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The Role of Teachers in Overcoming Technology Learning Loss: The Impact of Gadget Overstimulation on Elementary School Students

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Abstract: This study examines the role of teachers in overcoming technological learning loss caused by gadget overstimulation in elementary school students. The phenomenon of excessive use of gadgets has caused various academic and behavioral problems in students, including decreased concentration, learning motivation, and academic achievement. The purpose of the study was to analyze the impact of gadget overstimulation on the learning process of elementary school students and identify the strategies applied by teachers in restoring students' learning focus. The research uses a qualitative approach with a descriptive method. Data was collected through in-depth interviews with six classroom teachers (grades 1-6), one principal, three students' parents, and four students at SDN Rinjani Cirebon City in November-December 2024. The research instruments included structured interview guidelines and participatory observation. Data analysis uses the Miles and Huberman model through the stages of data reduction, data presentation, and conclusion drawn. The validity of the data is guaranteed through source triangulation and member checking. The findings of the study showed that overstimulation of gadgets had a significant impact on students' academic abilities, which was characterized by decreased concentration, interest in reading, and learning achievement. Impacts on daily habits include disruption of sleep patterns and reduced physical activity. Social-emotionally, there is a decrease in socialization ability and the emergence of antisocial attitudes. The strategies implemented by teachers include the application of various learning methods based on student-centered, ice breaking, project-based learning, and collaboration with parents. This study concludes that the role of teachers is crucial in overcoming technological learning loss through pedagogical innovation and multi-stakeholder cooperation. The limitations of the study lie in the scope of one school with a limited sample. Follow-up research is recommended to examine the effectiveness of long-term interventions and involve a broader sample and develop a school-based integrated intervention model.

Keywords : Learning loss of technology, overstimulation of gadgets, role of teachers, elementary school students, pedagogical strategies

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INTRODUCTION

The digital age has fundamentally changed the global education landscape. Digital transformation in education, accelerated by the COVID-19 pandemic, has expanded access to learning technologies but at the same time poses complex new

challenges (Pokhrel & Chhetri, 2021). One of the significant challenges faced by education systems in various countries is the phenomenon of learning loss, which is a decline in students' academic and cognitive abilities due to various external factors that interfere with the optimal learning process (Engzell et al., 2021).

In the Indonesian context, the use of gadgets among elementary school-age children has reached an alarming level. According to data from the Indonesian Child Protection Commission (KPAI), more than 70% of Indonesian children have been exposed to gadgets from an early age with an average duration of use reaching 3-5 hours per day. This condition is exacerbated by the lack of parental and teacher control over the content consumed by children. The excessive use of gadgets, especially to access fast and interactive entertainment content such as YouTube, TikTok, and online games, has contributed to the phenomenon of digital overstimulation that negatively impacts the concentration ability, short-term memory, and executive function of the child's brain (Lakilaki et al., 2025).

Gadget overstimulation refers to the condition of excessive exposure to intense, fast-changing, and interactive digital stimuli, which exceeds the child's cognitive processing capacity. Neuropsychological research shows that rapid and flashy exposure to digital content can alter brain structure and function, particularly in the areas responsible for attention, impulse control, and emotion regulation (Muppalla et al., 2023). Children who are accustomed to the instant gratification of gadgets tend to have difficulty completing tasks that require sustained concentration and deep thinking.

The impact of gadget overstimulation on the learning of elementary school students has been extensively documented in the international literature. Santos et al. (2022) in a systematic study found that excessive exposure to screen time in children is strongly correlated with attention problems and concentration difficulties in the context of learning. The Quebec Child Development Study's longitudinal study showed that every hour of television exposure at age 2 correlated with a 7% decrease in class participation and 6% in math ability in fourth grade (Muppalla et al., 2023).

The research gap arises when examining Indonesia's specific context, especially in schools with socio-economic and cultural characteristics that differ from international research settings. The majority of previous research focused on urban settings or schools with access to high technology, while the impact of gadget overstimulation on schools in areas with moderate access to technology but minimal control is still poorly studied (Agustina et al., 2024).

Several previous studies have examined the relationship between the use of gadgets and their impact on learning. Lakilaki et al. (2025) conducted a phenomenological analysis of the impact of digital overstimulation on attention control in elementary school students with a focus on the phenomenon of "brain rot". The study found that the use of gadgets for 3-4 hours per day, especially to access fast

and interactive content, contributes to decreased concentration, being easily distracted, and having difficulty completing tasks. Sappaile (2024) examines the impact of gadget dependence on students' concentration and academic performance using quantitative methods. The study found that gadget dependence can interfere with students' learning concentration and have an impact on academic achievement, such as decreased test scores and poor learning quality. Sari Rezeky and Zendrato (2023) examine the impact of gadget use on the motor and intellectual development of elementary school children. The results of the study show that excessive use of gadgets has a great influence on children's development, both in terms of psychology, physical, and social. Agustina et al. (2024) in their research at Lanas Elementary School examined the perception of parents and teachers towards the use of electronic gadgets in kindergarten students and their relationship with attention and focus. The study found that kindergarten students had a moderate level of gadget involvement with an aggregate mean of 3.20. In the context of learning loss due to the COVID-19 pandemic, Ahmad (2024) identified four main strategies for teachers in recovering learning loss in the new normal era, namely: 1) using various strategies, media, and learning resources; 2) doing remedial/enrichment; 3) require students to actively ask questions; 4) Involve the role of parents. Hargreaves (2021) in his comprehensive study of learning during the pandemic highlights the importance of teachers' pedagogical expertise which cannot be replaced by parental improvisational support. This research emphasizes the value of social connections, face-to-face communication, and collaboration in supporting effective learning.

This research has several novelties that distinguish it from previous research. First, this study specifically examines the active role of teachers in overcoming technological learning loss caused by gadget overstimulation, not just identifying its negative impact. Second, this study integrates multi-stakeholder perspectives (teachers, principals, parents, and students) to provide a holistic picture of the phenomenon of gadget overstimulation and its handling strategies. Third, this research was conducted in a post-pandemic context where the use of technology has become an integral part of students' lives. Fourth, this study explores concrete pedagogical strategies applied by teachers in the field. Fifth, this study examines the phenomenon in schools with unique characteristics: schools that have adopted technology (Chromebooks) in learning but face challenges in controlling the use of students' personal gadgets.

The urgency of this research is driven by several crucial factors. First, the phenomenon of learning loss of technology due to gadget overstimulation is increasingly worrying and requires immediate intervention. Field data showed that teachers had significant difficulty in maintaining students' focus and concentration during learning. Second, although many schools have implemented policies related to the use of gadgets, the effectiveness of their implementation is still low due to a lack

of understanding of appropriate pedagogical strategies to address technological learning loss. Third, collaboration between schools and families in overcoming gadget overstimulation is still weak. Fourth, in the inevitable era of digitalization, prohibitive approaches are no longer realistic or effective.

Based on the background and research gaps that have been presented, this study aims to:

1. Analyzes the impact of gadget overstimulation on the academic abilities, daily habits, and social-emotional interactions of elementary school students.
2. Identify signs of technology learning loss that appear in students due to gadget overstimulation.
3. Explore pedagogical strategies that teachers apply to reduce gadget distractions and restore students' focus on learning.
4. Identify obstacles faced by teachers in an effort to overcome technological learning loss and find solutions that have been implemented.
5. Analyze school policies related to the use of gadgets and coordination between teachers, principals, and parents in dealing with the problem of gadget overstimulation.

RESEARCH METHODS

Approaches and Types of Research

This study uses a qualitative approach with a descriptive type of research. The qualitative approach was chosen because this study aims to explore and understand in depth the complex phenomenon of technological learning loss due to gadget overstimulation from the perspective of the actors who experience it directly, namely teachers, principals, parents, and students (Creswell & Poth, 2018).

The type of descriptive research was chosen because this research seeks to systematically and accurately describe the facts and characteristics of the phenomenon being studied (Sukmadinata, 2016). Qualitative descriptive research allows researchers to describe the impact of gadget overstimulation, signs of learning loss, teachers' strategies, and obstacles faced in detail and comprehensively based on empirical data collected in the field.

Research Location and Time

This research was conducted at SDN Rinjani Cirebon City, West Java Province, Indonesia. The selection of this location is based on several considerations. First, SDN Rinjani is a school that has integrated technology in learning, especially the use of Chromebooks for grades 4, 5, and 6. Second, based on initial information from principals and teachers, there are strong indications that there is a learning loss problem related to excessive use of gadgets among students.

The research was carried out for two months, namely in the November-December 2025 period. This period was chosen because it is the middle of an odd semester where the learning process has been going on for quite a long time so that teachers have had adequate experience in observing students' learning behavior and applying various learning strategies.

Data Source

The data sources in this study are divided into two categories, namely primary sources and secondary sources.

1. Primary Data Sources

Primary data sources were obtained directly from informants through in-depth interviews. The informants in this study were selected by purposive sampling with certain criteria that are relevant to the research objectives. The total number of informants was 14 people consisting of: (1) Six classroom teachers, each representing grades 1, 2, 3, 4, 5, and 6; (2) One school principal who plays the role of a policy maker at the school level; (3) Three parents of students representing various backgrounds; (4) Four students in grades 5 and 6 who already have adequate verbal skills.

2. Secondary Data Sources

Secondary data sources were obtained from school documentation and literature studies. School documentation includes school profiles, student data, school policies regarding the use of technology, and records of students' academic achievements. Literature studies include international and national journals, books, research reports, and education policy documents relevant to the research theme.

Data Collection Techniques and Instruments

The main data collection techniques in this study are in-depth interviews and participatory observations. In-depth interviews were chosen because they allowed researchers to dig into detailed and in-depth information about informants' experiences, perceptions, and strategies (Kvale & Brinkmann, 2009).

The main research instrument is an interview guide developed based on the research objectives and theoretical framework. The interview guidelines grid for teachers include: (1) Teachers' perceptions of changes in student learning behavior related to the use of gadgets; (2) Identify signs of learning loss that appear in students; (3) Strategies applied to reduce gadget distractions; (4) Methods of restoring students' focus and concentration; (5) Obstacles faced in overcoming technological learning loss.

Data Analysis Techniques

The data analysis in this study uses the model of Miles and Huberman (1994) which consists of three flows of activities: data reduction, data presentation, and conclusion/verification.

1. Data Reduction

Data reduction is the process of selecting, focusing, simplifying, and abstracting rough data that arises from field notes and interview transcripts. At this stage, the researcher codes the data that has been collected to identify key themes relevant to the research objectives.

2. Data Presentation

Data presentation is a set of structured information that provides the possibility of drawing conclusions and taking action. The data is presented in the form of structured narrative texts, supplemented by verbatim excerpts from interviews to provide concrete illustrations.

3. Conclusion

Drawing conclusions is the final stage in data analysis where the researcher begins to identify the patterns, regularity, explanations, and causal flows of the data that has been presented. The initial conclusions drawn are tentative and will continue to be verified throughout the study.

Data Validity Test

To ensure the validity and reliability of the data, this study uses several validation strategies. First, source triangulation is carried out by collecting data from various informant sources (teachers, principals, parents, students) to get diverse perspectives on the same phenomenon. Second, the triangulation method is carried out using interviews and observations as a complementary data collection method. Third, member checking is carried out by returning interview transcripts and provisional findings to informants to verify the accuracy and suitability of the researcher's interpretation.

RESULTS AND DISCUSSION

Research Results

The results of the study are presented based on the reduction, presentation, and interpretation of data obtained from in-depth interviews with 14 informants. The findings were organized according to the research objectives and presented by retaining the informant's verbatim statements to maintain the authenticity of their voices.

1. The Impact of Gadget Overstimulation on Elementary School Students

Based on the analysis of interview data, the impact of gadget overstimulation on elementary school students can be categorized into three main dimensions: academic impact, impact on daily habits, and social-emotional impact

a. Impact on Academic Ability

Grade 1 teachers reported that gadget overstimulation caused several significant academic impacts:

> "*Decreased concentration and interest in learning, decreased motivation to learn, decreased achievement, lazy writing and reading." These findings are consistent with the report of grade 2 teachers who stated, "Interest in learning is less, reading interest is less* (Grade 1 Teacher, 2025)."*That is why*

The 3rd grade teacher gave a more specific description:

> "*With the excessive use of gadgets, children's focus and concentration in learning activities have decreased drastically. As well as there are indications of students' dependence on gadgets to instantly find answers that are difficult for students* (Grade 3 Teachers, 2025)."

The 4th grade teacher added an observation about distractions:

> "*Children become easily distracted, their focus is short and it is difficult to stay calm when studying." Furthermore, the teacher reported, "Easy to forget material, reading and numeracy skills decrease, and slow to grasp material when explained* (Grade 3 Teacher, 2025)."

Grade 5 teachers highlight the broader impact:

> "*Declining intellect and skills, declining creativity, psychological and psychological distress, learning access gaps, problems with basic literacy and numeracy skills* (Grade 3 Teachers, 2025)."

b. Impact on Daily Habits

Grade 1 teachers identified three main impacts on daily habits: "*Disrupting sleep quality, lazy physical activity, addiction*." This observation is supported by a report from a student's parents describing the pattern of using children's gadgets:

> "*Starting from the 2nd grade which comes in at 10 o'clock in the afternoon, sometimes I just wake up at half past 6 immediately hold the cellphone and tell to pray first, sometimes I want to sometimes not play the ipad/cellphone until 9 o'clock when I say it's difficult, mom will go home and immediately take the ipad again while eating until*

3 o'clock, get ready to go home and recite after prayer and continue to be at home eh cellphone again if you tell me to study who is angry (Parents of student A, 2025)."

Parent of student B reported a significant duration of use: "3 Hours for 1x24 hours." While C's parents said, "3 hours or less." Data from the students themselves showed variations in usage, with one 5th grader reporting, "The video is from 12 noon to 8 p.m., the game is only 2 minutes," while the 6th grader mentioned, "1 hour (watching the video and playing the game)."

c. Social-Emotional Impact

Grade 1 teachers reported three social-emotional impacts:

"*Decreased socialization skills, antisocial attitudes, mental and emotional disorders.*" *The 2nd grade teacher observed, "If the child overuses the gadget, first if he is called to not respond, the communication and socialization are lacking* (1st grade teacher, 2025)."

The 6th grade teacher gave a more specific description:

"*Children if they are over-stimulated, usually their emotions are high and also tantrums. We as teachers must slowly be diverted to more interesting learning.*" *The student's parents also confirmed the emotional impact: "Children are easily emotional, and their words are the same as what they watch on their cellphones* (Grade 6 Teacher, 2025)."

2. Signs of Learning Loss Technology

Data analysis identified several consistent signs of technology learning loss reported by various teachers. Grade 1 teachers identified:

"*Lack of concentration, lack of reasoning, decreased academic achievement, difficulty understanding the material, unbalanced emotions* (Grade 1 Teacher, 2025)."

Grade 3 teachers provide a more structured list:

"*Reduced focus and concentration of learning, decreased academic grades, laziness to think, easy to forget what has been learned* (Grade 3 Teacher, 2025)."

The students' own observations confirmed the difficulty of focusing. Grade 5 students stated,

"*It's hard to focus, because a lot of playing is noisy,*" *while a 6th grader reported, "It's hard to focus because of the thought of games* (Grade 5 Students, 2025)."

3. Teachers' Strategies in Overcoming Technology Learning Loss

Teachers have developed various strategies to overcome technology learning loss. These strategies can be categorized into several main approaches.

a. Innovative Pedagogical Strategies

Grade 1 teachers apply:

> "*Applying more varied learning methods and models, resting on student centers, and can attract students' interest in learning.*" *Grade 3 teachers use a project-based approach: "Implement more project-based learning so that students' concentration is diverted to learning* (Grade 1 Teachers, 2025)."

Grade 6 teachers emphasized the importance of learning modifications:

> "*One of the alternatives, we modify learning so that learning is even more interesting. And the student's activities must be more activities so that the gadget can be diverted to hobbies or children's learning that is more fun* (Grade 6 Teacher, 2025)."

b. Focus and Concentration Restoration Techniques

Grade 1 teachers use a variety of techniques: "Restoring students' focus and concentration in the classroom can be done by guessing, playing clapping, playing games, singing." *The 2nd grade teacher applied: "Learning while playing, increase ice breaking.*"That is why

Grade 4 teachers use a step-by-step approach:

> "*Start with a simple activity, pause and repeat the material slowly.*" *Grade 5 teachers focus on concrete experiences: "Ice breaking in learning, prioritizing the use of media and teaching materials that are close to children and prioritizing concrete objects* (Grade 4 Teachers, 2025)."

c. Collaboration Strategies with Parents

The 3rd grade teacher emphasized the importance of coordination: "Coordinate with the student's parents to better supervise the use of gadgets while at home. And also socialize the rules for using gadgets in the classroom." The principal explained the school's monitoring system: "To monitor the gadgets used properly by the students, every one month the children bring the gadgets as if the school is providing learning about IT. After that, we check one by one, whether the gadget is used positively or negatively."

4. Obstacles in Overcoming Learning Loss Technology

Teachers identified several major obstacles in efforts to overcome technological learning loss. The 1st grade teacher mentioned:

"*Infrastructure aspects, the readiness of human resources (teachers and students), and psychological or social factors* (Grade 1 teachers, 2025)."

Grade 3 teachers highlight the challenges of collaboration:

"*Cooperation with parents in terms of restricting and supervising the use of gadgets by students at home. The stigma that gadgets are currently very important in the current digital era in helping the learning implementation process* (Grade 3 Teachers, 2025)."

The 5th grade teacher explained the fundamental dilemma:

"*We cannot eliminate 100% of the use of gadgets because in this era of digitalization, children are prepared for all AI and other digital intelligence. As teachers, we need to be wise and direct balanced learning between the use of gadgets and learning with a real context* (Grade 5 Teacher, 2025)."

Grade 6 teachers identified coordination problems:

"*Collaboration between parents and teachers. Sometimes schools have a rule that they are not allowed to bring mobile phones, but parents still allow their children to bring mobile phones to school for communication* (Grade 6 Teachers, 2025)."

Discussion

The findings of this study are in line with various theories and previous research on the impact of digital overstimulation on children's learning. The discussion was organized based on the main themes that emerged from the data.

Overall, this study found that gadget overstimulation has a significant and multidimensional impact on elementary school students at SDN Rinjani Cirebon City, covering academic, daily habit, and social-emotional dimensions. Teachers have responded to this phenomenon through various innovative pedagogical strategies, including student-centered learning, project-based learning, ice breaking techniques, and active collaboration with parents. School policies also play an important role in shaping a more controlled and balanced digital environment for students.

These findings align with several previous studies while also revealing some distinctions. In terms of similarities, the decline in students' concentration, focus, and academic achievement reported by teachers in this study is consistent with Santos et al. (2022), who found a strong correlation between excessive screen time and attention difficulties in children. Likewise, the social-emotional disruptions identified, such as reduced socialization and emotional outbursts, are in line with Muppalla et al. (2023), who highlighted the impact of intense digital exposure on the development of the prefrontal cortex responsible for impulse control. In terms of differences, most prior studies were conducted in urban or high-technology school settings, whereas this

research took place in a school with moderate technology access, namely the use of Chromebooks limited to grades 4–6, combined with low parental control over students' personal gadget use at home. Unlike Agustina et al. (2024), who focused on kindergarten students, this study involves a broader age range across all elementary grades. Furthermore, while Ahmad (2024) addressed general pandemic-related learning loss recovery, this study specifically examines technology-induced learning loss in a post-pandemic context where digital habits formed during the pandemic have persisted and intensified.

The findings of this study carry several important implications. From a theoretical standpoint, this research reinforces the relevance of cognitive load theory (Sweller, 1988) and constructivist learning theory (Piaget, 1970; Vygotsky, 1978) in understanding how digital overstimulation disrupts children's cognitive development. The findings also extend these theoretical frameworks into a post-pandemic digital context in Indonesia, where gadget use has become deeply embedded in students' daily lives. From a practical perspective, this study underscores the urgent need for systematic professional development programs for teachers, equipping them with neuropsychological knowledge about the effects of gadget overstimulation and concrete pedagogical strategies to address it. Schools should prioritize the development of structured parent engagement programs to ensure consistent monitoring of gadget use both at school and at home. From a policy standpoint, the findings suggest that ad hoc school-level policies are insufficient to address technology learning loss effectively. A more comprehensive regulatory framework at the district or national education level is needed to standardize gadget use guidelines in elementary schools, supported by digital literacy curricula that promote healthy and critical engagement with technology.

1. The Impact of Gadget Overstimulation: Neuropsychological and Cognitive Perspectives

The findings of research on the drastic decrease in students' concentration and focus support the theory of cognitive load put forward by Sweller (1988). Rapid and conspicuous exposure to digital content creates cognitive overload that exceeds the child's working memory capacity, resulting in difficulties in processing information that requires deep thinking (Vedechkina & Borgonovi, 2021).

The decline in literacy and numeracy skills reported by teachers is in line with the findings of Muppalla et al. (2023) which showed that every additional one hour of screen exposure at an early age correlates with a decline in long-term academic ability. This mechanism can be explained through the displacement hypothesis, where time spent on gadgets replaces activities important for cognitive development such as reading, creative play, and social interaction (Kirkorian et al., 2009).

2. Social-Emotional Impact: A Theory of Social Development

The findings about the decline in socialization ability and the emergence of antisocial attitudes can be explained through Social Learning Theory (Bandura, 1977) and Vygotsky's theory of social development (1978). Excessive use of gadgets reduces the child's chances of engaging in direct social interactions that are important for the development of social skills and emotional intelligence.

Teacher reports of students who were "emotionally high" and experienced "tantrums" when overstimulated were consistent with research on the impact of screen time on emotion regulation. Muppalla et al. (2023) explain that exposure to intense digital content can interfere with the development of the prefrontal cortex responsible for impulse control and emotion regulation.

3. The Role of Teachers in Overcoming Learning Loss: A Constructivist Pedagogical Perspective

The strategies applied by teachers reflect the principles of constructivist pedagogy and student-centered learning. The application of varied, project-based, and hands-on learning methods is in line with the constructivist theories of Piaget (1970) and Vygotsky (1978) which emphasize the importance of active and concrete experiences in learning.

The use of ice breaking, games, and fun activities reflects the teacher's understanding of the importance of engagement and motivation in learning. Research shows that the combination of social presence, cognitive presence, and facilitatory presence in learning increases student engagement and learning outcomes.

4. Smart Technology Integration

The findings on the use of Chromebooks in grades 4-6 and teachers' strategies in "utilizing gadgets in learning activities through various supporting applications" demonstrate teachers' understanding of the importance of a balanced approach to technology. This is in line with the concept of TPACK (Technological Pedagogical Content Knowledge) developed by Mishra and Koehler (2006).

CONCLUSION

Based on the results of the research and discussion, several main conclusions can be drawn that answer the formulation of the research problem:

First, gadget overstimulation has been shown to have a significant and multidimensional impact on elementary school students. In the academic dimension, there was a drastic decrease in concentration, learning motivation, interest in reading, and academic achievement. In the dimension of daily habits, excessive use of gadgets interferes with sleep quality, reduces physical activity, and has the potential to lead to

addiction. In the social-emotional dimension, there is a decrease in socialization skills, the emergence of antisocial attitudes, and disturbances of emotional control.

Second, the identified signs of technology learning loss include decreased focus and concentration on learning, decreased academic scores, easy to forget the material that has been learned, difficulty reasoning and understanding the material, slow grasp of the teacher's explanations, the emergence of laziness in thinking, unbalanced emotions, and dependence on technology for academic tasks.

Third, teachers have developed various innovative strategies to overcome technological learning loss. The pedagogical strategies applied include various student-centered-based learning methods, project-based learning, the use of ice breaking and games, learning with concrete media, modification of materials according to students' talents and interests, and effective classroom management.

Fourth, the main obstacles faced by teachers include limited infrastructure, gaps in human resource readiness (teachers and students), psychological and social factors of students, difficulties in collaboration with parents, and the dilemma between utilizing technology for learning and limiting its negative impacts.

Fifth, school policies have shown proactive efforts in overcoming this problem through measurable technology integration, periodic monitoring systems on the use of student gadgets, coordination between teachers-principals and parents, and plans to strengthen digital literacy.

Among all these findings, the most critical is the recognition that teachers function not merely as subject matter instructors but as active recovery agents for technology-induced learning loss. This study demonstrates that teachers, when equipped with an understanding of the neuropsychological consequences of gadget overstimulation, are capable of designing responsive and innovative learning environments that restore students' focus and engagement. This finding is particularly significant because it shifts the discourse from a deficit-focused view, which simply documents the negative effects of gadgets, toward a capacity-oriented perspective that foregrounds the transformative potential of teacher agency. Unlike previous studies that largely identified problems without exploring teachers' active responses, this study provides empirical evidence of how classroom teachers in a real-world, resource-constrained setting effectively navigate the challenges of technology learning loss through creativity, pedagogical flexibility, and stakeholder collaboration.

This study makes several noteworthy contributions to the field of education. Conceptually, it operationalizes and contextualizes the concept of "technology learning loss" as a distinct phenomenon arising from gadget overstimulation in the Indonesian elementary school setting, distinguishing it from the broader pandemic-related learning loss discussed in much of the existing literature. Methodologically, the multi-stakeholder approach employed in this study, integrating perspectives from

teachers, the principal, parents, and students, provides a more holistic and ecologically valid understanding of the phenomenon compared to single-informant studies. Practically, this research produces a documented map of concrete pedagogical strategies that teachers have developed and applied in the field, which can serve as a practical reference for other schools facing similar challenges. Collectively, these contributions position this study as a foundational work for developing evidence-based intervention models that address technology learning loss in Indonesian elementary schools in the post-pandemic digital era.

Research Limitations

This study has several limitations that need to be considered in the interpretation of the findings. First, the study was conducted in only one school (SDN Rinjani Cirebon City) with a limited sample of 14 informants, so the findings may not be fully generalized to the context of other schools with different characteristics.

Second, the relatively short data collection period (two months) limits the ability of researchers to observe longitudinal changes and the long-term effectiveness of the strategies applied by teachers. Third, this study relies on self-report data from interviews, which can be affected by social bias of desiraability and recall bias.

Recommendations

Based on the findings and limitations of the study, several recommendations are put forward for further research and educational practice:

First, longitudinal studies with a larger and diverse sample need to be conducted to evaluate the long-term effectiveness of the various intervention strategies implemented by teachers. Second, mixed-methods research that integrates objective quantitative measurements with in-depth qualitative exploration can provide a more comprehensive understanding. Third, experimental or quasi-experimental research needs to be conducted to test the causal effectiveness of specific interventions.

Second, schools need to develop a home-based integrated intervention model that synergistically involves teachers, principals, counselors, and parents. Second, teachers need to receive systematic professional training on the neuropsychological impact of gadget overstimulation and innovative pedagogical strategies.

Third, schools need to develop comprehensive digital literacy programs that focus not only on technical skills but also on critical digital literacy. Fourth, parents need to get support and resources to manage their children's gadget use at home.

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