

Digital Leadership in Action: A Case Study of Principal's Technology-Based Supervision and its Impact on Teacher Development

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Abstract: This qualitative case study investigated the role of a primary school principal in implementing technology-based academic supervision and teacher competency development. Data were collected through interviews, observations, and documentation at SDN 1 Sumber Hidup, Indonesia. Findings reveal three key strategies: needs-based training, the establishment of a teacher learning community (Kombel), and technology-based individual mentoring. The study demonstrates that a shift from a control-oriented to a coaching-oriented supervision model, facilitated by digital tools, fostered a collaborative professional culture and enhanced teacher capacity. The findings contribute to understanding how principals can operationalize instructional leadership in the digital era to build sustainable teacher professional development.

Keywords: Academic Supervision, Educational Technology, Student Learning Outcomes, Teacher's Competence

A. Introduction

Many aspects of school management have changed due to the shifting paradigm of education in the digital age. This includes how principals carry out their duties of overseeing learning and developing teacher professionalism. Principals function not only as administrative managers but also as transformational leaders who can drive innovation and change in educational practices. Principal leadership significantly influences school culture, teacher performance, and student learning outcomes. The two most commonly discussed approaches to elementary educational leadership are instructional leadership and transformational leadership. Instructional leadership emphasizes managing and supervising the teaching and learning process, while transformational leadership emphasizes individual development and developing teacher potential (Megayanti & Asri, 2023).

Principals who use a transformational leadership style can boost teacher morale and enhance their work ethic, creating a dynamic school culture. Principals who implement this method have the ability to motivate the school community to achieve better learning outcomes (Armiyanti et al., 2023). This leadership style is particularly relevant in facing the challenges posed by the globalization of education and rapid technological developments (Lamirin et al., 2023). Responsive leadership, responsive to school and external demands, has been shown to be crucial for improving the quality of learning (Qudsiyyah et al., 2024).

The use of technology-based academic supervision is a crucial component in improving the quality of learning in elementary schools. Technology-based supervision allows principals to monitor teacher performance better and more accurately (Koyongian et al., 2021). New alternatives for flexible supervision implementation are offered by digital platforms and technology-based evaluation tools such as e-supervision and online learning applications. However, the success of these methods depends on teachers' readiness to use technology and institutional support from the principal. Conversely, some challenges in implementing technology-based supervision include inadequate infrastructure and lack of training. Not all teachers are comfortable using technology as part of the employee development process. Therefore, the principal's role in organizing teacher competency development programs is crucial (Chervony & Mahmudah, 2023).

Principals must also consider non-technical aspects such as teacher well-being and workload management when developing teacher competencies. In the teaching process, teacher well-being will increase their engagement and motivation. Principals are expected to be, in addition to being managers and strategic decision-makers, leaders who care about the well-being of their teaching staff. Furthermore, teachers with adequate digital skills can deliver teaching materials in a more interactive and engaging manner (Fauzan et al., 2021). Students have a more enjoyable learning experience because of this, which in turn results in better learning outcomes. Providing teachers with access to technology training is a form of strategic leadership for principals. The achievement of educational goals in elementary schools is directly supported by principals who pursue digital transformation in learning.

Ultimately, many factors work together to influence student learning outcomes, including teacher quality, the principal's leadership style, the learning environment, and educational facilities. Furthermore, the involvement of parents and teachers in the educational process is crucial, particularly in helping students overcome learning difficulties (Tauqifa et al., 2021). A principal who is able to create a positive learning culture will impact the overall school climate. Principals also play a crucial role in integrating various components into a synergistic and effective educational system. In the context of national policies such as Merdeka Belajar (Freedom to Learn), principals

are crucial in incorporating literacy and character values into learning activities. This has a direct impact on student learning outcomes (Handayani & Rohman, 2020).

Positive perceptions of supervision encourage teachers to actively participate in their professional development. In other words, good supervision is more than just an administrative activity; it helps improve education at the school level. Recent technology-based supervision practices in elementary schools have shown promising results in improving learning management and teaching quality. Digital tools allow teachers to receive immediate and contextual feedback, accelerating improvements in instructional practices (Akmaluddin & Sari, 2024).

Based on this explanation, it is clear that principals play a crucial role in supervising learning and developing teacher competency. A technology-based approach enables principals to improve the quality of teacher development and create a teaching system that is innovative, flexible, and adaptable to students' needs. Ultimately, the primary goal of the educational process is to improve student learning outcomes. While the importance of principal leadership is well-established, less is known about the specific mechanisms and processes through which principals integrate technology into their core supervisory and developmental functions to foster teacher growth. An example is SDN 1 Sumber Hidup, Pedamaran Timur District. It is hoped that a deeper understanding of these practices will allow for the development of a leadership model that is useful for addressing educational challenges in the computer and internet era. SDN 1 Sumber Hidup has adequate facilities and a principal, but the principal's role in technology supervision and teacher development programs has not been well implemented. This situation indicates a gap between the available opportunities and the implementation in the field. Therefore, this research is expected to maximize the role of principals by utilizing technology-based supervision to improve teacher competency and student learning outcomes in elementary schools.

Based on the description above, the formulation of the problem in this article is as follows: 1) What is the role of the principal in implementing technology-based supervision at SDN 1 Sumber Hidup, Pedamaran Timur District?, 2) How is the role of the principal in developing teacher competency at SDN 1 Sumber Hidup, Pedamaran Timur District?, and 3) How do stakeholders (teachers, students) perceive the impact of the principal's technology-based supervision and teacher development on the learning process and environment at SDN 1 Sumber Hidup, Pedamaran Timur District?. In accordance with the formulation of the problem, the objectives of the research in this article are as follows: 1) Describe the implementation of technology-based supervision by the principal at SDN 1 Sumber Hidup, Pedamaran Timur District, 2) Describe the role of the principal in developing teacher competency at SDN 1 Sumber Hidup, Pedamaran Timur District, and 3) Explain the impact of the implementation of

technology-based supervision and teacher competency development on improving student learning outcomes at SDN 1 Sumber Hidup, Pedamaran Timur District.

It is hoped that this article will provide conceptual contributions to educational policymakers, principals, and teachers. It will also contribute theoretically to the development of educational management studies, particularly regarding technological supervision and leadership.

B. Methods

This research employs a qualitative method with a case study approach. This study employed a single instrumental case study approach to gain an in-dept understanding of the principal's leadership practices at SDN 1 Sumber Hidup, selected as an exemplary case of technology integration in school supervision. One example is how the principal contributes to technology-based supervision and teacher skill development to improve student learning outcomes. The qualitative process allows researchers to understand the meaning, processes, interactions, and field experiences contextually. Consequently, this method can uncover the social and psychological dynamics behind the principal's policies and practices.

This research aims to thoroughly investigate one case unit, SDN 1 Sumber Hidup, as an illustration of the principal's leadership practices in the context of technology-based teacher development and supervision. SDN 1 Sumber Hidup was purposively selected because it was identified by the local education office as a school that had successfully implemented technology-based supervision. Therefore, this type of case study was chosen. Case studies help understand phenomena beyond the boundaries of the real context, especially in cases where the boundaries between the phenomenon and the context are unclear or overlapping. The case limitation in this study is the principal's role in two main areas that impact student learning outcomes: technology supervision and teacher development. Research informants were selected through purposive sampling, so the informants for this research were the principal, teachers, and students in grades 5 and 6 who were nominated by their teachers as being articulate and able to reflect on their learning experiences of SDN 1 Sumber Hidup, as well as the supervisor or school committee. Data were collected through observation, interviews, and documentation. The following outlines the research interviews with informants:

Table 1. Principal Interview Guidelines

No	Aspect	Indicator	Interview Questions
1	Supervision Planning	Understanding technology-based supervision planning	How do you design technology-based supervision in this school?
2	Teacher Development Strategy	The role of the principal in improving teacher competence	What is your strategy in developing teacher competency?
3	Supervision Follow-up	Supervision results analysis process	How do you follow up on the results of supervision?
4	Solutions to Teacher Obstacles	Principal's strategy to overcome teacher obstacles	How do you overcome teachers' barriers to using technology?

Table 2. Teacher Interview Grid

No	Aspect	Indicator	Interview Questions
1	Technology-Based Supervision	Teachers' experiences in implementing digital supervision	What is your experience in technology-based supervision?
2	Technological Barriers	Knowing the obstacles teachers face in using digital devices	What challenges do you encounter when using digital devices?
3	Supervisory Feedback	Effectiveness of principal guidance	How does the principal's feedback impact your learning?
4	Teacher Training	Impact of workshops on teacher competency	How did the training provided by the school improve your skills?

Table 3. Student Interview Grid

No	Aspect	Indicator	Interview Questions
1	Motivation to learn	The impact of digital learning on learning interest	Does learning using digital videos and quizzes make you more enthusiastic?
2	Concept Understanding	Quality of teacher material delivery	How do teachers explain lessons when using technology?
3	Learning Change	Learning outcomes from the student's perspective	What changes do you feel in your learning?
4	Ease of Learning	Effectiveness of digital media	Do you find it easier to understand lessons with technology?

Before data analysis is conducted, the interview data obtained will first be tested for validity. To ensure the trustworthiness of the findings, this study employed triangulation (of data sources: principal, teachers, students), member checking (returning transcript and preliminary findings to key informants for verification), and peer debriefing (discussing emerging themes with research colleagues). The data analysis techniques used in this study include: 1) Data reduction, 2) Data presentation, and 3) Conclusion drawing/verification.

C. Results and Discussion

Results

State Elementary School (SDN) 1 Sumber Hidup is located in Pedamaran Timur District, Ogan Komering Ilir Regency, South Sumatra Province, where this research was conducted. This research conducted qualitative research with a case study type. The purpose of this study is to explain the role of the principal in technology-based supervision and teacher skill development to improve student learning outcomes. State Elementary School 1 Sumber Hidup is child-friendly and has supporting internet access to support technology learning activities. The school uses PLN electricity to ensure that education runs smoothly. At SDN 1 Sumber Hidup, there are facilities such as 12 Learning Groups in grades one to six, a library, a principal's office, and a teacher's room for discussions and Learning Community meetings.

This study conducted qualitative data analysis using the interactive analysis model of Miles, Huberman, and Saldana for presentation, reduction, and conclusion drawing. Researchers collected data through in-depth interviews with the principal, teachers, and administrative staff; observations of technology supervision activities; and documentation, including supervision reports, school data, and student learning outcomes, member checking with the principal, triangulation across data sources. The results of the analysis are presented in a descriptive narrative at SDN 1 Sumber Hidup, Pedamaran Timur District.

Implementation of Technology-Based Supervision by the Principal

To ensure that the learning process aligns with teacher competencies and the national curriculum, the principal regularly conducts academic supervision. According to interviews with the principal, supervision at SDN 1 Sumber Hidup has evolved, particularly in terms of the use of digital technology as a tool for supervision and coaching. The principal stated that the use of online applications such as Google Forms, Zoom Meetings, and professional WhatsApp groups is crucial to conducting supervision.

During the supervision planning process, the principal involves all teachers in creating the supervision schedule and submitting it through a digital platform. Each teacher must upload a digital Lesson Implementation Plan (RPP), which must be reviewed before the start of class. Direct classroom observation and online observation with video recordings of lessons are two methods used to carry out the implementation phase. Furthermore, supervision results are communicated through written feedback shared via Google Drive.

In interviews, several teachers said that the digital supervision model facilitates communication because reports can be accessed anytime without having to wait for a face-to-face meeting. "Now the principal often provides feedback via Google Forms and WhatsApp, so we can immediately improve lesson plans or teaching materials without waiting long," said Yayuk Sri Rahayu, S.Pd., a third-grade teacher. This demonstrates that the supervision follow-up process has been accelerated by technology integration. Furthermore, supervision activities are now accompanied by reflective discussions conducted online via Zoom or face-to-face in the teachers' lounge. The principal emphasizes a teamwork approach, inviting each teacher to discuss learning challenges and successes. Observations indicate that supervision at SDN 1 Sumber Hidup is not solely evaluative but also places greater emphasis on teacher development and capacity building. The principal strives to create a friendly and open supervisory environment.

The Role of the Principal in Developing Teacher Competence

The strategic role of the principal of SDN 1 Sumber Hidup is focused on improving teacher competency to meet the demands of 21st-century education. According to interviews, the strategic role consists of three main stages:

a) Needs Based Training

The principal conducts a digital survey at the beginning of each semester to identify teacher training needs. The data from this survey is used to develop training activities tailored to teacher needs. For example, the majority of teachers indicated they needed training on creating digital learning media by 2024. The principal then invited facilitators from the Education Office to learn how to use the Kahoot and Canva for Education apps. The focus of this training was to improve teachers' digital literacy so they could use technology in the teaching and learning process. Observation-based training was delivered in the form of a two-day workshop with hands-on practice. More experienced teachers were responsible for supporting other teachers and creating a collaborative learning environment. Activities like this have been shown to increase teacher motivation and foster a sense of collaborative learning.

b) Teacher Learning Community (Kombel).

The principal established a Teacher Learning Community, also known as "Kombel," for teachers to discuss and develop as professionals. These activities are held monthly with a different theme, such as "Digital Learning Evaluation" or "Strategies for Improving Numeracy Literacy." Teachers are encouraged to share their experiences, demonstrate good instructional practices, and discuss challenges facing

their classes. Because the principal acts as a facilitator and discussion facilitator, the classroom becomes an important setting for informal supervision. According to Leni Maryani, S.Pd., a fifth-grade teacher, "In Kombel, the atmosphere is more relaxed." The principal doesn't provide judgment, but encourages students to continue learning and sharing experiences.

c) Technology-Based Individual Mentoring

The principal assists teachers who need special guidance in person, in addition to conducting collaborative activities. Direct classroom observation and digital monitoring of online learning materials are two ways this support is provided. The principal provides thoughtful notes and helpful criticism. For example, a fourth-grade teacher was asked to create a short video about the lesson material and upload it to the school's digital folder. The principal reviewed the findings and noted the clarity of the concepts and the delivery method. The analysis shows that the principal of SDN 1 Sumber Hidup uses a sustainable and responsive teacher development strategy. Teachers are not only evaluated but also mentored to develop.

The Impact of Teacher Supervision and Development on Student Learning Outcomes

Two main indicators can be used to measure the impact of implementing technology-based supervision and teacher competency development at SDN 1 Sumber Hidup, namely as follows:

a) Improving the Quality of the Learning Process

Observations show that teachers are more actively using digital media in the classroom after implementing digital supervision and technology training. Compared to previous years, the use of visual presentations, interactive quizzes, and instructional videos has increased. This has impacted student enthusiasm for learning. Teachers now employ project-based learning strategies, group discussions, and problem-solving instead of solely lecturing. After receiving positive feedback from supervisors, the principal attributed these changes to increased teacher confidence.

b) Improving Student Learning Outcomes

Evaluation results for the odd semester of the 2025/2026 academic year showed an average increase in student grades of 7.5 percent compared to the previous year. Furthermore, the number of students meeting the Minimum Completion Criteria

(KKM) increased from 82 percent to 90 percent, and teachers reported improved student motivation and class attendance. "Kids are more enthusiastic about learning now when they use videos or digital quizzes. They feel like they're playing, but they're learning at the same time," said Angga Permana, S.Pd., a sixth-grade teacher. Increased parental involvement in supporting their children's learning is an additional effect found. To provide online student progress reports, the principal established a communication group for teachers and parents. Consequently, the relationship between families and the school became more synergistic.

Supporting and Inhibiting Factors in the Implementation of Technology-Based Supervision

The results of observations and interviews show that the components that support the implementation of technology-based supervision at SDN 1 Sumber Hidup include:

- a) Innovative and open leadership of the principal.
- b) Availability of internet networks and digital devices in educational institutions.
- c) A culture of collaboration between educators and school principals.
- d) Support from the government in providing training.

Then, there are also several obstacles, including the following:

- a) Technology limitations for senior teachers.
- b) Disruptions that occur on the internet during peak hours.
- c) Teachers' limited time to complete comprehensive digital reports.

Providing additional training, forming digital mentor groups, and scheduling flexible supervision are ways principals can address this issue.

Discussion

Implementation of Technology-Based Supervision by the Principal

The principal at SDN 1 Sumber Hidup uses technology-based supervision. This demonstrates a paradigm shift from traditional supervision focused on control to contemporary supervision emphasizing coaching, collaboration, and innovation. Not only the tools and media used, but also the way the principal manages, regulates the supervision rhythm, and builds more open and critical interactions between teachers and school leaders are all examples of this transformation. Technology-based supervision is a strategic effort to increase the effectiveness, efficiency, and speed of teacher professional development, not simply a shift from paper to digital media. Therefore, this process is crucial. Several recent studies conducted by Puspita et al. (2024) confirmed that digital supervision enables the teacher development process to be

more systematic and measurable, while also providing greater space for teachers to reflect on themselves based on the information they collect (Puspita et al., 2024).

The research results show that academic supervision at SDN 1 Sumber Hidup has shifted from conventional methods to technology-based ones. This model utilizes digital technology as the primary medium for planning, implementing, and following up on supervision. In their role as digital instructional leaders, principals are responsible not only for monitoring the learning process but also for providing instruction to teachers on how to use technology to design, implement, and evaluate teaching and learning activities.

The principal at SDN 1 Sumber Hidup uses tools such as Google Forms to track learning, Google Drive to collect supervision documents, and a professional WhatsApp group for reflective communication. Using these digital tools allows the principal and educators to communicate more freely, resulting in a clearer and more accountable supervision process. From a theoretical perspective, the principal's actions align with the clinical academic supervision model, which emphasizes the importance of a collaborative cycle of planning, observation, and reflection between supervisors and teachers. Using this technology allows for faster communication and greater collaboration. Transformational leadership principles enable the principal to provide innovation, vision, and example through a technology-based supervision approach.

Research by Wardani et al. (2022) confirms that transformational leadership in supervision has been shown to increase teachers' professional commitment and their ability to accept change (Wardani et al., 2022). However, challenges remain when implementing this model. Some senior teachers still struggle with technology. Principals can address this by providing comprehensive training and providing opportunities for junior teachers to act as peer mentors. This can foster a collaborative work environment and reduce resistance to change. Furthermore, principals' use of technology-based supervision has shown increased efficiency in the teacher development process. Recent research suggests that the use of digital platforms in supervision can expedite the follow-up process, increase observation accuracy, and improve learning documentation.

The principal at SDN 1 Sumber Hidup conducts technology-based supervision that is highly adaptable to the diverse needs of teachers. In the interview, he stated that digital supervision allows teachers to reflect on learning at any time without relying on a face-to-face schedule. Since 2024, the principal has implemented the use of Google Forms, Google Drive, and professional WhatsApp groups as part of the school's routine supervision system. He stated that to avoid waiting for face-to-face supervision, each teacher must use Google Drive to submit lesson plans, learning videos, and digital

portfolios. Furthermore, the principal emphasized that the use of technology reduces administrative time. As a result, as supervisors, they can focus more on providing substantive guidance related to education to teachers.

Interview results indicate that the principal's approach to technology-based supervision reflects the transformational, humanistic, and collaborative nature of supervision. The principal at SDN 1 Sumber Hidup uses technology as a teaching and coaching tool. In addition to conducting interviews with teachers, the principal reflected deeply on the importance of technology-based supervision with a personal touch. He stated that the core of supervision is a shared commitment to improving the quality of learning, honest communication, and trusting interpersonal relationships. The principal stated that while technology speeds up the process, conversation makes it even better.

This school's digital supervision process is highly structured, as evidenced by observation and documentation data. Each teacher has a dedicated folder in Google Drive containing lesson plans, learning videos, class activity photos, and digital reflections. Using the comments feature, the principal provides notes so teachers can immediately identify areas for improvement. This aligns with research conducted by Zulfa et al. (2021), which suggests that well-documented digital supervision facilitates monitoring teacher progress over time (Zulfa et al., 2021). In practice, technology-based supervision at this school begins with a digitally communicated supervision schedule through the school's official WhatsApp group. Instructions are given to teachers to upload lesson plans, teaching media, and materials to be used for the week to Google Drive, in a dedicated folder designated for supervision. Therefore, the principal can use these digital documents to monitor teacher readiness before classes begin.

The teachers indicated that technology-based supervision not only improves the quality of instruction but also creates a culture of collective learning that strengthens teacher professionalism. This statement aligns with previous research showing that technology-based supervision can accelerate the feedback process, enhance professional interactions between principals and teachers, and improve learning reflection (Lahade et al., 2023). At SDN 1 Sumber Hidup, digital supervision is used to help students collaborate and improve the quality of learning rather than to control. Furthermore, the principal stated that digital supervision is designed to consider teachers' needs. Senior teachers receive more intensive mentoring, while junior teachers have the opportunity to assist with technology use. This differentiated approach aligns with the collaborative supervision model, which emphasizes that successful supervision rests on the principal's ability to manage the diverse abilities of teachers (Sary & Wulandari, 2022).

In general, the implementation of technology-based supervision at SDN 1 Sumber Hidup demonstrates a shift toward a coaching paradigm rather than a control

paradigm. Beyond simply assessing administrative performance, the principal successfully used supervision as a means to improve teacher professionalism.

The Role of the Principal in Developing Teacher Competence

At SDN 1 Sumber Hidup, three key strategies needs-based training, teacher learning communities (Kombel), and technology-based individual mentoring help the principal improve teacher competency. Principals are no longer simply administrative managers; they now act as instructional leaders and instructional leaders focused on improving teacher competency (Tauqifa et al., 2021). This is also used by the SDN 1 Sumber Hidup principal, who consistently assesses teacher needs before initiating development programs. One of the principal's top priorities at SDN 1 Sumber Hidup is improving teacher competency, especially after the school implemented a technology-based supervision system. Based on research, interviews, observations, and documentation, it appears that principals go beyond administrative duties; they also actively assist, guide, and encourage teachers to improve their professional skills. At this school, the principal's role aligns with the concept of instructional leadership, which positions the principal as a learning leader.

At SDN 1 Sumber Hidup, the principal's responsibility is clearly demonstrated through various strategic steps that are consistent, planned, and supported by the use of educational technology. The three main steps are technology-based individual mentoring, the formation of a teacher learning community, and needs-based training and workshops. Sustainable professional development consists of three interrelated elements.

a) Needs-Based Training and Workshops.

The principal's primary strategy for improving teacher competency is needs-based training. The principal of SDN 1 Sumber Hidup consistently uses digital surveys, reflective interviews, analysis of supervision results, and observations of classroom learning processes to identify teachers' learning needs. These identification results are then used as the basis for developing relevant training programs, not simply formalities. Based on the surveys and teacher reflections, needs-based training is held regularly. This method aligns with andragogy, which positions educators as adult learners capable of understanding their own needs (Knowles, 2020). This training program improves teachers' digital skills. For example, teachers have begun using Canva for Education and Kahoot during their lessons. This demonstrates that principals can successfully create a culture of lifelong learning within their schools. Principals who actively support ongoing training have the potential to improve learning efficiency and motivate teachers (Fauzan et al., 2021).

Interviews with twelve teachers revealed that the principal significantly influences their skill development. At the end of each training session, the principal conducts a digital evaluation and solicits teacher feedback. This information is used to improve subsequent training sessions. Therefore, the SDN 1 Sumber Hidup training model is considered sustainable and data-driven.

b) Formation of Teacher Learning Community (Kombel).

At SDN 1 Sumber Hidup, the Merdeka Belajar policy is implemented, emphasizing the importance of a community of practice as a platform for teacher professional development. This community activity is part of the implementation of this policy. In this activity, teachers talk with each other, present good learning practices, and provide feedback. Field analysis shows that the complex activities at SDN 1 Sumber Hidup increase teacher openness, generate new ideas, and raise awareness of the importance of educational technology. Therefore, the principal plays a crucial role in creating a learning environment where students collaborate with one another and support the development of teachers' professional skills.

At SDN 1 Sumber Hidup, the Teacher Learning Community, or "Kombel," is a forum for reflection and professional development established directly by the principal as part of a strategy to strengthen teachers' pedagogical and technological competencies. Kombel activities are held monthly and serve as a formal gathering place for teachers to learn from each other, share best practices, and discuss issues in the learning process. In an interview, the principal explained that Kombel was established in response to teachers' need for a collaborative space. Furthermore, the Kombel also serves as a forum for discussion about the results of academic supervision. After digital supervision is completed, the principal holds a meeting with teachers to discuss overall findings rather than individual ones. Therefore, the establishment of the Kombel by the principal not only helps teachers improve their pedagogical skills but also fosters a strong culture of collaboration, unity, and professionalism within the school. The Kombel is an essential foundation for building a school with a positive and successful learning culture, not just a place for discussion.

c) Technology-Based Individual Mentoring.

A personal approach is crucial for improving teacher skills. The principal uses a digital reflection-based coaching supervision model. Teachers are asked to upload learning videos. Afterward, the principal provides written feedback that includes an analysis of strengths and areas for improvement. This method fosters self-confidence and a desire for independent development. Previous research results show that

technology-based mentoring accelerates follow-up of coaching results and strengthens professional relationships between teachers and principals when supervision is carried out via digital media (Handayani, 2024). The principal provides individual mentoring to provide teachers with more specific guidance tailored to their individual needs. Therefore, the principal's role in teacher development encompasses pedagogical and technological aspects, as well as administrative ones. The principal of SDN 1 Sumber Hidup has implemented a contemporary supervisory function that is data-driven, participatory, and reflective.

The Impact of Teacher Supervision and Development on Student Learning Outcomes

The study results showed that technology-based supervision and teacher development activities significantly improved student achievement. Student grades increased by an average of 7.5 percent over the course of the academic year, according to academic data. This improvement was due to increased student learning intensity and improved instructional quality. Teachers' pedagogical competence and the principal's leadership support significantly impacted student learning outcomes (Adesta & Khasanah, 2022). Teachers who received technology training and regular coaching tended to be more innovative in managing their classes and presenting materials. Teachers at SDN 1 Sumber Hidup more frequently employed a student-centered learning approach using engaging digital media. Students also become more active in conversations and presentations. Teachers also engage students in projects related to topics relevant to everyday life. This strategy improves critical thinking skills and increases enthusiasm for learning.

Increased parental involvement in supporting children's learning is another significant benefit. Teachers can quickly provide learning outcomes reports and student progress notes through digital communication platforms. Principals provide online reporting systems that facilitate collaboration between families and schools. These results demonstrate that the shift toward digital learning and supervision improves teacher performance and strengthens the overall education ecosystem.

At SDN 1 Sumber Hidup, the impact of technology-based supervision and teacher competency development on student learning outcomes is highly dependent on the principal's policies, teachers' readiness to implement learning innovations, and students' responses to classroom changes. This study shows that principals can transform their academic supervision by using a digital, reflective, and collaborative approach. These effects emerge in three main forms: improved learning processes, increased student desire to learn, and improved academic achievement throughout the semester. These impacts are not only driven by policies, but also by the interactions between students, the principal, and teachers during daily learning.

Interviews with teachers demonstrated the impact of this supervision strategy. Most teachers stated that the principal's humanistic, mentoring-based approach gave them more confidence to try new learning methods. These student interviews further corroborated research findings that technology-based and interactive learning can increase student active participation, enthusiasm, and intrinsic motivation. This has a direct impact on improving student understanding and academic achievement (Adesta & Khasanah, 2022).

The increase in students' average grades in the odd semester evaluation of the 2025/2026 academic year is evidence of the academic impact. The percentage of students achieving the Minimum Competency (KKM) increased from 82% to 90%, representing a 7.5% increase compared to the previous year. Second-grade teacher Rita Kurniati also acknowledged that the change in learning approach helped previously passive students become more active in class. Eliyana, a religious education teacher, said that using digital media helps students understand religious values by watching stories that are more relevant to their lives.

Students also become more active in conversations and presentations. Teachers also engage students in projects related to topics relevant to everyday life. This strategy improves critical thinking skills and fosters enthusiasm for learning. Increased parental involvement in supporting children's learning is another significant benefit. Teachers can quickly provide learning outcomes reports and student progress notes through digital communication platforms. Principals provide online reporting systems that facilitate collaboration between families and schools. These results demonstrate that the shift toward digital learning and supervision improves teacher performance and strengthens the overall education ecosystem.

The principal himself explained that improved learning outcomes are not only reflected in academic results but also in changes in the classroom atmosphere. He stated that because the mentoring process has become more flexible, technology-based supervision has helped narrow the gap between junior and senior teachers. The principal stated that technology is used to enhance the mentoring process rather than replace human interaction. This aligns with the notion that reflective leadership is key to the successful implementation of digital supervision because it emphasizes positive relationships among school members (Handayani, 2024).

The research also involved interviews with teachers and the principal. Four students from grades 5 and 6 were also involved to find out how they perceived changes in learning after teachers were given technology-based supervision. Fifth-grade student Aleesya Sabrina said learning is now more enjoyable because there are many educational videos and games. She said she often felt sleepy during lessons, but now

that the material is presented in a different way, she is more focused. Fifth-grade student Nofal Zaidan Dzaki said that using pictures and videos instead of just writing on the board makes lessons easier to understand. These student interviews indicate that incorporating technology into instruction significantly benefits their learning experience. These results align with research findings showing that using digital media can increase students' desire to learn and allow them to see concepts more concretely, allowing them to grasp what they are learning more quickly (Fauzan et al., 2021). Another significant change is the increased discipline and responsibility of students. Because learning is partially conducted through digital platforms, teachers can assign assignments with clear deadlines, and the entire process is automatically documented through the app. This helps students develop more systematic study habits and take more responsibility for their schoolwork.

Parents also find it easier to monitor their children's progress. The principal asks each teacher to submit progress reports on their children's learning outcomes through a Google Drive group or WhatsApp. Consequently, communication between the school and parents becomes more regular and clearer. As teachers become more proficient, their collaboration with parents also improves, resulting in tripartite collaboration between the principal, teachers, and parents. These findings reinforce the notion that collaboration across all school levels can ensure successful teacher supervision and training (Handayani, 2024).

Based on the overall research results, it can be concluded that technology-based supervision and teacher competency development clearly impact the learning process, student learning outcomes, motivation, active participation, and working relationships between teachers, principals, and parents at SDN 1 Sumber Hidup. Learning in the digital era has become more relevant, modern, and tailored to student needs. This change did not happen overnight; more principals are working together to build an innovative learning culture that focuses on teacher progress and student needs.

D. Conclusions

Based on the results of research, data analysis, and discussion on the Role of the Principal in Technology-Based Supervision and Teacher Competency Development to Improve Elementary School Student Learning Outcomes, several conclusions can be drawn, namely as follows: 1) At SDN 1 Sumber Hidup, technology-based supervision has been running well and innovatively. The principal's success lies in a shift from evaluative control to collaborative, coaching-oriented, technology-mediated support for teachers. The principal has used digital media such as Google Forms, Google Drive, and professional WhatsApp groups to conduct supervision activities. Technology is not only used as an administrative tool; it also helps teachers communicate carefully and

provide professional coaching. This technology-based supervision demonstrates transformational leadership focused on improving the quality of learning; 2) Principals are responsible for actively, collaboratively, and sustainably improving teacher competency. They assist, guide, and encourage teachers to become more professional through needs-based training, teacher learning communities (Kombel), and technology-based individual mentoring. This strategy fosters a culture of collaborative learning and enhances teachers' digital and pedagogical skills; 3) Developing teacher competencies and technology-based supervision improves the quality of instruction and student learning outcomes. This increases student average academic grades, student active participation in lessons, and parental involvement. Digital supervision models have been shown to improve the quality of teacher instruction and create a more modern learning environment. Limitations of the study, reliance on perceptual data for student outcomes, short time frame. Suggestion for future research is multi case comparative studies, longitudinal studies tracking student achievement data, studies measuring teacher self-efficacy changes.

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