

Development of an Integrated Analytical Framework for Evaluating Early Childhood Digital Content: A Conceptual Model Based on Literature Review

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Abstract: This study aimed to propose a foundational integrated analytical framework for evaluating early childhood digital content, based on a systematic review of literature from 2015 to 2025. Through inductive content analysis of 52 selected studies, six interrelated domains were identified: (1) Linguistic Quality, (2) Cognitive and Pedagogical Design, (3) Developmental Appropriateness, (4) Multimodal Design, (5) Cultural and Social Representation, and (6) Accessibility and Ethics. These domains were synthesized into a conceptual model illustrating how linguistic, pedagogical, and multimodal dimensions interact under the moderating influence of developmental appropriateness, while cultural and ethical dimensions ensure inclusivity and child protection. The framework contributes theoretically by integrating developmental and media literacy perspectives, and practically by providing evaluation guidelines for educators, parents, and content developers. This pre-validation model lays the groundwork for future Delphi validation and empirical testing toward a standardized tool for assessing early childhood digital content quality..

Keywords: Early Childhood Education, Digital Content Evaluation, Conceptual Framework, Developmental Appropriateness, Multimodal Learning

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I. INTRODUCTION

Digital technology has become deeply embedded in the daily lives of young children, transforming the way they learn, play, and interact with the world around them. Tablets, smartphones, YouTube, streaming platforms, and interactive applications are now integral parts of early childhood environments, serving both as educational tools and entertainment media (Marsh & Li, 2022). In this rapidly evolving digital era, children are not merely passive consumers of media but active participants who navigate and co-construct digital experiences. This shift presents both opportunities and challenges for educators, parents, and policymakers seeking to ensure that digital content supports children's holistic development rather than undermines it.

The global expansion of early childhood media has prompted numerous studies examining the effects of digital exposure on children's cognitive, linguistic, and socio-emotional development (Bolten, 2025; Chaudron et al., 2018). Many of these studies emphasize factors such as screen time, parental mediation, and behavioral outcomes, identifying both benefits and risks associated with early digital engagement.

However, these approaches tend to focus on quantitative measures of exposure rather than the qualitative characteristics of the content itself. The internal features of digital media—such as language complexity, pedagogical design, multimodal presentation, cultural inclusivity, and ethical safety—remain insufficiently explored, particularly in the context of early childhood education (Mayer, 2009; Kress & van Leeuwen, 2001).

In South Korea and globally, the educational media market for young children continues to grow exponentially, yet standards for evaluating the developmental quality of such content remain fragmented. Recent domestic efforts, such as Jo and Choi's (2023) development of a digital content evaluation tool for young children, represent an important step toward establishing evaluative criteria. Their study produced a six-domain, 36-item instrument focusing on instructional design, interface usability, and technological quality. Nevertheless, linguistic quality, developmental appropriateness, multimodal composition, and sociocultural representation were relatively underrepresented, limiting its capacity to assess content from a truly holistic perspective. Internationally, frameworks have similarly prioritized

usability and pedagogy while neglecting the interplay of linguistic, affective, and ethical factors that shape children's meaning-making in digital spaces (De Medeiros & Lopes, 2023; Li & Marsh, 2022).

This imbalance highlights a critical research gap: the lack of an integrated analytical framework capable of assessing the educational, developmental, cultural, and ethical dimensions of early childhood digital content. Given that early childhood is a sensitive period for language acquisition, symbolic play, and socio-emotional development (Piaget, 1970; Vygotsky, 1978), the quality of media input can profoundly influence emerging literacy, empathy, and worldview formation. Content that aligns with children's developmental readiness—what NAEYC (2019) defines as developmentally appropriate practice—can foster cognitive growth and language comprehension, while poorly designed media may lead to cognitive overload, imitation of inappropriate behaviors, or reduced interpersonal interaction.

Furthermore, the increasing prevalence of algorithm-driven platforms such as YouTube Kids necessitates renewed attention to cultural representation and ethical responsibility. Children's media today functions not only as a vehicle for entertainment but also as a cultural curriculum through which norms, values, and identities are transmitted (Fairclough, 1995; Banks, 2009). Issues of inclusivity, diversity, gender roles, and moral messaging are therefore inseparable from pedagogical quality. UNESCO (2018) underscores that media for young audiences must integrate ethical safeguards, accessibility features, and privacy protection to ensure that children's rights and dignity are respected in digital environments.

Against this backdrop, the present study aims to develop a conceptual model of an integrated analytical framework for evaluating early childhood digital content. Unlike previous empirical studies limited to single perspectives, this research synthesizes multi-dimensional criteria drawn from developmental psychology, media studies, linguistics, and education. The proposed framework encompasses six interrelated domains: Linguistic Quality, Cognitive and Pedagogical Design, Developmental Appropriateness, Multimodal Design, Cultural and Social Representation, and Accessibility and Ethics. By consolidating these domains, the framework seeks to establish a foundation for future validation and empirical applications, ultimately contributing to the creation of child-centered, developmentally appropriate, and ethically sound digital learning environments.

This study is significant in three main aspects. First, it contributes theoretically by offering a comprehensive, literature-based conceptual model that integrates diverse disciplinary perspectives. Second, it provides practical guidelines for educators, parents, and media developers to evaluate the quality of digital content for children. Third, it offers policy-level implications for establishing standards and ethical guidelines for child-centered digital media. Ultimately, this pre-validation framework aspires to serve as a foundational step toward developing a standardized, evidence-based tool for assessing the quality and developmental suitability of early childhood digital content worldwide.

II. LITERATURE REVIEW

The increasing integration of digital technology into early childhood education has brought unprecedented opportunities for learning, creativity, and engagement. Yet, it has also raised pressing questions about how to assess the developmental appropriateness and educational quality of digital content for young children. To construct a theoretically grounded analytical framework, this literature review synthesizes findings from six major domains identified in prior research: linguistic quality, cognitive and pedagogical design, developmental appropriateness, multimodal design, cultural and social representation, and accessibility and ethics. Together, these dimensions provide a comprehensive basis for understanding how digital media affects the holistic development of children.

A. Linguistic Quality

Language serves as the foundation for early learning and communication. In early childhood, linguistic input directly influences vocabulary growth, syntax acquisition, and literacy readiness (Vygotsky, 1978; Nation, 2013). Research on educational media highlights that linguistic quality—clarity, repetition, pronunciation, and interactivity—enhances comprehension and retention (Mayer, 2009). Mayer's *Cognitive Theory of Multimedia Learning* emphasizes that learners process information through auditory and visual channels; therefore, clear verbal cues and concise narration reduce cognitive load and support learning efficiency. Repetition and rhythmic phrasing, often used in nursery rhymes or story-based apps, foster phonological awareness and memory consolidation. In addition, interactive speech—such as questions (“What do you see?”) or invitations (“Can you say this with me?”)—encourages children's verbal participation and self-expression. However, some studies caution that excessive narration or complex syntax can overload young learners' working memory (Bolten, 2025). Hence, linguistic quality in digital content should prioritize clarity, developmental vocabulary, and meaningful engagement rather than quantity of exposure.

B. Cognitive and Pedagogical Design

Digital content in early childhood education must be more than visually appealing—it must be pedagogically coherent. Constructivist theories of learning propose that children build knowledge through active exploration and scaffolding (Vygotsky, 1978). Mayer (2009) and Anderson and Krathwohl (2001) argue that the pedagogical design of multimedia should align with cognitive development principles, including clear learning goals, sequential structure, feedback loops, and reinforcement. Effective digital media promotes active learning through problem-solving, storytelling, and self-paced exploration. For instance, adaptive educational apps that provide immediate feedback or encourage reflection help children internalize learning objectives. Conversely, content with disorganized sequencing or excessive stimuli may hinder comprehension by increasing cognitive overload. Therefore, the cognitive and pedagogical design of early childhood digital media must balance engagement with structured, developmentally appropriate learning sequences.

C. Developmental Appropriateness

The principle of *Developmentally Appropriate Practice (DAP)*, established by NAEYC (2019), emphasizes that educational experiences must align with children's age, individual needs, and cultural context. In digital content, this principle extends to the control of pacing, emotional tone, and sensory intensity. Young children have limited attention spans and heightened emotional sensitivity (Kim & Park, 2021). Overly stimulating visuals or rapid transitions can lead to frustration or distraction, while content that mirrors real-life experiences enhances comprehension and socio-emotional growth. Piaget's (1970) theory of cognitive development further supports the use of concrete imagery and symbolic play during the preoperational stage, suggesting that children learn best through tangible representations rather than abstract explanations. Thus, developmentally appropriate digital content should provide emotional safety, simple cause-and-effect structures, and realistic scenarios that resonate with children's everyday experiences.

D. Multimodal Design

Modern children's digital environments are inherently multimodal, combining visual, auditory, textual, and gestural cues to create meaning. Kress and van Leeuwen (2001) define *multimodal discourse* as the coordinated use of multiple semiotic systems in communication. Within early childhood media, multimodal design determines not only the attractiveness of content but also its pedagogical effectiveness. Mayer (2009) identifies the *modality* and *redundancy* principles as key to reducing cognitive overload—visuals and narration should complement rather than duplicate each other. Music, rhythm, and imagery can enhance children's engagement and emotional connection when used intentionally (De Medeiros & Lopes, 2023). However, excessive transitions, bright colors, or chaotic soundscapes can fragment attention and impair comprehension. Effective multimodal design, therefore, demands a balance between stimulation and simplicity, ensuring that visual and auditory elements support, rather than distract from, conceptual understanding.

E. Cultural and Social Representation

Children's media functions not only as a tool for learning but also as a medium for socialization and cultural transmission (Fairclough, 1995). Through digital narratives, children internalize worldviews, values, and norms that shape their understanding of diversity and identity. However, recent analyses reveal that much of global children's media still reflects Western-centric, gender-stereotypical, and homogeneous family representations (Li & Marsh, 2022). Banks (2009) argues that inclusive and multicultural education must reflect multiple perspectives, emphasizing respect, empathy, and representation of marginalized groups. In this sense, early childhood digital content carries the responsibility of portraying varied racial, linguistic, and cultural identities fairly. Exposure to diverse characters and stories fosters intercultural sensitivity and prevents bias formation during formative years. Therefore, evaluating the *cultural and social representation* of children's media is crucial for ensuring that it promotes inclusion, equality, and global citizenship.

F. Accessibility and Ethics

Ethical and accessibility considerations have become increasingly critical as children's digital consumption expands. Young users are particularly vulnerable to privacy risks, commercial manipulation, and exposure to inappropriate content (COPPA, 1998). UNESCO (2018) emphasizes that children's digital media should uphold principles of transparency, safety, and accessibility. Ethical design involves protecting user data, avoiding intrusive advertising, and providing accessible features—such as captions, sign language, or audio descriptions—for children with disabilities. These components align with global standards of inclusive education and the rights of the child. Moreover, ethical media must guide screen-time moderation and model responsible digital citizenship. Incorporating accessibility and ethics into evaluation frameworks ensures that digital content is not only educationally sound but also socially responsible and equitable.

Across these six domains, a coherent pattern emerges: high-quality early childhood digital content integrates linguistic clarity, pedagogical coherence, and multimodal expressiveness within a developmentally appropriate, culturally inclusive, and ethically secure environment. These dimensions are not independent but dynamically interconnected—language shapes cognition; multimodal design enhances comprehension; cultural representation frames values; and ethics ensure children's protection and dignity. Together, they provide the foundation for constructing an Integrated Analytical Framework for Evaluating Early Childhood Digital Content, which serves as the conceptual basis for the present study.

III. METHODOLOGY

A. Research Design

The present study adopted an exploratory-descriptive qualitative design (Creswell & Poth, 2018), appropriate for generating theory-driven frameworks in underexplored areas. The research aimed to conceptualize evaluative dimensions of early childhood digital content by reviewing prior academic and institutional literature published between 2015 and 2025.

Following the logic of *theory synthesis* (Lynham, 2002), the study integrated findings from educational technology, developmental psychology, linguistics, and cultural studies to establish the structural components of the proposed framework.

The process unfolded in three stages:

- Identification and Collection of Literature (scoping and database search),
- Thematic Coding and Categorization (content analysis of criteria),
- Framework Construction and Theoretical Integration (conceptual mapping and synthesis)

B. Data Sources and Search strategy

Relevant literature was collected from both international and Korean academic databases, including Scopus, Web of Science, ERIC, Google Scholar, RISS, and DBpia.

The following search terms were used, in various Boolean combinations:

“early childhood digital content,” “educational media evaluation,” “YouTube Kids,” “children’s media quality,” “developmentally appropriate practice,” “multimodal learning,” and “child-centered technology design.”

To ensure comprehensiveness, government and institutional reports—such as those from UNESCO (2018) and NAEYC (2019)—were also reviewed. This multi-source strategy allowed for the inclusion of theoretical, empirical, and policy-based perspectives on digital content for young children.

C. Inclusion and Exclusion Criteria

To focus the review, the following inclusion criteria were applied:

- Peer-reviewed articles published between 2015–2025, in English or Korean.
- Studies targeting children aged 3–8 years.
- Articles explicitly discussing evaluation frameworks, quality indicators, or pedagogical design of digital or multimedia educational content.
- Studies addressing language, cognition, development, or ethics in early childhood digital contexts.

The exclusion criteria were:

- Articles focusing solely on adolescents or adults.
- Studies analyzing *hardware, engineering, or technical usability* without educational or developmental focus.
- Opinion pieces or reports lacking empirical or theoretical grounding.

Through this process, an initial pool of 138 documents was identified, of which 52 studies met the inclusion criteria after full-text screening.

D. Data Analysis Procedure

The selected studies were analyzed using inductive qualitative content analysis (Krippendorff, 2018) and conceptual clustering techniques.

This approach allows researchers to identify emerging patterns and categories without imposing preconceived structures.

The analysis proceeded in the following steps:

- **Open Coding:** Each study was read carefully, and key phrases or constructs related to evaluation dimensions were highlighted and coded (e.g., “interactive language,” “feedback,” “diversity,” “privacy protection”).
- **Axial Coding:** Codes were then grouped into conceptual clusters representing shared meanings, such as *linguistic clarity, pedagogical structure, developmental fit, and ethical safety*.
- **Categorization:** Six higher-order categories were derived through iterative synthesis—Linguistic Quality, Cognitive and Pedagogical Design, Developmental Appropriateness, Multimodal Design, Cultural and Social Representation, and Accessibility and Ethics.

- **Model Integration:** Finally, the relationships among these categories were mapped into a conceptual diagram, illustrating the interaction and hierarchical alignment among domains.

E. Ethical Considerations

This study did not involve human participants or sensitive data; therefore, institutional review board (IRB) approval was not required. However, all literature sources were cited and acknowledged following APA 7th ethical publication standards. The proposed framework aligns with UNESCO’s (2018) ethical principles for children’s digital environments, emphasizing inclusivity, privacy protection, and equitable access.

IV. RESULTS AND CONCEPTUAL FRAMEWORK

Through inductive content analysis of 52 selected studies, six interrelated domains were identified as the essential components of quality in early childhood digital content: (1) Linguistic Quality, (2) Cognitive and Pedagogical Design, (3) Developmental Appropriateness, (4) Multimodal Design, (5) Cultural and Social Representation, and (6) Accessibility and Ethics. Each domain represents a critical lens for understanding how digital content supports or hinders young children’s holistic development.

A. Linguistic Quality

The first domain, Linguistic Quality, emerged as a central dimension because language serves as both the medium and the message in early childhood learning. High-quality digital content consistently exhibited features such as developmentally appropriate vocabulary, simple sentence structures, rhythmic repetition, and interactive dialogue (Vygotsky, 1978; Nation, 2013). These linguistic features support comprehension, retention, and early literacy development. Conversely, content with inconsistent language levels, excessive narration, or slang expressions was found to confuse or disengage young viewers (Bolten, 2025). Linguistic quality in digital content functions not merely as a communicative component but as a scaffold for cognitive construction, bridging comprehension and conceptualization in multimedia environments.

B. Cognitive and Pedagogical Design

The second domain, Cognitive and Pedagogical Design, reflects how effectively the content organizes learning experiences according to developmental theories.

Effective digital materials share five pedagogical attributes: (1) clear learning objectives, (2) logical sequencing, (3) scaffolding of knowledge, (4) interactive feedback, and (5) reinforcement through meaningful repetition (Mayer, 2009; Anderson & Krathwohl, 2001). In contrast, some popular children’s media rely primarily on entertainment-driven elements without clear educational progression, which may overstimulate attention without promoting sustained learning. Thus, pedagogically sound design ensures that children’s engagement translates into conceptual understanding, making learning both enjoyable and meaningful.

C. Developmental Appropriateness

The third domain, Developmental Appropriateness, acts as a moderating layer that aligns all other domains with children's cognitive, emotional, and social capacities. As defined by NAEYC (2019), developmentally appropriate digital content must consider children's attention span, emotional regulation, symbolic understanding, and cultural context. The analysis revealed that content designed with slower pacing, predictable storylines, and emotionally balanced visuals was more likely to foster engagement and comprehension.

Piaget's (1970) stage theory and Vygotsky's (1978) concept of the Zone of Proximal Development both suggest that learning is most effective when tasks are just beyond the child's current competence, supported by clear visual and linguistic cues. Therefore, developmental appropriateness ensures that the integration of technology does not disrupt but instead enhances the natural rhythm of early learning and play.

D. Multimodal Design

The fourth domain, Multimodal Design, recognizes the interdependence of sensory modes—visual, auditory, linguistic, and kinesthetic—in shaping children's learning experiences. Drawing on Kress and van Leeuwen's (2001) multimodal discourse theory and Mayer's (2009) cognitive load principles, the literature underscores that well-designed multimedia integrates imagery, narration, and music synergistically. For instance, visual emphasis on key vocabulary, synchronized audio cues, and rhythmic motion can reinforce meaning and attention. However, overly dynamic animation or inconsistent sound effects can overwhelm children's limited processing capacity (De Medeiros & Lopes, 2023). Effective multimodal design, therefore, balances sensory richness with cognitive simplicity, promoting focus, emotional engagement, and comprehension simultaneously.

E. Cultural and Social Representation

The fifth domain, Cultural and Social Representation, pertains to the way digital content portrays social values, diversity, and inclusion. The literature highlights that children's media often reproduces stereotypical roles, Eurocentric imagery, and homogenous family structures (Li & Marsh, 2022; Fairclough, 1995). In contrast, content reflecting

multicultural perspectives, balanced gender representation, and varied family forms fosters empathy, global awareness, and positive identity development (Banks, 2009). Media thus operates as a cultural curriculum that teaches implicit lessons about equity, kindness, and respect. Evaluating the cultural representation of digital content is essential to ensure that young viewers encounter narratives that affirm diversity and human dignity.

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G. Accessibility and Ethics

The sixth domain, Accessibility and Ethics, encompasses issues of privacy, data protection, screen-time management, and inclusivity for children with disabilities. The Children's Online Privacy Protection Act (COPPA, 1998) and UNESCO (2018) guidelines emphasize that media developers and educators share the responsibility to safeguard children's digital rights. Accessibility involves the presence of subtitles, voice narration, sign language options, and safe navigation interfaces, ensuring that all children—regardless of ability—can benefit equitably. Ethical design also includes transparency in sponsorships, avoidance of manipulative advertising, and clear crediting of sources. Incorporating these elements reinforces the moral integrity of educational content and aligns it with global child protection standards.

Based on the synthesis of these six domains, the study proposes the Integrated Analytical Framework for Evaluating Early Childhood Digital Content (IAF-ECDC), illustrated conceptually below:

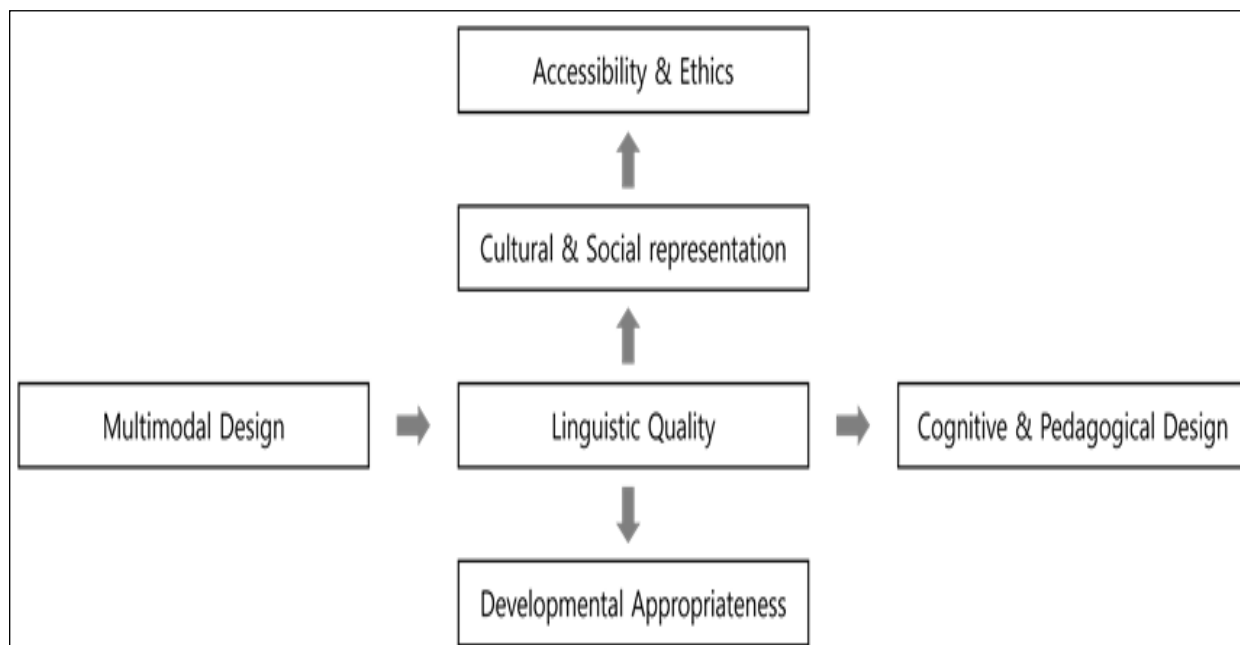


Fig 1. IAF-ECDC framework

In this conceptual model:

- Linguistic Quality and Cognitive & Pedagogical Design form the *core instructional axis*, determining clarity and educational depth.
- Multimodal Design enhances sensory engagement and comprehension.
- Developmental Appropriateness serves as a *moderating filter* that ensures all other domains align with the developmental needs of children.
- Cultural and Social Representation and Accessibility & Ethics provide the *socio-ethical foundation* that guarantees inclusivity, safety, and humanistic integrity in digital content.

The interconnections among these domains demonstrate that high-quality early childhood digital media must be linguistically clear, pedagogically structured, developmentally appropriate, multimodally balanced, culturally inclusive, and ethically responsible.

V. CONCLUSION

This study developed a conceptual and integrated analytical framework for evaluating early childhood digital content (IAF-ECDC) in response to the growing need for systematic, developmentally informed standards in children's digital media. As digital technologies increasingly shape how young children learn, communicate, and interact, it becomes imperative to ensure that the content they consume is not only engaging but also linguistically sound, pedagogically meaningful, developmentally appropriate, culturally inclusive, and ethically responsible. By synthesizing theoretical and empirical insights from fifty-two international and Korean studies published between 2015 and 2025, the research identified six interrelated domains—Linguistic Quality, Cognitive and Pedagogical Design, Developmental Appropriateness, Multimodal Design, Cultural and Social Representation, and Accessibility and Ethics—as the multidimensional foundation for assessing digital content for early learners.

The findings reveal that effective digital content for children should prioritize clarity and interactivity in language use, establish coherent pedagogical structures that guide understanding, and ensure alignment with children's developmental capacities. Furthermore, multimodal design must enhance comprehension through balanced use of visual and auditory elements rather than overstimulation. Content should also reflect diversity and social equity, recognizing that children construct their values and identities through media exposure. Lastly, ethical and accessibility considerations—including privacy protection, data transparency, and inclusivity for children with disabilities—are essential to building safe, human-centered digital learning environments. Collectively, these insights affirm that digital content for early childhood is not merely a technological product but an educational ecosystem that influences the child's holistic growth—cognitive, emotional, social, and moral.

Theoretically, this study contributes to the field by integrating concepts from sociocultural learning theory (Vygotsky, 1978), developmentally appropriate practice (NAEYC, 2019), and multimodal literacy (Kress & van Leeuwen, 2001) into a single analytical construct. The IAF-ECDC thus bridges early childhood education, educational technology, and digital ethics, providing a unified perspective for understanding the quality of children's media. Practically, the framework serves as a diagnostic and developmental tool for educators, researchers, content creators, and parents to evaluate and design child-centered media. It also offers a structural foundation for policymakers and educational institutions to establish national or institutional standards for evaluating children's digital content.

However, this study is not without limitations. Because it is a conceptual and literature-based model, empirical validation remains necessary to confirm its construct validity and reliability. The review was limited to English- and Korean-language sources, which may exclude relevant works from other cultural contexts. Moreover, the rapid evolution of digital technologies—such as artificial intelligence

storytelling, augmented reality, and interactive learning platforms—requires ongoing adaptation of the framework to emerging media forms. Despite these limitations, the study's pre-validation model offers a crucial first step toward establishing a standardized, evidence-based approach for assessing early childhood digital media.

Future research should focus on empirical validation and refinement of the proposed framework. Conducting Delphi studies with experts in early childhood education, digital media, and linguistics can establish consensus on the relative importance of each domain. Subsequent exploratory and confirmatory factor analyses could be employed to statistically test the framework's dimensionality and psychometric properties. Additionally, cross-cultural comparative studies are recommended to explore how different educational and cultural contexts shape perceptions of digital content quality. Finally, integrating AI-based content analysis tools may enhance the objectivity and scalability of digital content evaluation in future implementations.

The Integrated Analytical Framework for Evaluating Early Childhood Digital Content (IAF-ECDC) lays the groundwork for a new paradigm in early childhood media evaluation—one that unites educational purpose with ethical responsibility. By acknowledging that every story, image, and sound presented to children shapes not only their intellect but also their character, this framework invites educators, parents, and developers to participate in the shared responsibility of nurturing children's digital well-being. Ultimately, the framework envisions digital media not as a substitute for human interaction but as a meaningful extension of learning, imagination, and empathy—guiding young children toward a future where technology truly serves their development and dignity.

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