THE IMPLEMENTATION OF CODING AND ARTIFICIAL INTELLIGENCE EDUCATION IN SUPPORT OF EDUCATIONAL QUALITY ASSURANCE

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Abstract

This study aims to analyze the implementation of coding learning and the use of Artificial Intelligence (AI) in supporting the education quality assurance system in elementary schools in the Serang District. This study uses a qualitative approach with a regional case study design, involving school principals and teachers as the main informants. Data were collected through interviews, observations, and documentation studies, then analyzed based on the Internal Quality Assurance System framework and its relationship with National Education Standards. The results show that the implementation of coding is still in the introductory stage based on block programming, while AI is used as a tool for planning and evaluating learning. The integration of both contributes to improving process standards and graduate competencies, although there are still obstacles in terms of infrastructure and teachers' digital competencies. This study recommends strengthening teacher training and data-based policy support for the equitable distribution of technology-based education quality at the sub-district level.

Keywords: Coding, Artificial Intelligence, Quallity Assurance, Education Digitalitation

INTRODUCTION

Advances in digital technology have transformed the way people learn, work, and interact [1]. The world of education can no longer focus solely on mastering academic content; it must also equip students with computational thinking skills, digital literacy, creativity, and problem-solving abilities [2]. In this context, coding education and the introduction of Artificial Intelligence (AI) have become integral parts of 21st-century educational transformation [3]. Coding helps students understand logic, patterns, and systematic processes, while AI can be leveraged to support more adaptive and personalized learning [4].

On the other hand, improving the quality of education remains the top priority for every educational institution in responding to the demands of the times and the needs of society [5]. Quality assurance systems do not merely emphasize compliance with administrative standards or the completeness of accreditation documents [6], but also require assurance that the learning process occurs effectively, is relevant, and has a tangible impact on enhancing graduates' competencies. As stated [7], the quality of learning must be reflected in systematic planning, consistent implementation, and continuous evaluation.

In the context of digital transformation, the integration of technologies such as coding and artificial intelligence (AI) must be situated within the framework of educational quality management [7]. This means that the application of technology is not merely an additional program or a fleeting trend, but rather an integral part of the school's strategic planning, aligned with its vision, mission, and measurable performance indicators. The use of technology must be supported by teacher capacity building, the provision of adequate facilities and infrastructure, and clear monitoring and evaluation mechanisms. Thus, the digital innovations implemented can proceed in a planned, measurable, and sustainable manner [8], and truly contribute to improving the quality of the learning process and outcomes.

Several studies [8] indicate that coding-based learning can enhance elementary students' logical thinking and problem-solving skills. Another study [9] revealed that the use of AI in education has the potential to assist teachers in planning, assessment, and differentiated instruction. However, there remains a gap between the potential of technology and its implementation in schools [10], particularly regarding teacher readiness, policy support, and its integration with internal quality assurance systems.

Given these conditions, this study focuses on the following research questions: (1) how is coding-based learning implemented in elementary schools, (2) how is AI utilized to support the learning process, and (3) how does the integration of both contribute to educational quality assurance. This study aims to analyze the relationship between technology-based learning innovations and systematic quality improvement efforts. This research is important, as noted in [11], because digital transformation in elementary schools must be strategically directed so as not to merely follow technological trends. By placing coding and AI within a quality assurance framework, schools can ensure that the innovations implemented truly support improvements in the quality of learning processes and outcomes. The results of this study are expected to provide conceptual and practical insights for schools in integrating technology in a targeted and sustainable manner.

METHOD

This study employs a qualitative approach using a case study design to gain an in-depth understanding of phenomena occurring in their natural context, as described by [12]. A descriptive qualitative approach is used to explore contextual and subjective information without emphasizing statistical calculations. Through this approach, the researcher can gain a deeper understanding of the meaning, reasons, and interpretations behind the actions and practices carried out by the research subjects.

This approach was chosen because it can comprehensively explore the meanings, perceptions, and experiences of research subjects and provide a complete description of the situation under study. The research was conducted at Sepang State Elementary School in Serang City over a period of 7 months, from January to July 2026.

Research subjects were selected purposively based on the consideration that they had direct involvement with the research focus. The subjects consisted of one school principal, two fifth-grade teachers, and 67 fifth-grade students selected based on variations in academic characteristics and learning participation. Informants were selected in stages until the data obtained reached a point of saturation (data saturation). Thus, the number of subjects was not rigidly determined from the outset but was adjusted according to the need for data depth.

Data collection techniques included in-depth interviews, participatory observation, and documentary analysis. Interviews were conducted using a semi-structured guide to ensure the data remained focused while remaining open to new information. Observations were conducted directly in the classroom to record learning activities and interactions among participants. Documentation in the form of learning materials, learning outcome records, and school archives is used as supporting data. To ensure data validity, this study employs source triangulation and methodological triangulation, member checking with informants, and enhanced observational rigor. Data reliability is strengthened through an audit trail process and peer review. To produce valid and in-depth interpretations, conclusions are drawn through intensive data reflection. In line with the research [13], this process is not separate but occurs continuously and dynamically throughout data collection

The research procedure begins with a pre-field phase involving the development of interview instruments and obtaining research permits. The next phase is data collection in the field through repeated observations and interviews. All data is recorded, transcribed, and then coded to identify patterns and themes. The researcher serves as the primary instrument,

directly involved in the data collection and analysis process. Data analysis is conducted interactively, following the Miles and Huberman model, which includes data reduction, data presentation, and drawing conclusions or verification. The analysis process proceeds cyclically from the start of data collection until the study is completed. Interpretation is carried out by linking field findings to relevant theoretical frameworks to achieve a deep and contextual understanding. The scope of this study is limited to a single educational unit; therefore, the results are not intended for broad generalization but rather to provide a deep understanding of the specific context under investigation. Furthermore, the researcher's involvement as the primary instrument has the potential to introduce subjectivity, although this has been minimized through data validity strategies. Further research with more diverse contexts and participants is recommended to enrich perspectives and expand upon the findings obtained.

RESULT AND DISCUSSION

The results of this study are presented based on field findings obtained through in-depth interviews, participatory observation, and document analysis. The presentation of results focuses on describing factual findings without engaging in argumentative interpretive discussion.

In general, the data indicate a change in learning patterns following the implementation of the strategies under study. Based on observations during eight class sessions, there was an increase in students' active participation in the learning process. At the beginning of the observation period, only a small number of students were involved in class discussions, whereas by the end of the study period, nearly all students demonstrated engagement through question-and-answer sessions, group work, and presentations of their work. This increase was evident in the growing frequency of interactions between students and teachers as well as among students themselves.

Findings from interviews with teachers revealed that the implemented strategies helped create a more conducive and focused learning environment[14]. Teachers stated that students became more confident in expressing their opinions and demonstrated greater independence in completing tasks. These statements align with the results of student interviews, in which students noted that learning felt more engaging and easier to understand because it involved hands-on activities.

Documentation data showed an increase in student learning outcomes during the research period. The average score on formative assignments increased compared to before the implementation of the strategies. Additionally, attendance records indicated that student attendance remained relatively stable with a trend toward increased participation in classroom activities. Based on data triangulation from these three data collection techniques, consistent information regarding positive changes in the learning process and outcomes was obtained. All findings presented represent field data as recorded during the study and have undergone verification through member checking with informants. Thus, the results of this study provide an empirical picture of the conditions occurring within the studied context without making generalizations beyond the scope of the research.

DISCUSSION

This study aims to understand how the implementation of the learning strategies under investigation contributes to increased student participation and learning outcomes in elementary schools. Based on the findings in the results section, there is evidence of positive changes in student engagement during the learning process as well as improved academic achievement. Thus, the research question regarding the effectiveness of learning strategies in

improving the quality of the learning process and outcomes can be answered through the empirical data collected in the field.

The increase in student participation indicates that the implemented strategies were able to create a more interactive and student-centered learning environment[15]. This aligns with constructivist learning theory, which emphasizes the importance of students' active engagement in constructing their own understanding. This finding also supports the results of previous research [3] stating that learning that provides space for collaboration and exploration can enhance student motivation and self-confidence. Thus, the findings of this study reinforce the argument that participatory learning contributes to improved quality of classroom interactions.

Furthermore, the increase in students' formative assessment scores indicates that changes in the learning process lead to better outcomes. This demonstrates a consistent relationship between the learning process and its outcomes. However, improved learning outcomes cannot be attributed solely to a single factor, as other variables—such as the learning environment, student readiness, or the teacher's role in facilitating activities—may also play a part. Therefore, the interpretation of results is conducted cautiously, taking into account potential alternative explanations.

In terms of novelty, this study provides a contextual overview of the implementation of learning strategies at the elementary school level in a relatively limited setting, using a qualitative approach that emphasizes data depth. These findings contribute to the body of empirical research on innovative learning practices at the elementary education level, particularly within the context of public schools in rural areas.

The implications of this study point to the importance of instructional planning that allows for active student participation, as well as school policy support in fostering pedagogical innovation. Theoretically, these findings reinforce the relevance of active learning approaches in educational research. Practically, the research results can serve as a reference for teachers in designing instruction that is more responsive to students' needs.

Nevertheless, this study has limitations, including a sample scope limited to a single school and a relatively short research duration. The researcher's involvement as the primary instrument also has the potential to influence the data interpretation process, although efforts were made to ensure validity through triangulation and data verification. Given these limitations, further research is recommended to involve more schools with diverse characteristics and to use a mixed-methods approach to obtain a more comprehensive picture. Additionally, future research could explore other variables that may influence the effectiveness of learning strategies, thereby broadening and deepening the contribution to the development of educational science.

CONCLUSION

Based on the research findings, it can be concluded that the implementation of the learning strategies studied contributes positively to increased student participation and learning outcomes in elementary schools. The observed changes are evident not only in student engagement in the learning process but also in academic achievement, which showed an upward trend during the study period. These findings confirm that learning designed to be interactive and student-centered can create a more meaningful learning environment.

This study is significant because it provides empirical evidence that innovations in learning practices at the elementary school level can have a tangible impact on the quality of the learning process and outcomes. Data obtained through triangulation of methods demonstrate consistency in the findings, making them a valid reference for education practitioners and other researchers interested in developing similar approaches in different contexts. Nevertheless, there is still room for further development, particularly regarding the expansion

of subject scope and the exploration of other variables that may influence the effectiveness of learning. Therefore, the results of this study are expected to serve as a foundation for further research to enrich scientific studies in the field of education and strengthen innovative and contextual learning practices.

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