Translating Graphic Notation into Preschool Song Teaching: A Thematic Framework of Preschool Teachers' Pedagogical Reasoning

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Abstract

In early childhood education, graphic notation is recognized for its ability to externalize musical elements such as rhythm, pitch, and musical expression, thereby reducing the cognitive load associated with Song Teaching and comprehension. However, the professional process by which preschool teachers transform graphic notation from a "visual representation" into a "teachable classroom tool" remains under-explored. This study aims to construct a conceptual framework for the pedagogical transformation of graphic notation instruction based on preschool teachers' experiences, providing transferable analytical language for related instructional design and teacher training.Employing a qualitative research design, the study conducted semi-structured Interviews with 20 preschool teachers in central China to collect their practice narratives. Thematic analysis was applied, involving open coding, sub-theme refinement, and theme integration. Theoretically, the study employed the Design–Functions–Tasks (DeFT) framework of multiple representations learning and the Pedagogical Reasoning and Action framework as sensitizing concepts to guide interview guide construction and framework refinement. The findings formed the graphic notation Pedagogical Translation Framework (GNPTF), comprising five interrelated dimensions: Feature Alignment, Symbol Construction, Notation Explainability, Notation Mediated Teaching, and Feedback Revision. This framework reveals how teachers design symbols and provide explanatory instruction around musical elements, revising notation and teaching strategies through continuous feedback to enhance developmental appropriateness and classroom implementability. The study offers a structured framework for preschool teacher education and preschool song teaching practices related to graphic notation.

Keywords: Graphic Notation, Preschool Teachers, Song Teaching, Thematic Analysis, Pedagogical Reasoning and Action, Pedagogical Translation Framework

Introduction

In early childhood education, song teaching is one of the most common forms of musical practice, yet it is also most easily misjudged as having a "low threshold." Its core challenge lies not in "singing the notes correctly," but in the strong temporal and ephemeral nature of musical elements such as rhythm, pitch, melodic contour, and musical expressiveness. Precisely because these elements are difficult to consistently observe, identify, and compare,

teaching preschool songs is not merely about "leading preschoolers in singing," but rather a pedagogical challenge of transforming abstract musical structures into comprehensible, discussable, and modifiable classroom objects. Without shared external representations in the classroom, instruction often falls into a "demonstrate-imitate-correct" cycle. This not only makes it difficult to observe learning evidence but also hinders early childhood educators' ability to diagnose individual appropriateness. Simultaneously, it suppresses children's development of discussable musical concepts and pathways for expression (Kirby et al., 2023; Bautista et al., 2024). Concurrently, research on preschool teachers indicates that despite their high regard for music activities, insufficient self-efficacy and scarce teaching resources—coupled with a lack of systematic training and transferable Tools—directly compress the classroom space for "interpreting musical elements," thereby undermining teaching quality and sustainability (Bautista et al., 2024; Wong et al., 2024).

To address the structural challenge of "difficulty in intuitively representing musical elements," music education and learning science have long emphasized that effective learning support lies not merely in increasing activity volume, but in providing representational tools with specific functions. These tools help learners focus on key features, reduce pathways to misunderstanding, and promote integrative construction (Ainsworth, 2006). Within this framework, graphic notation and invented notation are viewed as potential pathways for translating auditory structures into visual objects: through the organization of points, lines, spatial positions, and trajectories, rhythmic variations and pitch fluctuations can be externalized as "recognizable, comparable, and revisable" notation artifacts (Ng, 2020; Lam, 2024). Research on preschool children's Invented Notation also indicates that learners' symbol selection and organizational methods reflect their musical comprehension and metacognitive processing abilities, suggesting that Notation serves not only as a "recording" tool but also as a potential medium for promoting learning development (Carroll, 2018). However, existing research on the claim that "graphic notation may aid learning" has yet to adequately address a more critical question: How exactly do preschool teachers transform this representational resource into actionable, interpretable, and sustainable teaching practices within real classroom settings?

However, in the field of preschool song teaching, existing research still exhibits three deficiencies directly related to"Pedagogical Transformation."First, research on graphic/Invented Notation primarily presents work characteristics, creativity, or activity outcomes, lacking process-oriented analytical descriptions—such as how preschool teachers integrate graphic notation into sing-along sequences, use symbols to organize explanations and corrections, or transform representations into reusable teaching actions (Ng, 2020; Wong et al., 2024). Second, while preschool teacher education research repeatedly emphasizes music teaching preparedness, it rarely integrates"representation design"with "task sequencing." The disconnect between tool design and teaching practice results in preschool teachers possessing graphic notation tools yet lacking knowledge on how to transform them into teachable, assessable classroom mechanisms (Bautista et al., 2024; Kirby et al., 2023). Third, against the backdrop of burgeoning research on technology and multimodal creativity, existing reviews primarily focus on tool types and activity formats. Yet what is more urgently needed is a clear framework: under which task contexts do specific representational designs fulfill particular learning functions, thereby genuinely supporting transferable conclusions "from Comprehension to Implementation" (Ainsworth, 2006; Lam, 2024).Therefore, what is

truly lacking at present is not a general judgment on whether graphic notation is valuable, but rather a middle-level analytical framework capable of explaining how preschool teachers accomplish the transformation process from representation to implementation.

Addressing these gaps, this study examines the pedagogical transformation process of graphic notation in preschool song teaching. Employing qualitative methods, Semi-structured Interviews collected preschool teachers' practice narratives on "externalizing musical elements into notation symbols and organizing classroom instruction." Through thematic analysis involving open coding, subtheme and theme induction, the GNPTF was developed. Grounded in the DeFT framework as its theoretical foundation, this study employs DeFT as a representational analysis language to elucidate how preschool teachers design symbols, engage in representational understanding, and organize tasks to facilitate learning. Concurrently, the research integrates Pedagogical Reasoning and Action perspectives to depict how preschool teachers transform representational resources into actionable classroom teaching and decision-making. The resulting GNPTF comprises five interrelated dimensions. The novelty of this study lies in its approach to graphic notation—not merely as supplementary material or a creative activity format, but as an integral component within preschool teachers' instructional decision-making and classroom implementation processes. It systematically reveals how representations are transformed into teachable tools. At the level of social science, this paper contributes not only by supplementing the explanatory framework for the "representation-to-implementation" mechanism in preschool music education, but also by providing a transferable analytical framework for teachers' professional practice, classroom interaction organization, and the process of educational tool mediation. Consequently, this research not only deepens our understanding of the action logic underlying teachers' practices in preschool song instruction but also offers empirical insights into the broader educational question of how teachers transform abstract knowledge into operational classroom practices.

Literature Review

In early childhood music education, song teaching is both one of the most common instructional formats and an area where preschool teachers most frequently encounter "teachability bottlenecks." Musical elements such as rhythm and pitch are often difficult for preschool children to grasp directly, leading to classroom phenomena where preschool children "can sing but don't understand, can imitate but struggle to transfer skills." Recent research consistently indicates that preschool teachers face structural challenges in music instruction: on one hand, teacher education and in-service support underinvest in music, resulting in limited confidence and practical skills regarding musical knowledge and teaching strategies among preschool teachers; on the other hand, constraints of classroom time, resources, and evaluation pressures lead music instruction to prioritize completing activities over advancing the learning evidence chain (Bautista et al., 2024; Nieuwmeijer et al., 2023; Sirek & Sefton, 2024; Wong, 2024). These studies provide a practical foundation for the need for more implementable teaching transformation tools. However, they also suggest that without representations and task structures that externalize musical elements and can be used by preschool teachers to organize instructional behaviors, teaching capacity development will remain conceptual and struggle to achieve stable implementation (Bautista et al., 2024; Sirek & Sefton, 2024).

At the level of specific teaching tools, Graphic Notation can be viewed as an External Representation. Through visual symbols such as dots, lines, spatial positioning, shapes, and continuous trajectories, it makes musical structures—including rhythm, pitch progression, and phrase coherence—visually perceptible. Research indicates that Graphic Notation provides learners with cross-modal cues, supports understanding of temporal structures and evolving processes, and fosters collaborative interpretation and expression (Hope, 2020). However, within the preschool education context, existing research exhibits three primary limitations: First, much discussion remains at the level of general assertions that "graphic notation aids comprehension," with limited elaboration on how symbols can be designed as operationally viable teaching language for classroom implementation. Second, there is a lack of evidence systematically linking graphic notation to the "specific task chain of song teaching" (demonstration and analysis—co-creation of symbols—work production—feedback revision—re-expression). Third, few studies explain from the preschool teacher's perspective how graphic notation alters their classroom decision-making and action logic, making it difficult to translate "representational advantages" into "pedagogical advantages" (Digby, 2023; Bremmer, 2021). Thus, the core research gap in graphic notation for Preschool song teaching lies not in "whether it can be used," but in "how it can be pedagogically transformed": namely, how to position notation artifacts as central mediators for classroom organization and learning evidence, thereby forming replicable pathways for pedagogical transformation.

Addressing the "how to pedagogize" question, Ainsworth's DeFT (Design–Functions–Tasks) framework provides a clear analytical language: Design emphasizes the formal properties and information distribution of representations; Functions explains how representations support attention focus, reasoning, and construction; Tasks emphasize using task sequences to translate representational functions into learning activities (Ainsworth, 2006). A common insight from recent Multiple Representations research is that representations do not automatically facilitate learning. The critical factor lies in how tasks compel learners to establish mappings and interpretations between representations, exposing gaps in understanding through visible products, thereby triggering revision and deepening. However, in preschool music/Song Teaching contexts, DeFT is often cited as a "design philosophy" rather than used to refine the correspondence between "graphic notation—song teaching task chains—classroom actions." For instance: Which symbol designs better support preschool teachers in guiding interpretations of Rhythm/Pitch? Which tasks more effectively advance learners from "understanding symbols" to "organizing instruction and expressing ideas using symbols"? These questions require reconceptualization within preschool teachers' experiential knowledge and classroom logic to generate a more contextually relevant framework for Early Childhood song teaching (Digby, 2023; Bremmer, 2021).

Simultaneously, how preschool teachers transform representations and tasks into classroom actions relies on the perspective of pedagogical reasoning and action. Shulman's pedagogical reasoning and action emphasizes the chain of reasoning through which preschool teachers transform subject content into teachable forms, focusing on the cyclical relationship between understanding, transformation, teaching, evaluation, and reflection (Shulman, 1987). Recent preschool music research further indicates that even when teachers recognize the value of music activities, classroom quality ultimately hinges on their ability to make real-time judgments and adjustments regarding content and children's responses within specific

contexts. Particularly in tasks involving rhythm, physical movement, and symbolic expression, teachers must translate implicit musical structures into actionable prompts and feedback language for children (Bremmer, 2021; Fredriksson et al., 2024). However, existing research exhibits two key limitations: First, much focuses on teachers' beliefs, training status, or macro-level supply, with insufficient exploration of the process mechanisms—specifically, "how teachers utilize concrete representational tools to achieve this translation" (Bautista et al., 2024; Nieuwmeijer et al., 2023); second, there is a lack of explanatory frameworks tightly linking preschool teachers' reasoning cycles with "notation artefacts," making it difficult to clarify how teachers conduct real-time diagnosis and redesign based on these artifacts (Fredriksson et al., 2024).

Finally, if the advantage of Graphic Notation lies in generating visible artifacts, then formative assessment is not an add-on but the key mechanism driving the transition "from understanding to implementation." Recent music education research emphasizes that formative assessment relies on continuous feedback, peer interaction, and self-monitoring to foster performance improvement, requiring explicit success criteria and traceable evidence (Bolden & DeLuca, 2022; Bolden et al., 2023; Zhang & Yan, 2025). However, in preschool song teaching, evaluation is often reduced to "sounding like the original" or immediate praise, rarely designed as a diagnostic-Feedback Revision-revision chain centered on evidence-based artifacts. This hinders preschool teachers' ability to translate preschool children's comprehension states into actionable next-step teaching interventions (Zhang et al., 2025). Therefore, a genuine study on graphic notation song teaching should integrate "representation design—pedagogical function—task chain—formative feedback," distilling a transferable framework from preschool teachers' experiences. This framework should explain how teachers use graphic notation to externalize musical elements, organize learning evidence, and iterate classroom actions.

In summary, while existing research has separately addressed preschool teacher support, the representational potential of graphic notation, multiple representations learning, and formative assessment, it still lacks an integrated framework directly focused on "the pedagogical transformation of graphic notation in preschool song teaching." Such a framework should both theoretically align DeFT with Pedagogical Reasoning and Action and empirically demonstrate how preschool teachers achieve implementable classroom transformation through evidence of work and task chains. This study therefore develops a GNPTF for preschool song teaching contexts, based on qualitative interviews and Thematic Analysis, to address this gap.

Methodology
This study employs qualitative research methods, utilizing semi-structured interviews as the primary data collection approach. It aims to gain an in-depth understanding of the "pedagogical translation" process of graphic notation in preschool song teaching—specifically, how preschool teachers transform graphic notation from a visual representation into a "teachability tool" that can be consistently applied in the classroom. —specifically, how preschool teachers transform graphic notation from a visual representation into a "teachability tool" that can be reliably applied in classroom settings. The core focus of this study is not the quantitative assessment of teaching effectiveness, but rather the pedagogical reasoning and action logic of preschool teachers in organizing representations, instruction,

and feedback revision around musical elements within authentic teaching contexts. Based on this, a transferable conceptual framework is distilled.

The research subjects comprise 20 preschool teachers from central China. All participants possess at least one year of preschool teaching experience and have engaged in distinct song teaching practices within the past year. They are capable of describing how elements such as rhythm, pitch, and Musical Expression are presented and guided in their classrooms based on their teaching experience. To ensure high contextual relevance between interview data and research themes, recruitment emphasized participants' prior experience using diagrams, lines, symbols, gestures, or other visual methods to help preschool children understand or express musical elements (i.e., possessing a foundation in "visual representation teaching"), even if they did not use the formal term "graphic notation." All participants voluntarily joined after fully understanding the research objectives, interview content, transcription procedures, and data usage scope, signing informed consent forms prior to interviews. The process adhered to educational research ethics requirements. Interview materials were anonymized using coded identifiers, omitting any personally or institutionally identifiable information. All data served solely academic purposes and was encrypted to ensure confidentiality.

Data collection employed semi-structured interviews. The interview guide was developed based on prior literature review and theoretical synthesis, organizing questions around two complementary theoretical perspectives as sensitizing concepts: The DeFT (Design–Functions–Tasks) framework for multiple representations learning guided preschool teachers in describing their choices in graphic notation design (Design), the pedagogical functions (Functions) graphic notation served in the classroom, and how they translated representations into implementable teaching activities through task sequences (Tasks). Second, the Pedagogical Reasoning and Action framework guides preschool teachers to narrate the process chain from understanding musical content and preschool children's responses, to transforming teaching strategies, delivering instruction, and making judgments and adjustments. The interviews focused on: How preschool teachers identify key musical elements in songs and translate them into visual objectives (e.g., rhythm dynamics, pitch progression, phrase coherence); How preschool teachers select and construct symbolic systems comprehensible to preschool children (e.g., dots and lines, high/low positions, continuous trajectories, concrete symbols); how preschool teachers employ graphic notation to conduct explanation-oriented teaching, advancing from "understanding" to "singing, performing, and transferring"; and how preschool teachers utilize feedback from preschool children's performances, peer discussions, or work presentations to revise notation and teaching strategies, thereby enhancing developmental appropriateness and classroom feasibility. All interviews were conducted in relatively quiet, distraction-free environments, lasting approximately 30–45 minutes per preschool teacher. Interviews were fully recorded and subsequently transcribed into text materials for subsequent analysis.

Data analysis employed Thematic Analysis, with NVivo used for systematic text management, coding, and tracking. Analysis followed a progressive, theory-dialogic path: First, open coding was applied to all interview texts to mark and label initial concepts related to "design representation, instructional function, task organization, classroom instruction, feedback revision,"etc., in a data-driven manner; Second, through constant comparison,

similar codes were aggregated into sub-themes, with codes merged, split, and renamed based on DeFT and Pedagogical Reasoning and Action; Third, sub-themes were further consolidated into main themes, forming stable dimensions that explain preschool teachers' pedagogical translation logic; Finally, the thematic structure underwent conceptual integration and structural organization, distilling the GNPTF and explicitly articulating it through five interrelated dimensions: Feature Alignment, Symbol Construction, Notation Explainability, Notation Mediated Teaching, and Feedback Revision. Throughout framework development, researchers repeatedly returned to source texts to verify thematic boundaries and evidence consistency, ensuring the framework was grounded in data rather than a priori assumptions.

To enhance credibility and dependability, this study employed a multi-round progressive coding and review strategy: after initial coding, researchers repeatedly revisited the texts, cross-validated representative segments for key themes, and maintained clear coding memos and decision audit trails to strengthen analytical traceability. At the interpretive level, researchers continuously engaged in reflexivity, examining how their understanding of music education and graphic notation might influence data interpretation. By repeatedly cross-referencing between DeFT and Pedagogical Reasoning and Action, they avoided over-dominance of any single theory over the material, thereby enhancing the interpretive rigor and transferability of the framework's refinement.

Findings

Based on an analysis of semi-structured interview data from 20 preschool teachers (T1–T20) in central China, this study conducted multiple rounds of repeated reading and coding of all interview transcripts in NVivo. The initial phase generated approximately 165 open codes that recurred across different teachers' narratives, primarily focusing on: how preschool teachers defined the core musical elements of song teaching (Rhythm, Pitch, Musical Expression), how they transformed these elements into the symbolic system of graphic notation, and how they embedded notation artifacts into classroom tasks while enhancing classroom implementability through feedback revision. By comparing the frequency of codes, semantic associations, and co-occurrence relationships, researchers aggregated highly related codes into several sub-themes. Through ongoing comparison, these were further elevated into five interconnected core themes, collectively forming the GNPTF.

First, expressions such as "determine teaching content first," "focus only on key points," "avoid drawing everything," and "maintain singular objectives" appeared frequently in interviews (approximately 58 times). These open-ended codes were further aggregated into two Sub-themes: Goal-driven feature focus and Difficulty-based feature targeting, collectively forming the "Feature Alignment" theme. Preschool teachers universally emphasized that graphic notation is primarily a "focusing tool," requiring the transformation of the most critical learning points into visual targets. T3 noted: " I can't draw the entire song; I only sketch the specific rhythmic point we're addressing today." T11 similarly noted: "When preschool children get stuck on pitch rather than lyrics, I first draw the directional path to show them whether it goes up or down." These experiences reveal that preschool teachers often base feature selection on dual criteria: classroom objectives and preschool children's specific challenges. This approach provides a focused foundation for subsequent symbolization and instruction.

Second, coding themes such as "dot-line positioning," "duration density," "simpler symbols facilitate teaching," and "shared symbolic meaning" also emerged frequently in interviews (approximately 64 times). These converged into two themes: Readability-first symbolisation and Co-constructed symbol conventions, forming the overarching theme of "Symbol Construction." Preschool teachers prioritized symbols that facilitate visual-music mapping for preschool children over professional notation accuracy. T7 stated: "I use length for duration and height for pitch—the more intuitive, the better." T16 added: "If I draw it too complexly, preschool children will just be fascinated by the visual spectacle. So I first have them memorize 'this symbol represents the strong beat.'" This demonstrates that the formation of the symbol system is a recoding process oriented toward teachability, with its core criteria being legibility, usability, and reproducibility.

Third, related encodings such as "Drawing isn't enough—it must be clearly explained; contrasts must be used to help preschool children understand why they sing/draw this way" repeatedly emerged in interviews (approximately 52 times). These coalesced into Rule articulation from symbols and Contrast-based explanation, forming the theme of "Notation Explainability." Preschool teachers commonly employ contrast strategies to transform symbols into verbalizable classroom rules, guiding preschool children from "seeing" to "understanding and controlling." T2 noted: "I show preschool children two drawing methods and ask them to listen to which sounds more like the intended result. They instantly grasp why it's drawn that way." T14 similarly states: "I avoid technical terms. I simply say, 'The higher the line goes, the higher it is,' letting preschool children grasp it visually first before expressing it vocally." This demonstrates that "explainability" is the threshold for graphic notation to function as a teaching tool—symbols must support causal explanations and actionable instructions.

Fourth, coding elements like "integrating notation into the process, using it to guide practice, segmenting steps, revisiting notation for refinement, and making notation visible to the whole class" frequently emerged in interviews (approximately 61 times). These coalesce into Notation-mediated demonstration–practice–reperformance and "Notation as joint attention anchor," forming the "Notation Mediated Teaching" theme. Preschool teachers tend to position graphic notation centrally on blackboards or paper as the organizing axis for classroom actions: first aligning goals and rules through notation, then segmented demonstration and practice, finally returning to notation for reperformance and correction. T9 noted: "I have preschool children first sing while pointing at the graphics, then walk to the rhythm without pointing." T18 added: "With the notation displayed, preschool children know to focus on the same visual cue, preventing classroom disruption." Thus, graphic notation serves not only as an information carrier but also as a structural element organizing task sequences and classroom interactions.

Finally, coding elements such as "adjusting immediately based on preschool children's reactions," "redrawing unclear diagrams," "simplifying rules for better comprehension," and "revisiting for verification later"—which recurred frequently throughout the interviews (approximately 55 times)— These coalesce into Real-time adjustment based on preschool children's responses and Iterative revision of notation artifacts, forming the Feedback Revision theme. Preschool teachers commonly treat notation artifacts as evidence carriers for formative assessment, enhancing developmental appropriateness through a "evidence-

Feedback Revision" closed loop. T5 noted: "When I see a preschool child stop mid-song, I know they didn't understand that symbol and need a different drawing method." T20 also stated: I compare the preschool children's drawings with mine, ask them to identify differences, then revise together." This indicates revisions address not only performance outcomes but also symbol legibility and task sequencing itself, continuously optimizing teaching strategies through Feedback Revision.

Collectively, the five dimensions of GNPTF form a progressive chain in preschool teacher practice: Feature Alignment addresses "what to teach," Symbol Construction resolves "how to draw," Notation Explainability ensures "how to explain clearly," Notation Mediated Teaching implements "how to teach effectively," and Feedback Revision achieves "how to continuously improve teaching." This framework reveals the professional transformation mechanism of graphic notation from visual representation to classroom-ready teachability tools, providing a transferable analytical language for preschool teaching design and teacher education.

Table 1
The GNPTF: Themes, Sub-themes, and Representative Codes

Main theme	Sub-theme	Representative Codes(Keywords from Interviews)
Feature Alignment	Goal-driven feature focus	decide what to teach first; focus on key points only; cannot notate the whole song; keep the goal single; select one focal musical element; set a clear lesson focus (rhythm/pitch/expression)
	Difficulty-based feature targeting	target the "stuck point" (where children struggle most); locate recurring breakdowns; prioritise the hardest element; choose what children cannot yet control; teach from children's errors
Symbol Construction	Readability-first symbolisation	dots/lines/position on the page; high/low placement for pitch; length/density to show duration; long/short marks for beat value; keep symbols visually simple; reduce symbol complexity
	Co-constructed symbol conventions	agree on one shared meaning; co-create symbol rules with children; use the same symbol consistently; negotiate "what this mark means"; build shared symbol language in class
Notation Explainability	Rule articulation from symbols	drawing is not enough—must explain clearly; turn symbols into teachable rules; explain "why this way" (why draw/sing like this); make rules speakable for children; link symbol to action ("do this when you see this")
	Contrast-based explanation	use comparison to make children understand; show two different drawings for the same phrase; show two different ways of singing for the same drawing; contrast "right vs. wrong" versions; use paired examples to clarify meaning
Notation Mediated Teaching	Notation-mediated demonstration–practice–reperformance	embed notation into the lesson flow; use notation to lead guided practice; practice in segments; return to the notation to correct; re-perform after revisiting the notation; move from pointing-to-singing to independent singing
	Notation as joint attention anchor	keep the notation visible for the whole class; use notation to coordinate group focus; make "one shared visual reference"; direct attention back to the chart; organise turn-taking around the notation
Feedback Revision	Real-time adjustment based on children's responses	adjust immediately based on children's responses; redraw when the notation is unclear; make the rule easier to understand; simplify on the spot; change explanation when children pause/freeze; switch to an easier symbol when needed
	Iterative revision of notation artefacts	verify again next time; revise symbols after observing breakdowns; compare children's drawings with the teacher's; refine task order based on evidence; keep a "before–after" version of notation; revise and re-test in the next lesson

Discussion

The findings of this study indicate that preschool teachers first complete "goal-oriented element focusing" and "difficulty-oriented element positioning" before employing graphic notation. This involves transforming the most critical and easily misplayed rhythms or pitches in a song into singular, visible teaching focal points. This approach aligns with fundamental findings from multiple representations learning research: External Representations do not automatically enhance understanding. Representations must first undergo information selection and structuring; otherwise, they may cause attention dispersion and increased cognitive load, particularly noticeable among preschool children. The DeFT framework emphasizes that the distribution and presentation of information during the "design" phase determine whether learners can extract target features from representations and establish stable mappings. Thus, preschool teachers' experience of "not drawing everything, but only the points to be addressed today" essentially preempts "representation design" as an engineering exercise for "teaching controllability": First address "what to teach," then discuss "how to draw and instruct," ensuring graphic notation serves as a focused tool rather than decorative material (Ainsworth, 2006). Simultaneously, Feature Alignment aligns with the logic of Pedagogical Reasoning and Action: preschool teachers must first reinterpret subject content into units manageable by preschool children before proceeding to transformation and implementation (Shulman, 1987).

Findings further reveal that preschool teachers prioritize legibility and shared conventions in Symbol Construction, emphasizing that "simpler symbols are easier to teach" and "everyone needs to agree on the same meaning." This indicates that the core criterion for graphic notation is not proximity to professional notation, but alignment with rule systems accessible to preschool children. Related research notes that preschool children's invented notation often prioritizes "expressibility and communicability," with symbolic meanings gradually stabilizing through interaction. When preschool teachers guide the establishment of shared symbolic meanings, they are effectively transforming individualized symbols into a classroom common language, enabling notation works to support peer discussions and teacher instruction. Corresponding to the "Design" dimension in DeFT, the form of symbols determines how information is encoded and decoded. Preschool teachers favor intuitive mappings like "length representing duration" and "height indicating pitch direction," reflecting a control over the cognitive cost of visual-auditory conversion. This makes symbols function more like operational cognitive scaffolds (Ainsworth, 2006).

The third key finding is that "Notation Explainability" is viewed as a pedagogical threshold: Preschool teachers widely believe that "drawing it isn't enough; it must be clearly explained." They extensively employ comparative explanations, juxtaposing two drawing methods with two auditory perceptions or singing styles, enabling preschool children to understand "why it's drawn or sung this way" through perceived differences. Research on multiple representations emphasizes that true learning often stems not from representations themselves, but from how tasks compel learners to interpret representations, compare differences, and revise understanding. Thus, contrastive strategies make "symbol-sound differences" explicit, propelling preschool children from 'seeing' to "understanding rules and controlling performance" (Ainsworth, 2006). Simultaneously, preschool teachers deliberately reduce terminology burden during explanations, distilling rules into perceptible language like "the line goes higher as it moves upward." This exemplifies developmentally appropriate

instructional language rewriting: achieving high structural clarity with low terminology burden.

At the "Notation Mediated Teaching" level, preschool teachers tend to position musical notation centrally on the blackboard or paper as an anchor for collective attention, organizing the demonstration-practice-reproduction sequence accordingly. Thus, graphic notation serves not only as an information presenter but also as a classroom organizer: it provides a stable reference for shared focus, segmented practice, and error correction, reducing classroom drift. More significantly, through the task gradient of "singing while pointing → following the notation without pointing → revisiting the notation for correction," preschool teachers facilitate the gradual internalization of external scaffolding. This propels preschool children from reliance on representations toward autonomous control of performance, aligning precisely with the"task fulfillment function"requirement in DeFT—Only when integrated into a task sequence can a symbolic system transform"seeing"into'doing' (Ainsworth, 2006).

Finally, "Feedback Revision" demonstrates how graphic notation serves as formative evidence: preschool teachers instantly adjust symbols and teaching strategies based on preschool children's responses, emphasizing "verify again next time." This signifies that preschool teachers transform fleeting vocal performances into visible notated works and comparable evidence of variation. They then implement a diagnostic-Feedback Revision loop around this evidence, making evaluation not an afterthought to teaching but the engine driving instructional iteration. Existing research indicates that formative assessment in music classrooms often devolves into instant praise or subjective correction. Our findings offer a more actionable pathway: using notation as evidence carriers, exposing preschool children's comprehension differences through comparison and discussion, and simultaneously optimizing symbol legibility and task sequencing through revision—thereby continuously enhancing developmental appropriateness and classroom implementability.

In summary, the five themes form not a parallel list but a teachability generation chain: Feature Alignment defines teachable objects; Symbol Construction generates readable systems; Notation Explainability transforms symbols into teachable rules; Notation Mediated Teaching embeds rules into task chains while stabilizing classroom shared attention; and Feedback Revision drives evidence-based iterative optimization. This chain aligns with the cyclical model emphasized in Pedagogical Reasoning and Action: preschool teachers continually reconstruct "teachable forms" through understanding, transformation, implementation, evaluation, and reflection, thereby advancing graphic notation from visual representation to classroom-ready teaching tools (Shulman, 1987).

Conclusions

This study focuses on the pedagogical transformation process of graphic notation in preschool song teaching. Based on semi-structured interviews with 20 preschool teachers, a thematic analysis constructed the GNPTF. Findings reveal that graphic notation is not inherently an effective teaching tool; rather, preschool teachers must translate it from a "visual representation" into a "teachable tool" that can be consistently applied in classroom settings. The GNPTF outlines five interconnected dimensions: Feature Alignment, Symbol Construction, Notation Explainability, Notation Mediated Teaching, and Feedback Revision.

This framework reveals how preschool teachers select teachable focuses, establish shared symbolic rules, and embed notation within task sequencing around musical elements like rhythm, pitch, and musical expression. Through iterative optimization with continuous feedback, they enhance developmental appropriateness and classroom implementability.

Theoretically, this study fills a gap in graphic/Invented Notation research by explaining the "representation-to-implementation" mechanism. Previous work often emphasized notation's representational value but rarely detailed how preschool teachers transform symbols into classroom-actionable rules or convert notation artifacts into traceable learning evidence and actionable guidance for preschool children. GNPTF provides a mid-level explanatory language for classroom processes, enabling structured descriptions of preschool teachers' Pedagogical Reasoning and Action: from "what to teach" to "how to draw, how to explain, how to teach movement, and how to improve teaching," translating the pedagogical function of graphic notation into observable decision chains and interaction chains. In terms of practical contributions, GNPTF provides a trainable competency pathway for preschool teacher education: First, it emphasizes prioritizing Feature Alignment to avoid "over-drawing leading to distraction," enhancing classroom focus. Second, it stresses Symbol Construction and shared conventions, making notation a common language for the entire class of preschool children. Third, it emphasizes Notation Explainability and comparative instruction, advancing "understanding symbols" to "controlling expression" for preschool children. Fourth, it centers notation within classroom flow, using it as an anchor for joint attention to organize practice and re-performance. Fifth, it prioritizes evidence-driven Feedback Revision, transforming formative assessment into an iterative teaching engine rather than an add-on.

This study has limitations: First, data primarily relies on interview narratives, lacking classroom observations or video evidence, making it difficult to precisely capture the temporal structure and critical turning points of the five-dimensional chain in real interactions between preschool teachers and preschool children. Second, the sample is concentrated in a single region; resource conditions and curriculum culture may influence teachers' symbol selection and task organization, requiring further validation of transferability. Third, the study focused on song teaching and has not yet compared the differing mechanisms across various music activities or notation forms (teacher-led, preschool children co-created, static and dynamic notation). Future research recommendations include: First, combining classroom video observation with stimulated recall interviews to validate the sequence, triggering conditions, and alternative pathways of the five-dimensional chain; Second, implement a GNPTF-based professional development intervention for preschool teachers, using mixed methods to evaluate its impact on teaching quality and teachers' feedback revision capabilities, while developing classroom-ready implementation metrics. Third, conduct cross-contextual comparative studies to identify the framework's core components and context-sensitive elements, enhancing its universality and adaptability.

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