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Adaptive Learning Based on Artificial Intelligence Technology in Improving the Quality of Graduates (Case Study of SDN 4 Ciseureuh Students in the Context of Digitalization)

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ABSTRACT

Artificial Intelligence technology is implemented through a learning platform that is able to automatically adjust the material based on individual student performance and interests. However, in the realities at school, there are still many students who have difficulty in utilizing this technology. The purpose of this study is to analyze the application of adaptive learning integrating artificial intelligence (AI) technology and its impact on improving the quality of graduates. The research method used is a descriptive qualitative method with a case study approach. Data was collected through participatory observation, in-depth interviews, and documentation. The results of the study show that (1) the integration of AI in adaptive learning can significantly improve the quality of graduates because the material is presented according to the level of understanding; (2) Teachers' time efficiency in assessing and mapping student competencies. This study concludes that AI technology as an instrument is used in learning activities so that it can improve the quality of graduates.

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1. INTRODUCTION

Education at the elementary school level is a crucial foundation in shaping students' character and basic competencies before stepping to a higher level. In the era of the industrial revolution, educational challenges are increasingly complex with the diversity of students' learning speed and cognitive styles in one class. Conventional *one-size-fits-all* learning often fails to provide optimal educational services for each individual. Therefore, a paradigm transformation is needed towards adaptive learning that is able to adjust materials, methods, and learning speed based on the specific needs of each student. Rusman (2018), learning is a systemic process that involves interaction between students and educators as well as learning resources in a learning environment. However, as the times progress, this definition is evolving towards the use of technology to create flexibility. Adaptive learning itself is defined as an instructional method that uses computer algorithms to organize interactions with learners and present custom resources and learning experiences to meet the unique needs of each learner (Walkington & Bernacki, 2019). In this context, technology is no longer just an aid, but a strategic partner in personalizing the curriculum.

The integration of Artificial Intelligence (AI) technology is the main catalyst in realizing adaptive learning in elementary schools. As stated by Luckin et al. (2016), AI in education has great potential to support teachers through intelligent tutoring systems that provide instant feedback to students. AI is able to analyze learning activity data in *real-time*, detect student weaknesses, and provide targeted material recommendations. At SDN 4 Ciseureuh, the challenge of improving the quality of graduates in the midst of the limited ratio of teachers to students requires a technological solution that can accompany the learning process independently but is still monitored. The quality of graduates is an indicator of the success of an educational institution which includes cognitive, affective, and psychomotor aspects. Sallis (2012) stated that the quality of education is about meeting the needs of customers, in this case students and the community, to the set competency standards. In the context of elementary school, the quality of graduates is not only measured by exam scores, but also by their readiness to face the increasingly dominant digital ecosystem. By implementing AI technology, SDN 4 Ciseureuh seeks to equip its students with digital literacy skills from an early age while ensuring maximum academic achievement through a personalized approach.

The gap between a dense national curriculum and a varied student absorption capacity often triggers low motivation to learn in primary schools. The implementation of AI in adaptive learning at SDN 4 Ciseureuh is expected to bridge this gap. Through the AI-based platform, teachers can focus more on character coaching and creativity, while routine tasks such as diagnostic assessments and practice repetitive questions can be managed automatically by the system. This approach will theoretically create a more inclusive learning environment and increase students' confidence in mastering basic competencies. Based on this background, this study aims to explore the effectiveness of AI integration in adaptive learning models at SDN 4 Ciseureuh. The main focus lies in how this technology is able to transform the instructional process so that it has a direct impact on improving the quality of learning outcomes. Through an in-depth analysis of the application of this technology, it is hoped that a learning pattern or model can be found that can be replicated by other schools in an effort to improve the quality of basic education nationally in the future.

2. METHODS

This research uses a case study approach with the aim of exploring in depth the phenomena, events, and behaviors of the integration of Artificial Intelligence (AI) technology in adaptive learning. According to Creswell and Poth (2018), qualitative research is a method to explore and understand the meaning that a number of individuals or groups of people consider to be derived from social or humanitarian problems. The selection of the case study approach is considered the most relevant because the researcher intends to provide a detailed and contextual overview of the implementation of specific AI technology carried out in the SDN 4 Ciseureuh environment, so that a comprehensive understanding of the process and its impact on the quality of graduates is obtained. Suharyanto H. Soro (2023) defines a case study as a scientific activity that is carried out consciously, both single and plural problems using observation, interview, questionaire, and documentation data collection methods or the like so that they can describe and exploit the findings comprehensively and in depth.

The sample in this study was selected by *purposive sampling*, which is a method of collecting data through respondents that have been determined with rational consideration. The respondents in this study are school principals, classroom teachers who apply AI technology, and SDN 4 Ciseureuh students who are directly involved in the adaptive learning process. The determination of respondents aims to obtain rich and accurate information or data from various perspectives of stakeholders who have direct experience of digital transformation in the school, so that the validity of data contextually can be accounted for.

The data collection method was carried out through triangulation of sources and techniques, which included participatory observation, in-depth interviews, and documentation studies. As explained by Suharyanto H Soro (2023), in educational research, the use of the right instruments greatly determines the validity of the data obtained, where direct observation and in-depth interaction through

interviews can reveal phenomena that are not captured by statistical numbers. The observation method is carried out to observe the interaction between students and the AI platform during the learning process. In-depth interviews were directed to explore educators' perceptions of the effectiveness of adaptive systems in assisting the instructional process. Meanwhile, documentation in the form of report card scores, AI-based assessment results, and graduate profiles are used as supporting data to see trends in quality improvement. In line with the opinion of Miles, Huberman, and Saldaña (2014), the use of various data collection techniques aims to ensure the objectivity and credibility of research findings.

The data analysis technique follows an interactive model developed by Miles, Huberman, and Saldaña (2014), which includes three simultaneous flow of activities, namely data reduction, data presentation, and conclusion or verification. Data reduction is carried out by summarizing and focusing field data on matters related to the effectiveness of AI-based adaptive learning. Furthermore, the data is presented in the form of a systematic descriptive narrative so that the pattern of relationships between variables can be clearly seen. The final stage is the drawing of conclusions that are carried out continuously throughout the course of the study to ensure that the resulting findings have a strong evidence base from the field.

To ensure the validity of the data, the researcher applies qualitative validity standards through credibility, dependability, and confirmability tests. One of the steps taken is through *a member check*, where the results of the interview are confirmed back to the informant to ensure that there is no misinterpretation of the information provided. In addition, the researcher conducted observation diligence by being intensively involved in a certain duration of time at SDN 4 Ciseureuh. This is done to ensure that all phenomena related to technological adaptation and the dynamics of student learning quality are recorded honestly and in accordance with the objective reality at the research site.

The research instrument in this qualitative study places the researcher as a key instrument (*human instrument*). According to Lincoln and Guba (as quoted in Moleong, 2017), researchers as instruments have the advantage of adjusting to various realities in the field and can immediately understand the relationship between realities encountered during the AI integration process at SDN 4 Ciseureuh. However, to maintain objectivity, the researcher is assisted by supporting instruments in the form of semi-structured interview guidelines and validated observation sheets. These guidelines serve as a guide so that data mining regarding students' adaptive behavior when interacting with artificial intelligence technology remains focused on research objectives without limiting the emergence of unique information from the field.

Research ethics are also a fundamental aspect that is considered during the data collection process in the school environment. The researcher applied the principle *of informed consent* by providing explanations about the objectives, procedures, and guarantees of identity confidentiality to all participants, including teachers and parents of students at SDN 4 Ciseureuh. This is in line with the views of Creswell and Poth (2018) regarding the importance of maintaining privacy and minimizing psychological risks in qualitative research, especially involving children at the elementary school level. In addition, the researcher ensured that the implementation of the observed AI technology did not interfere with the regular learning schedule, so that the integrity of the educational process in the school was maintained during the observation period.

3. FINDINGS AND DISCUSSION

The following researchers describe research findings in the field through observation, interviews, and documentation studies. Teachers in carrying out learning activities both in the classroom and outside the classroom always adjust to the planning that has been made before learning takes place.

> *As a classroom teacher, I always make learning plans based on AI technology. This is done to create an interesting and fun learning atmosphere. So in the presentation of teaching materials guided by the planning that I made earlier.*

The data above describes the importance of making a lesson plan by classroom teachers. In theory, planning is defined as conscious kinship carried out to compile important components to be realized as organizational achievement targets effectively and efficiently. Good planning is a plan that is made or prepared based on (1) data or information from the results of identification, (2) needs not desires, (3) common sense (the plan is realistic, i.e. it can be done), (4) objectivity (5) factual (Suharyanto H. Soro, 2024). Based on data obtained from observations, it shows that teachers use AI technology as a learning medium. This is done because AI plays a strategic role in building a learning ecosystem that is adaptive and responsive to individual student differences.

AI systems are able to analyze data on student learning activities on an ongoing basis, such as the speed of completing assignments, the level of accuracy of answers, and patterns of errors that appear. Based on this analysis, the system automatically adjusts the difficulty level of the material and provides formative feedback. This adaptive learning ecosystem has a positive impact on the learning climate in the classroom. Students no longer feel pressured by the demands of uniform achievement, but rather receive learning services according to their needs and potential. This condition creates a sense of psychological security and increases students' motivation to learn, which ultimately contributes to the overall improvement of the quality of graduates.

> *I think that the implementation of learning must display interesting and fun learning media so that the teaching materials presented using AI or technology by students can be understood or understood. So it can be concluded that the use of AI, in my opinion, helps students and myself as a teacher to deliver teaching materials with a visual appearance so that students are motivated or students are not bored in following the learning materials.*

The data above describes the reasons why teachers use AI as a learning medium. Learning activities are the implementation of the learning process and learning in real terms both in the classroom and outside the classroom. Implementation refers to the form of real action in the field. The implementation of educational activities is manifested in the form of learning involving teachers and students. Cognitively, the use of multimedia helps optimize students' memory work by presenting information through various sensory channels. Students become more focused and able to maintain concentration for a longer duration compared to conventional learning. This impact can be seen from the increase in students' ability to re-explain the material that has been learned and the increase in the results of formative evaluations carried out through AI systems.

The results of the observation show that the presentation of learning materials through the AI platform at SDN 4 Ciseureuh is dominated by the use of multimedia learning, which is a combination of text, audio, visual, animation, and interactive simulation. This approach has proven effective in helping students understand material that was previously considered abstract, such as concepts of mathematics, science, and social phenomena. The improvement in the quality of graduates at SDN 4 Ciseureuh is reflected in the increase in student activity in the learning process. This activity includes integrated physical, mental, and social involvement. Physically, students are actively involved in the use of digital learning devices, such as operating applications, working on interactive assignments, and participating in learning simulations.

From the mental aspect, students show increased focus, concentration, and critical thinking skills. This is characterized by an increasing frequency of students asking questions, providing responses, and trying various problem-solving strategies. Meanwhile, from the social aspect, students become more open to collaborating with peers through group discussions and technology-based projects. One of the important findings in this study is the increased curiosity of students as a result of the use of AI systems. An interactive and adaptive learning platform is able to give rise to students' intrinsic drive to learn independently. Students not only wait for the teacher's instructions, but actively explore additional material recommended by the system.

This increase in learning motivation contributes significantly to the quality of graduates, because students have a positive attitude towards the learning process. This attitude is an important capital in

forming the profile of graduates who have a lifelong passion for learning, which is urgently needed in facing the challenges of the digital era. The results of the study confirm that the successful implementation of AI-based adaptive learning is inseparable from the strategic role of teachers. At SDN 4 Ciseureuh, teachers no longer play the role of the only source of information, but rather as facilitators who design, direct, and evaluate students' learning experiences. Teachers are responsible for selecting and curating learning content to align with curriculum goals and educational values.

This change in role requires teachers to have adequate pedagogic competence and digital literacy. Through teacher assistance, students are helped to interpret the information obtained from AI technology, so that learning does not lose the dimension of value and character. The quality of graduates at SDN 4 Ciseureuh is not only measured by academic achievements, but also by mastery of 21st century skills which include critical thinking, creativity, communication, and collaboration (4C). AI integration provides ample space for the development of these four skills through technology-based projects and collaborative learning. Students are trained to analyze problems, come up with creative ideas, convey ideas effectively, and work together in teams. This skill is an important provision for elementary school graduates in facing the next level of education and social life in the digital era.

Despite showing positive results, the implementation of AI-based adaptive learning at SDN 4 Ciseureuh still faces several challenges, especially related to the readiness of digital infrastructure and teachers' adaptation to new technologies. The limitations of devices and internet networks are obstacles that need serious attention. However, school policy support and teacher competency training on an ongoing basis are key factors in mitigating these obstacles. The school actively encourages the improvement of teachers' digital literacy and provides technical assistance so that the integration of AI technology can run optimally and sustainably. So the findings of this study have important implications for the development of the quality of basic education, especially in the context of digitalization of learning. The integration of AI technology has been proven to be able to improve the quality of student learning processes and outcomes holistically. Therefore, the AI-based adaptive learning model applied at SDN 4 Ciseureuh can be used as a reference for other schools in an effort to improve the quality of graduates in an ongoing manner.

4. CONCLUSION

The results of this study can be concluded that the integration of Artificial Intelligence (AI) technology in adaptive learning can improve the quality of elementary school graduates. The application of AI technology allows for an adaptive, personalized, and student-centered learning process, so that it is able to accommodate differences in abilities, learning speed, and characteristics of students more optimally. The improvement in the quality of SDN 4 Ciseureuh graduates is reflected in the development of student activity in the learning process which includes physical, mental, and social aspects. Physically, students demonstrate active involvement in utilizing technology-based learning media and tools.

Mentally, students experience increased focus, concentration, and critical thinking skills in understanding the learning material. Meanwhile, from the social aspect, students are increasingly skilled in communicating and working together through project-based collaborative discussion and learning activities. These findings show that AI-based adaptive learning not only impacts academic achievement, but also on the formation of students' attitudes and social skills as part of the quality of graduates. The successful implementation of AI-based adaptive learning at SDN 4 Ciseureuh is also supported by the role of teachers as learning facilitators.

Teachers play a role in designing learning experiences, selecting and curating AI-based learning content, and guiding students so that the use of technology remains in harmony with educational goals and character values. Thus, AI technology functions as a pedagogical support instrument that strengthens the role of teachers in improving the quality of graduates. Although there are still obstacles in its implementation, such as the limitations of digital infrastructure and the need to improve teacher competence, school policy support and continuous training are able to minimize these obstacles. So

adaptive learning based on the integration of Artificial Intelligence (AI) technology is a relevant, effective, and potentially developed approach as a strategy to improve the quality of graduates at the basic education level, especially in facing educational challenges in the digital era.

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