

The Impact of AI-Enabled Teacher Feedback on Teacher-Child Interaction Quality in Early Childhood Education: A Literature Review

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Abstract. Nowadays, AI is booming, and the education sector is thus deeply influenced. The quality of teacher-child interaction, as a core component of preschool education quality, is deeply influenced by teacher feedback, which remains at a relatively low level. AI feedback offers new possibilities for improving the quality of teacher-child interaction. This study, through a systematic review approach, examined the three proposed research questions and explored the correlation between AI feedback empowering teacher-child interaction. The results revealed that AI can effectively enhance teachers' capabilities, and teachers can effectively improve the quality of teacher-child interaction. However, there is currently no empirical research on AI feedback for teacher-child interaction. However, there are already two chains of evidence that can indirectly prove that there may be a positive correlation between AI feedback and teacher-child interaction. More empirical research is needed in the future to confirm and discuss this, and to turn the indirect theory into real evidence, thereby filling this research gap.

Keywords: interaction quality, teacher feedback, AI

1. Introduction

With the continuous rise of AI, it has evolved from a branch of computer science to a core driving force for the development of modern technology. Apart from the application of AI in the field of mathematics, existing research has demonstrated that AI has permeated various fields in the education sector such as the K12 stage, the higher education, lifelong learning, and interdisciplinary integration is also constantly advancing [1].

Many early studies focused on how AI affects students, but nowadays, more and more research is beginning to pay attention to how AI empowers and supports teachers and promotes their professional development. With the popularization of artificial intelligence, some primary and secondary schools and colleges and universities can use generative AI to provide personalized teaching feedback for teachers, and it has been fully proven that it can effectively improve the quality of interaction between teachers and students. However, there is a lack of exploration for adaptation in the field of preschool education [2].

Preschool education is a crucial link in the field of education at all stages. The high-quality development of preschool education has become the core focus of the digital transformation of education. At present, it is widely recognized in the academic circle that teacher-child interaction is a very important indicator and dimension for measuring the quality of preschool education [3]. Nowadays, the teaching levels of front-line teachers vary greatly, some forms of interaction between teachers and children are monotonous, and the evaluation language is lacking and targeted, which leads to a lot of room for improvement in the quality of interaction between teachers and children [2].

Most of the paths for enhancing interaction between teachers and children in kindergartens rely on traditional models such as teaching and research training, and teachers' observation and feedback within the kindergarten. This kind of feedback mode has certain practical effects, but it is difficult to meet the frequent demands of all front-line teachers for improving their feedback during daily activities. Therefore, it is extremely urgent to leverage the efficient features of artificial intelligence to empower teachers' feedback and enhance the quality of interaction between teachers and children.

With the increasing popularity of AI nowadays, why haven't kindergarten teachers made good use of AI to empower and enhance the quality of interaction between teachers and children? Therefore, this study raises the following three research questions:

What are the conceptual basis and current challenges of teacher feedback in the context of quality interaction between teachers and children in kindergartens?

What is the current status of research evidence on AI-generated feedback in supporting teachers? What are the key adoption obstacles?

How can AI-generated feedback be meaningfully integrated into the feedback practices of preschool teachers to enhance the quality of interaction between teachers and children?

2. Method

The literature of this study was retrieved through two retrieval platforms, Google scholar and CNKI, using keywords such as teacher children interaction quality, AI, feedback. Screening a number of relevant studies from the past five years lays the foundation for this literature review. And finally select eleven articles for subsequent analysis.

3. Main content

3.1. The review of the interaction quality and teachers' feedback

Teacher-child interaction is the most fundamental and core form of interpersonal interaction in preschool education and also the core indicator for measuring the quality of the educational process in kindergartens. The academic circle defines the concept of teacher-child interaction in a broad sense as the interaction between nursery teachers and children aged 0-3 and that between kindergarten teachers and children aged 3-6. In a narrow sense, teacher-child interaction is generally defined as the interaction between teachers and children in kindergartens [3]. Then, how can the abstract quality of teacher-child interaction be quantified into visible data to facilitate measurement and evaluation? At present, the CLASS scale developed based on the theory of effective teacher-child interaction is regarded as one of the most authoritative assessment scales in the teacher-child interaction evaluation system [4]. The CLASS scale encompasses three major areas: emotional support, class management, and teaching support, as well as ten dimensions including feedback

quality, cognitive development, and behavioral management. It fully demonstrates the complexity of teacher-child interaction and the comprehensiveness of the CLASS scale.

As mentioned earlier, the assessment areas of the class scale are divided into emotional support, class management, and teaching support. Among them, teaching support focuses on the role of teachers' support strategies in students' development. The scale will evaluate from three aspects: cognitive development, feedback quality, and language demonstration. Feedback quality is also one of the most core dimensions in the field of teaching support. The feedback quality dimension specifically includes five behavioral indicators, namely: support, feedback loop, promoting thinking, providing information, encouragement and affirmation. Specifically, a support system refers to the situation where teachers, based on the current level of children, provide appropriate guidance and assistance when children encounter difficulties and challenges in their development, enabling them to gain and develop on their original level [5]. The feedback loop refers to the complete closed-loop logic of "teacher questions - children respond - teacher feedback" [3]. Promoting thinking means that teachers, through support, enable children to actively explore and think about their own thoughts, rather than directly providing answers and merely imparting knowledge. Encouragement and affirmation are given to children in a timely manner through verbal or non-verbal forms, providing them with emotional attention and support, so that they can promptly gain a sense of satisfaction and achievement, thereby stimulating their own motivation to participate and self-confidence. Based on these various evaluation indicators, it is clear to see an ideal model of high-quality teacher feedback, that is, teachers need to fully respond to the needs of children, encourage and affirm their reasonable behaviors, act as supporters, collaborators and guides, provide appropriate supports for children, and stimulate their active thinking and creative expression. Enable young children to develop within the zone of proximal development. Teacher feedback is never a one-way output; rather, it is a true manifestation of mutual understanding, mutual trust, and mutual growth between teachers and children.

It is worth noting that teachers' feedback varies in different forms of activities. Research has found that during collective teaching activities, regional activities and outdoor activities, teachers' feedback is mostly at a medium level. However, when it comes to washing up, having meals and taking naps, teachers' feedback performance declines. One possible reason is that teachers regard such life activities as "management tasks" rather than "educational opportunities", and thus their emphasis on the quality of feedback has correspondingly declined [3]. This reflects a very important predicament: some teachers do not have a sufficient understanding of the concept that "every day is a course", and some teachers find it difficult to apply theoretical knowledge to practical activities in reality after grasping it. In addition, kindergartens generally adopt traditional methods such as teaching evaluation to help teachers improve their own qualities and enhance the quality of feedback in response to the problems of uneven English teaching levels among front-line teachers, monotonous forms of interaction between teachers and children, and the lack of targeted evaluation language. However, such methods are inefficient and the problem of untimely feedback is also very prominent. Such realistic predicaments are troubling both new and experienced teachers in the field of early childhood education.

3.2. The review of AI empowers teachers' feedback

At present, there is no globally unified standard for AI feedback. However, in general, AI feedback refers to the process of using artificial intelligence to automatically track and evaluate the behavioral performance of students and systems, and generate guiding content to promote improvement and enhancement. Compared with traditional AWE/AES, AI feedback does not require as much advance

training as traditional AWE/AES, and its capability range is also much broader [6]. Compared with AES and AWE, which can only do one thing, the advantages of AI feedback are quite obvious. It can simultaneously handle functions and skills such as correcting grammar, analyzing logic, offering suggestions, demonstrating, and engaging in dialogue and discussion. In addition, compared with AWE/AES, the more attractive aspect of AI feedback lies in its dialogue function, which enables users to ask questions, make modifications, and ask again, thereby obtaining answers that are infinitely close to their satisfaction.

In Teng's research, it can be seen that he focused on five dimensions to examine the quality of AI feedback itself [7]. These five dimensions are: accuracy, clarity, timeliness, usefulness and constructiveness. Users can conduct a comprehensive assessment through these five dimensions to determine the quality of this AI, whether its content is accurate and error-free, whether the feedback expression is clear and easy for users to understand, whether it can quickly provide assistance to users in the first place, and whether the specific improvement directions provided are practical and useful to users. In addition to judging whether the AI feedback tool itself is of high quality, it is also necessary to seriously recognize that AI feedback is not merely a tool; its generation is a success. What is more important is to observe the effect of this tool on the person being fed feedback. Pahi et al. conducted an empirical study comparing the feedback quality differences between TA and ChatGPT, and established seven criteria for evaluating the effectiveness of feedback, namely technical content, encouragement, hidden answers, identification of the next step, clarity and completeness, gap identification, and usage examples [8]. These seven criteria can well reflect what kind of feedback is effective for the person receiving it.

Some people may have doubts: Why should we shift from traditional human feedback to AI feedback after using it for so many years? Wouldn't such a transformation bring about huge challenges? There is no doubt that human feedback gap recognition ability is stronger than that of AI. This is because during the long-term interaction with young children, teachers have a deeper understanding of them than AI. Teachers understand a complete and vivid child, while AI can only make judgments based on a small amount of existing information. In addition, human feedback is also better at concealing information and has a higher technical quality compared to AI feedback. The advantage of AI feedback lies in its clarity and completeness, as well as its adept use of encouraging words. This is particularly important in the feedback from kindergarten teachers, as children need a great deal of emotional support from teachers. Encouraging words can continuously inspire children's confidence and sense of security. And AI feedback is better at using specific examples to illustrate the key points of feedback [8]. It is obvious that both human feedback and AI feedback have their irreplaceable advantages. To stand at the forefront of education and continuously improve the quality of one's own feedback, it is necessary to fully recognize the merits of these two feedback models. Humans and AI each have their own strengths. Through the collaboration between humans and AI, one's own feedback capabilities can be optimized and enhanced in the most efficient mode.

Nowadays, AI is constantly evolving, and the technical quality of AI feedback can also reach a decent level. Then why is the usage rate of AI feedback among actual teachers still not high? Helm & Hesse cited data from multiple empirical studies and found that more than half of learners did not adopt AI feedback after receiving it [6]. The possible reasons might be that the AI feedback was too timely, leaving learners no time to build a judgment distance. The feedback is too comprehensive, causing cognitive overload. The core cognitive process of self-diagnosis replaced by AI feedback, etc [6]. For the user group like teachers, those with a high professional identity prefer AI to offer effective suggestions, but they do not like AI to directly provide corresponding specific and detailed

step-by-step instructions. They prefer AI as a tool that supports professional autonomy and guides their thinking rather than a tool that commands and instructs actions [7]. Secondly, teachers generally recognize the importance of high-quality feedback, but it is difficult for them to implement it effectively in actual teaching or life activities. The AI feedback tool itself adds new technical operation and learning costs. If it conflicts with the existing workflow of teachers, it will instead increase the burden of separation of knowledge and action [3]. Just because a tool is user-friendly does not mean that a teacher knows how to use it. To enable teachers to effectively utilize AI feedback to enhance their own capabilities, in addition to learning basic AI knowledge and literacy, the AI feedback tool itself should also be appropriately modified to adapt to the special changes in the scenarios of the teaching staff and more naturally integrate into their daily work. Thirdly, teachers' trust in AI also needs to be enhanced. Teachers' concerns about whether AI will affect students' creative expression, social skills, and value education, etc., may all impact their own trust in AI as a tool, thereby reducing their willingness to actively use AI feedback tools [9].

3.3. The review of usage AI feedback and interaction quality

Existing research has demonstrated that AI feedback can activate teachers' self-regulated learning and creative self-efficacy, thereby enhancing their teaching abilities. However, it only stops at the level of teachers' teaching capabilities [7]. Secondly, teachers' concepts and behaviors will to some extent affect the quality of interaction between teachers and children [3]. Based on existing research, the conclusion that can be drawn is that AI can transform teachers, and teachers can change the interaction between teachers and children. However, no research has directly examined the complete path through which AI feedback directly affects the quality of teacher-child interaction through teachers.

Although there is no direct evidence yet, the above two chains of indirect evidence can effectively provide two inferential paths. However, it should be noted that the dependent variable of the first chain of evidence, that is, AI can enhance teachers' teaching ability, in this study is the ability of instructional design, not the quality of interaction between teachers and children. In the second chain of evidence, which is that teachers can improve the quality of interaction between teachers and children, the quality of teachers' feedback is generally at a relatively low level.

4. Discussion

Based on review findings, it can indicate the conceptual definitions and existing empirical studies of the quality of teacher-child interaction and AI feedback. It can be seen that there is no empirical study on the improvement of the quality of teacher-child interaction by AI feedback at present. However, two key evidence chains can be discovered, that is, AI can change teachers, and teachers can improve the quality of teacher-child interaction. The two paths each hold true but are separate, which means that the influence of AI feedback on the quality of interaction between teachers and children is theoretically valid, but there is a lack of empirical research on this part. This section will base on this current pattern and construct a complete theoretical framework that is realistic and feasible, laying a theoretical foundation for future empirical research.

The logical leap between the two parts as The improvement of teachers' capabilities does not necessarily mean an improvement in the quality of interaction between teachers and students. The improvement of ability does not entirely represent a change in behavior. Therefore, this study further explores how to improve and enhance AI feedback to effectively connect these two paths.

First of all, AI feedback needs to be of high enough quality to activate the intrinsic motivation within teachers. Teng's research indicates that the quality of AI feedback significantly influences teachers' intrinsic self-efficacy [7]. This also implies that when AI feedback merely remains at the surface level of textual information and does not touch upon teachers' inner self-efficacy, it will have a considerable impact on teachers' subsequent behavioral changes. Therefore, AI feedback effectively stimulates teachers' inner self-efficacy and activates their psychological mechanisms, which constitutes the starting point of this theoretical framework.

Second, the design of AI feedback tools should be in line with the cognitive level of users and professional contexts. Helm and Hesse pointed out that the current problems of timeliness, comprehensiveness, and professionalism in AI feedback are essentially caused by a lack of understanding of users' cognitive processes, cognitive levels, and professional contexts [6]. Furthermore, Teng's research also pointed out that teachers with a higher sense of identity are more resistant to procedural and all-inclusive AI feedback [7]. In such cases, if the AI feedback cannot be adjusted in a timely manner and provide targeted feedback based on the specific circumstances of the users, it will greatly affect the users' willingness to use and their interest in continuous use. This also means that if AI feedback cannot well understand the user's cognitive level and professional context, it cannot be well and naturally integrated into the daily work of teachers. In conclusion, the adaptation of tools to the workflow of teachers is the prerequisite for the subsequent integration behavior to occur.

Thirdly, under the above premises, the integration of AI feedback by teachers themselves becomes particularly crucial. According to the research by Ge et al., the key to the effectiveness of AI does not lie in the frequency of use, but in the "coupling quality" of teachers, that is, whether AI can be effectively integrated into teachers' daily workflows and effectively applied in practical practice under the integration of teachers [10]. At the same time, Cheng Xunan further pointed out that the gap between teachers' "knowledge" and "action" is also a major and significant obstacle [3]. All these studies have fully demonstrated that whether AI feedback can effectively enhance the quality of interaction between teachers and children, teachers are also a crucial link. Whether teachers can effectively integrate and embed it into their daily work, ultimately forming an effective closed loop where AI feedback improves the quality of interaction between teachers and children.

5. Conclusion

This study collected relevant literature on the Google scholar platform to explore the relationship between AI feedback and the quality of interaction between teachers and children. This study systematically sorted out the relevant Literature on AI feedback and teacher-child interaction through the method of Literature Review, and was carried out around three research questions.

Firstly, the quality of interaction between teachers and children is a core component of the quality of preschool education. Teacher feedback plays a crucial role in it, and the score of teacher feedback on the CLASS scale is at a relatively low level. The main problems faced are mostly due to insufficient time resources and the separation of knowledge and action. These current situations and predicaments indicate that teachers need the support and assistance of certain external tools to effectively improve the quality of interaction between teachers and children. Secondly, AI feedback can effectively help teachers enhance their capabilities, but there are still problems such as the feedback critical distance and the impact of teachers' professional identity on the use of AI feedback tools. Thirdly, for AI feedback to effectively enhance the quality of interaction between teachers and children, it is necessary to ensure that AI feedback can effectively activate the internal psychological mechanisms of teachers, understand their cognitive levels and professional environments, and thus

naturally integrate into their daily work. Most importantly, teachers should effectively integrate AI feedback through a "highly coupled" rather than a "substitutive" approach to empower and improve the quality of interaction between teachers and children.

Of course, this review still has certain limitations, such as insufficient number of retrieved literatures and the lack of longitudinal follow-up studies. In conclusion, AI feedback has the potential to become an important tool for enhancing interaction between teachers and children. However, at present, it only remains at the indirect theoretical level. From the accumulation of indirect evidence to the verification of direct evidence, more empirical studies need to be conducted in real kindergarten contexts. Filling this knowledge gap is precisely an important direction for future research.

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