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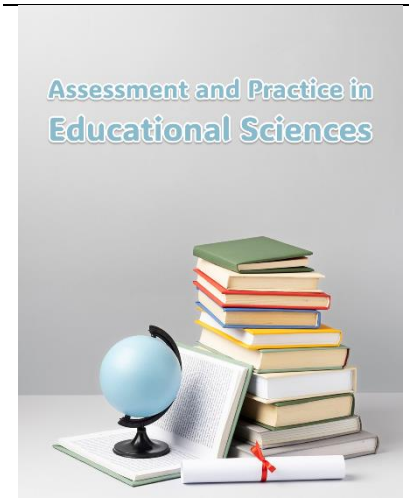

Application of Micro Educational Management in Documenting the Knowledge of Biology Teachers in Baghdad Schools

1. Fadhil Kadhim. Allawi Alsaadi: PhD Student, Department of educational management, Isf.C., Islamic Azad University, Isfahan,Iran.
2. Ali. Khalkhali*: Department of Educational Sciences, T.C., Islamic Azad University, Tonekabon, Iran. (Email: 1502113554@iau.ac.ir)
3. Salwan. Abed Ahmed: Assistant Professor, Department of Educational Sciences, Faculty of Educational Counseling, Diyala University, Diyala, Iraq.
4. Zohreh. Aghakasheri: Department of Educational Sciences, Ya.C., Islamic Azad University, Yazd, Iran.

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ABSTRACT

This study aimed to design a localized model for documenting the knowledge of biology teachers in Baghdad secondary schools, based on the principles of *micro educational management*. Micro educational management conceptualizes the teacher as a leader at the classroom level who manages the teaching and learning process through moment-to-moment decision-making and continuous reflection. Within this framework, a teacher's professional knowledge is categorized into three types: "substantive knowledge" (scientific concepts), "contextual knowledge" (lived experience), and "explicit knowledge" (observable documentation). This qualitative study was conducted within an interpretive paradigm, employing semi-structured interviews, participatory observation, and document analysis of 12 biology teachers in four schools in Baghdad. The data were analyzed using the Attride-Stirling thematic analysis method. Findings led to the extraction of five basic themes: documentable content as substantive knowledge, strategies for recording and organizing knowledge, implicit and non-recordable knowledge, criteria for selecting documentable content, and enablers and barriers to documentation. These themes were ultimately integrated into an overarching theme entitled "The Intelligent Model of Teacher Knowledge Documentation within the Framework of Micro Educational Management." This model demonstrates that documentation becomes intelligent and effective when the teacher, guided by reflective and situational rationality, assumes the role of a knowledge manager and designer, establishing interconnections among the three types of knowledge. This process transforms documentation from a mere administrative task into a research-based and knowledge-creating practice that leads to sustainable individual and organizational learning. The results indicate that implementing this model can foster teachers' professional growth, strengthen the school's intellectual capital, and enhance the quality of biology instruction. The study underscores the necessity of institutionalizing documentation within the school culture and providing institutional support for teachers to realize micro educational management.

Keywords: micro educational management; teacher knowledge documentation; teachers' professional knowledge; intelligent documentation model; biology teachers of Baghdad

Introduction

Across contemporary education systems, the pressure to convert dispersed, practice-based teacher know-how into systematic, shareable, and improvable knowledge has intensified, driven by accountability demands, rapid curricular change, digital transformation, and post-pandemic recovery agendas (1, 2). Knowledge management (KM) provides a structured response to these pressures by creating processes and infrastructures that enable schools to produce, store, circulate, and reuse pedagogical knowledge for strategic and instructional improvement (1, 3). Yet, KM in education is not a mere transplantation

of corporate techniques; it must be reframed to respect the social, ethical, and contextual specificities of classrooms, teachers' professional learning, and student outcomes (4, 5). This article positions teacher knowledge documentation and sharing as the core of a school-level KM approach that aligns strategic planning with day-to-day teaching practices, arguing that sustainable professional development and organizational learning emerge when micro-level teacher decisions are linked to macro-level managerial capabilities and supportive infrastructures (6, 7).

The strategic promise of KM for schooling has been articulated in studies showing that KM can sharpen school-wide planning cycles, align resources with pedagogical priorities, and institutionalize reflective practice (1). When schools treat lesson artifacts, assessment feedback, classroom videos, and reflective notes as organizational assets—subject to curation, analysis, and purposeful reuse—they increase coherence between strategy and instruction, and reduce variance in classroom quality across departments and grade levels (1, 3). Research in Russian educational organizations underscores that KM practices (standardized repositories, communities of practice, and analytic dashboards) are feasible and performance-relevant when leaders scaffold both technical and social routines for sharing and learning (3). In parallel, evidence from Tehran's education sector identifies the enabling conditions—leadership commitment, process clarity, and technology readiness—required to establish and sustain KM routines, especially where resources are constrained and change initiatives are frequent (4).

Teacher professional development sits at the center of this KM proposition. Sustainable development is achieved not simply by episodic training, but by building systems that codify tacit expertise and feed it back into practice in timely, context-relevant ways (6). Empirical work shows that teachers' professional growth relates directly to students' academic performance, particularly when mediated by relational mechanisms such as school bonding and climate that distribute knowledge and norms across a staff (8). In knowledge-rich schools, human resource development functions as a bridge between KM processes and job performance, translating shared practices into improvements in instructional execution and coordination (5). Taken together, these strands suggest that PD is strongest when designed as an organizational learning system: teachers produce knowledge through classroom inquiry, HR systems validate and disseminate it, and leaders use strategic planning to resource its scaling (1, 5, 6).

At the classroom level, the nature of teacher knowledge itself demands careful modeling. Science education research has long emphasized integrated frameworks that braid content, pedagogy, and technology, recognizing that effective instruction depends on their joint optimization rather than any single strand (9). The rise of blended and virtual modalities has amplified the need to manage these knowledge components as dynamic, evolving assets of the school, not solely as individual teacher competencies (10). Conceptual models of electronic learning environment management stress governance of platforms, content workflows, data security, and teacher supports—capabilities that rely on codified processes and shared standards to be effective across teams (10). In this sense, TPACK-like teacher models and school-level e-learning governance are complementary layers of the same KM architecture: they specify what knowledge needs to be produced and how the organization will curate and circulate it (9, 10).

The COVID-19 shock exposed both the fragility and the potential of educational KM. In Pakistan's higher education system, rapid shifts to e-learning illuminated barriers (infrastructure gaps, digital literacy, institutional inertia) and facilitators (policy clarity, support services, communities of practice) that mediated adoption and instructional continuity (2). These findings generalize beyond the crisis moment: robust KM capabilities—knowledge repositories, peer mentoring structures, and decision supports—are the scaffolds that make instructional innovation adoptable and improvable, whether in emergencies or routine change cycles (1, 2). For schools serving diverse communities and operating with constrained resources, this implies prioritizing lean but resilient KM processes that convert teacher ingenuity under pressure into organizational assets for future reuse (3, 4).

A crucial but often overlooked dimension is the ethical and communicative framing of teacher knowledge. Classroom knowledge is enacted through relationships, meaning that information literacy, interpersonal communication, and beliefs about student ability shape both the production and the uptake of knowledge artifacts (11). When teachers' ethical dispositions—fairness, respect, and responsibility—are integrated with the dimensions of teacher knowledge, documentation practices become trustworthy, dialogic, and oriented toward student growth rather than mere compliance (12). Schools, therefore, must design KM routines that honor ethical safeguards (privacy, consent, non-stigmatizing language) and inclusive communication norms, increasing the likelihood that shared practices are adopted with fidelity and sensitivity (11, 12).

Teacher knowledge is also situational: it includes safety, health, and crisis-response know-how that must be codified and routinized to protect students. Studies of pre-service and in-service teacher preparedness for managing life-threatening allergic reactions illustrate how critical, high-stakes protocols can be unevenly known and enacted without systematic training and documentation (13). Likewise, planned instructional programs that strengthen teachers' first-aid knowledge demonstrate measurable gains when development is sequenced, assessed, and embedded in work processes—precisely the conditions that KM architectures can provide (14). These findings broaden the KM remit: beyond pedagogy and assessment, schools should treat safety and wellbeing protocols as knowledge assets to be curated, drilled, and refreshed through feedback loops (13, 14).

From a micro-cognitive lens, the distinction between novice and expert teachers can be understood as differences in "classroom management scripts," that is, anticipatory mental models and situational awareness that guide rapid, fine-grained decision-making (15). KM can help externalize and share these scripts—through annotated videos, decision logs, and scenario libraries—so they are not locked within individuals but become communal resources for induction and coaching (15). When schools scaffold the articulation of such scripts, they accelerate the movement from tacit to explicit knowledge and reduce the time needed for novices to acquire adaptive expertise (1, 15).

At the meso-organizational level, empirical links between KM, psychological empowerment, and creativity suggest that teachers are more innovative when they perceive autonomy, meaningfulness, influence, and competence in their roles (16). Information-rich environments that value teacher voice and provide safe spaces for experimentation tend to yield higher creativity and, by extension, more diverse and effective instructional strategies (12, 16). In industrial and service contexts, knowledge sharing, learning organization practices, and employee engagement are associated with performance gains—insights that, while contextually distinct, are conceptually instructive for schools seeking to build high-reliability teaching organizations (17). The implication is that teacher engagement is not only a climate outcome but also a KM lever: when teachers experience reciprocal knowledge exchange and growth opportunities, they contribute more fully to collective performance (5, 17).

Leadership capacity is the system driver that ties these elements together. Structural models of school managers' competencies—strategic thinking, instructional leadership, data use, and stakeholder engagement—are repeatedly linked to sustainable development outcomes at the school level (7). In KM terms, leaders curate the conditions for knowledge capture (time, tools, norms), enable its socialization (peer observation, lesson study), and ensure its strategic exploitation (integration into planning, evaluation, and resource allocation) (1, 7). Where leadership intentionally aligns KM with improvement cycles, the returns in consistency, equity, and resilience are greater and more durable (3, 7).

Quality management and innovation perspectives provide additional macro-level rationale for educational KM. In higher education institutions, organizational performance is positively associated with combined regimes of innovation, total quality management (TQM), and internationalization—an architecture that presupposes robust KM to sense, evaluate, standardize, and scale improvements across units (18). Translating these lessons to K-12 contexts, schools that standardize core processes (e.g., curriculum mapping, assessment calibration) while protecting zones for teacher-led innovation can better balance reliability

with adaptation (1, 18). Such balance is particularly salient for digital ecosystems, where platform governance, content versioning, and data-informed iteration are prerequisites for sustaining quality at scale (2, 10).

The human factors that enable KM include teachers' information literacy and communication skills, which shape how evidence is sourced, interpreted, and translated into classroom action; they also influence student outcomes indirectly through academic self-efficacy pathways moderated by beliefs about intelligence (11). Schools that cultivate these capabilities—through targeted PD, mentoring, and reflective documentation—create more reliable pipelines from knowledge acquisition to instructional impact (8, 11). Ethical conduct in teaching further undergirds trust in knowledge exchanges; codifying ethical expectations around data use, feedback, and peer observation strengthens the legitimacy and uptake of shared practices (12). In short, KM succeeds not only on technical grounds but also through professional norms that dignify teacher agency and student rights (4, 12).

Despite these benefits, adoption challenges persist. Studies report misalignments between KM rhetoric and resource realities, leading to documentation overload without analytic payoff, or to technology deployments without social supports for sense-making (2, 4). Conceptual clarity about "what counts" as valuable knowledge—content schemas, classroom scripts, safety protocols, micro-assessments—is often lacking, resulting in repositories that are difficult to navigate and integrate into planning and instruction (1, 3). To address these issues, frameworks for establishing KM in education emphasize phased implementation: define priority domains; build minimal viable repositories; embed reflective routines (e.g., after-action reviews); and link outputs to appraisal, coaching, and strategic planning cycles (1, 6). Such disciplined sequencing helps schools avoid initiative fatigue while delivering visible wins that build momentum (4, 5).

This study contributes to the literature by integrating micro-level teacher knowledge work with meso-level HR and leadership systems into a coherent, context-sensitive KM model for schools. It takes seriously the cognitive architecture of teaching (scripts, anticipatory attention), the ethical and communicative preconditions for trustworthy knowledge exchange, and the digital governance imperatives of contemporary learning environments (10, 12, 15). It also foregrounds safety and wellbeing knowledge as first-order assets that should be curated and rehearsed with the same rigor as curricular content (13, 14). By drawing on cross-sectoral findings about knowledge sharing, learning organization practices, and engagement, the model identifies motivational and structural levers that can enhance instructional reliability and innovation simultaneously (17, 18). Finally, it aligns with emerging evidence that leadership competence is the decisive variable in translating KM infrastructures into sustainable development at the school level (3, 7).

Given this background, the present article develops and justifies a school-based KM model that systematizes teacher knowledge documentation and sharing, integrates ethical and communicative safeguards, and aligns micro-level instructional decision-making with strategic planning and leadership capacity to support sustainable professional development and improved student outcomes in diverse and resource-constrained contexts (1-18).

This study aims to design and empirically ground a school-level knowledge management model that connects teacher knowledge documentation and sharing with strategic planning, leadership competencies, and professional development mechanisms to enhance instructional quality and student outcomes (1, 7).

Methods and Materials

This study employed a qualitative design with an interpretivist approach. Within this framework, the researcher's objective was not to measure variables but rather to gain a deep and multilayered understanding of the process of knowledge documentation among biology teachers in Baghdad secondary schools. The qualitative orientation of this study was grounded in the belief in the complexity of educational realities and the importance of interpreting the meanings of phenomena from the

participants' perspectives. Since micro educational management derives its meaning from teachers' daily interactions with students and educational resources, the qualitative method allowed for uncovering teachers' lived experiences, beliefs, and practical strategies in documenting their professional knowledge through dialogue and in-depth data analysis.

The research field comprised four public secondary schools located in central Baghdad where biology was taught within the framework of the new science curriculum (STEMA). These schools were selected to ensure diversity in geographical location, teacher composition, and levels of educational resources. The participants were 12 biology teachers selected through purposive sampling. The inclusion criteria were a minimum of five years of teaching experience in biology, willingness to participate in interviews and classroom observations, and basic familiarity with educational technologies. The participants represented diversity in gender, years of service, and school type (public and semi-public), allowing for a variety of perspectives regarding the concept of micro educational management and approaches to knowledge documentation.

Data collection utilized three primary tools: semi-structured interviews, participatory observation, and analysis of teacher-generated documents. The interviews were in-depth and semi-structured to provide general guidance by the researcher while allowing for follow-up questions based on participant responses. Each interview sought to explore three core domains: teachers' lived experiences in classroom management (contextual knowledge), their understanding of scientific content and its pedagogical application (substantive knowledge), and their strategies for recording and documenting teaching and learning processes (explicit knowledge). The interviews were conducted in Arabic and, in some cases, in a combination of Arabic and English. They were later translated into Persian and reviewed to preserve conceptual accuracy.

Participatory observation was conducted in biology classrooms to examine teachers' actual behaviors, decision-making, and interactions during instruction. The researcher assumed the role of an assistant observer, striving to record authentic patterns of micro-level educational decisions and documentation practices without interference. During the observations, special attention was paid to teachers' managerial actions (such as time regulation, responses to unpredictable situations, and interactions with students) and their use of documentation tools (notebooks, experience-recording forms, video recordings, and reflective notes). In addition to these two sources of data, teachers' instructional documents were also collected and analyzed. These materials included lesson plans, reflective journals, laboratory reports, and, in some cases, teaching video files. These datasets enabled the researcher to connect verbal and behavioral data and develop a multidimensional understanding of the process of knowledge documentation and the manifestation of micro educational management.

Data were analyzed using thematic analysis, which is suitable for qualitative educational research to extract concepts and patterns of meaning from textual data. In the first step, all interview transcripts and observation notes were fully rewritten and reviewed. In the second step, meaning units related to the three domains of substantive, contextual, and explicit knowledge were identified. Subsequently, open coding was carried out based on intra-textual concepts, and the codes were grouped into initial themes. Next, these themes were compared with the theoretical foundations of micro educational management and instructional documentation approaches to reveal their conceptual relationships. Finally, a network of main and sub-themes was mapped, serving as the conceptual framework derived from the study. To ensure analytical coherence, the coding and theme review process was repeated several times to confirm that interpretations were emergent from, rather than imposed upon, the data.

To ensure validity and reliability of the findings, several complementary strategies were employed. First, internal validity was established through data triangulation among interviews, observations, and documents to confirm that the findings were supported by multiple independent sources. Second, member checking was conducted by sharing summarized preliminary analyses with participating teachers and requesting their feedback on the accuracy of interpretations. Third, to enhance dependability, the entire process of data collection and analysis was documented in a fieldwork log, enabling other researchers

to audit the research trajectory. Additionally, the researcher engaged in continuous reflexive journaling to monitor and control personal assumptions and potential influences on data interpretation.

In terms of ethical considerations, the study was designed and implemented based on the ethical principles of qualitative research. Before data collection began, informed consent was obtained from all participants, who were assured that the collected data would be used solely for scientific purposes. Confidentiality and anonymity were guaranteed by assigning substitute codes to participants. The researcher also avoided any behavior or decision that could harm the teachers' professional status or reputation. Data were securely stored and accessible only to the research team.

Ultimately, the research methodology was designed to reflect both the complexity and contextual realism of Baghdad's schools and, simultaneously, to generate rich and multilayered data through a documentation-oriented approach for analyzing teachers' micro educational management. This flexible design enabled the researcher to collect and interpret classroom realities, teachers' lived experiences, and their reflective practices within a coherent analytical framework while upholding both scientific rigor and ethical standards.

Findings and Results

The findings section was structured according to the Attride-Stirling thematic analysis in five main stages, aiming to explain how *micro educational management* is applied in the process of knowledge documentation among biology teachers in Baghdad schools.

Identification and Extraction of Meaningful Units from the Data

In the first stage, an analysis of in-depth interviews and classroom observations yielded 240 meaningful codes that reflected teachers' real-life experiences in interacting with the three types of knowledge: substantive, contextual, and explicit. These codes included statements concerning daily lesson planning, the use of visual models and tools, experimental design, reflective teaching methods, and strategies for coping with limited resources. This stage revealed that biology teachers in Baghdad, within their micro educational management, engage in a spectrum of reflective actions ranging from writing in daily journals to video recording lessons.

Extraction of Basic Themes from the Meaningful Units

In the second stage, the initial codes were grouped according to conceptual and functional similarities into five basic themes: (1) documentable content as substantive knowledge; (2) strategies for recording and organizing knowledge; (3) tacit and non-recordable knowledge; (4) criteria for selecting documentable content; and (5) enablers and barriers to documentation. These themes illuminated the main dimensions of how micro educational management manifests in teachers' professional practice—showing that their daily decisions about documentation are not merely technical, but profoundly cognitive and reflective. The following section defines each theme in detail.

(1) Documentable Content as Substantive Knowledge

This theme refers to that part of the teacher's knowledge rooted in the scientific and conceptual foundations of biology that can be transformed into objective and documentable evidence. Within the framework of micro educational management, "documentable content" represents the portion of substantive knowledge that the teacher organizes and structures during lesson planning and instruction so that it can later serve as instructional data for reuse or transfer. Such content typically includes key scientific concepts, causal relationships, and biological processes that lend themselves to demonstration, experimentation, or empirical description. For example, the design and execution of a biology experiment on photosynthesis constitute not only substantive knowledge but also documentable content, as it relies on scientific concepts and can be recorded, reviewed, and analyzed. The distinctive feature of this theme lies in its *objectifiability*. While other themes focus on processual, mental, or

organizational aspects of documentation, this theme concerns the type of knowledge that can be materialized in textual, visual, diagrammatic, or video form. Hence, documentable content as substantive knowledge establishes a direct link between the scientific domain of biology and the processes of micro educational management, forming the epistemological foundation of documentation.

(2) Strategies for Recording and Organizing Knowledge

This theme encompasses the set of methods, models, and decisions that teachers use to collect, categorize, and represent knowledge throughout the teaching process. In micro educational management, recording and organizing knowledge is not a merely technical task but the manifestation of a cognitive and reflective process in which the teacher decides *what* to record, *how*, and *for what purpose*. Recording strategies may include the use of daily teaching journals, reflective notes, student observation sheets, recorded videos, or laboratory activity analysis forms. In contrast, organizing knowledge refers to arranging and linking these data systematically so that they transform from scattered information into usable and transferable resources. The distinctive feature of this theme lies in its *process orientation*. Unlike the first theme, which focuses on content, this one emphasizes the mechanisms by which experience is converted into data. In fact, strategies for recording and organizing knowledge represent the intersection of micro educational management and documentation, where small decisions, momentary reflections, and individual methods evolve into a structured system for producing explicit knowledge.

(3) Tacit and Non-Recordable Knowledge

This theme refers to the aspect of teachers' knowledge embedded in their real-time classroom actions, which cannot easily be captured in concrete documents. Such knowledge stems from teachers' experience, intuition, and professional sensitivity and becomes evident in their immediate decisions when facing unpredictable situations, student behaviors, or informal learning contexts. *Tacit knowledge* represents the hidden layer of micro educational management transmitted through dialogue, behavior, or situational judgment. For instance, a teacher's ability to recognize the right moment to pose a thought-provoking question or to select a metaphorical expression to explain a complex concept exemplifies tacit knowledge that cannot be fully documented. The distinctive feature of this theme lies in its *ineffability and non-codifiability*. While other themes deal with explicit and transferable knowledge, this one emphasizes the hidden layers of understanding that transform documentation from a merely archival activity into an interpretive and multifaceted process. In analyzing micro educational management, recognizing and reflecting upon tacit knowledge enables teachers to expand the boundaries of their understanding and convert parts of it into explicit knowledge through professional dialogue.

(4) Criteria for Selecting Documentable Content

This theme focuses on teachers' reflective decision-making about what should or should not be recorded in the documentation process. In micro educational management—especially in resource-limited educational environments—documentation follows a certain *logic of selection*, where teachers decide which data or experiences to document based on instructional objectives, the innovativeness of activities, their future learning value, and their shareability. Criteria such as "the conceptual significance of the content," "its connection to students' lived experiences," "its potential for replication in other contexts," and "its professional reflection value" are among the indicators teachers consider in their choices. The distinctive feature of this theme lies in its *normative and value-based dimension*. Whereas previous themes addressed knowledge or procedural aspects, this one highlights teachers' professional judgment and ethical reasoning about the value of documentation. In essence, the selection of content reflects teachers' professional agency and autonomy as micro educational managers—where deciding whether to include or exclude an experience embodies the prioritization of educational values and learning goals.

(5) Enablers and Barriers to Documentation

This theme describes the set of factors that directly or indirectly influence teachers' ability or quality in documenting knowledge. Enablers include institutional support from the school, a culture of collaborative learning, access to educational technologies, dedicated time for reflection and recording, and supportive policies. Conversely, barriers include heavy teacher workloads, lack of time and resources, absence of managerial feedback, technical limitations, and traditional attitudes toward the value of documentation. This theme reveals that documentation is not merely an individual act but a *context-dependent and organizationally embedded* process. Its distinctive feature lies in its *contextual and systemic level*. While other themes address teachers' personal actions and decisions, this theme emphasizes the external and environmental forces that facilitate or constrain the documentation process. In other words, enablers and barriers determine to what extent micro educational management can be effectively implemented and sustained in practice. In the context of Baghdad schools, this theme holds particular importance, as the quality of infrastructure and school policies directly affects the realization of micro educational management and teachers' capacity to document their knowledge.

The five basic themes above constitute the conceptual structure of the thematic analysis, revealing multiple dimensions of the relationship between micro educational management and the knowledge documentation of biology teachers. Each theme represents a different aspect of the teacher's interaction with knowledge, practice, and context: the first highlights the epistemic dimension, the second the procedural dimension, the third the experiential and implicit dimension, the fourth the decision-making and value dimension, and the fifth the contextual and organizational dimension. Together, these themes present a coherent picture of micro educational management as a professional learning process—one in which documentation is not merely the recording of the past but a strategic pathway for constructing the professional future of teachers.

Derivation of Organizing Themes from Basic Themes

The third stage involved the derivation of *organizing themes*. Each organizing theme, emerging from the axial analysis phase, needed to be defined comprehensively, analytically, and at a higher level of abstraction than the basic themes. Each definition illustrates the linkage between the micro-level of teachers' knowledge and the macro-level of leadership and organizational learning. At the same time, the distinct conceptual boundaries between each organizing and basic theme were carefully maintained.

(1) Intelligent Strategies for Selecting and Organizing Transferable Knowledge

This organizing theme represents a level of professional action in which the teacher evolves from being a "consumer and recorder of knowledge" to becoming an "epistemic designer and selector." At this level, documentation is no longer a merely accumulative act but a form of *systematic thinking about the value, applicability, and transferability of knowledge*. The teacher, as a micro-level epistemic manager, makes deliberate decisions—based on the educational context and learners' needs—about which experiences hold value for documentation and how they should be organized to ensure future usability, recreation, or generalization.

This theme reflects the emergence of *reflective decision-making intelligence*, where teachers consciously and contextually select knowledge. Each act of knowledge selection represents a professional judgment concerning the "importance," "durability," and "effectiveness" of content. Consequently, documentation becomes a rational and selective process with both a cognitive dimension (analysis and organization of concepts) and an ethical dimension (conscious selection of what should endure). The distinctive feature of this theme, compared with the basic themes, is that it operates at a higher level—addressing not "what" or "how" to record, but "why" it should be recorded and "how" it can be transferred. This theme thus represents the *epistemic design stage* of micro educational management, during which the teacher, through a future-oriented perspective, transforms experience into reproducible knowledge.

(2) Managing Tacit Knowledge: The Art of Professional Leadership in Momentary Situations

This organizing theme constitutes the dynamic and living core of the knowledge network within micro educational management. At this level, the teacher is not merely the possessor of tacit knowledge but also its manager—that is, capable of integrating intuition, experience, and reflective thought for decision-making in real time. This theme represents a form of *situated epistemic leadership* through which the teacher draws upon hidden reservoirs of knowledge to guide learning processes in response to unpredictable events. Here, managing tacit knowledge entails the *conscious regulation of unconscious processes*—in other words, the teacher learns to identify and share what was once only intuitively practiced through professional reflection. Thus, the moment of classroom decision-making becomes a scene for the manifestation of managerial wisdom.

The distinctive feature of this theme lies in its departure from the basic themes, which described tacit knowledge as inherently unrecordable. Here, the focus is on *managing that knowledge*: the teacher, through reflective practice and professional dialogue, seeks to make the boundary between tacit and explicit knowledge fluid. Theoretically, this theme bridges personal and organizational knowledge, demonstrating that educational leadership at the micro level is, before being a skill, an epistemic capacity for flexible engagement with the complexities of learning.

(3) The Dual Process of Documentation: Objective Recording and Experiential Reconstruction

This theme signifies a transition from a linear, one-dimensional perspective on documentation to a cyclical and reflective one. At this level, documentation comprises two complementary dimensions: *Objective Recording*, which includes the collection of observable data, written, and visual records; and *Experiential Reconstruction*, which involves interpreting and revisiting experiences through reflective writing, pedagogical storytelling, and critical analysis. The dual process of documentation forms the cognitive core of the micro educational management network because it simultaneously encompasses two counterbalancing flows: the external flow of "recording and preserving knowledge" and the internal flow of "reconstructing and making sense of experience."

At this stage, the teacher transforms from a passive recorder to an analyst and re-creator. Each documentation experience becomes an opportunity for relearning and enhancing professional knowledge. The distinctive feature of this theme lies in its *duality*: instead of focusing on a single dimension of documentation (content or method), it emphasizes the interaction between them. This theme demonstrates that documentation is not the end of teaching but the beginning of professional learning. Thus, documentation at this level is viewed as a *research-based and reflective act* through which teachers reconstruct their personal knowledge into an analyzable and discussable form.

(4) Context-Based Organization of Documentation: From Individual Effort to Institutional Synergy

This theme represents the institutional and systemic dimension of the network of themes, describing a level of meaning in which documentation evolves from an individual and fragmented activity into a collective, synergistic, and organized process. At this level, the teacher's micro educational management finds meaning within a broader framework beyond the classroom and becomes part of the school's organizational learning. *Context-based organization* refers to the coordination among three main components: (1) the school's supportive structures, (2) technologies and tools that facilitate documentation, and (3) a culture of teacher collaboration. When these components interact, documentation transcends the individual level and becomes an institutional mechanism for knowledge creation and sharing.

The distinctive feature of this theme is its *shift of focus* from "teacher action" to "school system." Unlike previous themes centered on individual agency and personal decisions, this theme highlights the necessity of *collective infrastructures and supportive policies* that ensure the continuity of micro educational management. Accordingly, the school is conceptualized as a *knowledge ecosystem* in which each teacher functions as a unit of knowledge production, and documentation forms a network

of concurrent learning among them. Theoretically, this theme elucidates the linkage between *micro educational management* and *organizational learning*, showing that individual educational wisdom attains sustainability only when it is institutionally reproduced. Therefore, sustainable documentation is not the result of individual skill but of systematic synergy among structure, culture, and teacher agency.

The four organizing themes above serve as conceptual intermediaries between the basic themes (micro-level knowledge) and the overarching global theme (macro-level theory). Collectively, they reveal three levels of semantic transformation within micro educational management:

1. From data selection and organization to epistemic design (Theme 1);
2. From individual intuition to situated leadership (Theme 2);
3. From data recording to meaning reconstruction (Theme 3);
4. And from individual action to institutionalized knowledge (Theme 4).

This developmental progression extends from the individual level of cognition and decision-making to the collective level of learning and knowledge reproduction. It illustrates that micro educational management functions as a mechanism for transforming personal experience into organizational knowledge. Each organizing theme within this network acts as a node connecting "knowledge," "action," and "context," and in interaction with other themes, constitutes a system of *reflective rationality* and *professional learning* within Baghdad schools.

Emergence of the Global Theme from the Organizing Themes

In the fourth step, the organizing themes were integrated into a global theme titled "The Intelligent Model of Teacher Knowledge Documentation within the Framework of Micro Educational Management." This global theme represents the final level of a cognitive, reflective, and professional process in which the teacher, through micro educational management, documents their knowledge in a systematic, deliberate, and goal-oriented manner. The term "intelligent" in this construction refers to a form of reflective and situational rationality that transforms the teacher from a passive recorder of experiences into a designer and engineer of educational knowledge. In this sense, documentation is not merely the storage or preservation of information, but a strategic, selective, and regenerative act that emerges from the interplay among substantive knowledge, contextual knowledge, and explicit knowledge. Within the intelligent model, the biology teacher, acting as a micro-level educational manager, draws on three combined capacities: 1) the ability to discern the knowledge value of each experience (through scientific and pedagogical sensitivity); 2) the ability to convert experience into analyzable and shareable instructional data (through documentation tools and strategies); and 3) the ability to reflect upon, reconstruct, and transfer that knowledge within professional and institutional frameworks (through dialogue, collaboration, and collective learning).

This model is considered "intelligent" when the teacher employs critical thinking, situational analysis, and contingent decision-making at all stages of knowledge production, organization, and transfer. Such a model is linked to the teacher's self-regulatory and self-reflective mindset; that is, the teacher decides what to document, how to document it, and for what purpose—not merely based on prescribed guidelines, but on the basis of professional judgment and in response to specific educational situations.

From a theoretical standpoint, this global theme integrates three layers of knowledge within micro educational management: substantive knowledge as the epistemic foundation, i.e., the scientific content and fundamental principles of biology that set the direction and cognitive framework for documentation; contextual knowledge as the regulatory force, i.e., the teacher's understanding of the learning situation, students' needs, and environmental contingencies that shape documentation decisions; and explicit knowledge as the observable output, i.e., the set of documents, notes, videos, forms, and narratives that convert the teacher's tacit knowledge into explicit and transferable forms.

In this model, the relationship among these three types of knowledge is not linear but networked and recursive. Documentation both draws from existing knowledge and becomes a source for generating new knowledge. Accordingly, the documentation process in the intelligent model constitutes a cycle of continuous professional learning in which each instructional action becomes data for reflection, and each reflection becomes a point of departure for future educational decision-making.

From a functional perspective, the intelligent documentation model possesses several key characteristics:

1. Reflectivity: the teacher continuously reflects on what has been done and what could be improved; documentation becomes a tool for self-awareness and action refinement.
2. Contextual Adaptivity: documentation is not based on predefined templates but is tailored to the cultural context, school resources, and learners' needs.
3. Integrative Knowledge Work: the boundaries among scientific, experiential, and pedagogical knowledge are dissolved, and the teacher becomes a producer of interdisciplinary knowledge.
4. Professional Regeneration: documentation evolves into a process of organizational learning and knowledge exchange among teachers; knowledge that was initially individual is reproduced at group and institutional levels.

At a deeper level, this global theme demonstrates that micro educational management is not merely a skill of classroom administration but a system of Epistemic Self-Management; that is, the teacher continuously reconstructs and regulates their own knowledge. In this approach, documentation becomes the "internal logic of professional growth," because by observing themselves in practice, teachers can design their trajectory of professional development.

The distinctive feature of this global theme, compared to the basic and organizing themes, is that it no longer discusses the "components of documentation," but rather a holistic and self-organizing model that integrates all components. Whereas the basic themes focused on knowledge content, recording processes, selection criteria, or environmental conditions, the global theme centers on how these elements synergize within a self-regulating learning system. In other words, this theme shows how the biology teacher, through micro educational management, moves from the level of recording experiences to the level of producing professional and institutional knowledge.

Ultimately, the theme "The Intelligent Model of Teacher Knowledge Documentation within the Framework of Micro Educational Management" expresses the theoretical and practical maturation of the documentation process in Baghdad schools; a model that enables teachers, amid structural challenges, resource constraints, and cultural exigencies, to become creators of localized and reflective educational knowledge rather than mere consumers of knowledge. This theme marks the intersection of "knowing," "managerial wisdom," and "organizational learning," where the school—as a learning institution—is built from within the intelligent actions of its teachers.

Interpretation of the Network of Themes

The network of themes in this study is the result of the juxtaposition and interweaving of three levels of meaning: the first level, which includes the basic themes and refers to the granular and concrete components of micro educational management in teachers' practice; the second level, which, in the form of organizing themes, explains the relationships among teachers' actions, decisions, and forms of knowledge; and the third level, which, through the global theme "The Intelligent Model of Teacher Knowledge Documentation within the Framework of Micro Educational Management," confers theoretical and functional unity on the meaning network. The interpretation of this network shows how documentation in Baghdad schools has transformed from a descriptive and administrative activity into an epistemic, reflective, and knowledge-producing process.

At the inner core of the network, the basic themes function as the building blocks of teachers' epistemic micro-wisdom. "Documentable Content as Substantive Knowledge" constitutes the epistemic foundation of the network and indicates that

documentation, above all, rests on a deep understanding of scientific concepts and principles. This theme delineates the underlying level of the network in which the teacher is not merely a consumer of content but its scientific interpreter. Alongside it, "Strategies for Recording and Organizing Knowledge" forms the executive level of the network—where the teacher's reflective thinking and managerial skills transform substantive knowledge into a systematic structure by organizing data and experiences. Together, these two themes establish the "epistemic order" of documentation at the micro level.

On the other hand, "Tacit and Non-Recordable Knowledge" and "Criteria for Selecting Documentable Content" represent the reflective and value-laden layer of the network. The former points to the inner and personal dynamism of teachers' actions—knowledge that is not fully articulated at the level of conscious awareness but guides educational behavior, decisions, and judgments. The latter explains the ethical and professional criteria for data selection and shows that documentation, from the teacher's perspective, follows a form of moral and professional judgment. Thus, at the second level of the network, documentation is not merely a representation of what has occurred but a reflection of the values teachers ascribe to knowledge, learning, and professional responsibility.

Surrounding this inner structure, the theme "Enablers and Barriers to Documentation" functions as the contextual level of the network. As the "systemic and institutional setting," this theme indicates that the processes of micro educational management and knowledge documentation do not occur in a vacuum but are heavily influenced by contextual forces such as school policies, time, technology, and organizational culture. These external forces are not solely constraining; under favorable conditions, they become drivers for the formation of intelligent micro management. Consequently, the relationship between internal and external factors in the network of themes is reciprocal and reinforcing: the stronger the institutional and cultural support, the greater the capacity for reflection and documentation at the micro level.

In the next interpretive step, the organizing themes emerge as mediating axes within the meaning network. These themes play a linking role between the micro layers of knowledge and the macro level of management, demonstrating how teachers' individual experiences are transformed into a system of professional knowledge. "Intelligent Strategies for Selecting and Organizing Transferable Knowledge" introduces teachers as designers of knowledge systems who can select meaningful and generalizable segments from diverse data. This theme connects with the first and second basic themes (substantive knowledge and recording processes) and elevates them to a reflective level of decision-making. Conversely, "Managing Tacit Knowledge: The Art of Professional Leadership in Momentary Situations" bridges experience and decision-making. This theme shows that micro educational management—especially in complex environments such as Baghdad schools—requires a form of situational intelligence that enables teachers to draw on intuition and experience for immediate decisions. This level of meaning deepens the treatment of tacit knowledge in the basic themes, transforming it from raw and hidden knowledge into an active element within the micro management process.

The third organizing theme, "The Dual Process of Documentation: Objective Recording and Experiential Reconstruction," reveals the bidirectional nature of documentation. At this level, documentation is not limited to data collection; it also encompasses the reconstruction of experience through reflective narratives. This theme serves as the connecting loop among the different layers of knowledge: substantive knowledge orients empirical data; contextual knowledge regulates the mode of reconstruction; and explicit knowledge is the final outcome of this reconstruction.

Finally, the organizing theme "Context-Based Organization of Documentation: From Individual Effort to Institutional Synergy" demonstrates that documentation transcends the individual level when the school becomes a learning institution. This theme is linked to the fifth basic theme (enablers and barriers), but it elevates that theme from a descriptive level to one of institutional transformation; that is, the teacher's micro educational management bears fruit when it is consolidated within professional learning networks and teacher collaboration.

At the center of this multilayered network, the global theme "The Intelligent Model of Teacher Knowledge Documentation within the Framework of Micro Educational Management" acts like a thread that weaves dispersed elements of meaning into an integrated explanatory system. This theme explains all relationships among the themes as an interactive and cyclical model in which knowledge, action, and reflection continuously nourish one another. In this model, the teacher's micro educational management is the mechanism through which individual experiences are transformed into organizational knowledge, and the school evolves from an executive institution into a learning institution. The interpretation of the network of themes indicates that the movement from basic themes toward the global theme is a movement from "concrete knowledge" toward "systemic and reflective knowledge." At the initial level, the teacher is engaged in partial, day-to-day actions; at the final level, those same actions become part of a self-organizing system with the capacity for reproduction and learning. This process operates through a tripartite cycle: (1) extracting experience from practice (substantive and contextual knowledge), (2) reflecting upon and reconstructing experience in the form of documented knowledge (explicit and tacit knowledge), and (3) returning the new knowledge to practice (intelligent management and organizational learning).

Overall, the network of themes emphasizes an internal dynamism among managerial micro-wisdom, professional knowledge, and the institutional context. Managerial micro-wisdom enables teachers to balance the changing exigencies of the classroom with institutional requirements; professional knowledge provides the theoretical and methodological framework for decision-making; and the institutional context determines the feasibility or constraints of implementing these decisions. The intersection of these three dimensions is precisely where documentation is transformed from a technical act into an intelligent, knowledge-generating process. From an interpretive viewpoint, the network of themes mapped in this study portrays the "epistemic autonomy of biology teachers." In this model, teachers are no longer consumers of top-down policies and content; rather, through micro educational management, they have created a network of knowledge based on experience and reflection. Although this network operates at the micro level, it has the potential to influence the macro level of the school and even the educational system, because knowledge production occurs from the bottom up.

Ultimately, the interpretation of the network of themes shows that documenting teachers' knowledge in Baghdad schools, in light of micro educational management, has shaped a new "knowledge ecology," in which the teacher, as the active subject of knowing, transforms teaching into a research act and the school into a site of knowledge production. Thus, the network of themes in this study is not merely a map of relationships among concepts, but a blueprint for epistemological transformation in education—one in which intelligent documentation constitutes the point of convergence among individual learning, educational leadership, and the institutional regeneration of the school.

Discussion and Conclusion

The present study aimed to design, validate, and evaluate the effectiveness of an integrated resilience and play therapy training model on the problem-solving skills and mathematical performance of elementary school students. The results obtained from the repeated-measures ANOVA indicated that the intervention significantly improved both variables in the experimental group compared to the control group, with these positive effects persisting during the follow-up phase. This demonstrates that the combination of resilience training and play therapy provides a synergistic effect, leading to sustained cognitive and emotional development among students. The findings align with previous empirical research underscoring the complementary nature of resilience-building programs and play-based interventions in enhancing children's learning capacity and adaptive functioning (19-22).

The significant increase in problem-solving ability observed among students following the intervention can be attributed to multiple components of the integrated model. Resilience-focused sessions targeted the development of self-regulation,

emotional control, and cognitive flexibility, while play therapy facilitated experiential learning, creativity, and emotional expression. Together, these elements fostered a multidimensional learning experience that allowed children to approach challenges more constructively. This is consistent with the resilience framework proposed by Masten (2014), which conceptualizes resilience as the dynamic process of positive adaptation in the context of adversity (23). The current results also corroborate the theoretical perspective advanced by Rutter (2012), who emphasized that resilience acts as a mediating factor between stress exposure and adaptive outcomes, particularly when bolstered by supportive environments (24). By integrating structured play into resilience training, the present model strengthened children's intrinsic motivation and sense of mastery—key elements of successful problem-solving behavior (25, 26).

The findings concerning the enhancement of mathematical performance are similarly significant. Students who participated in the integrated training demonstrated higher posttest and follow-up scores in mathematics compared with the control group. This improvement reflects the intervention's effectiveness in addressing both cognitive and affective components of mathematical learning. Research has shown that emotional regulation and resilience are essential for overcoming mathematics-related anxiety, sustaining attention, and fostering self-efficacy (27, 28). The current findings are consistent with those of Habibi Khozani et al. (2024), who found that game-based and cognitive rehabilitation-integrated learning interventions significantly reduced anxiety and improved mathematical achievement among students with learning difficulties (21). Similarly, Samavati et al. (2024) reported that adaptive game-based learning enhanced mathematics performance and motivation in a mobile learning context, illustrating the powerful intersection between play, cognition, and academic resilience (20).

The persistent improvement observed during the follow-up period suggests that the effects of the integrated program extended beyond short-term behavioral changes and were internalized as enduring cognitive and emotional strategies. This durability of effects can be explained through Rogers' client-centered principles, emphasizing acceptance, empathy, and the facilitation of self-directed growth (29). Within play therapy sessions, these conditions were recreated through structured yet flexible activities that encouraged children to express feelings, test solutions, and experience mastery in problem-solving contexts. This aligns with Axline's (1947) child-centered play therapy approach, which views play as a natural means through which children resolve inner conflicts and develop adaptive coping mechanisms (30). The results also mirror Landreth's (2021) and Cochran et al.'s (2023) findings, which highlighted that play therapy nurtures emotional self-regulation, cognitive restructuring, and social competence, all of which contribute to improved academic performance (31, 32).

Another critical finding relates to the interaction effect between time and group for both dependent variables, indicating that the experimental group's progress over time was significantly greater than that of the control group. This trajectory of improvement underscores the developmental nature of the integrated program: children not only learned specific techniques but also internalized adaptive strategies that continued to operate autonomously. Such continuity of learning supports Piaget's (1962) developmental theory, which holds that cognitive progress is achieved through active interaction and reflective play (33). Moreover, as supported by contemporary research, cognitive and emotional skills develop interdependently; thus, integrating emotional resilience into academic instruction enhances both performance and well-being (34, 35).

The significant increase in problem-solving skills among students after exposure to the integrated intervention resonates with a growing body of evidence emphasizing the central role of resilience in cognitive flexibility and creativity. Studies have consistently found that resilience training fosters an adaptive mindset, enhances metacognitive monitoring, and strengthens students' capacity to confront and resolve novel problems (19, 36). The findings are congruent with those of Jahani Zadeh et al. (2023), who reported that explicit problem-solving training significantly improved academic achievement and reduced test anxiety among fourth-grade students (37). Similarly, Yasbolaghi Sharahi and Moradi (2023) found that design-thinking

strategies—which share conceptual similarities with problem-solving-based resilience training—enhanced creative reasoning and adaptive cognitive processes among elementary learners (38).

From an emotional-cognitive standpoint, the intervention's success can also be explained through the affect-regulation model of resilience proposed by Troy et al. (2023). According to this framework, resilience operates through the flexible regulation of emotions to maintain goal-directed behavior under stress. Within the present study, play therapy activities provided the experiential context for such regulation, enabling students to process frustration, practice emotional control, and experience mastery—all essential for academic persistence (26). Similar mechanisms have been described by Bates et al. (2024), who observed that resilience training among adolescents improved both affective balance and performance outcomes (39).

The positive impact on mathematical performance also corroborates prior findings from both educational and clinical contexts. Li and Disney (2023) reported that young children's mathematical thinking improved significantly when mathematical concepts were embedded within playful, collaborative environments (40). Likewise, Awofala et al. (2024) found that teacher-related anxiety in mathematics directly influenced students' achievement levels, emphasizing the importance of affective interventions to promote mathematical resilience (41). In the same vein, Gharibi et al. (2023) and Heydari et al. (2018) confirmed that play therapy enhances mathematical understanding and problem-solving among students with learning difficulties, as it combines emotional safety with cognitive stimulation (22, 42). The consistency between these results and the present findings underscores the mediating role of emotional resilience in cognitive performance and provides empirical justification for integrating play and resilience within mathematics instruction.

At a theoretical level, the integrated training model validated in this study is grounded in three complementary traditions—resilience theory, cognitive-developmental theory, and humanistic play therapy. From the resilience perspective, as posited by Rutter (2012) and Masten (2014), adaptive functioning results from the interaction between individual protective factors (such as emotion regulation and problem-solving ability) and environmental support systems (such as family, school, and peer relationships) (23, 24). From the cognitive-developmental standpoint, Piaget (1962) and subsequent researchers emphasized that play and exploration constitute the primary means of learning and knowledge construction in childhood (33). Finally, from the humanistic perspective articulated by Rogers (1951) and Axline (1947), the therapeutic relationship and acceptance of the child's inner world are essential for self-directed growth (29, 30). The integration of these frameworks offers a holistic structure for enhancing academic resilience through affective and cognitive channels simultaneously.

The study's outcomes further align with more recent empirical frameworks connecting resilience and digital or adaptive game-based learning. For example, Samavati et al. (2024) and Ventistas et al. (2024) demonstrated that technology-enhanced game-based learning can reinforce motivation and sustain problem-solving engagement, particularly among learners who struggle with traditional methods (20, 43). Similarly, Borazon and Chuang (2023) argued that resilience in educational systems can be intentionally cultivated through integrative pedagogical practices combining social–emotional and cognitive learning (44). This evidence strengthens the generalizability of the current findings to broader educational applications.

The results also reaffirm the importance of environmental and social support in promoting resilience. Consistent with Zhang et al. (2024), who found that family communication and social support predict family resilience and emotional well-being, the inclusion of group-based play activities in this study likely enhanced social cohesion and peer connectedness, further promoting emotional security and persistence in learning tasks (36). Furthermore, the use of play as a mediating medium allowed for cooperative problem-solving, aligning with Bahar and Aksut's (2020) findings that activity-based learning improves cognitive engagement and problem-solving skills in early education (45).

Overall, the findings of this research confirm that integrating resilience training with play therapy yields multidimensional benefits, strengthening children's problem-solving, emotional regulation, and academic performance. This model provides empirical evidence for the theoretical claim that resilience is not merely a trait but a trainable set of cognitive and emotional skills that can be effectively cultivated through experiential, play-based learning environments (35, 46, 47).

Despite its robust design and meaningful findings, this study has certain limitations that should be acknowledged. The first limitation lies in the relatively small sample size and the use of a single geographical location, which may restrict the generalizability of the results to wider populations. Second, the reliance on self-report instruments and standardized tests, although validated, may have introduced bias related to social desirability or subjective interpretation. Third, the study's duration was limited to a short intervention period followed by a single follow-up; therefore, long-term effects of the integrated training on resilience and academic achievement remain uncertain. Finally, since the study was conducted in an educational rather than clinical setting, the findings may not fully represent children with severe emotional or cognitive impairments.

Future studies could expand the scope of this research by employing larger and more diverse samples across multiple educational regions. Longitudinal designs with extended follow-up periods are recommended to evaluate the sustainability of the intervention's effects over time. Future research could also explore moderating variables such as gender, socioeconomic background, or prior exposure to emotional learning programs. Incorporating neurocognitive measures, such as executive function assessments, could further elucidate the underlying mechanisms linking resilience, emotional regulation, and problem-solving. Moreover, comparative studies testing digital and in-person implementations of resilience–play therapy integration could reveal the optimal delivery modes for modern classrooms.

Practitioners and educators can apply the findings of this study by embedding resilience training and play therapy principles within everyday classroom routines. Integrating playful problem-solving tasks, emotional regulation exercises, and cooperative learning activities into curricula can enhance students' cognitive engagement and psychological well-being. Teachers should receive training in both resilience-based pedagogy and therapeutic play techniques to better support students' emotional needs while maintaining academic rigor. Finally, school counselors and psychologists can adopt the integrated model as a preventive and developmental tool, promoting adaptive coping, emotional intelligence, and academic success in early education settings.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adhered in conducting and writing this article.

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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