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Kids Trackr: An AI-Powered Mobile-Based Information System for Monitoring Elementary School Child Development

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Abstrak

Kids Trackr is a mobile-based information system designed to facilitate the monitoring of primary school children's development in real-time and efficiently. This system integrates Artificial Intelligence (AI) technology through the use of Natural Language Processing (NLP) for chatbot features and Artificial Neural Network (ANN) for child development analysis based on academic data. Using the Agile software development approach, this application is built iteratively and adaptively to user needs, including features for lesson schedules, student attendance, child skills assessment, two-way communication between teachers and parents, and graph-based progress reports. The validation process was conducted through functionality testing and user trials involving teachers, parents, and students at SD Laboratorium Percontohan UPI Cibiru. The test results showed a high level of user satisfaction, with 87.3% of respondents stating the application was easy or very easy to use, 90% stating the application was interactive, and 83.3% stating the application was useful in monitoring children's development. In addition, the ANN algorithm is proven to be able to provide accurate predictive analysis of student learning outcomes. By combining AI technology and user-oriented design principles, Kids Trackr has great potential as an integrated solution in increasing parental involvement, teacher work efficiency, and accuracy of student development reporting at the primary school level.

***Keywords**: Artificial Intelligence, ANN, Child Monitoring, Mobile Application, NLP, Primary School*

INTRODUCTION

The rapid proliferation of smartphones in Indonesia over the last decade has significantly transformed the country's technological landscape. Recent studies indicate that smartphone penetration has reached an unprecedented level, with approximately two-thirds of the Indonesian population owning a device by 2024 a figure that continues to rise steadily, driven by broadening access and affordability across different regions and socioeconomic backgrounds (Ariesman, Syandri, & Faturrahman, 2025). Moreover, Indonesian consumers have become increasingly reliant on smartphones for various facets of daily life, spending substantial portions of their day engaged with mobile devices, which has fundamentally altered communication, commerce, and information consumption patterns nationwide (Statista Research Department, 2024). This pervasive integration of smartphones has established a robust foundation for leveraging mobile technology in critical sectors, including education (Ariesman et al., 2025).

In tandem with the widespread adoption of mobile technology, the role of mobile applications in educational contexts has gained considerable scholarly attention. Mobile educational apps are recognized for their capacity to enhance learning experiences, foster interactivity, and support flexible and individualized educational pathways (Hussain, Mkpojiogu, & Babalola, 2020; Dorofeyeva et al., 2024). Research has demonstrated that these applications facilitate access to learning resources anytime and anywhere, transcending the limitations of conventional classroom instruction and promoting greater student engagement and academic achievement (Dorofeyeva et al., 2024; Abdolreza, Jafar, & Milad, 2023). Furthermore, mobile apps often incorporate multimedia elements and gamified features, which have been shown to increase motivation and improve retention among elementary learners (Sari & Prasetyo, 2023). The expanding integration of digital technologies

into Indonesian education is not only reflective of global trends but also necessary to adapt to shifts in pedagogical approaches and to bridge gaps in resource distribution (Zhao, Zhang, & Wang, 2023).

A critical yet often overlooked dimension of this digital transformation in education is the evolving role of parents in supporting and monitoring their children's academic and developmental progress. Modern societal changes have placed new demands on parental involvement, with contemporary families frequently facing time constraints and competing responsibilities that hinder active engagement with their children's learning (Hertog, Weinstein, & Zhao, 2022; Wang, Lim, & Zhang, 2025). As such, there is a growing imperative for technological innovations that can empower parents to participate more effectively in their children's educational journey. Mobile-based monitoring systems have emerged as promising solutions, offering functionalities that range from tracking academic performance and screen time to providing developmental insights and facilitating digital engagement strategies (Hertog et al., 2022; Wang et al., 2025). These systems serve to bridge communication between home and school, enabling more responsive and data-driven approaches to supporting childhood growth and learning outcomes (Wang et al., 2025).

Recent peer-reviewed studies underscore the utility and necessity of such technological solutions for families in Indonesia, where challenges related to supervision, guidance, and support remain pronounced due to socioeconomic disparities and evolving educational expectations (Wang et al., 2025; Zhao et al., 2023). Child development monitoring apps, paired with mobile health (mHealth) frameworks, have demonstrated potential in helping parents balance the risks and opportunities associated with digital engagement, supporting not only academic but also cognitive, emotional, and social development (Wang et al., 2025). The integration of these tools into everyday life is aligned with wider digitalization in society, emphasizing the need for continued research and tailored solutions that reflect Indonesia's unique cultural and infrastructural context (Ariesman et al., 2025; Wang et al., 2025).

LITERATURE REVIEW

2.1 Machine Learning and Artificial Intelligence in Education

In recent years, the integration of artificial intelligence (AI) and machine learning (ML) into primary education has reshaped classroom dynamics, curriculum delivery, and student assessment. Systematic literature reviews have documented that AI technologies most notably adaptive learning platforms and intelligent learning management systems support the personalisation of instruction and data-driven decision making in elementary schools.

These platforms can dynamically adjust learning trajectories based on student responses, optimizing content to address individual needs and learning paces, which leads to measurable improvements in engagement and academic performance (Yim, 2024; Mijwil, Al-Rahmi, & Zamjani, 2022). Augmented and virtual reality applications powered by AI, as well as automated tutoring systems, have expanded experiential learning opportunities and enabled the early identification of at-risk students through predictive analytics (Mijwil et al., 2022). The potential of AI in this context extends to real-time formative assessment, whereby systems monitor student progress, adaptively intervene, and provide teachers with actionable insights for instructional planning (Mazı, 2025; Mijwil et al., 2022). Nonetheless, ongoing challenges include technological disparities, insufficient infrastructure in low-resource settings, the need for greater teacher training, and persistent privacy and ethical concerns related to student data usage (Yusuf, 2025).

2.2 Utilisation of NLP and ANN in Monitoring System

The application of Natural Language Processing (NLP) and Artificial Neural Networks (ANN) in educational monitoring systems has gained significant momentum, enabling advances in both the analysis and automation of learning support. NLP techniques now facilitate nuanced analysis of student-generated text, automated essay grading, dynamic feedback implementation, chatbot-based tutoring, and the identification of socio-emotional cues within school communication channels (Shaik et al., 2022; Litman, 2024). For example, transformer-based models such as BERT and T5 have been employed to parse student queries and generate personalized,

context-appropriate feedback within digital learning environments, thus enhancing formative assessment accuracy and efficiency (Akter Semi et al., 2025; Litman, 2024). In parallel, ANNs have been deployed for the classification and prediction of student learning outcomes, supporting both teacher and parental decision-making by highlighting learners at risk of underachievement (Shaik et al., 2022). These deep learning approaches underpin adaptive learning engines, which continuously monitor and adjust content difficulty based on multi-source data, including written responses, interaction histories, and behavioral signals. Furthermore, NLP-powered systems have been adopted to strengthen communication between schools and parents, offering real-time, language-sensitive reporting and closing gaps in home–school collaboration (Akter Semi et al., 2025; Mashudi et al., 2025). Despite these advances, challenges remain in model explainability, data privacy, and ensuring reliable performance across diverse linguistic and educational contexts (Shaik et al., 2023).

2.3 Effectiveness of the System in Supporting Basic Education

The effectiveness of mobile-based monitoring and EdTech systems in basic education has been substantiated through a variety of empirical studies focused on learning outcomes, parental involvement, and teacher workflow enhancements. Quantitative analyses reveal a clear positive trend in student learning outcomes with the adoption of mobile assessment tools and educational apps in elementary settings, highlighting improvements not only in academic achievement but also in student motivation and engagement (Setiawan, 2022). These systems are particularly valuable as they extend learning opportunities beyond the confines of the classroom—facilitating continuous feedback, real-time progress tracking, and more flexible engagement regardless of time or place. From the teachers' perspective, digital assessment and monitoring simplify the evaluation process and support individualized instruction without undue administrative burden (Setiawan, 2022). For parents, mobile monitoring tools have proven instrumental in fostering meaningful involvement in their children's education, bridging home–school divides and offering accessible, interactive channels for communication and oversight (Mashudi et al., 2025). This heightened connectivity and transparency, enabled by mobile and AI-powered platforms, contributes to holistic educational support and strengthens the collaborative ecosystem critical to children's development. Nevertheless, ensuring equitable access and digital literacy among all stakeholders remains a necessary focus to maximize the systemic benefits of such technologies (Yusuf, 2025).

2.4 Previous Research

Previous studies have developed mobile technology and artificial intelligence-based systems to support the monitoring of child development and student academic performance. However, most of these studies still focus on one specific aspect, such as monitoring child health, predicting academic performance, or using chatbots in learning.

Kitsao-Wekulo et al. (2021) developed a mobile application to monitor the developmental milestones of children aged 6–24 months through a text messaging system sent to parents. This system allows caregivers to report on their children's development in several domains, such as communication, motor skills, and problem solving. The results of the study show that the application is effective for monitoring child development in a public health context. However, this study only focused on early childhood development and did not integrate academic data or artificial intelligence technology into the analysis of child development.

Another study by Dewi et al. (2022) developed an Android application for monitoring child growth and development to complement child development cards at Posyandu services. This application allows for the recording of health data, immunisation schedules, and child health information. Although this application helps digitise child development records, the system still focuses on health aspects and does not yet provide predictive analysis or educational communication features between parents and teachers.

In the context of education, Abubakari and Suprapto (2020) developed an academic performance prediction model using Artificial

Neural Networks (ANN). This study shows that the neural network method is capable of producing a high level of accuracy in predicting student academic achievement. However, the study only focused on developing a prediction model and has not been implemented in a mobile information system that can be used directly by teachers and parents to monitor student development.

In addition, Mathew et al. (2021) developed an education chatbot based on Natural Language Processing (NLP) as a learning assistant for students. This system allows students to ask questions using natural language and obtain explanations related to learning materials. Although the chatbot is capable of increasing interaction in the learning process, this research focuses more on supporting student learning and has not been integrated with academic progress monitoring systems or communication between parents and teachers.

Based on these studies, it can be concluded that most previous studies still develop systems separately between monitoring child development, predicting academic performance, and learning chatbots. Therefore, this study proposes the Kids Trackr system, a mobile application that integrates student attendance monitoring, academic assessment, child development dashboards, communication between parents and teachers, and academic development analysis using Artificial Neural Networks (ANN) and Natural Language Processing (NLP) based chatbot systems. The integration of these various components is expected to provide a more comprehensive solution for monitoring child development at the primary school level.

METHOD

The development of this child development monitoring information system was conducted using the Agile Software Development approach, an iterative and incremental method that allows high flexibility in software development. This approach was chosen for its ability to handle changing requirements dynamically as well as its focus on team collaboration and end-user satisfaction (Majchrzak et al., 2022; Nurdiani et al., 2020). In general, the Agile method in this project is depicted in Figure 1, which includes several key stages such as product planning, system design, feature development, and continuous testing during the sprint cycle.

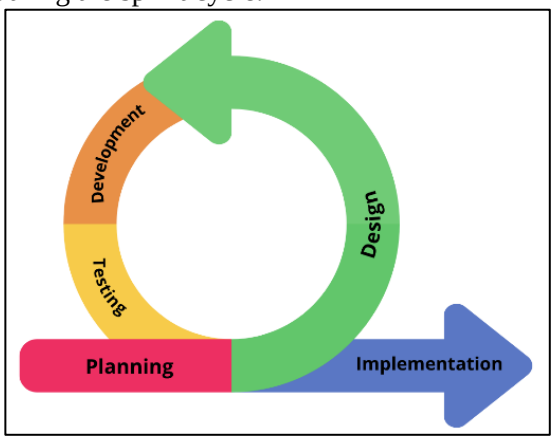

Figure 1. Flowchart of Agile Methodology

3.1 Planning

Product planning is the initial stage in developing a mobile application-based primary school child development monitoring information system. This stage is carried out to compile a systematic and measurable initial design based on real needs in the field. The main purpose of this planning stage is to ensure that the features developed are in accordance with the needs of users, both parents, teachers, and students.

The first stage in this planning was to conduct a needs analysis through informal interviews and observations of academic activities in the primary school environment. From this process, it was found that reporting children's development to parents was still manual and not optimally documented. Therefore, a system is needed that can record, store, and present child development data digitally, real-time, and can be accessed easily.

After that, the formulation of functional and non-functional requirements was derived into a backlog list of key features. The main features planned include: lesson schedule monitoring, child attendance recording, academic skills assessment, parent-teacher communication, school news, lunch nutrition information, and access to self-learning and practice modules for students. All these features were determined based on urgency and relevance to the learning process and communication between school and parents. Next, the application development roadmap is divided into several stages of core feature development. This roadmap takes into account

the order of implementation, estimated processing time, and prioritisation of user needs. This planning also considers the technical readiness of the development team, so that development runs efficiently and on target.

3.2 Design

Product planning is the initial stage in developing a mobile application-based primary school child development monitoring information

The system design stage aims to define the technical structure and overall system architecture. In this stage, database design is carried out using the MySQL database management system. Each important entity in the system is modelled into tables, such as user tables (parents, teachers, students), attendance tables, lesson schedules, student assessments, messages, news, and nutrition data. Relationships between tables are determined by using appropriate foreign keys, to maintain data integrity and consistency.

To support the communication process between system components, the backend was developed using the PHP programming language. This backend provides API services that can be accessed by the frontend application (Flutter) to display and send data to the database. Each API endpoint is designed to handle CRUD (Create, Read, Update, Delete) operations according to feature requirements.

Class diagram shows the main entities in the system and the relationships between entities, such as the relationship between students and lesson schedules, between teachers and assessments, and between parents and messages.

Use case diagram illustrates the actors (parents, teachers, students, admin) and their interactions with the features in the system. Each actor has different access rights according to their role.

System diagram shows the communication flow between the frontend component (Flutter mobile apps) with the backend (PHP-based API) and database (MySQL). This diagram explains the scheme of requesting and retrieving data from the application to the server. This design is done in detail to ensure that the structure of the system built can support all the features that have been planned in the previous stage. With a structured system design, the development process can be carried out more systematically and efficiently.

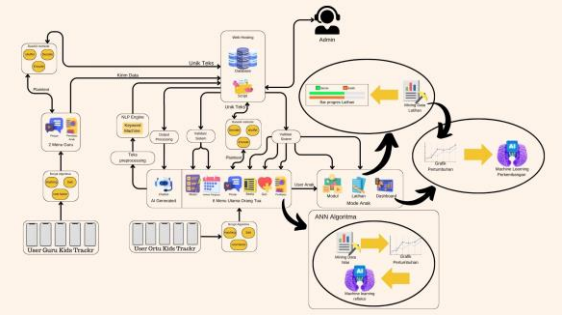

Figure 1. System Diagram

3.3 Development

System development is carried out based on the results of the planning and design stages that have been compiled previously. The application was developed using the Flutter framework which allows the development of multiplatform mobile applications based on the Dart language. Flutter was chosen because it supports the development of consistent user interfaces and high performance across multiple devices.

The backend of the system is developed in PHP, which provides an API endpoint for data exchange between the application and the MySQL database. This API handles various requests from the application such as retrieving schedule data, recording attendance, sending messages, and storing assessments and child development reports. The main features developed include:

a) Child Lesson Schedule, Displays the child's daily schedule based on the data entered by the school admin.
b) Child Attendance, Teachers fill in the daily attendance of students, and parents can monitor their child's attendance status every day.
c) Academic Skills Assessment, Teachers enter grades and records of children's progress. The system will present a progress report based on the data.
d) Message to Teacher, Parents can send and receive messages from teachers directly through the app.
e) Learning Modules and Independent Practice, Students can access learning materials and do practice questions independently.

f) Child Development Dashboard, Provides graphical visualisation of children's skill development based on teacher input and system data.

All features are tested during the development process to ensure proper functionality. The development process is carried out iteratively with periodic evaluations so that the final result matches the user's needs.

3.4 Testing and Implementation

After the development process is complete, the application is implemented in an elementary school environment as an initial trial. The implementation was conducted at Laboratory Percontohan UPI Cibiru Elementary School as a partner that provides a representative user environment. The application is installed on user devices consisting of teachers, parents, and students.

The testing method used was black-box testing, which focused on testing the functions of the application from the user's point of view without looking at the internal structure of the code. Each feature was tested based on actual usage scenarios, such as parents checking their child's schedule and attendance, teachers filling in grades, and students accessing learning materials.

In addition, user experience-based testing was also conducted by involving respondents directly from partner schools. Teachers, parents and students provided feedback regarding the ease of use of the application, the clarity of the information displayed, and the completeness of the features.

The test results show that most of the features run well and can be accessed smoothly. Some user feedback was used as evaluation material for further development, such as improving the user interface and simplifying navigation. With this methodology, the child development monitoring information system was successfully built gradually and systematically, ensuring that the developed application is relevant, easy to use, and effectively supports the communication process and monitoring of child development in the primary school environment.

RESULTS AND DISCUSSION

This section will explain in detail the results of the implementation of the mobile-based elementary school child development monitoring information system that has been developed. The discussion includes the final appearance of the application, the results of system testing, and user evaluation of the functionality and benefits of the application. This system, named Kids Trackr: An AI-Powered Mobile-Based Information System for Monitoring Elementary School Child Development, is designed to increase the efficiency and transparency of child development reporting with the support of artificial intelligence (AI) technology and integrated data processing.

4.1 System Implementation Results

Kids Trackr application is developed for three main types of users, namely parents, teachers, and elementary school students. Implementation is done in the form of Flutter-based mobile applications, with PHP backend and MySQL database. The following are the results of visualisation and explanation of the main features that have been successfully implemented:

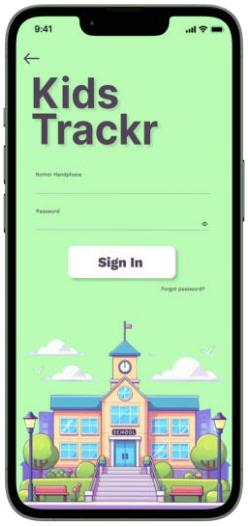

Figure 2. Login page

This page is where parents can log into their account using their pre-registered phone number and password. This allows access to all features and relevant information about their child's development.

Figure 3. Home Page

The home page presents a complete summary of the various features available in the application, providing quick and easy access to the various relevant sections. Users will find a complete list of the main menus.

Figure 4. Child Attendance Page

This page allows parents to view their child's attendance record at school. The information provided includes the complete daily attendance.

Figure 5. Child Skilled Assessment Page

This page contains information about the child's academic assessment, including quiz scores, assignments, and tests. Parents can also view their child's academic progress and additional notes from teachers here. By using the ANN (Artificial Neural Network) machine learning algorithm, this application can make final conclusions from existing assessments for children, and provide a more accurate picture of their progress and learning needs.

Figure 6. Message to Teacher page

This page allows parents and teachers to communicate with each other through in-app text messages. This facilitates effective communication between school and home.

Figure 7. Child Development Dashboard

The child development dashboard page in the application provides the child's development in the learning process and independent practice based on each category of learning.

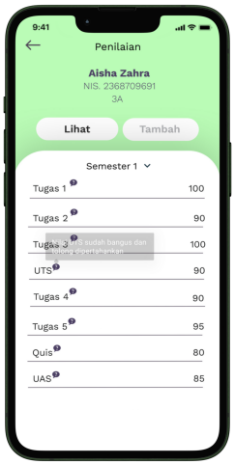

Figure 8. Student Assessment

This page is a place where teachers can see their students' grades according to the subjects they choose and can also add assessments and notes that are in accordance with the child's assessment.

Figure 9. Chatbot Page

The chatbot page in the application provides an instant communication medium for parents to get information about their child's development. This chatbot is equipped with NLP (Natural Language Processing) technology, allowing users to ask questions and receive answers automatically about various aspects of child development. With this chatbot, parents can easily and quickly get the information they need without having to wait for a response from the teacher.

4.2 System Testing Results

4.2.1 Functionality Testing (Black-box Testing)

Testing is done to evaluate the functionality of the main features of the application. This test uses a black-box approach that observes whether the system provides appropriate outputs against certain inputs without looking at the internal structure of the code.

4.2.2 User Validation Test

Conduct trials with several users representing parents and teachers at school to evaluate the readability and usability of the application through white box. Therefore, a survey was conducted by simulating the application at one school, namely the Laboratory Percontohan Upi Cibiru Elementary School. Then after simulating the application at the Upi Cibiru Pilot Laboratory Elementary School, a user satisfaction survey was conducted to collect feedback on user experience and features that need to be improved and the results obtained from this white box method are as follows.

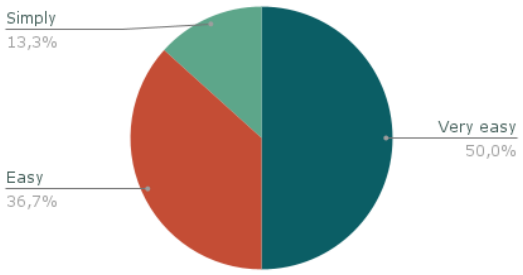

Figure 10. User satisfaction percentage

Most respondents, 50.5%, found the app ‘very easy’ to use. A significant proportion also stated that the app was ‘easy’ to use, at 36.7%. The combined total of these two categories was 87.30%, indicating that the majority of users found the app very easy to use.

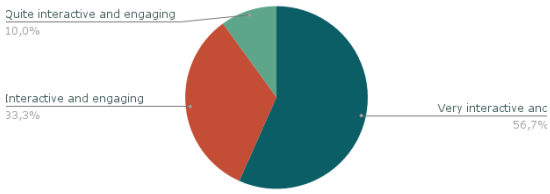

Figure 11. Interactive Percentage on Apps

Most respondents, 56.7%, felt that the app was ‘Very interactive and engaging’. In addition, a significant proportion, 33.3%, stated that the app was ‘Moderately interactive and engaging’. Thus, the combined total of these two categories

stands at 90%, indicating that the majority of users found the app interesting and interactive.

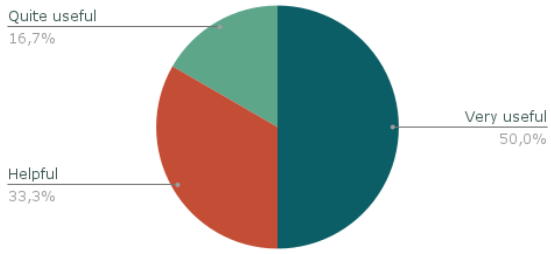

Figure 12. User usefulness percentage

Out of a total of 30 respondents, the majority, 50.0%, felt that the app was 'Very useful'. In addition, 33.33% of the respondents stated that the app was 'Helpful'. Thus, 83.33% of the total respondents found the app useful to varying degrees. Out of a total of 30 respondents, the majority found the app useful. A total of 24 out of 30 respondents found the app very useful or useful, while none found it less or not useful.

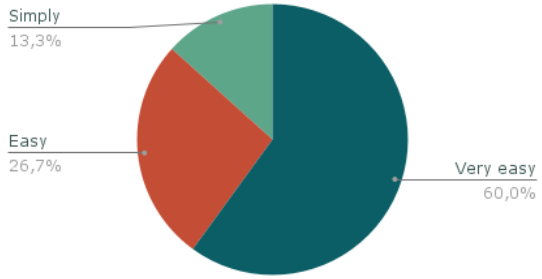

Figure 13. Percentage of Ease of Use of the application

Most respondents, 60.0%, found the app 'Very easy'. In addition, a significant proportion, 26.7%, stated that the app was 'Easy'. Thus, the combined total of these two categories stands at 86.7%, indicating that the majority of users found the app easy to use.

CONCLUSION

Based on the results of the design, development, implementation, and testing of a mobile-based elementary school child development monitoring information system called Kids Trackr, it can be concluded that this system is able to answer the problems that have been faced by schools and parents in documenting and monitoring children's development efficiently and accurately. The use of artificial intelligence technology through the Artificial Neural Network (ANN) algorithm allows the application to process and conclude children's academic data more intelligently and personally, making it easier for stakeholders to make educational decisions.

In terms of implementation, this application was successfully built using Flutter for the user interface and PHP and MySQL for backend and database management. The implementation results show that the app has an informative interface and is easy to use by different types of users, namely parents, students, and admins. Key features such as schedule monitoring, attendance, skill assessment, two-way communication between teachers and parents, and visualisation of child development dashboards have been successfully developed and function well.

The test results using the black-box method show that the main features of the application work functionally in accordance with the design. In addition, user validation from the pilot test at SD Laboratorium UPI Cibiru reinforces that this application is well received. Most users find the application easy to use, interactive, and provides real benefits in supporting the process of monitoring children's development more transparently and effectively.

Future research can further enhance the Kids Trackr system by integrating more advanced artificial intelligence models to improve the accuracy of student development analysis. In addition, future studies may involve larger datasets from multiple schools to evaluate the scalability and generalizability of the system. The integration of additional features such as real-time learning analytics, recommendation systems for learning improvement, and deeper communication tools between teachers and parents could also be explored. These improvements are expected to further strengthen the role of AI-based monitoring systems in supporting the educational development of elementary school students.

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