

Needs Analysis of AI-Assisted Graphic Notation Design in Kindergarten Music Activities: A Preliminary Study from Teachers' Perspectives

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DOI: <https://doi.org/10.47772/IJRISS.2026.100600684>

Received: 10 May 2026; Accepted: 16 May 2026; Published: 01 July 2026

ABSTRACT

With the rapid development of educational digitalization and generative artificial intelligence technologies, AI-assisted teaching has gradually entered different educational contexts, including early childhood education. In kindergarten music activities, graphic notation, as a visual representation tool of rhythm, melody, and musical structure, has been increasingly valued because it fits the concrete and image-based thinking characteristics of young children. Compared with traditional notation systems, graphic notation can help children understand abstract musical concepts more intuitively, improve participation in music activities, and enhance musical perception and expression. However, in actual teaching practice, many kindergarten teachers still encounter difficulties in designing and applying graphic notation, including insufficient design experience, lack of suitable teaching resources, time-consuming production processes, and limited digital design abilities.

Against this background, this study focuses on kindergarten teachers' needs for AI-assisted graphic notation design in music activities. As a preliminary investigation conducted during the early stage of a larger doctoral research project on AI-supported graphic notation teaching, the study aims to explore teachers' current use of graphic notation, their attitudes toward AI-assisted design, and their expectations regarding AI-related functions in kindergarten music education. A questionnaire survey was conducted among 126 kindergarten teachers from eastern and central regions of China, and descriptive statistical analysis was carried out using SPSS 26.0.

The findings indicate that kindergarten teachers generally hold positive attitudes toward AI-assisted graphic notation design. Teachers believe that AI technology may help reduce preparation time, lower the difficulty of graphic notation production, and provide richer teaching resources for music activities. The most expected functions include automatic generation of graphic notation based on music input, intelligent matching of child-friendly visual symbols, generation of supporting music activity plans, and one-click production of PPT or courseware materials. At the same time, teachers also expressed concerns regarding the child suitability, educational appropriateness, and editability of AI-generated content.

This study provides preliminary empirical support for the future development of AI-assisted graphic notation teaching models in kindergarten music education. It also enriches research on the integration of artificial intelligence, multimodal teaching, and early childhood music education under the background of educational digital transformation.

Keywords: artificial intelligence; graphic notation; kindergarten music activities; early childhood music education; multimodal teaching; teachers' needs

INTRODUCTION

Research Background

With the continuous advancement of educational digitalization, artificial intelligence technologies are increasingly influencing educational practice. In recent years, AI-assisted teaching tools have gradually expanded from higher education and online learning environments into primary education and early childhood education. AI technologies are now commonly used for teaching resource generation, instructional planning, personalized learning support, and classroom interaction assistance. Especially after the emergence of generative AI technologies such as OpenAI ChatGPT and DeepSeek, teachers have begun exploring new ways to integrate AI into teaching activities and curriculum design.

In the field of music education, AI technologies have shown potential in areas such as rhythm recognition, music generation, intelligent accompaniment, and teaching material design. At the same time, graphic notation has become an increasingly important teaching tool in music activities for young children. Different from traditional staff notation, graphic notation uses lines, colors, shapes, symbols, and spatial relationships to represent musical elements visually. This form of representation aligns well with the cognitive characteristics of children aged three to six, who mainly rely on concrete thinking and visual perception during learning activities.

In kindergarten music education, graphic notation can effectively simplify abstract musical concepts and transform rhythm, melody, and musical structure into visual and interactive learning experiences. Previous studies have suggested that graphic notation may improve children's musical perception, classroom engagement, creativity, and emotional expression. Chinese educational documents, including the Guide to Learning and Development for Children Aged 3–6 and the Arts Curriculum Standards for Compulsory Education (2022 Edition), also emphasize the importance of intuitive, experiential, and play-based artistic learning.

Despite its educational value, the practical implementation of graphic notation in kindergarten music activities still faces many challenges. Some kindergarten teachers lack sufficient music training and experience difficulties transforming musical content into child-friendly visual symbols. In addition, the process of creating graphic notation is often time-consuming and requires certain design abilities. Existing teaching materials provide limited examples, and many teachers find it difficult to locate suitable resources adapted to different classroom situations. Differences in teachers' digital literacy further affect the regular use of graphic notation in teaching practice.

Meanwhile, the rapid development of generative AI technologies has created new possibilities for solving these problems. AI tools may assist teachers in generating graphic notation automatically, matching visual symbols with music content, and producing teaching materials more efficiently. However, current studies on AI-assisted graphic notation in kindergarten music education remain relatively limited. Existing research mainly focuses either on graphic notation itself or on AI applications in general education contexts, while empirical investigations based on kindergarten teachers' actual needs are still lacking.

Therefore, this study explores kindergarten teachers' perspectives on AI-assisted graphic notation design and attempts to provide preliminary empirical evidence for future AI-supported teaching model construction.

Research Significance

Theoretically, this study contributes to the growing body of research on AI-assisted music education and multimodal teaching in early childhood education. Existing studies have widely discussed the educational value of graphic notation and the role of AI in teaching support, but relatively few studies combine these two perspectives within kindergarten music activities. By focusing on teachers' practical needs, this study enriches empirical research on the integration of AI technologies and multimodal music teaching.

Practically, the findings may provide useful implications for future AI tool development and kindergarten music teaching practice. Understanding teachers' difficulties and expectations can help developers design more child-friendly and education-oriented AI systems. The study may also support kindergarten teachers in improving teaching efficiency, reducing preparation burdens, and expanding the use of visualized music teaching approaches in classroom practice.

Research Progress and Scope

This study is a preliminary investigation conducted during the early stage of a larger doctoral research project focusing on AI-assisted graphic notation teaching in kindergarten music education. At the current stage, the research mainly involves questionnaire distribution, data collection, and descriptive statistical analysis. The subsequent stages of the doctoral research will further include AI-supported teaching model development, expert evaluation, pilot implementation, and empirical classroom validation.

In terms of research scope, the present study focuses specifically on kindergarten music activities and teachers' perspectives on graphic notation design. It does not involve the technical programming or software development of AI systems. The purpose of this paper is limited to needs analysis and preliminary empirical exploration.

Research Questions

Based on the above background, this study proposes the following research questions:

What is the current situation of graphic notation use in kindergarten music activities?

What difficulties do kindergarten teachers encounter in graphic notation design and application?

What are kindergarten teachers' attitudes toward AI-assisted graphic notation design?

What specific functions do teachers expect from AI-assisted graphic notation tools?

What implications can be drawn for future AI-supported graphic notation teaching models?

LITERATURE REVIEW

Graphic Notation in Early Childhood Music Education

Graphic notation has long been considered an effective visual representation approach in music education. Compared with traditional notation systems, graphic notation reduces the cognitive difficulty of musical learning by transforming abstract auditory information into visible symbols and images. According to Paivio's Dual Coding Theory, visual and verbal representations can work together to improve understanding and memory during learning processes. Similarly, Ainsworth's DeFT framework emphasizes the educational value of multiple representations in supporting learners' cognitive processing.

In early childhood music education, graphic notation is particularly suitable because young children rely heavily on visual perception and concrete experiences. Previous studies have shown that graphic notation may improve rhythm understanding, musical imagination, classroom participation, and expressive performance. Bautista and Ho also pointed out that multimodal music learning approaches can support children's musical development more effectively than single-modal instruction.

At the same time, teachers play an important role in transforming graphic notation into meaningful classroom activities. Effective graphic notation design requires not only musical understanding but also awareness of children's developmental characteristics, visual preferences, and classroom interaction patterns. Therefore, teachers' design abilities directly influence the educational effectiveness of graphic notation.

AI-assisted Teaching in Early Childhood Education

Artificial intelligence technologies have increasingly entered educational practice in recent years. In early childhood education, AI tools are mainly used for teaching assistance, personalized learning support, intelligent feedback, and digital resource generation. Generative AI technologies further expand the possibilities of educational content creation, including lesson plans, images, stories, and multimedia teaching materials.

Several studies have suggested that AI-assisted teaching may help reduce teachers' workload and improve instructional efficiency. However, concerns also exist regarding the suitability, safety, and educational

appropriateness of AI-generated content for young children. In early childhood education, teaching activities must consider children's cognitive characteristics, emotional development, and attention span. Therefore, AI systems designed for young learners should emphasize simplicity, child-friendliness, and teacher controllability.

In music education, AI-related studies mainly focus on music generation, intelligent accompaniment, and rhythm analysis. Research specifically addressing AI-assisted graphic notation design in kindergarten music activities remains limited, especially from the perspective of teachers' actual classroom needs.

Research Gap

Through reviewing existing literature, several research gaps can be identified. First, current studies on graphic notation mainly focus on its teaching value and classroom application, while few studies explore how AI technologies may support graphic notation design in kindergarten music education. Second, many AI-related educational studies focus on higher education or language learning contexts rather than early childhood music teaching. Third, there is still a lack of empirical investigations based on kindergarten teachers' real needs, attitudes, and practical difficulties.

Therefore, this study attempts to fill these gaps by investigating kindergarten teachers' perspectives on AI-assisted graphic notation design and providing preliminary empirical evidence for future teaching model construction.

RESEARCH METHODOLOGY

Research Design

This study adopted a quantitative research design using questionnaire surveys as the primary data collection method. Quantitative methods were selected because they allow efficient collection of large-scale data regarding teachers' experiences, attitudes, and practical needs.

Participants

Participants included kindergarten teachers from eastern and central regions of China who had experience conducting music activities. A total of 135 questionnaires were distributed, and 126 valid responses were collected, resulting in an effective response rate of 93.3%.

Among the participants, 63% worked in public kindergartens and 37% worked in private kindergartens. Regarding teaching experience, most participants had between one and ten years of teaching experience.

Research Instrument

The questionnaire was developed based on literature review, practical teaching situations, and expert suggestions. It included four sections: demographic information, current use of graphic notation, difficulties in graphic notation application, and needs regarding AI-assisted functions.

The questionnaire mainly adopted multiple-choice items and five-point Likert scale questions ranging from 1 ("strongly disagree") to 5 ("strongly agree").

Reliability and Validity

Before formal distribution, the questionnaire was piloted and revised. The Cronbach's α coefficient of the overall questionnaire reached 0.861, indicating good internal consistency reliability. The KMO value was 0.814, and Bartlett's Test of Sphericity was statistically significant ($p < .001$), suggesting acceptable construct validity and suitability for statistical analysis.

Data Collection and Analysis

Data collection was conducted through online questionnaire platforms. The collected data were imported into SPSS 26.0 for descriptive statistical analysis, including frequencies, percentages, means, and standard deviations.

RESULTS

Current Situation of Graphic Notation Use

The results show that 86.5% of the participating teachers had used or been exposed to graphic notation in kindergarten music activities. However, only 21.4% reported frequent use, while most teachers used graphic notation only occasionally.

Graphic notation was mainly applied in rhythm teaching, singing activities, and music games. Music appreciation activities showed relatively lower usage rates. Most teachers relied on simple hand-drawn symbols or basic PPT graphics rather than professionally designed multimodal graphic notation.

Difficulties in Graphic Notation Design

Teachers reported several major difficulties, including lack of design ability, time-consuming production processes, insufficient teaching resources, and limited digital skills. The inability to design child-friendly graphic notation was identified as the most common challenge.

Teachers' Attitudes Toward AI-assisted Design

Most teachers expressed positive attitudes toward AI-assisted graphic notation design. Teachers believed that AI could help improve teaching efficiency, reduce workload, and enrich music teaching resources.

However, teachers also emphasized that AI-generated content should remain editable and suitable for young children's developmental characteristics.

Teachers' Functional Needs

The most expected AI-assisted functions included automatic graphic notation generation, intelligent visual symbol matching, supporting activity plans, and PPT generation. Teachers also hoped AI tools could provide differentiated versions for different age groups.

DISCUSSION

Interpretation of Findings

The findings indicate that kindergarten teachers generally recognize the educational value of graphic notation, but practical barriers continue to affect its regular classroom application. This result is consistent with previous studies emphasizing the importance of teaching support systems and resource accessibility.

At the same time, teachers' positive attitudes toward AI suggest strong demand for efficient educational technologies in kindergarten music education.

Implications for Kindergarten Music Education

AI-assisted graphic notation tools may help kindergarten teachers improve teaching efficiency and reduce preparation pressure. Such technologies may be particularly valuable for teachers without strong music or design backgrounds.

In addition, AI-supported graphic notation may further promote multimodal teaching approaches in kindergarten music education.

Implications for AI Tool Development

Future AI systems for kindergarten music education should prioritize child-friendly design, simple interfaces, editable outputs, and curriculum alignment. AI-generated graphic notation should remain visually intuitive, age-appropriate, and flexible enough for teachers' personalized adjustments.

Limitations

This study has several limitations. First, the sample size was relatively limited and mainly covered eastern and central regions of China. Second, the study relied mainly on questionnaire data without qualitative interviews or classroom observations. Third, no actual AI system implementation was conducted at this stage.

This study mainly relied on questionnaire data and descriptive statistical analysis to explore teachers' perceptions toward AI-assisted graphic notation design. Although the findings provided useful preliminary insights, qualitative data such as interviews, classroom observations, and teacher reflections were not included.

Furthermore, the study focused primarily on teachers' perspectives and did not evaluate the actual effectiveness of AI-generated graphic notation on children's musical learning, participation, creativity, or developmental outcomes.

CONCLUSION

This study explored kindergarten teachers' needs regarding AI-assisted graphic notation design in music activities. The findings suggest that teachers generally recognize the value of graphic notation but continue to face practical difficulties in design and implementation. Teachers also demonstrate positive attitudes toward AI-assisted support and express strong demand for functions such as automatic generation, intelligent matching, and teaching material production.

Overall, AI-assisted graphic notation design shows promising potential in kindergarten music education. Future research should continue developing child-centered, teacher-friendly, and multimodal AI-supported teaching systems that can improve teaching quality and support young children's musical learning experiences.

Despite several limitations, this study provides preliminary empirical evidence for the integration of AI-assisted graphic notation design in kindergarten music education and offers useful implications for future research, teacher training, and intelligent music teaching development.

Conflict of Interest

The author declares no conflict of interest regarding this study.

Ethical Approval

This study followed the ethical research guidelines of Sultan Idris Education University. All participants voluntarily participated in the questionnaire survey and were informed about the purpose and confidentiality of the research.

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