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# Innovative learning as a strengthening of 21st-century skills of elementary school students

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**Abstract**

21st-century skills are essential competencies that need to be developed from the elementary school level to prepare students for future challenges. This study aimed to explore the role of innovative learning in strengthening 21st-century skills among elementary school students within the context of the Merdeka Curriculum. This study employed a qualitative case study design. The participants consisted of three elementary school teachers from two districts in Bogor Regency, Indonesia, who had implemented innovative learning practices in their classrooms. Data were collected through open-ended questionnaires and thematically analyzed in NVivo 12 using the stages of open coding, axial coding, and selective coding. The findings revealed that innovative learning practices, such as project-based learning, problem-based learning, collaborative discussion, and the integration of digital media, contributed positively to strengthening students' critical thinking, creativity, communication, collaboration, and problem-solving skills. Innovative learning also encouraged active student participation, increased students' confidence, and created more meaningful and student-centered learning experiences. Teachers played an important role as facilitators, guiding students through collaborative, context-based learning activities. However, the implementation of innovative learning still faced several challenges, including limited learning facilities, time constraints, and differences in students' learning abilities. This study concludes that innovative learning plays an important role in strengthening 21st-century skills in elementary schools and highlights the need for continuous teacher support, adequate learning facilities, and collaborative learning environments to sustain implementation.

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## 1. Introduction

The 21st century is often referred to as an era of knowledge development and rapid technological and information advances across various aspects of life, including education. The role of education in developing 21st-century skills requires learning processes that provide more meaningful, inclusive, and student-centered experiences, thereby creating open opportunities for every student to actively engage in learning (Carvalho & Santos, 2021). Current learning practices emphasize students' ability to integrate knowledge with real-world contexts critically and to master the use of technology (Muttaqin & Rizkiyah, 2022; Safrizal et al., 2026).

Learning in elementary school plays a crucial role in developing students' foundational competencies, including literacy and numeracy, as well as in fostering 21st-century skills (Pramulia et al., 2024). In addition, teachers are not only required to develop students' cognitive potential, particularly in relation to modernization, and to prepare them to face future challenges, but also to nurture their social and emotional development (N. W. Safitri & Andriani, 2025). However, in reality, the learning process in elementary schools still tends to focus on memorization, providing limited opportunities for students to develop the 4C skills (critical thinking, creativity, collaboration, and communication). As a result, students' skills develop in a limited and less optimal manner.

Meanwhile, 21st-century learning demands that students possess at least the 4C skills, essential competencies that should be developed from the elementary level onward. Therefore, learning needs to be supported by the effective use of instructional media and active collaboration to enhance students' skills. (Suryaningsih & Nurlita, 2021) ; (Mulyanti & Hayu, 2024). Learning design needs to be planned and developed in alignment with the 4C skills to ensure that instructional activities effectively foster critical thinking, creativity, collaboration, and communication (Rosnaeni, 2021). Learning innovation is essential to be developed to support the implementation of more inclusive learning practices (Hayu et al., 2024). In designing learning that aligns with contemporary developments and addresses students' needs, teachers must balance it with the competencies they possess to ensure effective and meaningful instruction (Rakhmawati et al., 2024). This is in line with the findings of a study conducted by. (2022), which found that in the Society 5.0 era, teachers need to possess problem-solving skills, critical thinking abilities, and collaboration skills, and to continuously develop their competencies in line with technological and societal advancements. This is further supported by Rivalina's (2020) research, which shows that teachers' Higher Order Thinking Skills (HOTS) have a significant influence on students' learning outcomes and the development of 21st-century skills.

The implementation of innovative learning in elementary schools still faces several challenges, particularly teacher readiness, limited learning facilities, and the need to adapt to continually evolving curricula. These conditions have resulted in the strengthening of 21st-century skills not being optimally implemented throughout the learning process. Innovative learning is considered capable of creating more meaningful learning experiences because the

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learning process can be connected to students' daily lives and encourages active student participation during classroom activities (Sitorus et al., 2025).

Several empirical studies on innovative learning and the strengthening of 21st-century skills among elementary school students have highlighted both the potential benefits and challenges of implementing these practices in elementary education. Previous studies indicate that teachers need to improve their competencies as classroom leaders by adapting teaching methods, models, and learning approaches to the characteristics of learning in the Society 5.0 era (Safrizal et al., 2026; Paz-Baruch et al., 2025). Research conducted by Rosa et al. (2024) revealed that implementing project-based learning improved elementary school students' collaboration and critical thinking skills. Another study by Suryaningsih & Nurlita (2021) emphasized that the use of digital learning media could support students' communication skills and creativity during the learning process. In addition, Mulyanti & Hayu (2024)stated that collaborative learning had a positive impact on students' active engagement in 21st-century learning.

Nevertheless, most previous studies have primarily focused on the effectiveness of specific learning models in a partial manner and have tended to employ quantitative approaches to measure students' learning outcomes. Previous research has also placed greater emphasis on the implementation aspects of learning models rather than on deeply exploring elementary school teachers' perceptions of innovative learning for holistically strengthening 4C skills. In addition, studies examining the implementation of innovative learning within the Merdeka Curriculum at the elementary school level remain relatively limited. Therefore, this study was conducted to address these gaps through a qualitative case study to deepen understanding of the role of innovative learning in strengthening elementary school students' 21st-century skills.

The novelty of this study lies in its in-depth analysis of the implementation of innovative learning, based on elementary school teachers' perceptions, to strengthen students' 4C skills within the context of the Merdeka Curriculum, using a qualitative case study approach.

Based on the explanation above, this study aims to explore how innovative learning strengthens elementary school students' 21st-century skills and to identify the supporting and inhibiting factors in its implementation.

## 2. Method

This study employed a qualitative case study design. A case study design is used to examine a case in depth, including events, activities, or processes involving individuals or groups (Creswell, 2018). This approach was selected to obtain and deepen an understanding of innovative learning practices and the process of strengthening 21st-century skills in elementary schools, as experienced and interpreted by teachers in real classroom contexts. The participants in this study were elementary school teachers who had implemented innovative learning practices in their classrooms. A total of 3 elementary school teachers from 2 districts in Bogor Regency, namely Megamendung and Dramaga, participated in this study. The instrument used in this research was an open-ended questionnaire.

Furthermore, the data were analyzed thematically using NVivo 12 software. The analysis began with data reduction to filter participants' responses for relevance to the study's focus. The next stage was open coding, which involved identifying keywords and main ideas based on similar patterns. The findings from this stage were then continued through axial coding by grouping the data into categories based on similarities in meaning and relationships among ideas. The next stage was selective coding to identify the main themes most relevant to the research focus.

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The themes that emerged were then interpreted by connecting the research findings with relevant theories and previous studies. To enhance the credibility of the data, the researchers repeatedly rechecked the coding results, categorization, and the consistency between the interpretations and participants' responses.

## 3. Results

The findings revealed that the implementation of innovative learning within the context of the Merdeka Curriculum in elementary schools was perceived by teachers as playing an important role in strengthening students' 21st-century skills, particularly in critical thinking, creativity, collaboration, and communication (4C). The data analysis process generated six main themes representing the implementation of innovative learning and its contribution to strengthening elementary school students' 21st-century skills, namely: (1) the benefits of innovative learning, (2) innovative learning models, (3) students' skill development, (4) the impact of learning, (5) supporting and inhibiting factors, and (6) strategies for overcoming challenges.

The findings indicated that innovative learning was not merely the use of specific learning models or instructional media, but also a learning strategy that provides opportunities for students' active participation during the learning process. Teachers perceived that group discussions, project-based learning, the integration of digital media, and problem-based learning encouraged more active student engagement than conventional teacher-centered learning approaches.

In addition, the analysis revealed that teachers' readiness influenced the successful implementation of innovative learning in the design of learning activities, students' ability to adapt to active learning, and the availability of supporting facilities at school. Nevertheless, several teachers also reported that limited learning facilities, low participation among some students, and differences in students' abilities posed challenges to strengthening 21st-century skills in elementary schools.

The first theme identified in this study was the benefits of innovative learning in elementary schools, as presented in Figure 1. Teachers perceived innovative learning as an approach that could attract students' interest, practically integrate media and technology, promote student-centered learning, and create effective, adaptive, and meaningful learning experiences. Innovative learning was also considered capable of connecting learning materials with students' daily lives, making the learning process more varied and meaningful.

Teachers stated that innovative learning encouraged students to become more active and engaged in the learning process. One teacher mentioned, "This learning approach makes students more active and helps them understand the material more meaningfully." This finding indicates that innovative learning contributes to creating active and meaningful learning experiences for elementary school students.

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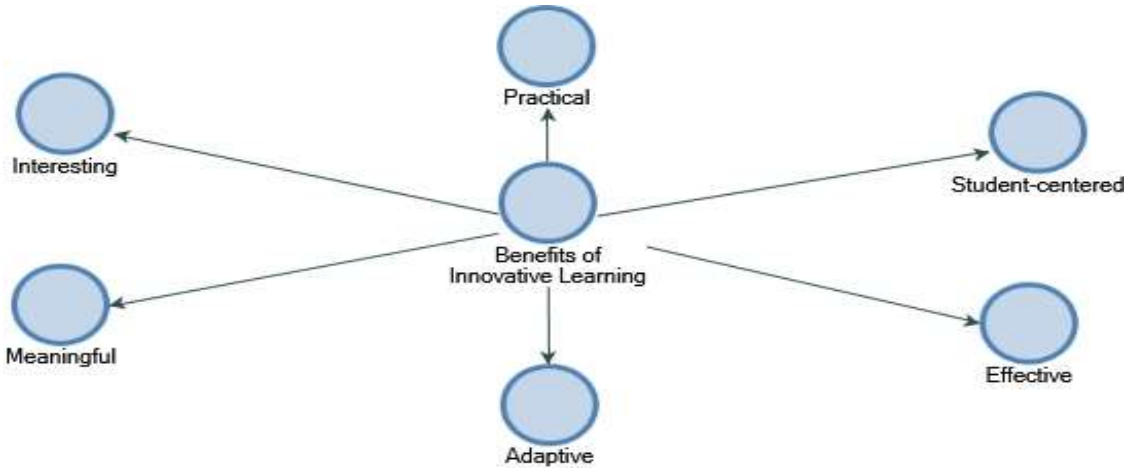


**Figure 1.** Benefit of innovative learning

The second theme concerns the strengthening of 21st-century skills through various forms of innovative learning, as illustrated in Figure 2. The implemented approaches include project-based and problem-based learning, group discussions, and the use and development of instructional media integrated with technology. Teachers stated that these approaches encourage students not only to receive information passively but also to actively engage in the learning process by exploring, processing, and presenting information independently.

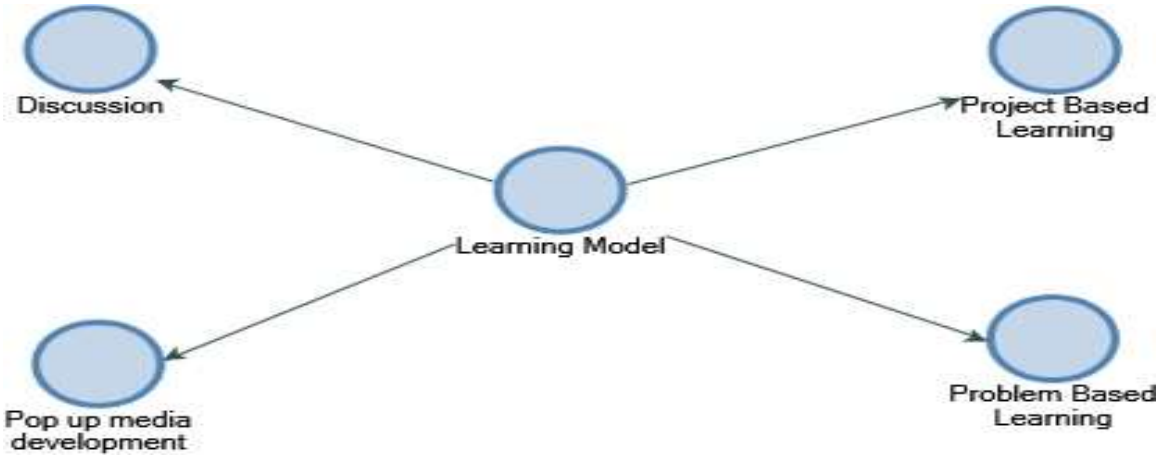


**Figure 2.** Innovative learning model

The third theme concerns the development of students' skills, as illustrated in Figure 3. The findings indicate that innovative learning is designed to foster 21st-century skills—namely critical thinking, creativity, collaboration, and communication—as well as problem-solving abilities. Through learning processes that incorporate project-based activities, problem-solving tasks, and discussions, students become more confident in expressing their opinions, listening to their peers' perspectives, and working collaboratively to achieve shared goals.

Teachers revealed that through open-ended tasks, simple projects, and guiding questions, students are trained to analyze problems, provide reasoning, and explore multiple alternative solutions. Students' creativity is reflected in their ability to generate diverse ideas, produce simple works or products, and express their imagination based on their understanding. Teachers

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also noted that innovative learning offers broader opportunities to accommodate diverse ways of thinking and learning styles among students.

One teacher stated that, "Innovative learning such as Project-Based Learning helps students develop 21st-century skills, namely critical thinking, creativity, communication, and collaboration." This statement indicates that innovative learning does not focus solely on content delivery but also encourages students to actively engage in thinking, collaboration, and communication during classroom activities. Learning activities involving projects and problem-solving provide students with opportunities to build more meaningful learning experiences that are relevant to the development of 21st-century skills.

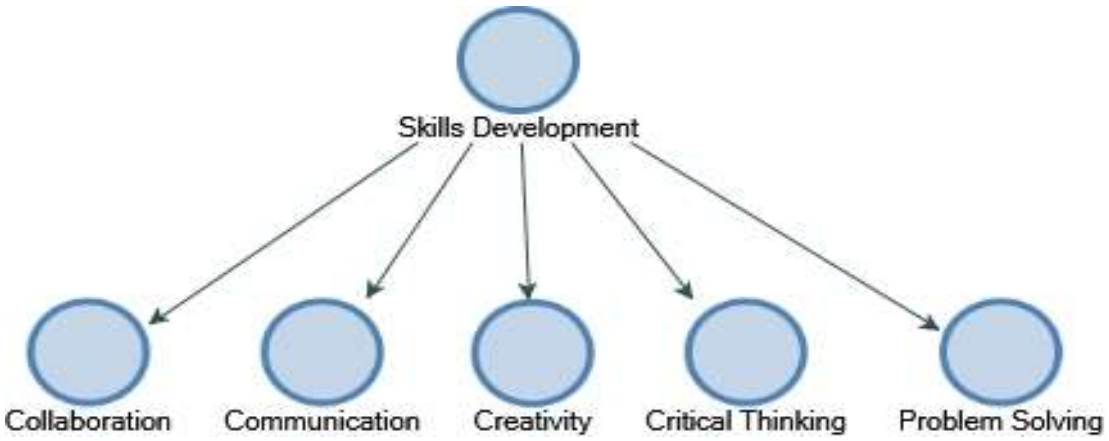


**Figure 3.** Student skills development

The fourth theme relates to students' responses and the impact of learning, as illustrated in Figure 4. Teachers observed improvements in students' active engagement, creativity, learning motivation, sense of responsibility, social ethics, self-confidence, and adaptability in learning. Students demonstrated more active, independent, and responsible attitudes toward the tasks assigned to them. Innovative learning also helped students develop positive attitudes toward learning, such as curiosity and the courage to try new things.

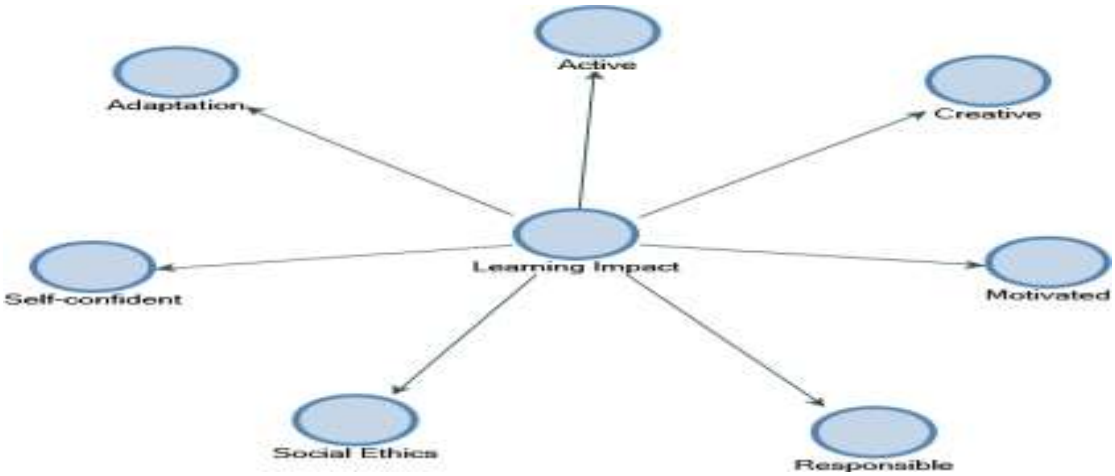


**Figure 4.** Learning Impact

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The fifth theme highlights the supporting and inhibiting factors in the implementation of innovative learning, as illustrated in Figure 5. Supporting factors include students' enthusiasm, school collaboration, teachers' competencies, and a conducive school environment. Meanwhile, commonly identified inhibiting factors include limited access to technology, insufficient institutional support, inadequate learning facilities, teachers' willingness to implement innovative approaches, students' varying abilities, and limited instructional time. Nevertheless, teachers continue to view innovative learning as an important and relevant strategy for preparing students to face the challenges of the 21st-century skills.

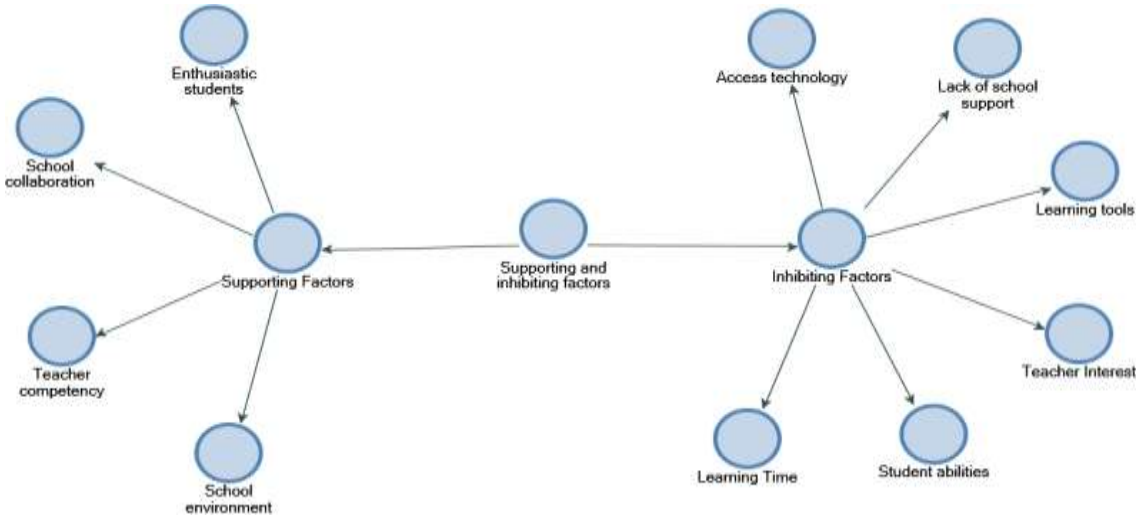


**Figure 5.** Supporting and inhibiting factors

The final theme focuses on strategies for overcoming challenges in implementing innovative learning in elementary schools, as illustrated in Figure 6. These strategies include optimizing the use of available learning facilities, strengthening support from school leadership, fostering collaboration with parents, implementing flexible learning approaches, and enhancing teachers' competencies through various professional development activities and supporting programs.

**Figure 6.** Strategies for Overcoming Challenges

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Overall, this study's findings indicate that innovative learning strengthens elementary school students' 21st-century skills, particularly in critical thinking, creativity, collaboration, communication, and problem-solving. The implementation of innovative learning through project-based activities, discussions, and problem-solving created more active, collaborative, and student-centered learning experiences. In this process, teachers played an important role as facilitators, designing meaningful learning experiences, encouraging student engagement, and adapting learning strategies to the needs and characteristics of elementary school students.

## 4. Discussion

The findings of this study indicate that innovative learning strengthens elementary school students' 21st-century skills, particularly in critical thinking, creativity, collaboration, communication (4Cs), and problem-solving. These findings reinforce the idea that the transformation of learning from teacher-centered to student-centered approaches is not merely a curriculum policy demand, but also a pedagogical necessity in responding to the challenges of the global era and Society 5.0.

This finding is consistent with previous studies conducted by Umayah & Riwanto (2020) and Dikta (2020), which emphasize that transforming elementary school learning through innovation integrated with digital media and student-centered instructional methods is essential for addressing the challenges of 21st-century education.

### 4.1. Innovative learning as meaningful and contextual learning

The findings of the first theme indicate that teachers perceive innovative learning as engaging, practical, adaptive, student-centered, and supported by technology-based media. This aligns with the goals of 21st-century education, which call for learning experiences that stimulate critical thinking skills (RAMDANI et al., 2019). Learning can be designed innovatively by connecting instructional content to students' everyday experiences. In practice, students work collaboratively in groups on shared projects, making learning more meaningful and fostering 21st-century skills—namely, critical thinking, creativity, collaboration, and communication (Arifah & Utami, 2023). Meaningful, innovative learning that explicitly trains creative thinking processes can improve the fluency and originality of elementary school students' ideas (Paz-Baruch et al., 2025).

These findings are consistent with previous studies, which show that innovative learning practices facilitate both teachers and students in accessing materials more concisely and efficiently. The flexibility inherent in innovative learning aligns with the spirit of the Kurikulum Merdeka, which empowers teachers to adapt instructional strategies to students' needs and characteristics. Such flexibility enhances students' understanding through more engaging, interactive, and meaningful learning environments (Kuncahyono et al., 2020); (Jenuri et al., 2025); (Maulana et al., 2024). Therefore, learning innovation does not stand alone; rather, it is integrated within the framework of national education policy that encourages teachers to be creative in designing flexible, adaptive, engaging, and student-centered instruction aligned with learners' needs.

### 4.2. Innovative learning models and students' active engagement

The second theme highlights innovative learning approaches implemented to enhance students' skills and active engagement, including project-based learning (PjBL), problem-based learning (PBL), group discussions, and the integration of digital media to encourage active

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participation. These models provide students with opportunities to directly experience the learning process through exploration, investigation, and collaboration. Digital-based, innovative learning provides students with opportunities to learn more actively, interactively, and collaboratively in accordance with the demands of 21st-century learning (Nurhaliza et al., 2026; Hori et al., 2025).

These findings are consistent with previous studies by Sari & Atmojo (2021), Maulana et al. (2023), and Korosidou & Griva (2024), which indicate that technology-based, innovative learning facilitates easier access to learning resources and creates collaborative spaces to meet students' needs. The implementation of PBL, in particular, provides students with opportunities to construct knowledge through solving contextual problems, thereby fostering critical thinking skills (Fitri et al., 2020). Furthermore, innovation through PjBL offers meaningful learning experiences that enhance 21st-century skills (Nirmayani & Dewi, 2021; Sutanto et al., 2026).

This study's findings are further supported by Rosyid & Mubin (2024), who emphasize that in responding to educational challenges in Indonesia, teachers need to innovate learning models—for instance, by developing the Model Blended Learning. Therefore, innovative learning functions not merely as a means of transferring information, but as a medium for knowledge construction and the enhancement of students' skills.

### 4.3. Strengthening 4c skills and problem solving

The third theme demonstrates that innovative learning directly contributes to the development of 4C skills and problem-solving abilities. Project-based and problem-based learning activities encourage students to analyze, evaluate, and formulate alternative solutions. The development of 21st-century skills requires learning practices that promote creative thinking, collaboration, communication, and problem-solving through active learning activities (Mei et al., 2025).

Students' creativity was reflected in their ability to generate diverse ideas and simple products. This finding indicates that when students are given freedom and open-ended tasks, they can express their ideas more originally. This finding aligns with previous research by Rahmawati et al. (2025), which found that students' critical thinking skills develop when learning activities provide opportunities to analyze problems, engage in logical reasoning, and develop solutions through direct learning experiences. Activity-based and game-based innovative learning can optimize students' conceptual understanding and support the development of 21st-century skills (, 2023; Diandini et al., 2025; Pasaribu et al., 2026).

Furthermore, integrating problem-solving-based pedagogy with interactive information technology media is considered important for developing elementary school students' cognitive abilities and 21st-century skills (Lingga et al., 2025; Hung & Pan, 2025). In terms of collaboration and communication, students learned to share roles, listen to their peers' opinions, and communicate ideas systematically. This finding supports the view of Rakhmawati et al. (2024), who emphasized that the teacher's role in managing classroom interaction greatly influences the development of students' social and communication skills. Therefore, innovative learning contributes not only to cognitive development but also to students' social and emotional development.

### 4.4. Affective impact and changes in learning attitudes

The fourth theme indicates that innovative learning positively impacts students' motivation, self-confidence, responsibility, and social ethics. These outcomes suggest that learning

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innovation carries strong affective implications. When students are actively involved and feel their opinions are valued, they tend to develop higher self-efficacy.

These findings are consistent with several previous studies (D. Safitri et al., 2021), which demonstrate that learning innovation can enhance students' motivation, engagement, and conceptual understanding, transforming passive learning into active participation. Active classroom interaction creates an environment that encourages students to express ideas and build self-confidence—an essential component of deep learning and critical thinking (Zainal et al., 2021).

Furthermore, Safitri & Andriani (2025) emphasize the importance of strengthening critical thinking skills from the elementary level through instructional practices that provide space for active participation. Therefore, innovative learning contributes to shaping students' independent and adaptive learning character.

### 4.5. Supporting and inhibiting factors in implementation

Despite its positive impacts, the implementation of innovative learning is not free from challenges. Limitations in infrastructure, access to technology, instructional time, and the heterogeneity of students' abilities emerge as major obstacles. These findings are consistent with those of Abidah et al., who state that teachers face complex challenges in developing 21st-century learning, particularly in terms of competency readiness and systemic support. Similarly, Saputro & Wijayanti (2021) highlight that challenges in classroom practice are closely related to the availability of adequate learning facilities.

On the other hand, students' enthusiasm, teacher collaboration, and strong school support are key drivers of successful implementation. This indicates that innovative learning requires a supportive educational ecosystem, rather than relying solely on individual teacher initiatives.

### 4.6. Strategies to overcome challenges and practical implications

The strategies implemented by teachers—such as optimizing available facilities, collaborating with parents, and enhancing competencies through professional training—reflect adaptive and reflective efforts. This indicates that teachers act as agents of change in the transformation of learning. These findings are consistent with Zulkarnaen et al. (2019), who emphasize that parents can significantly contribute to students' development, enabling synergistic collaboration among students, teachers, and parents.

The practical implications of this study highlight the need for: (1) strengthening teachers' capacity through continuous, practice-based professional development; (2) school policy support in providing adequate learning facilities; and (3) the development of teacher learning communities to share best practices. Theoretically, this study reinforces the notion that innovative learning is a strategic approach to holistically developing 21st-century skills across cognitive, affective, and social dimensions.

Overall, this discussion underscores that innovative learning is not merely a variation of instructional methods but a learning paradigm that positions students as active agents in constructing knowledge. Innovation in elementary education will have sustainable impacts if it is not treated as a temporary initiative, but rather systematically integrated into school operations and prioritized as part of everyday instructional practice (Tolan et al., 2024). Its success is largely determined by teachers' competencies, systemic educational support, and the school environment's readiness to adopt change sustainably.

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## 5. Conclusion and implications

The findings of this study indicate that innovative learning not only improves students' cognitive skills but also encourages their social and emotional engagement during the learning process. The implementation of innovative learning becomes more effective when supported by teachers' readiness, a collaborative learning environment, and the use of learning media that align with students' needs. Nevertheless, limited facilities and the heterogeneity of students' abilities remain challenges in the implementation of innovative learning in elementary schools.

This study concludes that innovative learning strengthens elementary school students' 21st-century skills, particularly in critical thinking, creativity, collaboration, and communication (4Cs). Through the implementation of project-based learning, problem-based learning, collaborative discussions, and the integration of media and technology, students became more active, independent, and responsible in the learning process. Learning was no longer oriented toward memorization, but toward meaningful, contextual, and student-centered learning experiences. The impact was reflected not only in improvements in cognitive abilities but also in affective and social aspects such as motivation, self-confidence, and adaptability.

Nevertheless, the implementation of innovative learning still faced several challenges, including limited facilities, time constraints, and the heterogeneity of students' abilities, indicating that its successful implementation requires systemic support. The implications of this study suggest that teachers need to improve their pedagogical competence and digital literacy continuously; schools need to provide adequate facilities and foster a collaborative culture; and policymakers need to ensure sustainable professional development programs to support the optimal, continuous implementation of innovative learning and to strengthen 21st-century competencies in elementary education.

### Declaration and Statement

**CRediT Authorship Contribution Statement**

Wiworo Retnadi Rias Hayu: Methodology, Formal analysis, Data curation, Conceptualization, and Writing Original Draft. Septian Maulana: Supervision, Methodology, Writing & Editing. Mega Febriani Sya: Review Methodology, Validation and Editing. La Ode Amril: Formal analysis and Data curation

**Declaration of Competing Interest**

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

**Funding Statement**

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

**Data Availability Statement**

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

**Ethical Declaration**

Participants consented voluntarily after being informed of the study's purpose and procedures, as well as their right to withdraw at any time without negative consequences.

**Informed Consent Statement**

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Informed consent was obtained from all participants involved in this study. Participants were informed about the purpose, procedures, and voluntary nature of their participation in the research.

**Acknowledgement (Optional)**
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**Declaration of Generative AI and AI-Assisted Technologies**
During the preparation of this manuscript, the authors used generative artificial intelligence and AI-assisted technologies solely to improve language clarity, grammar, and readability. The authors reviewed and edited the content and take full responsibility for the accuracy, originality, and integrity of the final manuscript.

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