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Coding And Artificial Intelligence Learning in Improving the Digital Skills of Grade 5 Elementary School Students (Case study at SDN 2 Cikumpay, Purwakarta Regency)

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ABSTRACT

This study aims to describe and analyze the effectiveness of coding and Artificial Intelligence learning in improving the digital skills of grade 5 students at SDN 2 Cikumpay, Purwakarta Regency. This research is motivated by the competency demands of the Industry 4.0 and 5.0 era, as well as the initial findings that students' digital skills are still diverse and not optimal. The method used in this study is qualitative with the type of case study. Data collection techniques include participatory observation, in-depth interviews, and documentation studies, which are then analyzed using the PDCA (*Plan, Do, Check, Act*) quality management cycle. The results of the study show that: (1) At the Plan stage, schools procure infrastructure and prepare *unplugged* and *plugged-based* adaptive teaching modules; (2) At the Do level, learning is carried out interactively (*student-centered*) using *the Scratch* and *Google Gemini platforms* to train digital logic and ethics; (3) At the Check stage, it was recorded that most of the 5th grade students were proficient in operating software, understanding algorithm logic, and having digital security awareness; and (4) At the Act stage, follow-up will be carried out in the form of organizing a "Digital Work Exhibition" and the appointment of students as School Digital Ambassadors. This study concludes that the integration of KKA in a structured and effective manner can improve students' digital skills, especially in the computational thinking skills of grade 5 elementary school students.

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1. INTRODUCTION

Learning Coding and Artificial Intelligence (KKA) is not just a trend, but a necessity in the world of modern education. The integration of coding and artificial intelligence in education is not only to improve digital literacy and problem-solving skills, but also to teach a range of essential skills that include computational thinking, data analysis, programming algorithms, KA ethics, human-centered mindset, KA system design, and KA techniques. Computational thinking teaches students to solve problems systematically and efficiently by performing the decomposition process (breaking down large problems into small parts), and the recognition of patterns, abstractions, and algorithms that help students understand and deal with digital challenges. With an inclusive and equitable learning ecosystem, education in Indonesia is expected not only to be able to produce a highly competitive generation, but also ensure that no child is left behind in gaining access to quality education.

The urgency of integrating coding and artificial intelligence in education is increasing along with the development of Industry 4.0 and 5.0, which demands superior human resources with strong digital understanding and skills. Without adequate digital literacy and skills in the field of digital technology, the younger generation will face difficulties in competing in an increasingly technology-based world of work. Therefore, the integration of coding and artificial intelligence in the school curriculum is not just an innovation, but a fundamental need in building superior human resources that are adaptive to the changing times. The government, schools, industry, and society need to work together in creating an educational ecosystem that is conducive to the development of science and skills so that Indonesia is not only a user of technology, but also an innovation producer who is able to compete at the global level.

Quality education focuses not only on mastery of technology, but also on ethical awareness in its use. KKA and automation systems bring their own challenges, such as data security, algorithmic bias, and broader social impact. Therefore, coding and artificial intelligence learning needs to be complemented by digital ethics education so that learners not only have technical skills, but also critical understanding in developing and applying technology responsibly. With this approach, quality education is truly accessible to all, equipping every child with the ability to compete and contribute in an increasingly digitized world.

The policy direction of coding learning and artificial intelligence is designed to prepare students to face the challenges of the digital era. The coding and artificial intelligence curriculum was developed based on Law Number 20 of 2003, which emphasizes adjustment to the needs of students, the times, and educational goals. This curriculum covers competencies that must be mastered by students at every level, from elementary to high school/vocational school, with a focus on computational thinking, digital literacy, programming algorithms, data analysis, and KA ethics. Coding and artificial intelligence learning can be applied through intracurricular, co-curricular, or extracurricular, taking into account technical, economic, and political aspects.

Learning coding and artificial intelligence aims to develop students' competencies according to their developmental stages. References such as the UNESCO ICT Competency Framework for Teachers (2018) and CSTA K-12 Computer Science Standards (2017) are the basis for curriculum development. The stages of competency mastery are divided by level of education, ranging from basic skills, such as solving daily problems in elementary school, to creating text-based programs and artificial intelligence applications in high school/vocational schools. The application of Coding and Artificial Intelligence learning can be done through several options, namely as a compulsory subject, an elective subject, or integrated with other subjects. Each option has its own considerations, such as the availability of teachers, infrastructure, and the learning burden of students.

Coding and artificial intelligence learning can use a variety of methods, such as problem-based learning, project-based learning, inquiry learning, gamification, and internet-based learning or digital devices. The learning media used includes digital devices (computers, laptops), digital platforms, interactive modules, and non-digital tools such as cards and boards. Teacher qualifications and competencies are also important factors, where teachers need to master professional, pedagogic, personality, and social competencies to teach coding and artificial intelligence effectively.

The Merdeka Curriculum also provides ample space for schools to implement project-based learning and technology exploration. Through KKA learning, students can participate in unplugged activities such as logic games, as well as plugged activities such as creating simple animations and programs using Scratch or Code.org. According to the Ministry of Education (2025), these activities can increase digital creativity, skill in operating devices, and awareness of digital ethics.

SDN 2 Cikumpay is an elementary school that began to integrate coding learning and artificial intelligence in grade 5. However, the results of the teacher's initial observations show that students' digital abilities are still diverse and some are not optimal. The teacher noted that some students still have difficulty understanding the logic of instruction and the use of devices independently. Documentation data also shows that students' digital security awareness is low, and the utilization of digital devices is still limited to core applications. This is in accordance with the findings of the Ministry of Education and Culture (2025) which states that the main challenge in implementing KKA in elementary schools is the readiness of students and teachers in the aspect of basic digital literacy.

Based on the teacher's data, the coding learning that has been carried out has not been comprehensively analyzed to see its contribution to students' digital abilities. Therefore, this research is important to understand how coding and artificial intelligence learning is carried out in the classroom, how teachers document the development of students' digital skills, and how the data shows indications of improving their digital skills. This research is expected to be material for the evaluation and improvement of the KKA learning program in improving students' digital skills that are more effective and directed at school.

2. METHODS

The approach used in this study is a case study approach which is the main foundation in determining the way researchers understand, collect, and analyze data. This study uses a qualitative approach, as it aims to understand the coding and artificial intelligence (KKA) learning process in depth through direct interaction with participants and analysis of available documents. According to Moleong (2019), "qualitative research intends to understand the phenomena of what the research subject experiences, such as behavior, perception, motivation, and action holistically" (p. 6). This confirms that the qualitative approach is naturalistic and is used when the researcher wants to examine the process in a real context.

The qualitative approach is also relevant because this research does not focus on measuring numbers, but on an in-depth understanding of the planning, implementation, checking, and improvement of coding learning and Artificial Intelligence based on PDCA theory. Sugiyono (2018) states that "qualitative research is used to research on the condition of natural objects, where the researcher plays the role of a key instrument" (p. 9). In this study, the natural condition in question is coding learning in grade 5 elementary school that runs as it is without special treatment. Researchers are present to observe, interview, and analyze teacher documents.

Thus, the qualitative approach is the most appropriate approach for this research because it provides flexibility, depth of analysis, and the ability to capture the reality of learning in a naturalistic manner. This approach also allows researchers to interpret data based on context, teacher experience, and classroom dynamics, resulting in a comprehensive understanding of the process and quality of coding and artificial intelligence learning at SDN 2 Cikumpay.

The method used is a case study, because this research explores the phenomenon that occurs in one specific location, namely grade 5 of SDN 2 Cikumpay. Case studies are used to examine an event, process, or program in depth. In this context, coding learning and Artificial Intelligence are actual phenomena that are ongoing and are being researched in real conditions in schools. Case studies are particularly appropriate because they provide space for researchers to explore various data sources, such as learning observations, teacher interviews, as well as portfolio documents and student development records. Poerwandari (2017) states that "case studies provide in-depth insights through diverse data collection and comprehensive analysis" (p. 45). Thus, this method allows researchers to interpret how the learning process goes and how teacher data can describe the development of students' digital abilities without conducting additional tests.

According to Sugiyono (2011:306), in qualitative research, researchers play the role of the main instrument (*human instrument*). He is in charge of determining the focus of the research, selecting informants, collecting and evaluating data, analyzing and interpreting the results, and drawing conclusions. The role of the researcher in the data collection process is very important because he has the physical and mental flexibility to utilize all of his abilities. The researcher is equipped with various natural tools such as the senses of sight, taste, touch, and smell that help him understand the object of the research. In addition, the researcher also uses his mind to interpret the sensory capture.

The data collection techniques in this study were adjusted to qualitative approaches and case study methods. According to Sugiyono (2018), "data collection techniques are the most important step in research, because the purpose of research is to obtain data" (p. 137). Therefore, this study uses three main techniques, namely observation, interview, and documentation, so that the data obtained is richer, more in-depth, and validated through triangulation. The observation was carried out to directly observe the implementation of coding and artificial intelligence learning in grade 5 of SDN 2 Cikumpay. This observation aims to obtain data on teacher activities, student involvement, media use, and learning dynamics that occur in the classroom. Moleong (2019) explains that "observation allows researchers to capture the meaning of behaviors and situations directly" (p. 173). Observation is carried out in a non-participatory manner, where the researcher is present as an observer without being involved in the learning process. The instrument used is in the form of an observation sheet containing indicators of learning implementation at the *Plan*, *Do*, *Check*, and *Act stages* according to the PDCA model.

The interviews were conducted to explore in-depth information regarding the perceptions, experiences, and understandings of teachers and principals related to the implementation of coding learning and Artificial Intelligence. Interviews were also given to several students to find out their responses and experiences during the lesson. According to Poerwandari (2017), "interviews allow researchers to obtain data on things that cannot be directly observed, such as thoughts, values, and motivations" (p. 78). The type of interview used is a semi-structured interview, as this format gives the researcher the flexibility to explore the answers more deeply while still following the question guidelines. The instrument used was an interview guide, which contained related questions: coding and Artificial Intelligence learning planning, learning implementation, analysis of students' digital abilities based on teacher data, and corrective actions taken by teachers.

Documentation is used to collect data in the form of official documents, teacher notes, photos of activities, learning videos, teaching tools, LKPD, and students' digital works. This technique is used to complement and corroborate the findings from observations and interviews. Sugiyono (2018) states that "documentation is a record of events that have passed and can be in the form of writings, drawings, or monumental works of a person" (p. 240). Documentation is very important because this study emphasizes the analysis of students' digital abilities based on data that is already available, such as: coding product portfolios, daily progress records, learning journals, teacher assessment rubrics, digital works in coding platforms. The instrument used in this stage is a documentation checklist sheet to identify the relevant document types and ensure the completeness of the data.

This research was carried out at SDN 2 Cikumpay, a public elementary school located in Campaka District, Purwakarta Regency. The school was chosen as the location of the research because it has started developing coding and artificial intelligence learning programs (Artificial Intelligence) in grade 5, making it relevant to the research focus. In addition, this school has characteristics that are in accordance with the needs of case studies, where coding learning is still in the development stage so that it provides opportunities for researchers to describe the learning process in a complete and in-depth way. The data sources in qualitative research are determined based on the principle of the research objective, not the number of population. According to Sugiyono (2018), "the main sources of data in qualitative research are words and actions, the rest is additional data such as documents and photographs" (p. 225). Therefore, this study uses primary and secondary data sources involving several key informants. Primary data sources in this study include:

(1) Grade 5 teachers, who are the main implementers of coding and Artificial Intelligence learning. Teachers provide information about the process of planning, implementing, checking students' digital abilities, as well as reflective actions or improvements made in learning.

(2) 5th grade students, who are participants in coding and Artificial Intelligence learning. They provide hands-on experience of learning participation, level of understanding, and response to coding activities. School principals, who provide data related to school policies, infrastructure support, and the development of technology-based learning programs.

In addition to primary data, this study also uses secondary data in the form of documents related to coding learning and Artificial Intelligence, such as teaching tools, lesson plans, LKPD, teacher notes, student work portfolios, photos, activity videos, and school policy documents. Thus, the location and data sources used in this study have been *purposively selected* according to the characteristics of the phenomenon being studied and the needs of the case study to gain a rich, in-depth, and contextual understanding of the implementation of coding learning and artificial intelligence at SDN 2 Cikumpay.

The data analysis technique in this study uses an interactive analysis model proposed by Miles, Huberman, and Saldana. This model consists of three main stages, namely data reduction, data presentation, and drawing conclusions. (1) Data reduction is the process of selecting, focusing, simplifying, grouping, and organizing raw data obtained from the field. At this stage, the researcher selects data from observations, interviews, and documentation that are relevant to the research questions, especially related to planning, implementation, checking, and improvement (PDCA) in coding learning and Artificial Intelligence. The reduction process is carried out on an ongoing basis so that the collected data can be well organized and support the next analysis.

(2) Data presentation is carried out by compiling information in the form of descriptions, tables, simple graphs, or matrices to make it easier for researchers to understand patterns and relationships between data. In this study, the presentation of data was carried out through a narrative description of each finding, a learning process analysis table, a PDCA matrix, an interview summary, and a summary of document findings. With the presentation of structured data, researchers can see the relationship between the components of coding learning and Artificial Intelligence and their impact on students' digital abilities. (3) The conclusion stage is carried out after the reduction and presentation of data shows certain patterns or findings. The researcher then interprets the meaning of the data obtained to answer the formulation of the problem. In this study, conclusions were drawn based on the findings of the learning planning and implementation process, data on students' digital abilities obtained from teacher documents, supporting factors and learning barriers. Conclusions are temporary and can change when new data is discovered, but they become strong after repeated verification through triangulation, *member checks*, and peer discussions.

The validity of data in qualitative research is essential to ensure that the data obtained is correct, trustworthy, and reflects the actual conditions. According to Moleong (2019), "the validity of data in qualitative research includes the degree of *credibility*, diversion, dependence, and certainty" (p. 321). In this study, the techniques used to ensure the validity of the data include source triangulation, technique triangulation, *member check*, and discussion with peers. Source triangulation is carried out by comparing and checking the correctness of information obtained from various informants, namely 5th grade teachers, students, and school principals. Sugiyono (2018) explains that "source triangulation is carried out by checking data through several different sources to obtain a more objective understanding" (p. 273). Through this triangulation, researchers can see similarities in patterns, differences in perspectives, and consistency of data related to planning, implementing, checking, and improving coding learning and artificial intelligence. Triangulation techniques are carried out using several data collection techniques at once, namely observation, interviews, and documentation. According to Sugiyono (2018), "technique triangulation is carried out by checking the same data with different techniques" (p. 274). For example, data on the implementation of coding learning is obtained from observations, then confirmed through interviews with teachers, and further corroborated through documentation in the form of photos or teaching devices. In this way, the data obtained becomes more powerful and valid.

Member checks are carried out by asking informants to double-check data, findings, or interpretations compiled by researchers. Moleong (2019) stated that "*member check* is a process of checking data to data providers to determine the compatibility between the findings and what is provided by the data source" (p. 330). In this study, the researcher provides a summary of the results of the interview or initial interpretation to teachers and principals to ensure that the meaning captured by the researcher is in accordance with the intention of the informant.

3. FINDINGS AND DISCUSSION

This research was carried out at SDN 2 Cikumpay, Purwakarta Regency, with a focus on 5th grade students. Data were obtained through participatory observation in the classroom, in-depth interviews with the Principal and Class Teachers, and documentation studies of student work. The research findings are presented based on the PDCA (*Plan, Do, Check, Act) quality management flow* which describes the coding and Artificial Intelligence (KKA) learning implementation cycle. This research was carried out at SDN 2 Cikumpay, Purwakarta Regency, with a focus on 5th grade students. Data were obtained through participatory observation in the classroom, in-depth interviews with the Principal and Class Teachers, and documentation studies of student work. The research findings are presented based on the PDCA (*Plan, Do, Check, Act*) quality management flow which describes the coding and Artificial Intelligence (KKA) learning implementation cycle.

a. Infrastructure Procurement. The principal allocates the BOSP budget and committee partnerships for the rejuvenation of information and communication technology facilities and ensuring a stable internet network.
b. Improving the Competence of Teachers. Send 5th grade teachers to take training on Block-Based Coding (such as Scratch) and the introduction to basic Coding and Artificial Intelligence for children.
c. Curriculum Flexibility. Establish Coding and Coding and Artificial Intelligence as a curriculum taught to high grade students (grades 5 and 6).

Grade 5 teachers develop adaptive Teaching Modules. Teachers don't jump right into complicated coding techniques, but rather design gamification-based learning. The teacher prepares picture and numerical patterns using paper (*unplugged*). Then the teacher also set up the *Scratch* platform for visual coding and *Google Gemini* for simple Artificial Intelligence recognition. In addition, teachers develop teaching tools with *the Project Based Learning* (PjBL) model and design contextual problems in the form of learning games that must be solved by students.

The implementation of learning takes place interactive and student-centered. The teacher starts the class not with a theoretical lecture, but a demonstration. Teachers teach how to use information technology properly in line with digital ethics. The teacher shows how logic blocks (*if-then-else*) can make characters move. Students are allowed to "play" with blocks of code. Teachers go around giving *scaffolding* (gradual assistance) only when students are at a stalemate. Then the teacher introduced the concept of Artificial Intelligence through google gemini. Students are invited to practice in compiling prompts to give commands to apply artificial intelligence in composing or creating something like a command. Students are invited to check the output results of the given commands. As an introduction first, the teacher invites students to arrange picture patterns to practice computational thinking and train students to arrange number patterns in an image. Students work in small groups (2-3 people). One student plays the role of a programmer (compiling blocks), one as a debugger (looking for errors), and one as a designer (creating image assets). Students are also given learning to think computationally with unplugged techniques. Students are given the challenge of composing image patterns, breaking large images into small ones, and composing solutions in logical and efficient steps. The information obtained from students related to coding learning and artificial intelligence had responses like this:

"The classroom atmosphere became very exciting, where at first students were passive in participating in learning, turned into active and enthusiastic learning. There was a fierce but positive discussion between students when solving problems (debugging), for example, "Why doesn't the character want to jump?". They try to change the order of the logical blocks independently until they succeed". (Student Resource Person, 2025)

This stage is a crucial phase to measure the impact of learning on student competence. Based on formative and summative evaluation data, very positive results were found. Observational data shows that most 5th graders are now proficient in operating software interfaces, understanding file management such as turning hardware on and off, opening documents, creating documents, storing documents, and fluently using logic in coding and AI *prompts*. They are no longer awkward interacting with new technologies. Every 5th grade student is able to sort out the correct information and use information technology in accordance with digital ethics such as not spreading hoax information, respecting the privacy of others, avoiding hate speech, not plagiarism, and maintaining data security. Then in getting to know an application such as Canva and Google Gemini, to use it to support the learning process. In the use of Scratch applications, it is intended that students are able to create simple coding to practice game-based learning.

Through a simple logic test, students show a significant improvement in decomposition skills, being able to break down large problems (making games) into small parts (making moves, making scores, making enemies). As well as the ability in Pattern Recognition, students realize that "repeat 10 times" commands are more efficient than composing the same 10 command blocks. In the reflection session, students are able to think logically by explaining the *causality relationship*. "If I don't put in the 'forever' block, then the object only goes once and then stops". This sentence indicates that the algorithm's logic has been developed. At this stage, teachers identify carrying capacity and obstacles that affect student learning outcomes. From the data obtained, the greatest carrying capacity is from the competence of teachers. Meanwhile, the obstacle arises from the limitation of digital technology facilities.

Through a simple logic test, students show a significant improvement in Decomposition skills, Able to break down large problems (making *games*) into small parts (making moves, making scores, making enemies). As well as the ability in Pattern Recognition, students realize that "repeat 10 times" commands are more efficient than composing the same 10 command blocks. In the reflection session, students are able to think logically by explaining the *causality relationship*. "If I don't put in the 'forever' block, then the object only goes once and then stops". This sentence indicates that the algorithm's logic has been developed.

Seeing the success at the *Check* stage, the school took further strategic steps. The Principal will initiate the "Digital Work Exhibition" activity, where students present their *game* work and coding projects to fellow students and parents. This increases students' confidence. In addition, the teacher develops the curriculum by revising the modules for the next semester by increasing the level of difficulty, such as the integration of coding with a simple microcontroller. The students who master the material the fastest are appointed as "School Digital Ambassadors" to help teach their fellow students or younger classmates, so as to create a sustainable learning ecosystem.

The relationship between the data findings at SDN 2 Cikumpay and *the grand theory of* the quality cycle from W. Edwards Deming (Deming Cycle). This analysis proves that the improvement of students' digital, logical thinking, and computational skills does not occur by chance, but is the result of structured management. The four basic principles of computational thinking are Decomposition (breaking down problems), Pattern Recognition (looking for similarities), Abstraction (filtering out unimportant details), and Algorithms (designing solution steps), which help to systematically solve complex problems by dividing them into smaller parts, identifying similarities, focusing on the core of the problem, and then creating structured solution steps.

1) Plan Stage Analysis: Management Commitment as a Quality Foundation.
   In Deming's theory, the first step to quality improvement is *Constancy of Purpose*. The findings of the study show that the Principal of SDN 2 Cikumpay has carried out this function well. The planning carried out is not only administrative (RPP), but also strategic. The principal's policy of allocating resources (budget and facilities) to coding and AI proves that the school has a long-term vision. This is in line with Deming's principle that management should be responsible for the system. Without a well-thought-out plan in the form of infrastructure support and a flexible curriculum, teachers will not have the space to teach complex material such as AI. The readiness of the teaching modules prepared by the teacher also minimizes unnecessary process variations, ensuring that every student gets the same material standards.
   The findings of this study prove that learning Coding and Artificial Intelligence at elementary school age, especially grade 5, is not just teaching "how to use a computer", but teaching "how to think".
   a. Computational *Thinking* Enhancement
      In accordance with Jeanette Wing's theory of *Computational Thinking*, students at SDN 2 Cikumpay have succeeded in moving beyond the basic literacy stage to the creation stage. When students compile blocks of code in *Scratch*, they are unconsciously doing *Algorithmic Thinking* . They learned that to achieve a goal, sequential and logical steps are needed. These findings confirm that coding is "living mathematics". Students who previously had difficulty understanding abstract mathematical logic became aware when the logic was visualized through the reactions of the characters in the game they created.
   b. Introduction to Coding and Artificial Intelligence (KKA).
      By trying to practice the technology's machine-based learning directly, students understand the basic concepts of data and probability. Their critical thinking skills are honed. They began to understand that bias in artificial intelligence could occur if the data entered was wrong. This is an advanced digital literacy provision that is very crucial in the era of the industrial revolution 4.0.
2) Do Stage Analysis: Transformation of the Learning Process (Process Quality)
   In the implementation stage, Deming's theory emphasizes the importance of adopting a new philosophy and *the Training on the Job Institute*. Field data show that teachers no longer use conventional lecture methods (old style), but instead adopt the philosophy of *Student-Centered Learning*. The use of *Scratch* and Gemini is a form of aid in the context of education to visualize abstract logic. When the teacher guides the student to *debugging* (fixing the wrong code), the teacher is applying the principle *of on the job training*. Students learn logic and computational thinking directly through practice. These findings confirm that the quality of the results is highly dependent on the quality of the process (*Do*). A classroom atmosphere that allows students to make mistakes (*trial and error*) when compiling algorithms is the key to the growth of students' critical and logical reasoning.
3) Check Stage Analysis: Validation of Student Competency Improvement
   The *Check stage* in the Deming cycle is not just looking for faults, but measuring achievement against standards. The results of the study showed positive data: students were able to think computationally (decomposition, abstraction, pattern recognition, and algorithms). In Deming's perspective, this is proof that the system is running effectively.
   a. Logical Thinking: Students' ability to explain cause-and-effect relationships such as "If I delete this block, then the object doesn't move" shows that they have understood the logic of the system, not just memorized it.
   b. Data Validation: The high percentage of student success becomes valid data that the coding teaching method applied is in accordance with the stage of cognitive development of 5th grade elementary school students. There is no *significant gap* between the material taught and the students' graspability.

4) Act Stage Analysis: Towards Continuous Improvement
   The Deming cycle does not stop at evaluation, but continues to *Act* to guarantee *Continuous Improvement*. The finding that schools hold "Digital Work Exhibitions" and appoint "Peer Tutors" is a real implementation of the *Act stage*. Schools are not satisfied with only report card scores, but want to cultivate these competencies.
   a. Standarisasi.
      The success of learning in grade 5 is now used as a new standard (*benchmark*) for other classes at SDN 2 Cikumpay.
   b. Quality Circularity
      The Principal's decision to raise the material level to robotics next semester shows that the PDCA cycle has reverted back to *a higher Plan* . This is the essence of Deming's theory: quality is an endless journey.

Overall, the improvement of digital skills and the logical way of thinking of 5th grade students of SDN 2 Cikumpay is the fruit of a harmonious educational ecosystem. The synergy between supportive school principal policies, adaptive teacher competence in using technology, and students' enthusiasm for learning in *the learning by doing method*, has succeeded in creating a strong culture of computational thinking in the school environment. The implementation of the PDCA cycle at SDN 2 Cikumpay has proven to be effective in improving students' digital skills and computational thinking.
a. *Plan*, ensuring the availability of facilities and curriculum.
b. *Do*, ensuring an interactive knowledge transfer process.
c. *Check*, validate the achievement of the student's logical thinking.
d. *Act*, ensuring the sustainability of the program.

This success confirms that to improve students' abilities in future materials (Coding and Artificial Intelligence), schools cannot work partially, but must use a quality management system approach that is integrated between leadership policies and teacher pedagogy.

4. CONCLUSION

Based on the analysis of research data regarding the implementation of coding learning and artificial intelligence at SDN 2 Cikumpay, Purwakarta Regency, it can be drawn conclusions that are structured according to the Deming Cycle as follows: Dimensions of Planning (*Plan*) and Implementation (*Do*): Policy Synergy and Pedagogy. The success of this program began from the mature Plan stage through the Principal's strategic policy in providing digital infrastructure and designing an adaptive local content curriculum. This planning is executed precisely at the *Do stage* by teachers who apply constructivism and gamification approaches. The research concludes that the synergy between managerial support (leadership policy) and teachers' pedagogical competence is a key factor that transforms lesson plans into effective real-world actions in the classroom. Without good facility planning from the principal and the execution of proper methods from the teachers, learning complex material such as artificial intelligence will not run at the elementary school level.

Dimension of Check: Factual improvement of students' abilities. At the *check* (evaluation of results) stage, the findings of the study show factual evidence of a significant increase in student competence. Learning coding and artificial intelligence have been empirically proven to be able to stimulate technical digital skills as well as high-level cognitive abilities, namely logical thinking and computational *thinking*. 5th grade students of SDN 2 Cikumpay were proven to be able to decompose problems and compile simple algorithms. This validates that the interventions carried out at the Do stage have successfully achieved, or even exceeded, the target success indicators set at the Plan stage.

Follow-up Dimension (*ACT*): The formation of a culture of sustainable innovation. In the perspective *of Act*, this study concludes that SDN 2 Cikumpay has moved from just implementing programs to cultivating innovation (*Continuous Improvement*). The school's actions to hold digital exhibitions, empower students as peer tutors, and advanced curriculum development plans, show that the quality cycle is in full swing. Learning coding and artificial intelligence is no longer considered an additional burden, but rather has become a new standard of school excellence that is poised to be improved in the next school year cycle.

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