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Artificial intelligence in preschool education: Personalized assessment and evaluation with artificial intelligence[1]

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Ethics Statement

✓ The author(s) declare(s) that the study is not subject to ethics committee approval.
✓ The study does not require ethical approval.

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1. Author contribution: Wrote the article, collected the data, and analyzed/reported the results (50%).
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The author(s) declare(s) that there is no potential conflict of interest in this study.

Similarity

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Abstract

Traditional assessment and evaluation methods in preschool education lack objectivity, limit process-oriented assessment, and fail to account for individual differences, reducing their overall effectiveness. This study aims to address these challenges by designing an artificial intelligence-supported model to enhance assessment and evaluation processes. The research examines the integration of assessment tools in Turkey's Preschool Education Program into an AI-supported model, focusing on the use of natural language processing (NLP), image recognition, and machine learning algorithms for a more detailed and objective evaluation of children's cognitive, social, and emotional development. A qualitative research method was employed, utilizing document and content analysis techniques. A comprehensive literature review was conducted, and the findings were systematically analyzed to develop a new AI-supported assessment model. The proposed model enhances individualized learning experiences, integrates AI into educational processes, and provides real-time feedback to students and teachers. This study presents an innovative alternative to traditional approaches by introducing AI-based assessment in Turkish preschool education. The model is expected to improve objectivity, consistency, and sensitivity to individual differences, offering a more efficient and data-driven evaluation framework for early childhood education.

Keywords: Artificial intelligence supported measurement and evaluation, Preschool education, Personalized learning, Data driven feedback, Educational technologies

EXTENDED ABSTRACT

Introduction

Traditional assessment and evaluation methods in early childhood education (ECE) often fall short of providing objective, process-oriented, and individualized evaluations. These limitations restrict the effectiveness of assessment processes and hinder the ability to track the cognitive, social, and emotional development of children holistically. The present study aims to address these challenges by proposing an artificial intelligence (AI)-supported model that integrates innovative technologies, such as natural language processing (NLP), image recognition, and machine learning algorithms, into ECE assessment processes. By leveraging AI-supported personalized assessment models, this study seeks to enhance real-time feedback mechanisms and support individualized learning experiences in early childhood education.

The research is significant as it proposes an alternative to traditional assessment methodologies, providing a more reliable, adaptive, and inclusive model. The study contributes to the literature by examining the integration of AI technologies into the Turkish ECE system and evaluating their potential benefits and challenges. The study also identifies various constraints encountered during the research process, including limitations in data accessibility, ethical considerations in AI applications for children, and infrastructural challenges in implementing AI-supported assessment models in real-world educational settings.

Conceptual and Theoretical Framework

Concepts

Key concepts addressed in this study include:

- **Artificial Intelligence in Education (AIED)**: AI-driven technologies that enhance educational assessment, learning experiences, and personalized feedback.
- **Personalized Learning**: Tailoring educational experiences to individual students' needs, preferences, and learning speeds through adaptive assessment tools.
- **Data-Driven Feedback**: AI-supported real-time assessment methods that provide educators with data-driven insights into children's cognitive, social, and emotional development.

Existing literature highlights the importance of assessment and evaluation in ECE, with studies emphasizing formative assessment methods and alternative assessment tools. Shepard (2000) and Black and Wiliam (2009) suggest that formative assessments are crucial for tracking students' development dynamically. Additionally, Holmes et al. (2019) argue that AI-based learning analytics and assessment models can enhance learning outcomes and increase the objectivity of assessments.

While traditional assessment methods rely heavily on teacher observations and subjective evaluations, AI-supported assessment tools offer systematic and real-time tracking of student progress. International research (e.g., Zawacki-Richter et al., 2019) indicates that AI can provide automated, adaptive, and data-driven evaluations that reduce bias and improve decision-making in educational settings.

In Turkey, research on AI applications in education remains limited, particularly in ECE. However, studies by Akdeniz and Özdinç (2021) suggest that AI has the potential to revolutionize assessment methods by offering individualized learning opportunities and improving feedback mechanisms for both students and educators.

Method

The study employs a qualitative research methodology with a descriptive design to investigate the integration of artificial intelligence in early childhood education (ECE) assessment. This approach enables an in-depth examination of current evaluation practices and the theoretical potential of AI-supported personalized models (Creswell, 2013; Merriam & Tisdell, 2016).

Data Collection and Analysis

• Data Sources:

Data were gathered through document analysis of national and international academic studies, theses, curricula, legislation, and policy documents related to AI applications in ECE. Purposive sampling ensured that only reliable, relevant, and up-to-date documents were included (Bowen, 2009).

• Analysis Techniques:

Content analysis was utilized to systematically identify key themes and trends in AI-supported assessment methods (Krippendorff, 2013). A three-stage coding process was implemented:

- *Open Coding:* Detailed examination of documents to extract meaningful expressions, concepts, and themes using established theoretical frameworks.

- *Axial Coding:* Grouping of identified themes based on relationships and similarities to form a hierarchical structure.

- *Selective Coding:* Integration of main and sub-themes into a coherent thematic framework through cross-validation and iterative discussions, enhancing the study's reliability (Patton, 2015).

Through thematic organization, categorization, and interpretative analysis, the study systematically examines both the advantages and challenges of integrating AI into ECE assessment models (Braun & Clarke, 2006; Miles, Huberman, & Saldaña, 2014).

Findings

The study identifies several limitations of traditional assessment approaches, highlighting key challenges such as subjectivity and bias, time and resource constraints, and the lack of individualization. Teacher-led evaluations often lack objectivity, leading to inconsistencies in assessment results. Additionally, teachers face difficulties in conducting comprehensive assessments due to limited time and resources, which affects the overall quality and reliability of evaluations. Traditional methods also fail to adequately consider students' individual learning styles and progress rates, limiting their effectiveness in addressing diverse educational needs.

To address these challenges, the study proposes an AI-supported assessment model that integrates several key components. Natural language processing (NLP) is utilized to analyze children's verbal and written communication skills, providing deeper insights into language development. Image recognition technologies are applied to observe children's physical and social interactions in educational settings, ensuring a more comprehensive evaluation of their social and motor skills. Machine learning algorithms personalize learning experiences by adapting assessment criteria based on students' performance data, allowing for a more individualized approach. Additionally, adaptive learning platforms provide real-time tracking of student progress and offer individualized feedback to optimize learning outcomes.

The implementation of this AI-supported model enhances the accuracy and objectivity of assessment processes, reducing inconsistencies associated with traditional methods. Real-time feedback mechanisms support teachers in making data-driven educational decisions, enabling more informed instructional planning. Adaptive learning platforms facilitate customized educational interventions by addressing individual student needs and learning paces. Furthermore, AI applications help identify learning gaps and provide targeted support to students requiring additional assistance, fostering a more inclusive and effective educational environment.

Conclusion, Discussion, and Recommendations

The findings of this study align with existing research highlighting the benefits of AI-based assessment models in education. The implementation of AI in early childhood education assessment presents a transformative approach to evaluating children's development more accurately and objectively. AI-supported assessment models increase objectivity, efficiency, and reliability in educational evaluations. Personalized learning experiences can enhance student engagement and improve educational outcomes. AI applications enable a more holistic and data-driven approach to early childhood education assessment.

Despite these advantages, the implementation of AI-based assessment models requires appropriate technological infrastructure and comprehensive teacher training. Ethical concerns, such as data privacy and AI bias, must also be carefully addressed to ensure the responsible use of AI in educational settings. Future research should focus on testing AI-supported assessment models in real-world educational environments to evaluate their long-term impact and effectiveness.

To maximize the benefits of AI-supported assessment, educators should be equipped with the necessary skills to effectively use AI in assessment processes through targeted teacher training programs. Additionally, government agencies should establish clear policies and guidelines for the ethical and responsible integration of AI in education. Further empirical studies are necessary to assess the effectiveness and feasibility of AI-supported assessment models across different educational contexts, ensuring their adaptability and sustainability in diverse learning environments.

This study provides a groundbreaking perspective on the integration of AI into early childhood education assessment. By leveraging AI technologies, educators can create a more personalized, efficient, and objective assessment environment. The proposed AI-supported model offers a viable alternative to traditional assessment methods, ensuring that the learning experiences of children are accurately evaluated and continuously improved.

INTRODUCTION

The concept of education has been defined in various ways by different thinkers and educators. The differences in these definitions stem from the fact that individuals have different perspectives on education. According to Senemoğlu (2005), education is seen as "the process of nurturing human personality" and "investment in human capital". Sönmez (2023) defines education as "the process of creating desired biochemical changes in the brain as a result of physical stimulation". In the most general sense, in the words of Ertürk (1972), education is considered as the process of "creating desired behavior" or "changing desired behavior" (Başaran, 2000; Senemoğlu, 2005; Sönmez, 2023). Education is a process that aims to develop human beings, to reveal their talents, to direct them to the good and the beautiful, and to create desired behavioral changes, starting with birth and continuing until death (Şişman, 2021).

Preschool education is a systematic educational process that directs all the development of children aged 0-72 months in line with the cultural values of the society; helps them in the reasoning process by increasing the development of their emotions and perception power; develops their creativity, enables them to express themselves and gain self-control (Güven & Azkeskin, 2010). Preschool education is a critical period that supports children's cognitive, emotional and social development processes. In this process, measurement and evaluation play an important role in improving the quality of education and enabling individualized learning experiences. Today, the main objectives of preschool education include monitoring children's

development, understanding their individual differences, and organizing education programs accordingly (Bayrak & Duruhan, 2013). In Turkey, preschool education is carried out within the framework of a program prepared in advance as formal education and developed in line with the needs of the age and society (Gelebek Üstün & Uzun, 2020). Early childhood educators believe that the individual interests and needs of the child should be taken into consideration in the preparation of the program and evaluation (Mağden, 1993; Sapsağlam, 2013). The behaviors acquired in this period affect the whole life of the child and therefore a planned education program is essential (Bayrak & Duruhan, 2013).

Measurement and evaluation is one of the fundamental elements of the educational process. In the most general sense, evaluation is defined as drawing conclusions from measurements and making a value judgment about the measured individuals or objects (Atılgan, Kan, & Doğan, 2019). While measurement indicates the amount of a characteristic, evaluation indicates whether this amount is sufficient or suitable for the purpose (Küçükahmet, 2009). Evaluation is a broader concept that includes measurement and involves the process of making decisions about the measured characteristics of individuals by comparing the measurement results with a criterion.

The knowledge and skills that teachers acquire in the field of measurement and evaluation have a critical importance for their professional lives. However, it is not easy to claim that all teachers have sufficient knowledge and skills in the field of assessment and evaluation (Yaşar, 2014). Especially in the implementation of alternative assessment and evaluation approaches, teachers need to have sufficient knowledge (Yenice, Özden, & Alpak Tunç, 2017).

It is very important to follow the development of children in preschool period. Therefore, it is necessary to use various assessment and evaluation tools to monitor and support the development of preschool children (Bayrak & Duruhan, 2013). Measurement and evaluation in preschool period is a broad and comprehensive process for the purpose of recognizing the child and planning education (Sapsağlam, 2013). The evaluation process is not only an action that takes place on paper, but also involves the knowledge, awareness and subjectivity of the person making the evaluation (Bentzen, 2005). However, existing research shows the limitations of traditional assessment and evaluation methods. Gül Can (2021) points out that methods based on observation and teacher evaluations involve subjectivity, which makes it difficult to reflect children's actual developmental processes. Çetin (2020) states that these methods do not sufficiently take into account individual differences and are result-oriented instead of process-oriented.

These limitations create serious disadvantages especially for children with special needs or children in mainstreaming education. In the literature, the variety of measurement tools used in the preschool period draws attention. In Turkey, the measurement tools recommended by the Ministry of National Education include skill observation forms, development reports, portfolios and anecdotal record forms (MEB, 2013). These tools are used to monitor children's cognitive, social, emotional and physical development. However, it is known that teachers face difficulties in the implementation of these tools, such as lack of time, large class sizes and lack of materials (Ata & Bolat, 2022).

In the international literature, the importance of assessment and evaluation in the preschool period has been widely discussed. Researchers such as Shepard (2000) and Black and Wiliam (2009) emphasize that formative assessment methods address children's developmental processes in a more dynamic and flexible way. In addition, artificial intelligence-supported systems aim to support teachers by offering innovative solutions in assessment and evaluation processes (Holmes et al., 2019). More studies need to be conducted on the functionality and applicability of the measurement tools in the current Preschool Education Program in Turkey.

The 2013 Preschool Education Program of the Ministry of National Education includes different assessment and evaluation methods to evaluate children. These methods include development observation forms, development reports, portfolios, checklists, anecdotes, and observation records (MEB, 2013; Gelebek Üstün & Uzun, 2020).

The 2024 Maarif Program is an approach to preschool education that aims to support children's cognitive, emotional, social and physical development. The program structures educational processes by taking into account children's individual differences to ensure their healthy development at an early age. It also encourages children's active participation in activities and learning processes. By adopting a multidimensional evaluation approach, the program creates a continuous feedback mechanism between the child, the teacher and the program. This approach aims to use a variety of assessment tools to monitor and support children's development and to support teachers' professional development. The 2024 Maarif Program also aims to provide a more effective educational experience through the diversification of educational materials and methods and the integration of innovative technologies. In the Maarif Model 2024 Preschool Education Program, the main purpose of the measurement and evaluation process is to support children's skill acquisition process, monitor their development and increase the effectiveness of teaching processes. Various measurement tools are used to monitor children's cognitive, social, emotional, physical and language development. By

adopting a multidimensional evaluation approach, the program creates a continuous feedback mechanism for the child, the teacher and the program itself (MEB, 2024). In this context, the assessment tools used in the program play an important role in evaluating the effectiveness of the program as well as providing continuous feedback to teachers by monitoring children's development.

Although traditional assessment and evaluation methods are widely used in education, they have various weaknesses. The most obvious weakness of these methods is their lack of objectivity. Methods based on observation and teacher evaluations can be subjective depending on the individual interpretations of the teacher. This makes it difficult to evaluate each student's development process in a consistent and unbiased manner (Gül Can, 2021).

When teachers evaluate children based on their personal perspectives, objective results may not be obtained (Sezer, 2010). Another important problem is that these methods fail to take into account the individual needs and learning styles of all students.

Every child has a different learning pace and style, but traditional methods ignore these differences (Çetin, 2020). This creates a major disadvantage, especially for children who are mainstreamed or have special needs (Gül Can, 2021).

Traditional methods are also outcome-oriented rather than process-oriented. Instead of following the child throughout the developmental process, the focus is usually on the final results. This makes it difficult to adequately understand the child's developmental stages and can lead to generalizations based only on specific results (Sezer, 2010). While the child's immediate performances are taken into consideration, the learning process and individual progress may be ignored (Çetin, 2020).

The importance of performance-based assessment methods increases in this context. In particular, tools such as portfolio assessment offer an effective solution for tracking children's individual learning processes. Portfolios provide a more systematic way of tracking children's learning outcomes, work and development. Similarly, methods such as anecdotal records allow for recording children's individual achievements and behaviors throughout the process. These tools enable a more in-depth analysis of each child's individual developmental needs through a process-oriented assessment.

Skill Observation Form: This form is used to observe and report the extent to which children acquire different domain skills (Turkish, math, science, social, movement and health, art, music). Teachers observe children and record their level of skill acquisition.

Anecdotal Record Form: Individual achievements, skills or behaviors of children that stand out during their learning process are recorded by teachers. These records are used to understand children's individual development and to provide feedback on the process.

Skill Acquisition Report: The skills that children acquire during their developmental periods are reported in line with the criteria set. These reports are important for determining in which areas children need to be supported.

Learning Evidence: In line with the learning outcomes in the program, the products (drawings, projects, presentations, etc.) in which children can demonstrate what they have learned are evaluated. Evidence of learning shows how children apply their knowledge and skills and is included in teachers' assessment processes.

Monthly and Daily Plans: Monthly and daily education plans prepared by teachers are used to observe and monitor children's skill acquisition throughout the process. These plans systematically evaluate children's progress in their learning experiences.

Family Participation Preference Form: Used for families to indicate how they would like to participate in the educational process. This form is important to assess children's learning processes at home and to ensure cooperation between school and home.

These tools allow teachers to closely monitor children's development. At the same time, these data are used to evaluate the effectiveness of the program and support teachers' professional development (MEB, 2024).

However, research shows that teachers experience various difficulties in using assessment and evaluation tools (Ata & Bolat, 2022). Teachers face obstacles such as lack of time, excessive class size, lack of materials and multiplicity of assessment tools (İnce, 2022).

Teachers' lack of knowledge about measurement and evaluation methods reduces the effectiveness of evaluation processes. In addition, it has been found that teachers have difficulty in applying tools such as checklists, anecdotes, observations, and portfolios, and therefore cannot adequately carry out measurement and evaluation processes (Sezer, 2010; Ata & Bolat, 2022). This situation may have negative consequences in terms of monitoring and supporting children's development.

Measurement and evaluation processes in the preschool period are critical for identifying children's developmental needs and preparing individualized education plans. As emphasized in the 2024 Education Program of the Ministry of National Education, the diversity and

accuracy of the tools used in these processes are seen as the cornerstones to increase the effectiveness of education (MEB, 2024). In addition to observation-based approaches in assessment and evaluation processes, the importance of dynamic and individual development-oriented methods through the integration of technology is frequently emphasized in the international literature (Shepard, 2000; Holmes et al., 2019). In this direction, it is necessary to overcome the knowledge and skill deficiencies of teachers in order to use assessment tools correctly and to increase the applicability of these tools. In particular, formative assessment methods are reported to effectively support both children's developmental processes and learning outcomes (Black & Wiliam, 2009).

Measurement and evaluation processes in the preschool period are critical for identifying children's developmental needs and preparing individualized education plans. As emphasized in the 2024 Education Program of the Ministry of National Education, the diversity and accuracy of the tools used in these processes are seen as the cornerstones to increase the effectiveness of education (MEB, 2024). In addition to observation-based approaches in assessment and evaluation processes, the importance of dynamic and individual development-oriented methods through the integration of technology is frequently emphasized in the international literature (Shepard, 2000; Holmes et al., 2019). In this direction, it is necessary to overcome the knowledge and skill deficiencies of teachers in order to use assessment tools correctly and to increase the applicability of these tools. In particular, formative assessment methods are reported to effectively support both children's developmental processes and learning outcomes (Black & Wiliam, 2009).

Measurement and evaluation in preschool education has a critical importance in terms of determining the individual differences of children, identifying their strengths and weaknesses, and shaping the educational process according to these data. Increasing the knowledge and skills of teachers in the field of measurement and evaluation is necessary to eliminate the difficulties encountered in this process and to implement education programs effectively.

Although traditional assessment and evaluation methods are widely used in education, they have various weaknesses. The most obvious weakness of these methods is their lack of objectivity. Methods based on observation and teacher evaluations can be subjective depending on the individual interpretations of the teacher. This makes it difficult to evaluate each student's developmental process in a consistent and unbiased manner (Gül Can, 2021). When teachers evaluate children based on their personal perspectives, objective results may not be obtained (Sezer, 2010). Especially in the preschool period, teachers' subjective evaluations with limited

knowledge and experience may lead to children's developmental processes not being fully understood.

Another important problem is that these methods fail to take into account the individual needs and learning styles of all students. Every child has a different learning pace and style, but traditional methods ignore these differences (Çetin, 2020). This creates a major disadvantage especially for children who are mainstreamed or have special needs (Gül Can, 2021). In the preschool period, this situation may cause difficulties in understanding developmental differences and individualized education plans may be incomplete.

Traditional methods are also outcome-oriented rather than process-oriented. Instead of following the child throughout the developmental process, the focus is usually on the final results. This makes it difficult to adequately understand the child's developmental stages and can lead to generalizations based only on specific results (Sezer, 2010). While the immediate performances of the child are taken into consideration, the learning process and individual progress may be ignored (Çetin, 2020). Especially in the preschool period, such approaches that do not focus on the process cannot fully support children's early learning experiences.

Performance-based assessment and evaluation methods can be used as an alternative to traditional methods to better understand children's developmental processes. These methods focus on children's individual performances and their progress in the process. However, there are also challenges in the implementation of such methods. For example, the preparation and evaluation of tools such as portfolio assessment can be time-consuming for teachers (Ata & Bolat, 2022). Moreover, teachers need to have sufficient knowledge to use these methods effectively (Sezer, 2010). The shortcomings in the implementation of performance-based assessment tools indicate that teachers' knowledge and skills in managing these processes need to be increased. In addition, digitalization of performance-based tools can both increase the speed of assessment processes and ensure objectivity (Holmes et al., 2018).

Finally, traditional methods lack measurement tools that fully cover children's emotional and social development. These methods generally focus on cognitive development and fail to assess the emotional and social aspects of the child (Gül Can, 2021). This may lead to the inability to fully assess the child's holistic development and to make the necessary interventions in these areas (Sezer, 2010). These weaknesses indicate that measurement and evaluation methods used in education should be updated with more holistic, process-oriented and individualized approaches.

AI-supported education applications offer innovative solutions to overcome these shortcomings. AI technologies can facilitate teachers' assessment processes by creating personalized learning experiences in education (Holmes, Bialik, & Fadel, 2019). Especially in preschool education, AI-based assessment tools can instantly monitor children's progress and provide detailed feedback to teachers (Chen, Chen, & Lin, 2020). These technologies can also help teachers overcome obstacles such as lack of time and resources in assessment and evaluation processes (Zawacki-Richter, Marín, Bond, & Gouverneur, 2019).

Moreover, AI applications allow teachers to manage classroom activities more efficiently and respond more quickly to individual student needs (Luckin, Holmes, Griffiths, & Forcier, 2016). For example, intelligent teaching systems and learning analytics analyze students' learning processes and provide teachers with information about individual learning needs (Siemens & Baker, 2012). Thus, teachers can plan and implement educational programs more effectively. AI-based educational platforms can support teachers' professional development and help them learn new assessment methods (Traxler & Kukulska-Hulme, 2015). In this way, teachers can use assessment tools more effectively and monitor students' progress more accurately (Nguyen, Gardner & Sheridan, 2018).

Research shows that AI-powered systems offer personalized learning experiences in education, making the processes of monitoring and evaluating student performance more efficient (Holmes et al., 2019; Woolf, 2010). Moreover, these technologies play an important role in improving the quality of teaching by providing teachers with easier access to educational materials and resources (Nguyen et al., 2020).

Based on these data, it is seen that artificial intelligence-supported educational applications can play an important role in overcoming the difficulties encountered in measurement and evaluation processes in preschool education. These technologies enable teachers to use assessment tools more effectively, identify children's individual differences and shape the educational process according to these data. Thus, the quality of education can be improved and the obstacles faced by teachers can be overcome.

The main purpose of this article is to contribute to the development of an artificial intelligence-supported model by bringing an innovative approach to measurement and evaluation processes in preschool education. The limitations of traditional methods, subjective evaluations and biases due to human factors can undermine objectivity. In this context, the need for a dynamic and continuous assessment and evaluation model that takes into account individual differences becomes more important. Accordingly, in this study, a personalized assessment and evaluation

model was designed using artificial intelligence technologies, aiming to eliminate the possible negative effects of the human factor and provide a more objective assessment process. The model aims to assess children's cognitive, emotional and social development more effectively and provide data-driven and objective feedback. This model is expected to provide a more holistic and objective assessment process for both educators and parents and transform current educational approaches.

METHOD

Research Model

This study is based on qualitative research method for the development of an artificial intelligence-supported personalized assessment and measurement model. Qualitative research enables in-depth examination of social phenomena and detailed analysis of complex processes (Creswell, 2013). The main purpose of the study is to systematically examine the existing assessment and measurement practices, to reveal the deficiencies in these practices and to theorize the potential contributions of artificial intelligence applications. In this context, a descriptive qualitative research design was adopted and the shortcomings of similar approaches in the literature were also taken into consideration to underline the unique contribution of the study (Merriam & Tisdell, 2016).

Population/Sample/Study Group

The population of the study consists of academic articles, theses, dissertations, curricula, legislation and policy documents published at national and international level, rather than a specific individual or group. Since this study was conducted as a document-based research, the sample group is the data set of documents that are directly related to the topic and meet the specified inclusion criteria. The documents selected using a purposive sampling strategy were compiled from current and reliable sources directly related to the topic in order to increase the validity and representativeness of the research (Bowen, 2009).

Data Collection Tools

In the data collection process, document analysis was applied as the main method. Document analysis provides a systematic review of relevant literature, training programs, national and international policy documents and documents on artificial intelligence applications. The documents analyzed were selected according to predetermined inclusion and exclusion criteria; thus, care was taken to ensure reliability and validity in the data collection process. The

documents used shed light on the potential contributions of artificial intelligence in the field of education as well as current practices regarding measurement and evaluation processes in education (Bowen, 2009).

Process (Data Analysis)

In the data analysis process, the content analysis method, which enables the systematic, objective and reproducible examination of large and heterogeneous data sets, was meticulously applied (Krippendorff, 2013). In the study, three-stage coding techniques were used to analyze the data in depth. In the first stage, open coding, the selected documents were examined in detail; meaningful expressions, concepts and themes in the text were identified, and basic conceptual elements were labeled with reference to existing theoretical frameworks. In the following stage, axial coding was applied by taking into account the relationships and similarities between the themes revealed in the open coding process; in this way, a hierarchical structure was created among the data and the themes were grouped systematically. In the last stage, the selective coding process was activated and the main themes and sub-themes were combined, and a holistic and consistent thematic structure was created. In order to ensure the consistency of the coding, cross-validation was performed between independent coders and the reliability of the analysis process was increased through repeated interviews (Patton, 2015).

The data analysis included thematic organization, categorization and interpretation beyond the three-stage process. First, in the thematic organization stage, the data obtained from the documents were organized in line with predetermined main themes; thus, the data were examined in a broad perspective and meaningful patterns in the content were identified (Krippendorff, 2013; Patton, 2015). In the second stage, based on the results of the thematic analysis, the data were divided into subcategories with similar characteristics under each main theme, and the relationships and variations of thematic elements were elaborated (Braun & Clarke, 2006). In the final stage, a comprehensive interpretation of the thematic structure was carried out; in the light of the findings obtained, the deficiencies in current assessment practices and the potential contributions that can be achieved by integrating artificial intelligence into educational processes were discussed in an academic framework. This interpretation was supported by comparative evaluations with similar studies and theoretical approaches in the literature, allowing for in-depth analysis of the practical and theoretical dimensions of the study (Miles, Huberman, & Saldaña, 2014).

During the research process, the principles of scientific research and publication ethics were adhered to, the sources used were meticulously referenced, and the reliability and validity of

the study were supported by implementing mechanisms to increase mutual verification and coding consistency between researchers during the data collection and analysis stages.

FINDINGS

Literature Review

The Role and Future of Artificial Intelligence in Education

Artificial intelligence (AI) technologies are receiving increasing attention in terms of their applications and potential impacts in education. The use of AI in education offers significant innovations in various fields such as personalized learning, automated assessment, and improving teaching processes (Holmes, Bialik, & Fadel, 2019). Artificial intelligence contributes to the development of more effective and efficient methods in education by supporting teachers in monitoring and evaluating student performance (Baker & Inventado, 2014).

The potential of AI technologies in education offers advantages such as personalization of teaching materials and methods and increasing student motivation (Luckin et al., 2016). AI provides solutions for individual learning needs by analyzing students' specific learning paths (Chen et al., 2020). This enables students to have better learning experiences.

The future of AI in education is constantly evolving at the pace of technological developments. Thanks to big data analytics and machine learning algorithms, artificial intelligence allows us to better understand and optimize students' learning processes (Zawacki-Richter et al., 2019). In the future, AI is expected to be used more widely and effectively in education, which will help educational systems become more flexible and adaptive (Holmes et al., 2019).

Evaluation in Preschool Education

Preschool education is a critical period for children's cognitive, emotional and social development (Pianta & Hamre, 2009). Assessments conducted during this period are critical for monitoring and supporting children's developmental processes. Traditional assessment methods are based on teachers' observations and standardized tests. However, these methods may be insufficient to fully reflect the individual needs and developmental rate of each child (Snow & Van Hemel, 2008).

Formative assessment is an approach that continuously monitors and evaluates children's learning processes and provides immediate feedback to teachers. This assessment method allows teachers to organize educational processes according to children's needs (Shepard,

2000). Formative assessment offers a more dynamic and flexible structure compared to traditional methods and addresses children's development in a more comprehensive way (Black & Wiliam, 2009).

Artificial Intelligence Assisted Systems

Artificial intelligence-supported systems offer innovative solutions in measurement and evaluation processes in education. By analyzing student data, these systems provide instant feedback to teachers and optimize educational processes (Holmes et al., 2019). AI-supported assessment tools offer significant advantages in monitoring and evaluating students' performance and providing personalized educational materials (Baker & Inventado, 2014).

Natural language processing (NLP) techniques are widely used in AI-assisted assessment systems. For example, systems that detect and correct grammatical errors in students' written work can help students improve their writing skills (LeCun et al., 2015; Nguyen et al., 2021).

Image recognition technologies also play an important role in AI-assisted assessment systems. These technologies enable the assessment of students' motor skills and social interactions by monitoring their physical activities and interactions (Holmes et al., 2019). For example, systems that monitor preschool children's play activities can assess the development of their motor skills and provide feedback to teachers (Luckin et al., 2016).

By analyzing student data, machine learning algorithms offer significant advantages in optimizing learning processes and providing personalized educational materials (Zawacki-Richter et al., 2019). These algorithms can identify students' learning styles and development speeds and provide them with customized educational materials and activities (Chen et al., 2020). Adaptive learning platforms can make learning processes more effective by supporting students' individual learning processes (Nguyen et al., 2021).

Various tools and techniques such as natural language processing, image recognition, machine learning algorithms and adaptive learning platforms are used for these areas (Nguyen et al., 2020; LeCun et al., 2015). For example, natural language processing techniques can be used to analyze children's language development and communication skills (Chen et al., 2020). Various studies on natural language processing, image recognition and machine learning technologies in Turkey provide important examples and suggestions on how these technologies can be used in education. Studies in the field of natural language processing (NLP) can be used to analyze children's language development in preschool education and integrate the data obtained from these analyses into educational processes. For example, using an NLP model, children's

vocabulary, grammar usage and expressive skills can be analyzed in real time. Thus, individualized education plans can be created by identifying a child's strengths and weaknesses in language development.

In one study, NLP methods were used to analyze children's storytelling abilities and these analyses were used to suggest to teachers what kind of activities would be more effective in supporting children's language development. Such a practice contributes to a more effective educational process by providing an accurate and objective assessment of children's language skills. For example, in read-aloud activities, NLP models can determine children's learning levels from the words they repeat and which types of words they are more interested in. This data makes it possible to design content and activities that support children's language development more efficiently.

In this study, the accuracy of news articles was analyzed using the Long Short Term Memory (LSTM) model with a high success rate, which shows the potential of language analysis-based applications in educational processes (Toğaçar et al., 2022). The use of natural language processing (NLP) technologies in preschool education has significant potential to support children's language development and integrate innovative approaches into educational processes. Language development at an early age is one of the key components of cognitive, emotional and social development. In this context, AI-based NLP models such as LSTM offer an effective tool to detect difficulties and progress in language development by analyzing children's language use, vocabulary and meaning-making processes. NLP technologies can contribute to the development of individualized language learning programs, enabling the design of educational materials and strategies appropriate to each child's language development level. In addition, more efficient and personalized learning experiences can be created by using NLP methods in areas such as evaluating the appropriateness of educational content for children's age and language levels, designing gamified applications to improve language skills, and instant detection of errors in language use. In this framework, artificial intelligence-supported language analysis and personalized feedback mechanisms offer an innovative approach to optimize language teaching in preschool education.

Image recognition technologies can be used to monitor children's physical activities and social interactions (Nguyen et al., 2020). In Turkey, research on the use of these technologies in education provides examples of applications and recommendations. Research on image recognition technologies evaluates how these technologies can be applied in education. Object recognition studies using deep learning methods such as Faster R-CNN have shown that these

technologies can be used to monitor students' motor skills and social interactions. In this way, children's classroom activities can be monitored and analyzed more closely (Yılmaz, Aydın, & Çetinkaya, 2020).

In addition, machine learning algorithms can identify children's learning styles and developmental rates to provide customized educational materials (Luckin et al., 2016). Adaptive learning platforms can enrich the learning experience by supporting each child's individual learning journey (Holmes et al., 2019). Studies on adaptive learning and machine learning in Turkey discuss the potential and applicability of these technologies in education. Studies on machine learning show that these technologies provide significant advantages in determining students' individual learning rates and providing personalized learning experiences.

The use of artificial intelligence (AI) technologies in education offers important innovations, especially in areas such as personalized learning, automated assessment and improvement of teaching processes. Various studies in Turkey have examined this issue. For example, Çavuş (2024) examined the benefits of AI-based assessment and evaluation tools in the field of education, the difficulties experienced in the process and the role of teachers in this process. Tonbuloğlu (2023) states that the use of current applications in educational technologies contributes to individualization, digital and physical interaction, increasing learning performance, gaining practical experience, gamification, motivating, encouraging, improving the learning experience and increasing its effectiveness, concretization, networking, feedback, providing effective and original content, creating alternative learning processes, data-based guidance and prediction. Artificial intelligence plays an important role in making education more efficient by monitoring students through big data, making performance evaluations and providing support to teachers (Arslan, 2020). In particular, deep learning techniques provide great convenience in tailoring educational materials specific to the student (Akbulut & Adem, 2023). Gürlek et al. (2023) found in their research that it helps teachers to follow student progress, evaluate their performance and improve their teaching processes. Altun (2024) found that artificial intelligence can make significant contributions to pedagogical processes such as personalized and differentiated learning, language learning, critical thinking skills, active learning, adaptive learning, creating collaborative learning environments, creative learning, problem-based learning, project-based learning, self-directed learning, self-paced learning, self-regulated learning and simulation-based learning. Research in Turkey on the use of artificial intelligence-based systems in education has focused on university students and

intelligent tutoring systems. Intelligent Tutoring Systems (ITS) are systems that support learners throughout the learning process by utilizing artificial intelligence technology. These systems guide the progress of learners with instant feedback, similar to the behavior of a tutor (Tuna, 2015). It is stated that there has been a great increase in the number of such studies in recent years and that these systems can be used at various levels from pre-school to higher education (Akdeniz & Özdinç, 2021).

The scarcity of studies on the applications and effects of artificial intelligence-supported systems in education in the Turkish literature indicates that more research is needed in this field (Arslan, 2020). This study aims to improve the quality of education by introducing an innovative artificial intelligence-supported approach to the preschool education system in Turkey.

In the light of these studies, the development of artificial intelligence-based educational applications in Turkey is gaining momentum. However, it is seen that there is still a limited number of studies examining the effects of artificial intelligence-supported systems in education in the Turkish literature. Increasing research in this field will contribute to the more widespread and effective use of artificial intelligence in education (Akdeniz & Özdinç, 2021).

Artificial Intelligence Supported Measurement and Evaluation Model

Components

Natural Language Processing (NLP)

Natural Language Processing (NLP) is used to assess students' language development and communication skills. NLP analyzes children's spoken and written expressions to identify skills in grammar, vocabulary and sentence structure. The use of NLP in preschool education is also increasing. For example, NLP-based practices such as interactive storytelling and educational games support children's language skills at an early age. Speech recognition technologies enable teachers to monitor children's pronunciation and speech development and help early detection of possible language delays. The use of NLP in education allows us to gain a deeper understanding of students' language skills (Oflazer, 2020; Artiwise, 2021).

Image Recognition

Image recognition technologies are used to monitor and assess children's physical activity and social interactions. Social cues such as facial expressions and body language can be analyzed through these technologies. Although there is a limited number of studies on the use of these

technologies in preschool education in Turkey, research from around the world provides important information.

In preschool education, image recognition technologies can be used to monitor children's social interactions and physical activities during group activities in detail. For example, children's motor skills can be assessed by recording their movements during play and analyzing this data (Edwards, 2018). These applications help individualize the educational process by providing teachers with important feedback on children's physical and social development. In addition, technologies based on facial recognition and emotion analysis can be used to identify children's emotional states and thus enable early intervention. These technologies contribute to the educational process by monitoring students' social interactions within the group. For example, teachers can use this data to tailor classroom activities and teaching strategies to children's needs.

Machine Learning Algorithms

Machine learning algorithms analyze student data to identify individual learning styles and development rates. These algorithms optimize learning processes by providing personalized feedback to each student. Several machine learning projects developed in Turkey offer individualized feedback by monitoring students' performance. For example, by analyzing children's projects and activity results, adapted learning paths can be suggested for each child (Arslan, 2020).

The use of machine learning algorithms in preschool education is becoming increasingly important. With these algorithms, children's play activities and interactions can be analyzed to create educational programs tailored to their individual learning needs. For example, the data obtained from the educational games played by children on tablets or computers can be analyzed with machine learning algorithms to provide content tailored to each child's interests and learning speed (Papadakis, Kalogiannakis, & Zaranis, 2018). These applications enable children to have individualized learning experiences at an early age and increase their motivation to learn (Neumann, 2018).

Furthermore, by using machine learning-based tools, teachers can better understand children's learning progress and needs and adapt their curricula accordingly (Edwards, 2018). In this way, educational processes can be optimized to contribute to the individual development of each child.

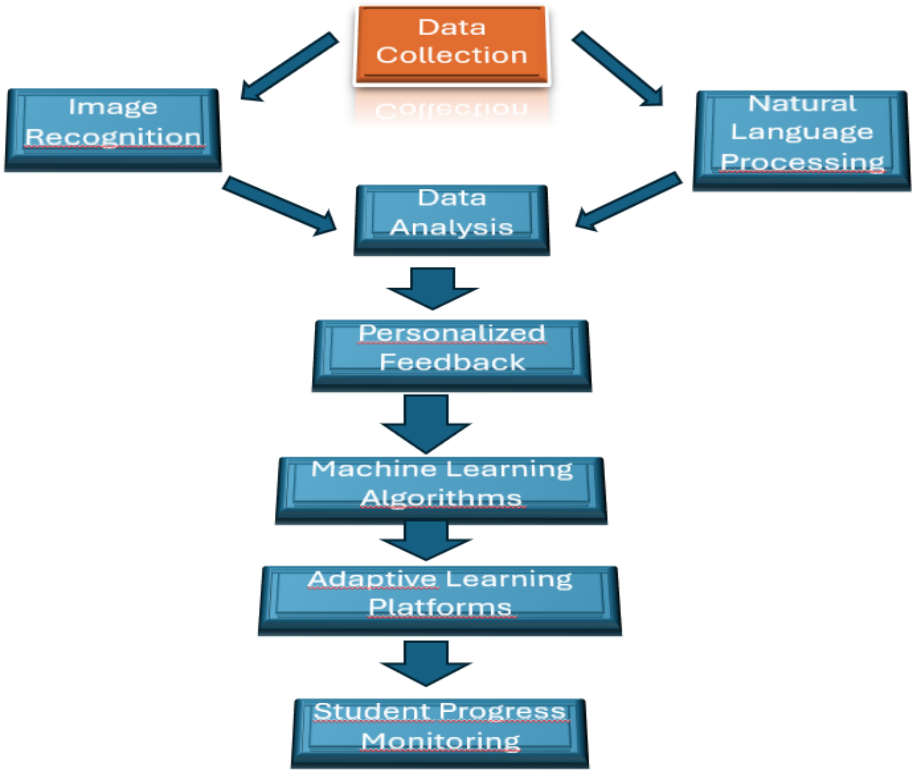
Adaptive Learning Platforms

Adaptive learning platforms support students' individual learning journeys and personalize educational materials. They enable more effective learning by providing content customized to students' needs. In the Turkish education landscape, projects for the automatic adaptation of personalized learning materials are becoming widespread.

In preschool education, these platforms support children's learning processes by providing activities that match their interests and developmental levels (Edwards, 2018). For example, interactive educational apps and game-based learning platforms provide adaptive content to develop children's cognitive and social skills (Papadakis, Kalogiannakis, & Zaranis, 2018). Through these platforms, teachers can track each child's learning progress and offer additional support where needed (Neumann & Neumann, 2014). These applications allow children to have individualized learning experiences at an early age and increase their motivation to learn (Zuckerman, 2016). These platforms aim to manage students' educational processes based on data.

Model Schematic

Figure 1. Model Functioning Diagram



The implementation process of the model includes data collection, analysis, personalized feedback and the use of adaptive learning platforms by integrating an AI-supported approach in education. This process is designed to monitor and support students' language development, social interactions, physical activities and overall academic performance.

To measure the impact of the model in education, various quantitative and qualitative methods are used to analyze student performances, teacher feedback and changes in learning processes. This measurement process allows for close monitoring of both learning outcomes and individual student progress. Below we detail how these impacts are measured:

Student Performance Data

In preschool education, children's developmental processes are assessed through observation in different areas such as language skills, motor skills, social interactions and cognitive development. These assessments are based on observation data obtained from various sources such as participation in classroom activities, play-based learning activities, art and drama activities, physical activities and social interactions. By automatically analyzing this performance data, artificial intelligence-supported systems monitor children's developmental levels and help understand their individual learning processes. In particular, machine learning algorithms analyze data to determine the individual developmental rates and learning paths of each child. By comparing this data with children's developmental goals, the effectiveness of educational applications can be evaluated and personalized learning experiences can be created according to needs.

Effectiveness of Personalized Feedback

The impact of the personalized feedback provided by the model on children's performance is examined. To measure the impact of the feedback, children's post-feedback performance improvements are tracked. For example, assessments on vocabulary, grammar use and communication skills of a child who receives feedback in the area of language development are used to measure the impact of the model. In this process, the contribution of feedback to children's development in specific areas is analyzed by comparing before and after performances.

Teacher Feedback

Teachers' experiences and feedback on the implementation of the model is an important source of data. Teachers evaluate changes in children's performance, the integration of the model into the activity process and how it affects their educational process. Feedback from teachers

through interviews and questionnaires is used to assess the overall impact of the model in education. This feedback provides information about the effectiveness of the model during teachers' classroom practice and indicates areas for improvement.

Student Progress Monitoring

Children's individual progress is regularly monitored through adaptive learning platforms. The speed at which children reach the set goals and their development processes are recorded by the platform's automatic monitoring systems. Changes in children's academic performance following adaptations to their learning processes are systematically evaluated. In particular, the differences between children's previous performances and their new performances are used to show whether the model is effective or not.

Quality of Learning Experiences

How children's learning experiences improve is another indicator of the impact of the model. Through questionnaires and interviews with children, it is questioned how personalized learning materials and feedback affect their learning experiences. The motivation of children to participate in activities, how satisfied they are with the learning process and how they evaluate their individual achievements are important data collected in this process. An increase in the quality of learning experiences is an important indicator of successful implementation of the model.

Long-term Impacts

In order to measure the long-term effects of the model in education, children need to be observed for a certain period of time. In this context, the long-term results of the model are analyzed by comparing children's periodic academic achievements and general development levels. Especially in children for whom the model is applied continuously, the sustainability of individual development and progress levels are examined. In this way, it is revealed whether the model is effective not only in the short term but also in the long term.

Artificial Intelligence Tools Used in the Model

The specific components in our model - natural language processing (NLP), image recognition technologies, machine learning algorithms and adaptive learning platforms - can be described as follows:

Zemberek NLP (Natural Language Processing Tool)

In Turkey, projects such as Zemberek have developed natural language processing systems that work on the rich morphological structure of Turkish. These systems can automatically monitor children's language development and provide developmental feedback. Zemberek can be used to analyze children's language development in our model as a natural language processing (NLP) technology specific to the Turkish language. This technology plays a major role in analyzing children's written and spoken language use to examine speech errors, vocabulary, and sentence structures (Oflazer, 2020). Teachers can use this tool to obtain data on children's language performance, especially for individualized assessment of children's writing and speaking skills. In the light of this data, targeted feedback can be provided to children who are lagging behind in language development.

Sample Usage: Zemberek analyzes children's writing their names, line work, drawing pictures and tracking their linear development, and automatically assesses grammar and vocabulary usage. As a result of this analysis, teachers can identify which children need more support in terms of language development and provide customized feedback to children accordingly.

Google Cloud Vision (Image Recognition Technology)

Google Cloud Vision (2021), which will be used in the model, is an important tool for monitoring children's physical activity and social interactions. This technology provides teachers with data on children's motor skills and social behavior by analyzing behaviors and interactions in classroom activities (Nguyen et al., 2020). Image recognition provides detailed information about how children move and interact with other children, especially in play-based activities, allowing teachers to track their social skill development.

Example Usage: Classroom activities are video recorded and analyzed with Google Cloud Vision. The tool evaluates children's movements, facial expressions and group interactions, providing teachers with data on their level of social interaction. With this data, teachers can identify which children need social skills development.

Machine Learning Algorithms

In our model, machine learning algorithms will be used to analyze data collected throughout children's learning process to determine their individual learning speed and learning style. Machine learning enables personalized feedback and recommendations based on learning performance (Luckin et al., 2016). By identifying children's individual learning needs, these

algorithms personalize teaching processes and provide children with more effective learning experiences.

Example Usage: Children's performance data (participation data, project work) is analyzed with machine learning algorithms. As a result of this analysis, learning materials and activities tailored for each child are presented and feedback is generated according to the development speed of the children.

Knewton (Adaptive Learning Platform)

Knewton (2021) will be used as the adaptive learning component of our model, delivering learning materials based on children's individual performance. By analyzing children's learning pathways, this platform provides the opportunity to deliver personalized educational content based on the needs of each child (Holmes et al., 2019). Thanks to the adaptive learning platform, educational materials are continuously updated in accordance with children's individual learning speeds and personalized learning paths are recommended.

Example Use: The Knewton platform automatically provides personalized learning paths based on children's performance in activities. Children's development processes are regularly monitored and content is updated according to the data obtained during this process. This way, each child's learning experience becomes individualized.

Faster R-CNN (Deep Learning Based Object Recognition Technology)

Faster R-CNN can be used to monitor children's interactions with objects and motor skills in classroom activities. This deep learning-based technology allows assessing children's motor skill development by analyzing their interactions with objects and physical activities (Yılmaz & Aydın, 2020). Teachers can use this data to identify which motor skills children need improvement in.

Example Use: Faster R-CNN analyzes video recordings of children interacting with specific objects during classroom activities. The tool assesses children's motor skills and provides teachers with data on which areas they need support.

The artificial intelligence tools that will be used in our model have a wide potential to provide personalized learning experiences in education to meet the individual needs of children. Tools such as Zemberek, Google Cloud Vision, Knewton and Faster R-CNN offer powerful support to teachers in monitoring and assessing language development, social interaction, motor skills

and individual learning processes. Effective use of these technologies will make education and training processes more efficient and effective.

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

The research findings show that the personalized learning experiences offered by AI in education and its potential to optimize student performance are in line with the existing literature. Chen et al. (2020) found that AI-supported systems facilitate data-driven decision-making in education and improve student performance. Similarly, Holmes et al. (2019) emphasize that artificial intelligence applications are effective in personalizing educational processes and increasing student achievement. Zawacki-Richter et al. (2019) stated that artificial intelligence has changed the roles of teachers in education and enabled teachers to make more strategic interventions with data-driven learning management systems. This model design confirms that teachers have the opportunity to monitor children's developmental processes more closely and provide instant feedback through AI-supported models. The model's ability to provide personalized feedback to meet children's individual learning needs can make teaching processes more effective and efficient. Adaptive learning platforms can update educational materials by continuously monitoring student performance and thus optimize students' learning experiences (Luckin et al., 2016). AI-supported assessment and evaluation models create a more objective, consistent and reliable assessment environment by significantly limiting human errors in assessment processes. The standardized and systematic approach of artificial intelligence algorithms prevents subjective judgments and inconsistencies, allowing for a fair assessment of each student's performance. In this way, students' true potential and abilities are accurately reflected, helping them to engage more effectively in the learning process. Furthermore, AI's capacity for fast and accurate data processing allows even large-scale assessments to be carried out in a short time and without errors. This allows teachers and educational administrators to save more time and energy, thus allowing them to focus more on educational activities. The ability of artificial intelligence-supported systems to minimize prejudices contributes to making evaluations on a more fair and egalitarian basis. This ensures equality of opportunity in education and allows each student to be evaluated in line with their individual characteristics. Thus, the negative effects of various socio-economic and cultural differences within the education system can be reduced. These developments pave the way for an increase in the quality of education in general and a more effective learning environment. It becomes possible for students to increase their motivation, develop positive attitudes towards learning and become an active part of their own learning processes. Educational institutions can

develop more efficient and effective educational strategies and use their resources more wisely. Artificial intelligence-supported assessment and evaluation models make significant contributions to both the individual development of students and the improvement of the overall education system by meeting the standards of objectivity, consistency and reliability required by modern education. The widespread and effective use of these technologies in the field of education will play a critical role in shaping the educational models of the future and contribute to increasing the level of knowledge and skills of societies. One of the most important limitations of this study is that more advanced technical infrastructures are required to use artificial intelligence technologies at full capacity. The generalizability of the AI-supported model should be evaluated by testing it in different student groups and educational environments. Such large-scale applications will allow us to measure the effects of the model more comprehensively. Following technological developments and the more widespread use of these technologies in education means that artificial intelligence-supported systems in education can be further developed (Holmes et al., 2019). It is also important for teachers to receive training to use AI-supported systems effectively and to create support mechanisms for these technologies. In the process of integrating artificial intelligence systems into education, programs should be developed to support teachers' adaptation to technology (Luckin et al., 2016). In addition, examining the long-term effects of such artificial intelligence-supported systems in education will provide important information about the sustainability and lasting effects of these technologies. The model has the potential to support the development of language and social skills by providing children with feedback tailored to their individual needs, and to enable teachers to manage educational processes more effectively. Future studies should test the wider applicability of such models and delve deeper into the role of AI technologies in education.

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