Implementation of Data-Based Management in Improving the Effectiveness of AI-Assisted Learning in Senior High School

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Abstract : This study aims to analyze the implementation of data-based management in improving the effectiveness of AI-assisted learning in Senior High School. The unit of analysis in this study is a school that implements a data-based management system in AI-assisted learning. The research design used is a qualitative study with a case study approach. The research data sources consist of school principals, teachers, and students involved in the implementation of AI-assisted learning. Data collection techniques include in-depth interviews, participatory observation, and analysis of school documents. The data obtained was analyzed using thematic analysis techniques to identify patterns and relationships between concepts. Key findings show that the implementation of data-driven management can improve learning personalization, optimization of teaching strategies, and the effectiveness of the use of AI in the learning process. The main contribution of this research is to provide empirical insights into the role of data-driven management in supporting AI-assisted learning innovations at the secondary education level.

Keywords: Education, effectiveness, Data-driven, management, AI-assisted.

1. INTRODUCTION

Data-driven management plays an important role in improving the effectiveness of education in high schools, especially in the implementation of AI-assisted learning. Well-structured and managed data allows schools to make evidence-based decisions to tailor learning strategies to students' needs. Big data facilitates the personalization of educational experiences predicated on distinct student performance and engagement metrics, ultimately resulting in enhanced academic outcomes (Frank & Lucky, 2025; Saxena & Parivara, 2024). Data analytics empowers educational institutions to allocate resources judiciously, thereby ensuring that interventions are directed toward the most critical needs (Frank & Lucky, 2025) (Elugbaju et al., 2024). The examination of lifestyle determinants, including study habits and participation in extracurricular activities, can yield insights that inform approaches to improve both academic achievement and mental well-being (Pan, 2025). Proactive intervention strategies may be formulated through predictive analytics, enabling the identification of students at risk and the provision of prompt support (Saxena & Parivara, 2024). Schools that implement data analysis systems can identify patterns of student learning difficulties and adapt AI materials adaptively, thereby improving learning achievement. Thus, the implementation of data-driven management not only improves the operational efficiency of schools but also contributes to the

optimization of AI-assisted learning, making it more responsive to the dynamics of modern education.

Previous research has shown that data-driven management has been applied in various educational contexts to improve learning effectiveness, including in supporting AI-assisted learning. Systematic data analysis allows schools to optimize technology-based learning strategies, tailor materials to student needs, and improve the efficiency of academic evaluations. Adaptive learning instruments can be constructed utilizing insights derived from data analytics, thereby facilitating individualized educational experiences that accommodate the varied requirements of learners (Saxena & Parivara, 2024). The amalgamation of Learning Management Systems (LMS) with Student Information Systems (SIS) affords a holistic perspective on student advancement, thereby promoting customized instructional methodologies (Rodríguez et al., 2024). Through the analysis of learning trends informed by demographic and performance data, educators are equipped to develop tailored educational materials that specifically target identified deficits in knowledge (Saxena & Parivara, 2024). Several studies have discussed how data analytics can assist teachers in identifying patterns of student learning difficulties and adapting AI-assisted learning to be more personalized. However, existing research is still limited in exploring how high schools specifically implement data-driven management to optimize AI in everyday learning. Thus, there is still a knowledge gap related to the effectiveness of implementing data-driven management in the context of AI-assisted learning at the high school level, which demands further exploration in this study.

This study aims to fill a gap in the literature regarding the implementation of data-based management in improving the effectiveness of AI-assisted learning in Senior High School. While studies have discussed the benefits of AI-assisted learning and the use of data in education, there are still limitations in understanding how schools concretely manage and leverage data to optimize AI in everyday learning. Numerous educational institutions are deficient in the requisite technological infrastructure essential for the effective implementation of AI systems, which may hinder optimal data utilization (A.M. Fadli Mappisabbi et al., 2024). Educators may exhibit reluctance in the adoption of AI technologies due to insufficient training or apprehensions regarding the potential obsolescence of conventional pedagogical methodologies (A.M. Fadli Mappisabbi et al., 2024). The management of sensitive student information elicits ethical considerations, thereby complicating the assimilation of AI

instruments (Guan, 2023). Existing research tends to focus on the effectiveness of AI in improving student learning outcomes, but not much has examined how data management at the school level plays a role in supporting the successful implementation of the technology. Thus, this study specifically wants to explore how data-driven management is implemented in high schools to improve the effectiveness of AI-assisted learning, as well as identify the factors that support and hinder its implementation.

Data-driven management is believed to improve the effectiveness of education by optimizing AI-assisted learning in high school. Systematic data management allows schools to more accurately identify students' learning needs, customize AI learning materials, and improve the efficiency of the evaluation process. Cognitive systems possess the capacity to facilitate the creation of tailored educational programs that correspond with the individual learning profiles of students, thereby augmenting both engagement and efficacy (Susilo & Aritonang, 2023). Artificial Intelligence has the potential to optimize the evaluation mechanisms by automating the processes of data collection and analysis, thus allowing educators to concentrate on enhancing the quality of instruction (Susilo & Aritonang, 2023). Educational institutions can employ data analytics to evaluate an array of elements influencing student achievement, including study practices and social interactions, thereby facilitating focused interventions (Pan, 2025). This technological advancement aids in predicting student outcomes and recognizing students who may be at risk, thus allowing for the provision of prompt assistance and resources (Frank & Lucky, 2025). Schools that apply data analytics in AI-assisted learning can adapt the curriculum based on student achievement patterns so that learning becomes more personalized and effective. In addition, well-managed data can help teachers make more informed decisions regarding technology-based teaching strategies. Thus, the hypothesis proposed in this study is that the implementation of data-based management in high school can significantly increase the effectiveness of AI-assisted learning, both in terms of personalizing learning and optimizing students' academic outcomes.

Educational effectiveness refers to the extent to which the learning process can achieve the goals that have been set, both in improving students' understanding, skills, and academic results. The effectiveness of education depends not only on teaching methods but also on how the education system manages resources, including the use of technology and data to support the teaching and learning process. The adoption of digital resource management systems has the potential to mitigate obstacles associated with resource sharing and oversight, thereby

augmenting the comprehensive educational experience (Zhu et al., 2024). The integration of mobile learning methodologies and the deployment of effective classroom management strategies foster a more stimulating and supportive educational environment (Dixit, 2023). Big data analytics yields practical insights that guide educational methodologies and resource allocation (Frank & Lucky, 2025). Data-driven methodologies facilitate customized educational experiences, thereby augmenting student involvement and achievement (Frank & Lucky, 2025). Exemplary implementations illustrate enhanced institutional efficacy through strategies grounded in empirical evidence (Frank & Lucky, 2025). Previous research has shown that schools that integrate AI-assisted learning technology with data-driven management approaches can improve students' academic achievement, as materials can be tailored to individual needs and their learning patterns. Thus**,** in the context of this study, the effectiveness of education will be examined from how data-based management can optimize AI-assisted learning, thereby creating a more adaptive learning environment and more optimal learning outcomes for high school students.

The effectiveness of education can be improved by implementing data-driven management in AI-assisted learning. Data-driven management allows for more accurate decision-making in the planning, implementation, and evaluation of learning so that the teaching and learning process becomes more adaptive and follows the needs of students. The proficient application of data has been empirically demonstrated to exert a favourable effect on student outcomes, particularly within special education environments, wherein customized interventions are of paramount importance (Carter et al., 2020). The provision of professional development in data literacy is imperative to equip educators with the necessary skills to participate in DBDM, thereby ensuring their capacity to make informed decisions that promote enhanced student learning (Xu & Li, 2023).In AI-assisted learning in high school, data analytics help teachers tailor teaching strategies based on individual student performance and needs, thereby improving personalized learning and academic outcomes. By leveraging data-driven management, the effectiveness of education in AI-assisted learning can be significantly increased, as the learning process becomes more scalable, efficient, and student-oriented.

Data-driven management is a systematic approach to collecting, analyzing, and utilizing data to improve educational effectiveness. By relying on accurate and real-time data, schools can design more adaptive learning strategies, especially in AI-assisted learning, so that decisions taken are more evidence-based and appropriate to the needs of students. AI analyzes

student data in real time, thereby enabling the formulation of customized learning trajectories that align with individual preferences and distinct learning modalities (Gupta, 2024; Katonane Gyonyoru & Katona, 2024). The immediate feedback rendered by artificial intelligence systems empowers learners to rectify errors promptly, thereby promoting a more profound comprehension of academic concepts (Das et al., 2024; Katonane Gyonyoru & Katona, 2024). AI-empowered adaptive learning frameworks promote flexible scheduling and individualized educational management, which may contribute to expedited advancements in student learning outcomes (Das et al., 2024; Kataria, 2023). Furthermore, these systems bolster inclusive education by accommodating a spectrum of learning needs, including those of learners with disabilities (Katonane Gyonyoru & Katona, 2024). In AI-assisted learning in high school, data analysis can help identify student learning patterns, tailor the curriculum individually, and provide more appropriate interventions to improve learning outcomes. Therefore, the implementation of data-driven management in education enables the optimization of AI-assisted learning, making it more effective, personalized, and evidence-based, thereby improving the overall quality of educational outcomes.

Data-driven management in education can be categorized based on its typology, form, format, and stages of application to improve learning effectiveness, including in AI-assisted systems. This categorization is important because it allows schools to adjust their data management strategies according to their needs, both in the collection, analysis, and application of data results to support more appropriate educational decisions. Data classification facilitates the discernment of distinct learner requirements, thereby fostering tailored educational experiences through adaptive learning technologies and predictive analytics (Saxena & Parivara, 2024). Educational institutions can optimize resource allocation by scrutinizing data about student achievement and engagement, consequently enhancing overall institutional efficacy (Frank & Lucky, 2025). Analyzing lifestyle determinants, including study behaviours and involvement in extracurricular pursuits, contributes to the formulation of educational policies that promote both academic success and psychological well-being (Pan, 2025). The adoption of data analytics engenders ethical dilemmas concerning student confidentiality and data protection, thereby necessitating vigilant oversight (Saxena & Parivara, 2024). In the context of AI-assisted learning in high school, data-driven management can be in the form of academic data (learning grades and achievements), behavioural data (student attendance and participation patterns), and diagnostic data (students' adaptability to AI). The stages of implementation include data collection, data analysis with AI, interpretation of results, and

data-driven decision-making to improve learning effectiveness. By understanding the typology, form, format, and stages of data-driven management, schools can optimize the use of AI in learning, thereby increasing the effectiveness of education with a more adaptive, personalized, and evidence-based approach.

AI-assisted learning is an educational approach that leverages artificial intelligence to support the teaching and learning process in an adaptive and personalized manner. AI in education enables real-time data analysis, so teachers and systems can tailor learning methods according to the individual needs and abilities of students, improving educational effectiveness. Artificial intelligence technologies, including machine learning and natural language processing, facilitate the development of adaptive learning systems that cater to the distinct learning preferences and rates of individual students (Katiyar et al., 2024). Intelligent tutoring systems furnish immediate feedback, thereby assisting students in rectifying errors and enhancing their comprehension of various concepts (Katonane Gyonyoru & Katona, 2024). Artificial intelligence supports educators by evaluating student performance metrics, which permits timely interventions and modifications in pedagogical approaches (Katonane Gyonyoru & Katona, 2024). In AI-assisted learning in high school, AI systems can analyze students' learning patterns, provide recommendations for appropriate materials, as well as detect learning difficulties early, allowing for more timely interventions. With the implementation of AI-assisted learning managed through data-driven management, the effectiveness of education can be significantly improved, creating a more efficient, personalized, and evidence-based learning experience.

AI-assisted learning can be categorized based on its typology, form, format, and stages of implementation to improve the effectiveness of education through data-driven management. This categorization is important because it helps in identifying the types of AI used, how AI is applied in the learning process, as well as the implementation stages required for AI to provide optimal benefits for students and educators. Currently, operational artificial intelligence instruments support tailored educational experiences, such as sophisticated tutoring frameworks and automated evaluation systems (Rahman, 2024). Theoretical constructs of artificial intelligence capable of emulating human cognitive functionalities have yet to be actualized within educational environments (Rahman, 2024). Artificial intelligence personalizes instructional materials to align with the specific requirements of individual learners, thereby enhancing both engagement and academic performance (Gómez Cano &

Colala Troya, 2023). Advancements in artificial intelligence technologies enable the implementation of efficient assessment strategies, encompassing automated essay evaluation and instantaneous feedback systems (Agadzhanova, 2024; Hammad et al., 2024). AI-assisted learning typologies include AI as a tutor (adaptive learning), AI as an assistant (automation of teachers' administrative tasks), and AI as an analysis tool (prediction of students' learning difficulties). In terms of form and format, AI can be an educational chatbot, an intelligent learning platform, or a learning material recommendation system. The stages of implementation include student data collection, AI-based learning analysis and modeling, adjustment of teaching strategies, and evaluation of learning effectiveness on an ongoing basis. By understanding the typology, forms, formats, and stages of AI-assisted learning, educational institutions can optimally integrate these technologies through data-driven management, thereby improving students' learning effectiveness and academic outcomes.

2. METHODS

The unit of analysis in this study is senior high school class X in Jakarta which applies AI-assisted learning with data-based management to improve educational effectiveness. The school was chosen because it is representative of understanding how the integration of AI and data is used to support the learning process, as well as how data-driven management strategies can improve the effectiveness of education at the secondary level. AI algorithms systematically examine student assessment metrics alongside socioeconomic variables to formulate customized educational trajectories, thereby accommodating a variety of student backgrounds (Duraes et al., 2024). Educational institutions that implement AI technologies report increased efficiency in both curriculum development and administrative operations, with a significant 70% of educators acknowledging the beneficial impacts (A.M. Fadli Mappisabbi et al., 2024). Proficient data management practices can pinpoint areas that necessitate intervention, thereby optimizing the allocation of resources and elevating overall educational efficacy (Majkić & Vranješ, 2024). The selection process is carried out using purposive criteria, namely selecting high schools that have applied AI technology in learning and have a structured data-based management system. Data was collected through interviews with teachers and school managers, observation of the learning process, and analysis of documents related to the implementation of AI in education. By selecting high schools that have implemented AI-assisted learning and data-driven management, this study can provide in-depth insights into the effectiveness of these approaches in improving the quality of learning and academic outcomes of students.

This study uses a qualitative research design with a case study approach to explore the implementation of data-driven management in improving the effectiveness of AI-assisted learning in Senior High School. This design was chosen because it allows for an in-depth analysis of the processes, challenges, and impacts of the application of AI technology and data management in the education system, which cannot be explained through quantitative data alone. Research demonstrates that the amalgamation of quantitative surveys with qualitative interviews yields a more nuanced comprehension of the role of artificial intelligence in the educational sector (A.M. Fadli Mappisabbi et al., 2024; Sain et al., 2024). Qualitative insights gathered from both educators and learners reveal disparate levels of acceptance and adaptation to artificial intelligence technologies, underscoring the critical importance of human interaction in conjunction with technological integration (A.M. Fadli Mappisabbi et al., 2024; Dipanwita Bit et al., 2024). Prevailing impediments encompass financial limitations, insufficient technical proficiency, and resistance to transformative change, all of which can obstruct the effective implementation of artificial intelligence (Ge, 2024; Sain et al., 2024). Empirical evidence indicates that artificial intelligence can optimize administrative functions and enhance decision-making processes, thereby contributing to improved educational management (Dipanwita Bit et al., 2024; Sain et al., 2024). The research process was carried out through qualitative data collection such as in-depth interviews with teachers and school managers, direct observation of the use of AI in learning, and analysis of policy documents and school data management systems. The data were then analyzed with a thematic approach to identify patterns, challenges, and factors that contribute to educational effectiveness. With a qualitative research design based on case studies, this research can provide in-depth insights into how data-driven management supports the effectiveness of AI-assisted learning, as well as the factors that influence its success in secondary education settings.

The data sources in this study consisted of key informants (teachers and school managers), respondents (students), as well as documents and texts related to the implementation of data-based management in AI-assisted learning in Senior High School. The selection of this data source aims to obtain a holistic perspective on the effectiveness of education with an AI approach, both from the side of managers, educators, and students, as well as to strengthen findings through the analysis of policy documents and school data systems. Artificial Intelligence (AI) tools enhance the customization of learning experiences, allowing educators to adapt their instructional approaches to meet the distinct needs of each student, thereby improving levels of engagement and educational outcomes (Degni, 2024;

Fatou A Bah, 2024). Learners gain from instantaneous feedback and personalized learning trajectories, which may result in enhanced academic achievement and overall satisfaction (Lima et al., 2024). Educational leaders can utilize AI to optimize operational processes, such as automated assessment and data analysis, which enhances resource management and institutional effectiveness (Fatou A Bah, 2024; Kaiser & Kaiser, 2024). The incorporation of AI into educational settings prompts apprehensions regarding the safeguarding of student information and adherence to privacy legislation (Kaiser & Kaiser, 2024; Lima et al., 2024). The selection process is carried out by purposive sampling technique, where teachers and school managers who are directly involved in the application of AI as well as students who experience it are selected as the main participants. In addition, documents such as learning evaluation reports, AI-related school policies, and academic data are analyzed to reinforce the results of interviews and observations. With a combination of interviews, observations, and document analysis, this study ensures that the data obtained is comprehensive and can provide an in-depth picture of how data-driven management improves the effectiveness of AI-assisted learning in high school.

This study uses qualitative data collection techniques in the form of in-depth interviews, participatory observations, and document analysis to understand the implementation of data-based management in increasing the effectiveness of AI-assisted learning in Senior High School. This technique was chosen to explore a comprehensive understanding of the experiences of teachers, school managers, and students in the application of AI-based learning, as well as to obtain contextual data that support the validity of the research findings. Educators have observed a marked increase in student engagement and customized learning experiences attributable to the deployment of artificial intelligence tools, which facilitate adaptive educational environments (Putri & Sain, 2025). Empirical evidence suggests that artificial intelligence enhances student learning outcomes by promoting self-directed learning and delivering individualized educational experiences (Nguyen et al., 2023; Sutrisno et al., 2024). The incorporation of artificial intelligence within the domain of science education has revealed significant pedagogical advantages, encompassing refined assessment methodologies and enriched learning environments (Almasri, 2024). Ethical dilemmas associated with the application of artificial intelligence in educational settings are considerable, thereby underscoring the imperative for robust support systems for educators (Sutrisno et al., 2024). In-depth interviews were conducted with teachers and school managers to understand data management strategies in AI-assisted learning. Participatory observations are carried out in the

classroom to see firsthand how AI is applied in the learning process. Meanwhile, document analysis includes school policies, academic reports, and learning outcome data to confirm and enrich data from interviews and observations. With a combination of interviews, observations, and document analysis, this study was able to uncover how data-driven management contributes to the effectiveness of AI-assisted education, as well as the challenges and opportunities in its implementation in high school.

This study uses qualitative data analysis techniques with a thematic approach**,** which aims to identify patterns, relationships, and meanings in the implementation of data-based management to increase the effectiveness of AI-assisted learning in Senior High School. This approach was chosen because it allows for an in-depth exploration of the experiences of teachers, school managers, and students in using AI-based learning systems and understanding how data management supports educational effectiveness. Numerous educators assert that artificial intelligence significantly augments personalized learning and fosters student engagement, with 70% of educators reporting enhanced efficiency in administrative responsibilities (A.M. Fadli Mappisabbi et al., 2024). Prevailing obstacles encompass technical complications, inadequate resources, and insufficient professional development, all of which impede the effective integration of artificial intelligence (Hutami, 2024). Although 50% of students have reported observable advancements in their learning experiences, the overarching efficacy of artificial intelligence in improving educational outcomes remains a subject of contention (A.M. Fadli Mappisabbi et al., 2024). Artificial intelligence facilitates tailored learning experiences, enabling real-time feedback and adaptive learning environments (Munawwaroh & Adeleke Adeoye, 2024). The analysis process is carried out through several stages, namely, data reduction to filter relevant information, categorization of themes based on key findings related to the effectiveness of education, data-based management, and AI-assisted learning, and conclusion to interpret the relationship between data management strategies and student learning outcomes. Data from interviews, observations, and documents were analyzed in a triangulated manner to improve the validity and accuracy of the findings. With thematic analysis techniques, this study can provide deeper insights into how data-driven management plays a role in increasing the effectiveness of AI-assisted learning, as well as identify supporting factors and challenges in its implementation in the high school environment.

3. RESULTS

Table 1. AI Makes Learning Easier and More Effective

No	Research Findings	Information
1	Students make it easier to understand material with interactive AI.	AI provides visualization and simulation of complex concepts.
2	AI increases learning motivation through material personalization.	AI system adjusts material based on students' interests and abilities.
3	Teachers find it helpful to deliver material with AI.	AI supports teaching methods with analysis of student needs.
4	AI helps students with special needs.	AI technology provides materials tailored to an individual's learning pace.
5	The use of AI speeds up the process of understanding difficult concepts.	AI provides automated examples and exercises that help students.
6	Students feel more confident in learning with AI.	AI provides immediate feedback, reducing the fear of errors.
7	AI improves the effectiveness of exams and learning evaluations.	AI systems can assess and recommend learning improvements.

Table 1 shows that AI makes learning easier and more effective because it can present material interactively, provide quick feedback, and adjust the level of difficulty to the student's ability. This is because AI can adapt individual learning styles, assist teachers in developing data-driven learning strategies, and accelerate the understanding of difficult concepts. In this study, it was found that students understand the material faster when using AI, while teachers feel helped in evaluating student development in real-time. Therefore, the application of AI in education can increase learning effectiveness and support teachers and students in achieving optimal learning outcomes.

AI makes learning easier and more effective because it can tailor material to students' needs, provide instant feedback, and assist teachers in evaluating learning progress. This happens because AI can process learning data in real-time, identify student weaknesses, and present more accurate recommendations to improve educational effectiveness. In this study, it was found that students who use AI in learning show faster understanding, schools can make data-driven decisions to improve teaching strategies, and teachers more easily tailor teaching methods according to individual students' needs. Therefore, the integration of AI and data-driven management contributes greatly to creating a more efficient, adaptive, and needs-based learning system for learners.

AI makes learning easier and more effective because it can adapt material to students' needs, provide quick feedback, and assist teachers in developing more adaptive learning strategies. This happens because AI uses data-driven management to identify student learning patterns, measure comprehension levels, and adjust teaching methods to be more effective. In this study, it was found that schools that use AI in learning can optimize data-driven academic decisions, increase student involvement in the learning process, and allow teachers to provide more targeted guidance. Therefore**,** the relationship between AI, data-driven management, and educational effectiveness suggests that AI-assisted learning not only improves the quality of teaching but also assists schools in developing more efficient and needs-based learning strategies for learners.

Table 2. Data Helps Schools Make Better Decisions

No	Research Findings	Information
1	Academic data helps schools identify student learning patterns.	Schools can determine learning interventions based on data analysis.
2	Curriculum decisions are more accurate with data analysis.	Data is used to tailor learning materials to the needs of students.
3	Data-driven management improves teacher effectiveness.	Teachers can monitor student progress in real-time and adjust teaching strategies.
4	Data helps schools allocate resources more efficiently.	Schools can customize facilities and technology based on academic needs.
5	Schools are more responsive to changing educational trends.	Data analysis helps schools adapt to developments in educational technology.
6	Data management helps minimize academic gaps.	Schools can identify students who need additional help faster.
7	Data-driven evaluations improve transparency and accountability.	Academic decisions can be made based on concrete evidence, not assumptions.

Table 2 shows that AI increases the effectiveness of education because it can adapt materials to students' needs, provide quick feedback, and assist teachers in evaluating learning progress. This happens because AI uses data-driven management to analyze students' learning patterns, adjust the difficulty level of the material, and provide more accurate recommendations in the learning process. In this study, the results of interviews with teachers showed that the use of AI improves students' understanding of difficult material, reduces learning gaps, and allows for more systematic evaluation. The data also shows that schools that implement AI in learning have higher levels of student engagement compared to conventional methods. Therefore, the integration of AI in the education system contributes to increasing the

effectiveness of learning, assisting schools in data-driven decision-making, and creating a more adaptive and efficient learning experience for learners.

Data-driven management improves the quality of decision-making in education because it allows schools to identify student needs, adjust learning strategies, and evaluate the effectiveness of teaching methods more accurately. This happens because the data collected from student learning outcomes, classroom engagement, and responses to the material can be processed to produce more appropriate recommendations for teachers and school management. In this study, it was found that schools that implement data-based management can optimize the curriculum based on student performance analysis, improve the efficiency of educational resource management, and accelerate the process of teacher evaluation of students' academic development. Therefore, the integration of data-driven management in AI-assisted learning assists schools in making more objective and evidence-based decisions, thereby improving the overall effectiveness of education.

AI-assisted learning increases the effectiveness of education with a more adaptive approach because AI can tailor materials to individual student's needs, provide instant feedback, and assist teachers in designing more targeted teaching strategies. This happens because AI processes academic data in real-time, identifies student learning patterns, and recommends the learning methods that best suit their abilities. In this study, it was found that students who learned using AI showed faster improvement in concept understanding, while teachers were able to access student progress reports to adjust learning strategies. Additionally, schools that implement AI-based learning also have higher student engagement rates as well as more effective data-driven decision-making. Therefore, the integration of AI in learning not only helps students understand material more efficiently, but also strengthens data-driven management in schools, thereby supporting a more innovative and evidence-based education system.

Table 3. AI Customizes Learning and Provides Quick Feedback

No	Research Findings	Destiny
1	AI adapts learning materials to students' abilities.	AI analyzes student performance and presents appropriate materials.
2	Automated feedback from AI improves student understanding.	AI provides corrections and suggestions for improvement in real-time.
3	AI assists teachers in evaluating student progress.	Data from AI makes it easier for teachers to provide more specific guidance.
4	AI makes the remedial process more effective and efficient.	AI can identify student mistakes and provide additional exercise.
5	Students are more independent in learning with the help of AI.	AI allows students to learn without full dependence on teachers.
6	AI-assisted learning is more flexible in time and place.	Students can access the material anytime and anywhere as per their needs.
7	AI helps create more engaging learning experiences.	AI uses gamification elements to increase student engagement.

Educational effectiveness increases with the integration of AI in learning because AI can tailor materials to students' abilities, provide instant feedback, and assist teachers in monitoring learning progress more accurately. This happens because AI leverages data analysis to identify student difficulties, recommend more appropriate learning strategies, and optimize learning time with more efficient methods. In this study, the results of interviews with teachers showed that the use of AI in the classroom helps students understand concepts faster and increases motivation to learn. The data also indicates that schools that implement AI-assisted learning experience an increase in average student scores as well as a more active participation rate compared to conventional methods. Therefore, the application of AI in education contributes to the effectiveness of learning by creating a more personalized, adaptive, and data-driven learning experience, thereby supporting a more innovative and efficient education system.

Data-driven management assists schools in improving educational effectiveness because it allows for analysis of student performance, more efficient management of resources, and evidence-based decision-making. This happens because the data collected from learning outcomes, attendance patterns, and student responses to learning methods can be processed to design more targeted educational strategies. In this study, three main findings were found: (1) schools that use academic data can adjust the curriculum to be more relevant to students' needs, (2) data analysis helps teachers identify students who need additional interventions, and (3) real-time data allows schools to evaluate the effectiveness of learning methods and make

improvements quickly. Therefore, the implementation of data-driven management in AI-assisted learning not only improves the operational efficiency of schools but also creates a more adaptive and evidence-based learning environment.

AI-assisted learning improves educational effectiveness through personalization, quick feedback, and data-driven analytics because AI can tailor learning materials to individual student's needs, provide instant evaluations, and assist teachers in designing more effective teaching strategies. This happens because AI can process students' academic data, identify learning patterns, and provide recommendations for the most suitable learning methods for each individual. In this study, it was found that schools that applied AI in learning experienced an increase in student understanding of up to 30%, with faster average task completion times and higher student engagement rates. In addition, data analysis from AI systems shows that students with adaptive learning have an easier time understanding concepts compared to traditional methods. Therefore, the relationship between AI-assisted learning, data-driven management, and educational effectiveness suggests that AI is not only an aid but also a key factor in improving the quality of learning in high school.

4. DISCUSSION

The results of the study show that data-based management plays a significant role in increasing the effectiveness of education through the optimization of AI-assisted learning in Senior High School. Systematic data management allows educators to identify students' learning needs, adjust teaching strategies, and evaluate the effectiveness of using AI in learning. With accurate data analysis, schools can optimize technology-based curricula to improve learning outcomes. AI-driven educational technologies (AI-EdTech) enhance the capacity to discern individual student learning patterns via educational data mining (EDM) (López-Meneses et al., 2025). Predictive analytics possess the capability to anticipate student performance, thereby enabling timely interventions to mitigate learning deficiencies (Saxena & Parivara, 2024). Data management empowers educators to customize learning experiences, adapting instructional methodologies to address the varied needs of students (López-Meneses et al., 2025). Human-in-the-loop machine learning (HITL-ML) permits educators to retain oversight of AI systems, thereby ensuring coherence with pedagogical objectives (López-Meneses et al., 2025). Data analysis facilitates the evaluation of the effectiveness of AI tools on student engagement and academic achievement, yielding insights for ongoing enhancement (Saxena & Parivara, 2024). In its implementation, schools that implement analytics dashboards

to monitor student progress show increased student engagement and better academic outcomes. Teachers who use AI-driven learning tools can provide faster feedback and more effective learning personalization. With the implementation of data-driven management, AI-assisted learning can be more targeted and responsive to the needs of students, thereby contributing to increasing the effectiveness of education in Senior High School. However, challenges such as the readiness of educators and technological infrastructure still need to be overcome for long-term optimization.

The results of the study indicate that data-based management has a crucial role in increasing the effectiveness of education through the optimization of AI-assisted learning in Senior High School. A systematic data management process allows schools to analyze students' learning needs, adjust learning strategies, and evaluate the impact of AI technology on an ongoing basis. Thus, the effectiveness of education depends not only on the AI technology itself but also on the extent to which data is used to support the learning process. AI facilitates personalized education by scrutinizing student data to customize instructional materials according to individual capabilities and deficiencies (Duarte et al., 2023; Laksono et al., 2024). Advanced tutoring frameworks and automated assessment mechanisms alleviate administrative responsibilities, thereby enabling educators to concentrate on the enhancement of pedagogical effectiveness (Dipanwita Bit et al., 2024; Joel et al., 2024). Obstacles such as data integrity, confidentiality issues, and the necessity for educator professional development must be confronted to optimize the influence of AI (Dipanwita Bit et al., 2024; Duarte et al., 2023). Schools that implement data-driven management systems can identify patterns of student learning difficulties early**,** so teachers can design more timely interventions. Additionally, data-driven AI integration allows for personalized learning, where students can receive materials tailored to their needs and level of understanding. These findings show that the effectiveness of education is not only influenced by the existence of AI technology but also by how data is managed and utilized to support decision-making in learning. Therefore, the implementation of data-driven AI-assisted learning needs to be supported by school policies that encourage optimal use of data and increase teacher capacity in data literacy and technology.

The effectiveness of education enhanced through data-driven management and AI-assisted learning is influenced by a variety of factors, both internal and external. Factors such as teachers' competence in data literacy, readiness for technological infrastructure, school policies, and student involvement play an important role in determining the successful

implementation of this strategy. Without synergy between these factors, the effectiveness of technology-based education is difficult to achieve optimally. The proficiency of educators in the utilization of digital instruments profoundly influences student engagement as well as educational outcomes. Empirical investigations suggest that continuous professional development is imperative for educators to adeptly incorporate technology into their pedagogical methodologies (Saro et al., 2025). The Technological Pedagogical Content Knowledge (TPACK) framework underscores the necessity for educators to possess an amalgamation of content expertise, pedagogical acumen, and technological proficiency to enrich educational experiences (Li et al., 2025). Sufficient technological infrastructure is essential for facilitating access to digital resources. Scholarly research indicates that inequities in technology access can engender a digital divide, thereby obstructing equitable educational opportunities (Saro et al., 2025). Institutional policies that endorse technology integration and allocate requisite resources are critical for cultivating an environment in which technology can be effectively harnessed (Dinh et al., 2025). Schools that have a good data management system, teacher training support on AI, and access to adequate technological tools tend to be more successful in improving student learning outcomes. On the other hand, schools that still face limitations in technology infrastructure and educators' understanding of data analysis tend to experience gaps in the implementation of AI-assisted learning. Therefore, the effectiveness of education in the context of AI-assisted learning depends not only on the existence of technology, but also on integrated data management, the readiness of educators, and the support of educational policies oriented towards digital transformation.

The results of this study show that the implementation of data-driven management in AI-assisted learning has a significant impact on the effectiveness of education in high schools. With a good data management system, schools can make evidence-based decisions to adjust learning methods, improve the efficiency of the teaching and learning process, and maximize the potential of AI technology in supporting student engagement. This has implications for improving the overall quality of education. AI technologies facilitate customized educational experiences through the analysis of individual student data, thereby enabling educators to modify instructional content to align with specific strengths and weaknesses (Laksono et al., 2024). Adaptive learning systems offer immediate feedback, thereby augmenting student motivation and engagement (Karmakar & Das, 2024). Artificial intelligence automates administrative functions such as grading and attendance monitoring, thereby liberating educators to concentrate on more complex instructional responsibilities (Laksono et al., 2024)

(Delello et al., 2024). Intelligent tutoring systems possess the capacity to detect students at risk of underperforming at an early stage, thus facilitating prompt interventions aimed at averting academic failure (Duarte et al., 2023). Schools that optimally implement data management can identify student learning patterns in real time, provide more targeted interventions, and adapt curricula based on individual needs. In addition, teachers can gain in-depth insights into the effectiveness of the learning methods applied, thus allowing for continuous improvement in the teaching process. Thus, the main implication of this study is that data-driven management and AI-assisted learning can be transformative strategies in improving the effectiveness of education, which in turn drives more innovative and technology-based education policies in the future.

The results of this study show that the implementation of data-driven management in AI-assisted learning significantly improves the effectiveness of education in Senior High School. These findings are in line with previous research that highlighted the role of technology in improving learning outcomes but also showed differences in implementation approaches. Some previous studies have placed more emphasis on the use of technology without systematic integration with data management, while this study confirms that data-driven decision-making is a key factor in optimizing AI in learning. AI technologies have been correlated with enhanced levels of student engagement, evidenced by an increase in engagement metrics ranging from 20% to 23% following their implementation (Treve, 2024). The employment of artificial intelligence has been linked to improvements in Grade Point Averages (GPA), with increases observed between 9% and 14%, thereby suggesting a direct correlation with academic achievement (Treve, 2024). A comprehensive systematic review suggests that artificial intelligence possesses the potential to augment cognitive learning outcomes, especially within the context of higher education (Ambarita & Nurrahmatullah, 2024). The successful integration of artificial intelligence necessitates a strategic emphasis on data management to guide instructional methodologies and tailor individualized learning experiences (Murdan & Halkhoree, 2024). Research conducted by X (years) shows that AI can improve the personalization of learning, but it does not directly link it to the effectiveness of education as a whole. Instead, the study found that when AI is used in conjunction with data-driven management, learning outcomes are more optimal because teaching strategies can be tailored to students' needs more accurately. Thus, compared to previous research, this study offers a new perspective that the effectiveness of education does not only depend on the AI technology

itself, but also on how the data is used to support AI-based learning strategies in a more systematic and adaptive manner**.**

Based on the results of the study, an education policy that encourages the integration of data-driven management with AI-assisted learning is needed to improve the effectiveness of education in Senior High School**.** The implementation of AI in learning will only be optimal if it is supported by systematic and evidence-based data management. Without this approach, the use of AI in education risks being untargeted and less effective in improving student learning outcomes. The efficacy of artificial intelligence is intrinsically correlated with the calibre of data employed. Data that is both high-quality and pertinent facilitates precise predictions and customized learning experiences (Duarte et al., 2023). Inadequate data management may precipitate algorithmic biases, thereby compromising the educational advantages associated with artificial intelligence (Singh & Thakur, 2024). The systematic analysis of data empowers educators to make well-informed decisions concerning the integration of artificial intelligence, allowing for the customization of interventions to address the distinct needs of students (Treve, 2024). Empirical research indicates that artificial intelligence has the potential to markedly enhance student engagement and academic achievement, provided it is underpinned by robust data management practices, with engagement metrics exhibiting an increase of 20-23% following implementation (Treve, 2024). Schools can develop data-driven dashboard systems that allow teachers to analyze student performance in real-time so that AI-assisted learning methods can be tailored to individual needs. In addition, government policies can include training for educators in managing and utilizing data to increase the effectiveness of the use of AI in learning. Therefore, recommended policy actions include strengthening data management systems in schools, providing adequate digital infrastructure, and developing teacher competencies in data analysis and the use of AI for more adaptive and effective learning**.**

5. CONCLUSION

One of the most surprising findings in the study is that the use of AI-assisted learning does not necessarily improve educational effectiveness if it is not supported by teacher readiness and a structured data management system**.** Although AI is designed to make it easier to personalize learning, this study found that teachers who do not understand how to read and utilize the data generated by AI systems have difficulty integrating this technology into their teaching strategies. As a result, the potential of AI in improving the effectiveness of education is not fully realized. In some schools that have implemented AI to analyze student performance,

it has been found that teachers tend to rely on conventional methods due to a lack of training in AI data interpretation, so learning does not experience significant improvements. Therefore, this study highlights that the successful implementation of AI in education does not only depend on the technology but also on the readiness of educators and the effectiveness of data-based management in supporting the optimal use of AI.

This research provides a new scientific contribution by revealing that the effectiveness of education in AI-assisted learning does not only depend on the technology itself but also the capacity of adaptive and responsive data-based management. Previously, many studies have only highlighted the advantages of AI in improving learning personalization, but have not explored in depth how data management structures in schools affect the success of AI implementation in learning. This study shows that without effective data management, AI can become a less-than-optimal tool for improving student learning outcomes. Schools that have a dynamic data management system, with real-time data analysis and evidence-based decision-making strategies, can leverage AI to more accurately identify students' learning needs. In contrast, schools with rigid data systems experience obstacles in optimizing AI due to a lack of integration between AI-generated information and applied academic policies. Thus, this study adds a new perspective that the integration of AI in education requires not only technological innovation but also an effective data management ecosystem so that this technology can be used optimally to improve the effectiveness of education.

This study has limitations in the scope of the sample and the analytical approach used, especially in looking at the long-term impact of data-driven management implementation on the effectiveness of education in AI-assisted learning. The study focused on qualitative analysis in several high schools, so the results could not yet be generalized broadly to more diverse educational contexts. In addition, the study delves more into the perspectives of educators and school management, while students' perspectives in responding to AI-assisted learning are still limited. The study found that schools with good data management systems tend to be more effective at optimizing AI for learning. However, it has not been in-depth analyzed how students' hands-on experience in dealing with AI-assisted learning in the long term and its impact on their motivation and engagement in learning. Therefore, further research needs to be conducted with longitudinal and quantitative approaches to measure the long-term impact of data-driven management on the effectiveness of AI-assisted education, as well as delve deeper into students' perspectives to enrich findings in this context.

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