly & Kumar, 2009](#)). These insights lead us to the concluding element of a sophisticated system: its management ([Churchman & Ulrich, 1980](#)). Cardenas ([2002](#)) outlines the aspects of cognitive competence as follows:

- Setting vision and strategic planning;
- Continuous evaluation and development;
- Environmental and health impacts;
- Utilizing local resources.

In this study, principals' cognitive competencies are defined as their ability to apply ideas, utilize mental processes, understand cognitive trends, improve productivity, demonstrate leadership, maintain self-

confidence, foster relationships, communicate effectively both verbally and in writing, persuade others, think systematically, and identify recurring patterns.

A review of the theoretical foundations and literature on cognitive competencies and cognitive sciences relevant to school managers indicates that no comprehensive model encompassing all cognitive aspects has been presented.

The study's background convincingly positions cognitive competencies—encompassing mental processes such as decision-making, self-awareness, emotional regulation, and neuro-leadership—as central to effective leadership. Incorporating interdisciplinary perspectives, including cognitive science, neuroscience, and psychological capital, strengthens the theoretical neuroscience in leadership studies, practical applications and empirical models remain underexplored. Although cognitive competencies are increasingly recognized as pivotal, there is a lack of validated, context-specific models tailored to the realities of school leadership. Thus, the background justifies the need for this study by revealing a clear gap in the literature and practice—a comprehensive cognitive competency framework specifically designed for school principals. Additionally, as the world becomes increasingly uncertain and complex, proposed cognitive competency models must be adapted to these changing circumstances.

While the reviewed literature provides a comprehensive overview of cognitive competencies, several critical observations emerge. Firstly, most theoretical frameworks—such as Information Processing Theory or Social Cognitive Theory—offer foundational insights but require contextual adaptation for practical application in school management. Secondly, despite the increasing emphasis on NeuroLeadership and cognitive neuroscience, empirical validation in school leadership contexts remains limited and underdeveloped. The field lacks longitudinal studies that examine how these cognitive competencies develop and influence school outcomes over time. Additionally, while categorizations such as Boyatzis' competency clusters and Shet's multidimensional framework (2024) offer detailed taxonomies, their applicability across diverse educational systems and cultural contexts requires further scrutiny. Cultural, socio-political, and institutional variables can significantly influence the development and expression of cognitive competencies by school leaders.

Moreover, the intersection between cognitive styles and leadership performance, although addressed in several studies, reveals inconsistent findings, suggesting a need for more nuanced models that account for

foundation. Furthermore, the inclusion of concepts such as neurocognitive principles of learning, social cognition, and multiple intelligences illustrates a broad understanding of the cognitive demands on school leaders.

However, while the background effectively highlights various isolated elements of cognitive functioning and their relevance to leadership, it lacks an integrated, school-specific framework of cognitive competencies. The reviewed literature tends to focus either on general leadership traits or fragmented cognitive constructs, often without anchoring them in the specific operational context of school management, particularly at the school level. Additionally, despite acknowledging the emerging significance of

environmental, relational, and psychological moderators. The review also highlights a gap in the integration of digital competencies, despite growing digitalization in education. Finally, much of the existing research draws from non-educational sectors or general organizational settings, necessitating more targeted investigations explicitly focused on school managers to ensure relevance and contextual fidelity.

In their 2023 research paper, *Crafting Competency Frameworks for Future Educators in Self-Directed Learning: An Indonesian Perspective*, Komariah et al. examined the essential cognitive skills required for prospective teachers to succeed in self-directed learning environments. At its core, the study delineates five essential teaching competencies alongside three critical cognitive competencies, encompassing the ability to structure lessons with appropriate instructional methodologies, effectively manage group dynamics while accommodating individual learning needs, and exhibit strong communication proficiency.

Sukoco et al. (2022), in their study *Middle Managers' Cognitive Styles, Capacity for Change, and Organizational Performance*, examined the influence of cognitive styles—knowing, planning, and creating—on organizational capacity for change (OCC) and performance in public sector institutions. The research, conducted among 75 middle managers and 238 subordinates in an Indonesian public organization, applied structural equation modeling (SEM) via partial least squares (PLS) for analysis. The findings indicate that only the creating cognitive style has a positive effect on OCC, enhancing organizational performance. In contrast, the knowing and planning styles do not exhibit a significant direct impact.

Masdarini and Ekayani (2021), in their study *The Effect of Social Perspectives on Cognitive Competencies and an Examination of How Educational Programs Influence the Quality of Life in Students' Families*,

investigated how social perspectives shape students' cognitive competencies within the context of an educational program. The findings indicated that 1) competencies remain unchanged by a range of educational programs. 2) Students' social status does not influence their competencies and cognitive performance, suggesting that students from various social backgrounds, including high, moderate, or low, exhibit similar skills and practical knowledge. 3) No significant link exists between students' social beliefs and cognitive competencies, meaning that students with high, moderate, or low social beliefs possess similar cognitive and practical skills.

Adna and Sukoco (2020) examine the relationship between managerial cognition, organizational capacity for change, and performance in their study, "Managerial Cognitive Capabilities, Organizational Capacity for Change, and Performance: The Moderating Effect of Social Capital." Using survey data from 313 middle managers and their immediate subordinates in Indonesia's Directorate General of State Assets

In their 2010 publication, "Characteristics and Competencies of Successful Project Managers," Mueller and Turner employed a quantitative approach to explore the competencies of project managers. Their research highlights the importance of cognitive competencies in the achievement of project managers. These cognitive competencies include critical thinking and decision-making (collecting data from various sources, assessing information, recognizing pros and cons, making informed decisions, understanding the consequences of various assumptions), creativity and foresight (exhibiting leadership creativity, predicting the impact of changes on operations, concentrating on business realities), and strategic vision (maintaining a wide view, balancing large-scale concepts and issues, planning for both immediate and future outcomes).

Acknowledging the crucial role of cognitive competencies in boosting productivity and the growth of the education sector, especially in schools where the principals' managerial competence is crucial for enhancing the quality and development of the school they lead. These competencies play a strategic role in improving school quality (Asyari et al., 2024). There is a clear need for an extensive research study that examines various angles of the subject. This research aims to develop and validate a comprehensive framework for principals' cognitive competencies. A hybrid qualitative and quantitative approach was employed to address the question: What are the key components of a valid cognitive competency model for school principals?

This study is grounded in several key theoretical frameworks, including **Information Processing**

(DGSA), the study employed structural equation modeling (SEM) to analyze the relationships between these variables. The findings confirm that OCC mediates the effect of managerial cognitive capabilities on organizational performance, emphasizing the importance of equipping middle managers with cognitive skills to navigate change effectively.

Chan et al. (2017), in their study *Self-Efficacy and Participation: Testing the Chain Model*, examined the influence of self-efficacy on employees' cognitive processes and emotional responses. They analyzed the data using a structural equation model, employing quantitative methods, including questionnaires. Their findings highlighted the crucial role of cognitive factors, particularly self-efficacy, in enabling individuals to meet workplace demands effectively. Essentially, cognitive components create a reinforcing cycle that supports the development of additional skills while strengthening personal capacities for overcoming professional challenges.

Theory, which posits that the human mind contains mental structures for processing information received through the senses (Gordon & Woods, 2021); and Social Cognitive Theory, which emphasizes learning from the social environment (Schunk & DiBenedetto, 2023).

Despite the extensive literature reviewed above, no comprehensive, school-specific cognitive competency framework currently exists. Most studies focus on either general leadership traits or fragmented cognitive constructs without anchoring them in the operational realities of school management. While cognitive neuroscience and NeuroLeadership are increasingly highlighted, their practical applications in school contexts remain underexplored, particularly empirical validation and longitudinal insights. Therefore, this study aims to develop and validate a comprehensive cognitive competency framework for school principals, integrating mental processes such as decision-making, self-awareness, emotional regulation, and neuroleadership. This framework represents an innovative contribution to the field by:

1. Addressing the gap in context-specific school leadership models.
2. Combining interdisciplinary perspectives (cognitive science, neuroscience, psychological capital).
3. Offering a validated, empirically grounded model that can inform both research and practice in school management.

Research Question:

- What are the key components of a valid cognitive competency model for school principals?

This addition clarifies the research gap, the innovation of the study, and explicitly presents research questions and hypotheses, directly addressing the reviewer's concerns without removing any original content.

Research Methodology

The present study employs an exploratory mixed-methods approach grounded in metaphorical realism. The exploratory-sequential approach which is used when the researcher is interested in following up qualitative findings with quantitative analysis, was employed. In the qualitative phase, data were collected through semi-structured interviews with 25 experts specializing in cognitive education. The experts were selected purposively based on their academic

qualifications, professional experience, and contributions to the field of cognitive learning and educational leadership. Selection criteria also included published works, engagement in cognitive learning methodologies, and the ability to provide deep insights into cognitive competencies in school leadership. The selected experts were characterized by their advanced academic degrees (primarily at the doctoral level), extensive teaching and research backgrounds, and active engagement in publishing scholarly work on cognitive learning. Data from interviews were analyzed through the Glaser coding method, encompassing open, selective, and theoretical coding steps. During the open coding stage, initial codes were extracted from participants' statements. Then, through selective and theoretical coding, these were grouped into broader conceptual categories representing cognitive dimensions of leadership. A summary of the coding process is presented below to clarify the qualitative procedure:

Table 1. A summary of the coding process

Social Cognition	Ability to structure and regulate human behavior	Ability to correct and modify inappropriate elements / coordination between regulation strategies and monitoring and evaluation strategies / selection of effective strategies
	Identification of environmental opportunities and threats	Identification and creation of new opportunities adapted to rapidly changing internal and external conditions / identification of emerging patterns in the environment / accurate interpretation of information related to patterns / recognition of environmental obstacles and issues
	Improvement of formal and informal relationships with others	Ability to interact with the environment and stakeholders / ability to interact with students, teachers, parents, etc. / skill in public speaking and meeting management / skill in information dissemination / skill in attracting public support and governmental assistance / skill in written communication and administrative reporting / skill in effectively organizing content
	Ability to gain others' trust	Respectful and friendly behavior toward others / understanding others' needs, desires, and concerns / providing convincing reasons / consistency and harmony between one's thoughts, words, actions, and behavior / keeping promises and commitments / fearlessness in expressing the truth

To ensure trustworthiness, techniques such as member checking, expert validation, and peer debriefing were used. In the quantitative phase, the Delphi method was applied to validate the identified categories and concepts. Out of 25 experts, 23 completed the Delphi questionnaire. To statistically test agreement among experts, a one-sample t-test was used to compare the obtained mean of each cognitive component with the hypothetical mean. The quantitative results demonstrated that the average values obtained for the 13 identified components were significantly higher than the

hypothetical mean ($p < 0.01$). This confirmed the experts' agreement on the proposed model. For this purpose, a one-sample t-test was used. The results are shown in Tables 2 and 3.

Table 2. Comparison of means across categories

Concepts	Mean	Standard Error	Standard Deviation	T	Df	Significance Level	Difference of Means
cognitive action	3.8804	0.18262	0.03808	49.383	22	0.000	1.88043
mental representation	3.6957	0.38403	0.08008	21.176	22	0.000	1.69565
self-awareness	3.5543	0.44566	0.09293	16.726	22	0.000	1.55435
psychological capital	3.8522	0.22738	0.04741	39.066	22	0.000	1.85217
awareness of the principles of neuropsychology of learning	2.4348	0.62712	0.13076	3.325	22	0.000	43478.
linguistic abilities	3.5217	0.38014	0.07926	19.198	22	0.000	1.52174
the neuroscience of emotions	3.8261	0.24349	0.07926	35.967	22	0.000	1.82609
social cognition	3.8043	0.28160	0.5077	30.729	22	0.000	1.80435
comprehensive and systematic approach	3.6087	0.41013	0.5872	18.811	22	0.000	1.60870
NeuroLeadership	3.6894	0.38682	0.08552	20.946	22	0.000	1.68944
neurocognitive principles of learning	3.4000	0.46319	3.4000	14.495	22	0.000	1.4000
multiple intelligences	3.5326	0.44788	3.5326	16.411	22	0.000	1.53261
perceptual and mental ability	3.8199	0.25196	3.8199	34.640	22	0.000	1.81988
cognitive-organizational readiness	3.7391	0.33480	3.7391	24.912	22	0.000	1.73913

The components include:

Metacognition (3.8804), Mental representation (3.6957), Self-awareness (3.5543), Psychological capital (3.8522), Cognitive Science and Neuroscience knowledge (2.4348), Linguistic abilities (3.5217), The Neuroscience of Emotions (3.8261), Social cognition (3.8043), Comprehensive and systematic approach (3.6087), NeuroLeadership (3.6894), Neurocognitive principles of learning (3.4000), Multiple intelligences

(3.5326), Perceptual and mental ability (3.8199), and Cognitive-organizational readiness (3.7391).

According to the observed t-values, differences between the obtained and hypothetical means were statistically significant ($p < 0.05$), indicating strong agreement among experts. Additionally, stress management and resilience had the highest mean (3.9565), while control and regulation of emotions had the lowest mean (2.5217).

Table 3. Comparison of means across concepts

Concepts	Mean	Standard Error	Standard Deviation	T	Df	Significance Level	Difference of Means
Innovation and Creativity	3.8696	0.34435	0.07180	26.038	22	0.000	1.8695
Cognitive-Organizational Flexibility	3.7391	0.44898	0.09362	18.577	22	0.000	1.7391
Planning and Goal Setting	3.8261	0.38755	0.08081	22.597	22	0.000	1.8260
Changeability and Transformationalism	3.8261	0.38755	0.08081	22.597	22	0.000	1.8260
Decision Making and Problem Solving	3.9130	0.28810	0.06007	31.845	22	0.000	1.9130
Explanation Ability	3.7826	0.42174	0.08794	20.271	22	0.000	1.7826
Active Memory	3.6522	0.48698	0.10154	16.271	22	0.000	1.6521
Attention	3.7826	0.42174	0.08794	20.271	22	0.000	1.7826
Physiological Awareness	3.6957	0.47047	0.09810	17.285	22	0.000	1.6956
Emotional and Psychological Self-Awareness	3.7826	0.51843	0.10810	16.490	22	0.000	1.7826
Mindfulness	3.7391	0.44898	0.09362	18.577	22	0.000	1.7391
Organizational Awareness	3.7826	0.42174	0.08794	20.271	22	0.000	1.7826
Resilience	3.9565	0.20851	0.04348	45.000	22	0.000	1.9565
Hope	3.9130	0.28810	0.06007	31.845	22	0.000	1.9130
Optimism	3.9130	0.28810	0.06007	31.845	22	0.000	1.9130
Ability to influence others	3.7391	0.44898	0.09362	18.577	22	0.000	1.7391
Mental Well-Being	3.6522	0.48698	0.10154	16.271	22	0.000	1.6521
Familiarity with Brain Study Methods	2.6522	0.83168	0.17342	3.761	22	0.000	65217.
Familiarity with respected neuroscience journals and resources	2.91	0.90015	0.18770	4.865	22	0.000	91304.
Skill in Basic Communication Principles	3.7826	0.42174	0.08794	20.271	22	0.000	
Effective Listening	3.7826	0.42174	0.08794	20.271	22	0.000	1.7826
Body Language	3.8261	0.38755	0.08081	22.597	22	0.000	1.7826
Conceptualization	3.6522	0.48698	0.10154	16.271	22	0.000	1.8260
Cultural-Linguistic Patterns	3.6522	0.57277	0.11943	13.834	22	0.000	1.65217
Regulation and Management of Emotions	2.5217	0.89796	0.18724	2.787	22	0.000	1.65217
Control, Management, and Regulation of Feelings	2.5217	0.66535	0.13873	3.761	22	0.000	52174.
Stress Management	3.9565	0.20851	0.04348	45.000	22	0.000	52174.

Motivational Orientation	3.8696	0.34435	0.07180	26.038	22	0.000	1.9565
Ability to Structure and Organize Human Behavior	3.7826	0.42174	0.08794	20.271	22	0.000	1.8695
Identifying Environmental Opportunities and Threats	3.6522	0.48698	0.10154	16.271	22	0.000	1.7826
Improving Formal and Informal Relationships with Others	3.6957	0.47047	0.09810	17.285	22	0.000	1.6521
Ability to build trust	3.8261	0.38755	0.08081	22.597	22	0.000	1.6956
Managing Organizational Processes	3.4783	0.66535	0.13873	10.655	22	0.000	1.8260
Systemic Perspective in Problem Solving	2.7826	0.99802	0.20810	3.761	22	0.000	1.4782
Holistic Attitude	2.7391	0.86431	0.18022	4.101	22	0.000	7826.
Strategic Foresight	3.5652	0.50687	0.10569	14.810	22	0.000	7391.
Educational Supervision	3.5217	0.51075	0.10650	14.289	22	0.000	1.5652
Coaching and Mentoring	3.6087	0.58303	0.12157	13.233	22	0.000	1.5217
Team Building and Collaboration Skills	3.6522	0.57277	0.11943	13.834	22	0.000	1.6087
Conflict Management	3.5652	0.66237	0.13811	11.333	22	0.000	1.6521
Situational Leadership	3.4783	0.73048	0.15232	9.705	22	0.000	1.5652
Time Management	3.5217	0.66535	0.13873	10.969	22	0.000	1.4782
Awareness of Early Signs of Illness and Timely Referral of Students	3.3913	0.58303	0.12157	11.445	22	0.000	1.5217
Knowledge and Information in the Field of Brain and Learning	3.5217	0.59311	0.12367	12.305	22	0.000	1.3913
Principles of Brain-Centered Learning	3.4348	0.50687	0.10569	13.575	22	0.000	1.5217
Understanding Neurological Barriers and Opportunities in Learning	3.5652	0.78775	0.16426	9.529	22	0.000	1.4347
Neuroscientific Educational Guidelines	3.5217	0.59311	0.12367	12.305	22	0.000	1.5652
Social Intelligence	3.4783	0.66535	0.13873	10.655	22	0.000	1.5217
Cultural Intelligence	3.5652	0.50687	0.20569	14.810	22	0.000	1.4782
Economic Intelligence	3.5217	0.59311	0.12367	12.305	22	0.000	1.5652
Visual/ Spatial Intelligence	3.3478	0.64728	0.13497	9.986	22	0.000	1.5217
Mental Reasoning	3.7826	0.42174	0.08794	20.271	22	0.000	1.3478
Critical Thinking	3.4783	0.73048	0.15232	9.705	22	0.000	1.7826
Technological Thinking	3.4783	0.59311	0.12367	11.953	22	0.000	1.4782

Analytical and Conceptual Thinking	3.6522	0.48698	0.10154	16.271	22	0.000	1.4782
Strategic Thinking	2.7391	0.96377	0.20096	3.678	22	0.000	1.6521
Strategic Reasoning	2.6522	0.83168	0.17342	3.761	22	0.000	7391.
Verbal Reasoning	3.4783	0.66535	0.13873	10.655	22	0.000	65217.
Understanding Workplace Dynamics	3.4783	0.59311	0.12367	11.953	22	0.000	1.4782
Dealing with Ambiguity and Uncertainty	3.7826	0.42174	0.08794	20.271	22	0.000	1.4782
Analyzing Environmental Complexity	3.6087	0.65638	0.13686	11.754	22	0.000	1.7826
Situational Awareness	3.6522	0.57277	0.11943	13.834	22	0.000	1.6087
Knowledge and Information Management	3.5652	0.78775	0.16426	9.529	22	0.000	1.6521
Organizational Maturity	3.6087	0.49901	0.10405	15.461	22	0.000	1.5652
Sense-Making Skills	3.3913	0.65638	0.13686	10.166	22	0.000	1.6087
Self-Development	3.9130	0.28810	0.06007	31.845	22	0.000	1.3913

According to the observed T, the difference between the obtained means and the hypothetical mean is significant at the $p < 0.05$ level, indicating that the experts participating in the interviews generally expressed a high level of agreement with each of these concepts. Other findings in Table 2 indicate that stress management and resilience have the highest mean of 3.9565 among the concepts constituting cognitive competencies. In contrast, the concepts of control, management, and regulation of emotions have the lowest mean of 2.5217 compared to other concepts.

Based on the results of the evaluation questionnaire, the following changes have been made to the concepts and categories:

Renaming the category of awareness from the principles of neuropsychology of learning to Cognitive Science and Neuroscience knowledge

Integrating the concepts of familiarity with Brain Study Methods and familiarity with respected neuroscience journals and resources within the category of Cognitive Science and Neuroscience knowledge.

Merging the two concepts of regulation and management of emotions, along with the control, management, and regulation of feelings, under the new concept of controlling, managing, and regulating emotions and feelings.

Combining the concept of systemic perspective in Problem Solving with the notion of Holistic Attitude

under the category of a Comprehensive and systematic approach;

Combining two ideas of strategic thinking and reasoning within the strategic thinking concept.

In summary, the Cognitive Competency Model for School Principals developed in this study demonstrates conceptual coherence and expert validation through both qualitative coding and quantitative analysis.

3 Findings

The last set of cognitive competencies for principals encompasses 13 categories, 63 concepts, and 527 open codes. Here, the study focuses on 13 categories, including cognitive action, mental representation, self-awareness, psychological capital, linguistic and linguistic abilities, neurological emotion, social cognition, holistic and systemic attitude, neurobiological leadership, awareness of neuroscience and principles, multiple intelligences, cognitive and mental ability, and cognitive-organizational readiness (Figure 1).

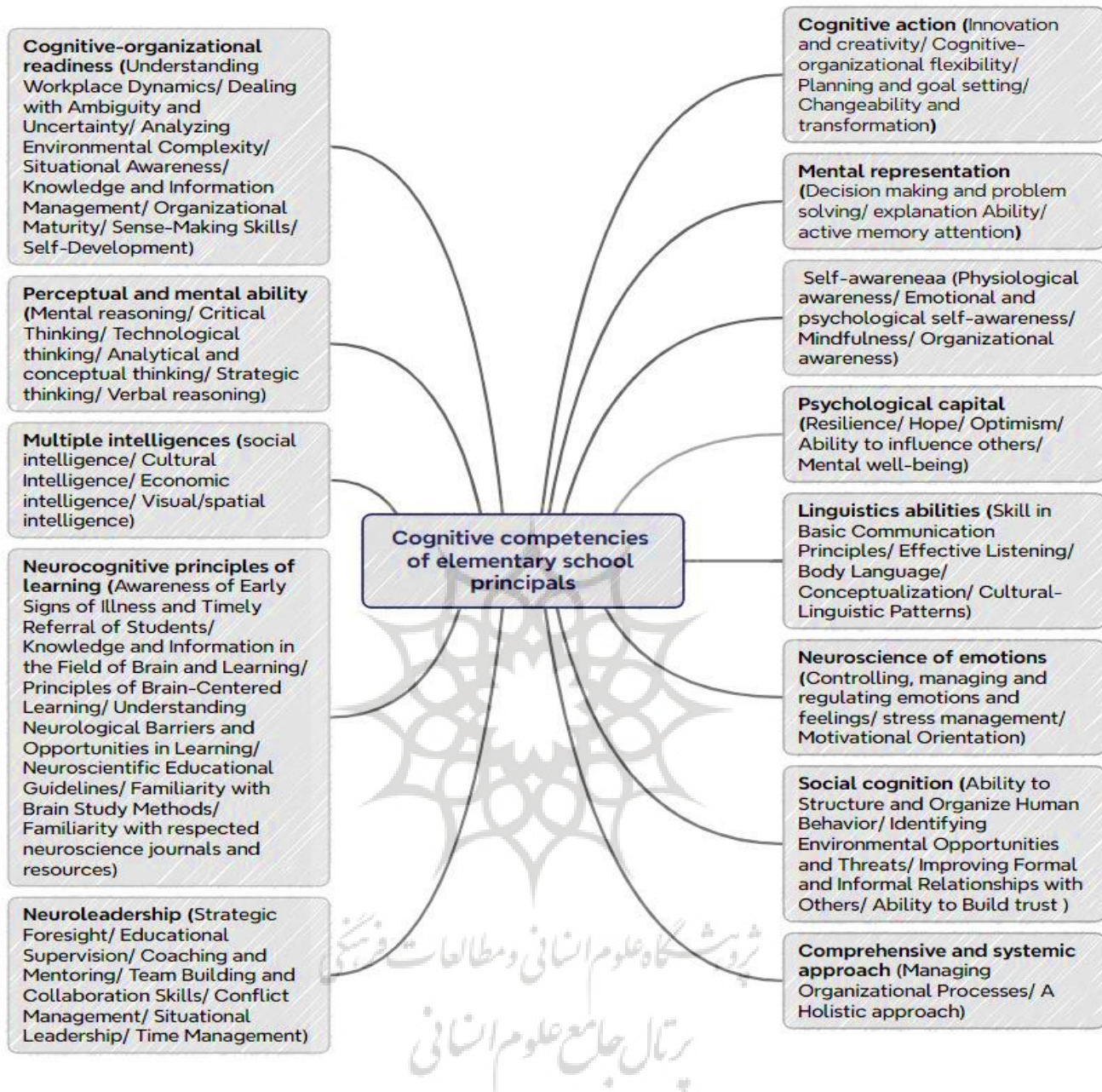


Figure 1. The final model of the school principal's cognitive competencies

Discussion and Conclusion

The qualitative study indicates that school principals' cognitive competencies comprise 13 categories and 63 concepts, aligning with Khanifar et al. (2023) in components including Situational awareness, managing stress and disorder in the workplace, social brain machine, risk and ambiguity management and Abili et al. (2020) in components including neuro-leadership, self-directed leadership and self-management. These categories include cognitive action, mental representation, self-awareness, psychological capital, knowledge of cognitive and neurological sciences, linguistic abilities, neurocognitive emotions, social cognition, holistic and systemic attitudes,

neuroleadership, neurocognitive principles of learning, multiple intelligences, perceptual and mental abilities, and cognitive-organizational readiness. Together, they define and explain the cognitive competencies necessary for effective school leadership.

To validate these categories and concepts, a quantitative Delphi method supported by a questionnaire was applied, and a one-sample t-test assessed expert agreement. Results show strong consensus across categories, with minor adjustments made to ensure consistency and theoretical-practical coherence. The combination of qualitative coding and quantitative validation demonstrates how mixed methods provided a comprehensive understanding of

cognitive competencies qualitative data captured the depth and diversity of principals' cognitive processes, while quantitative results confirmed their generalizability and structural robustness.

Cognitive Action encompasses innovation and entrepreneurship, cognitive-organizational flexibility, planning and targeting, and capacity for change and transformation. Planning is a systematic, multi-phase process essential for unified decision-making. Adaptability and flexibility are critical, especially in early education settings, where principals must ensure effective implementation of change while maintaining high creativity in teaching approaches (Newstead & Isles-Buck, 2019; Zidan & Qamariah, 2023; Nursaniah, 2023).

Mental Representation includes decision-making, problem-solving, articulation, working memory, and attention. Decision-making influences educational services, growth, and organizational performance (Rezaian et al., 2019; Klein et al., 2018). Attention organizes memory and perception, supporting principals in guiding early learning effectively (Taghi Zadeh et al., 2017).

Self-Awareness covers physiological awareness, emotional and psychological self-awareness, mindfulness, and organizational awareness, enhancing principals' career development, interpersonal effectiveness, and leadership skills (Zafari-Zadeh et al., 2013; Mahfouz, 2018).

Psychological Capital involves resilience, hope, optimism, influencing skills, and mental well-being. By fostering psychological capital, principals create environments where students can apply these skills in future challenges, while enhancing creativity and organizational development (Yousef Zadeh & Yousef Zadeh, 2016; Ismaili, 2014).

Linguistic Abilities include communication, listening, body language interpretation, conceptual formation, and recognition of cultural-linguistic patterns. Principals' advanced conceptual and cultural awareness supports effective interactions within the school community.

Neurocognitive Emotions encompass emotion regulation, stress management, and motivation. Brain regions, particularly the frontal lobe, mediate rational and emotional behaviors, while motivational signals influence responsibility, rule adherence, social engagement, and problem-solving. Supervisor support enhances these processes (Ahmadi, 2019).

Social Cognition involves organizing human actions, recognizing environmental opportunities and threats,

fostering interactions, and earning trust. Organizational support increases trust, belonging, commitment, and intrinsic motivation (AmirKafi & Hashemi Nasab, 2012).

Comprehensive and Systemic Approach integrates process management, organizational procedures, and a holistic perspective. Systems thinking, analytical reasoning, and innovation are critical for effective decision-making and improved student outcomes (Rickman, 2011; Bayat, 2020).

NeuroLeadership includes strategic planning, mentoring, collaboration,

oration, conflict resolution, adaptation, and time management. Awareness of the educational environment and targeted guidance supports resilience and effective change management (Bagheri et al., 2020; Golboo & Yazdani, 2022).

Neurocognitive Principles of Learning involve early detection of learning challenges, brain-informed teaching, brain-based learning principles, cognitive education guidelines, research methods, and familiarity with neuroscience literature, ensuring effective knowledge application (Im, 2024; Mirlou et al., 2015; Gore et al., 2018).

Multiple Intelligences cover social, cultural, economic, and visual/spatial intelligence, supporting adaptability and collaboration in diverse educational contexts (Zamani & Tabarsa, 2018; Ansari et al., 2012; Allameh et al., 2014).

Cognitive and Mental Ability includes logical reasoning, critical analysis, technological insight, conceptual thinking, strategic thinking, and verbal comprehension. Enhancing these skills improves organizational efficiency and leadership performance (Katz, 1974; Ahmadi & Dost Mohammadlu, 2008).

Cognitive-Organizational Readiness involves understanding environmental dynamics, managing uncertainty and ambiguity, situational competence, organizational growth, knowledge management, and self-improvement. Organizations function as information-processing systems; principals' competence in navigating complexity directly affects decision-making, planning, and operational effectiveness (Lotfi, 2019; Zandavanian & Meher-Alizadeh, 2006; Joshi et al., 2018).

Without comprehensive understanding of leadership environments, principals may struggle to implement effective practices (Kruse, 2021). This study offers a structured, validated framework of 13 categories and 63 concepts for school principals' cognitive competencies.

This mixed-methods design not only enriches theoretical understanding but also bridges the gap between qualitative depth and quantitative rigor, offering policymakers and educators a multi-layered view of cognitive leadership.

Innovative and Theoretical Contributions

This study introduces an integrated framework combining mental processes, self-awareness, emotional regulation, neuroleadership, and educational neuroscience into a cohesive model of cognitive leadership. Quantitative validation confirms high reliability across all components. Comparative analysis with prior studies (Komariah et al., 2023; Masdarini & Ekayani, 2021; Chan et al., 2017; Mueller & Turner, 2010) demonstrates both alignment and advancement, extending leadership theory into an empirically grounded, education-specific context.

Theoretically, this study:

1. Expands cognitive competency theory tailored to school principals.
2. Integrates cognitive science, neuroscience, and leadership theory into a cohesive framework.
3. Redefines competency structures through a neurocognitive lens, emphasizing the interplay of mental processes and brain-based leadership.

Practical and Policy Implications

From a policy perspective, integrating cognitive competency training into professional development programs can enhance principals' cognitive action, self-awareness, psychological capital, and neurocognitive learning skills. Educational policymakers should embed these findings into recruitment, evaluation, and promotion systems, ensuring cognitive readiness as a core leadership criterion. Targeted workshops can improve decision-making, problem-solving, and leadership effectiveness, while embedding cognitive education principles into school management can strengthen learning outcomes and institutional adaptability.

Limitations and Future Research

While the study provides a robust framework, it is limited to specific regional and contextual factors that may not generalize across all educational systems. Future research should employ longitudinal and cross-cultural designs to examine how cognitive competencies evolve over time and across contexts.

It is recommended to:

- Analyze each of the 13 categories independently through experimental or longitudinal methods
- Assess cognitive competencies among teachers and educational administrators in other provinces;
- Compare results across cultural and educational settings to refine and validate the model further.

Recognizing these limitations demonstrates scholarly humility and positions this research as a foundational step toward a deeper understanding of cognitive leadership in education.

Authors' Contributions

All authors have made significant contributions to the research process and the development of the manuscript.

Declaration

To correct and improve the academic writing in our paper, we utilized the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

Declaration of Interest

The authors report no conflict of interest.

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