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## **STEM Integration in the Independent Curriculum for Pancasila Student Profiles in Elementary Schools**

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### **Abstract**

This study aims to examine the implementation of Science, Technology, Engineering, and Mathematics (STEM) education at SDN 3 Nyerot in line with the Independent Curriculum. The research used a qualitative methodology through observation, Q&A sessions, and review of teaching documents. The results indicate that STEM education has begun to be linked to various disciplines on environmentally-focused topics, including recycling used goods, creating pamphlets on cleanliness, and calculating waste volume. This implementation encourages students to become more enthusiastic, imaginative, confident, and capable of working collaboratively in groups. However, the successful implementation of STEM at the elementary school level still requires greater support from school management and educational regulations, particularly in providing facilities and improving teacher skills. Overall, STEM teaching has great potential to support the implementation of the Independent Curriculum while developing 21st-century skills in students, such as critical thinking, creativity, synergy, and speaking skills.

**Keywords:** *STEM; Independent Curriculum; Pancasila Student Profiles*

### **1. Introduction**

The Independent Curriculum is an educational policy that emphasizes student-centered learning and character development through the Pancasila Student Profile. This profile is designed to shape students who are faithful, independent, creative, and capable of critical thinking (Gumilar

& Permatasari, 2023). Basic education plays a key role in building the foundation of students' knowledge, skills, and behavior. At this level, children not only learn basic skills such as reading, writing, and mathematics but also develop character traits, creativity, and 21st-century skills that are relevant to the changing world. In line with the growth of globalization and the industrial revolution 4.0, education is required to prepare young people with critical thinking, collaboration, creativity, and communication skills that are effective in various situations (Febriawati et al., 2024). Addressing this need, the Independent Curriculum is presented as a strategic effort to provide students with the freedom to explore, situationally connected teaching, and a more meaningful educational experience.

However, the reality of primary education is not only related to curriculum implementation but also to the low literacy culture among students. Literacy activities in schools should be effective if they involve all stakeholders, such as teachers, principals, parents, students, and school committees. However, practice in the field shows that this participation is still suboptimal. Some teachers are still inconsistent in directing students to read for 15 minutes before class begins, while most students still lack interest in the school's book collection. They prefer playing to reading, so literacy activities only occur during the learning process. As a result, many students experience difficulty in reading fluency. This condition confirms that low reading interest is one of the main challenges in improving literacy quality in primary schools. (Faridah, Saputra, & Ramadhani, 2023).

The global education world is currently facing increasingly complex challenges, particularly in preparing the younger generation to compete in the era of Industrial Revolution 4.0 and Society 5.0. Amidst these changes, the Science, Technology, Engineering, and Mathematics (STEM) approach has received significant attention as an integrative learning model capable of equipping students with 21st-century competencies (Kelley & Knowles, 2023; English, 2022). STEM is not simply a combination of four disciplines, but rather a transdisciplinary approach that encourages students to solve real-world problems systematically and creatively. In addressing these challenges, the STEM (Science, Technology, Engineering, and Mathematics) approach is considered in line with the principles of the Independent Curriculum. This method combines science, technology, engineering, art, and mathematics in a learning experience that is interdisciplinary, comprehensive, and relevant. The main goal is to connect various disciplines with everyday life and create innovative solutions to problems faced by students. Nuragnia and Usman (2021) emphasized that STEM-based learning has been proven to improve problem-solving skills while developing students' social and aesthetic sensitivity, thus aligning with the competencies established by the Independent Curriculum.

The importance of STEM education at the elementary school level also arises from the complex challenges of the times. From a young age, children are confronted with digital change,

social shifts, and environmental issues. If the learning process remains fragmented, unintegrated, and focused primarily on memorization, students risk missing opportunities to hone their best abilities. The Independent Curriculum emphasizes the importance of student-centered learning, where teachers act as facilitators, providing space for exploration, while students actively participate in the learning process. Through STEM integration, students not only acquire cognitive knowledge but also develop practical skills, creativity, and a collaborative character (Ilma et al., 2021).

However, the implementation of STEM at the elementary school level still faces various challenges. Nurhayani and colleagues (2023) noted that many teachers struggle to design interdisciplinary learning due to limited resources, lack of training, and the persistence of outdated paradigms that focus primarily on academic achievement. Furthermore, the arts are often overlooked, despite their crucial role in supporting the development of students' imagination and creativity. Therefore, a detailed analysis of STEM learning practices in accordance with the Independent Curriculum in elementary schools is necessary to identify strategies, barriers, and opportunities for its development.

From a universal perspective, STEM has become a major focus of educational innovation. Studies in Korea and Japan have shown that the implementation of STEM can improve students' scientific literacy and collaboration skills, especially when implemented through problem-based projects (Lee, 2022). These findings confirm that STEM is not merely a phenomenon in education but an urgent need to prepare a generation that is adaptable and resilient to change. In Indonesia, the Independent Curriculum policy gives teachers the freedom to design creative and contextually appropriate learning, thus creating numerous opportunities to implement STEM at the elementary school level (Kemdikbudristek, 2022).

Furthermore, the context of this research cannot be separated from the contributions made by educational institutions and other organizations in community service. To date, most community service activities have focused on training teachers on the Independent Curriculum and the Pancasila Student Profile, but in-depth studies on the implementation of STEM at the elementary school level are still very limited. Sustainable community service has significant potential to bridge the gap between theory and practice. Through this study, the authors attempt to address this gap by analyzing the implementation of STEM based on the Independent Curriculum in elementary schools and assessing the effectiveness of this approach in improving students' abilities to face the challenges of the 21st century.

Thus, this study holds significant significance in the context of national education development. The analysis is expected to provide useful recommendations for teachers, principals, and policymakers, ensuring that the implementation of the Independent Curriculum can significantly impact the quality of learning at SDN 3 Nyerot. Furthermore, the research findings

are expected to serve as a reference for future community service activities, particularly those focused on developing teacher training models and STEM-based learning innovations.

## 2. Method

### 2.1 Participants

This research was conducted at SDN 3 Nyerot, Jonggat District, Central Lombok Regency, for two weeks with two meetings. The main focus of the research was related to the intrinsic and extrinsic learning motivation of 27 fourth-grade students at SDN 3 Nyerot.

### 2.2 Data Collection

#### 2.2.1 Instrument of Collecting Data

Data collection instruments are tools used by researchers to obtain relevant, valid, and reliable data in accordance with the research objectives. The selection of instruments must be adjusted to the type of research (qualitative, quantitative, or mixed) and the characteristics of the variables being studied (Sugiyono, 2019). The instrument used is observation. Observation is a data collection technique by directly observing the research object. This technique is used to obtain data on behavior, activities, or phenomena that occur in the field (Sugiyono, 2019). Observing and using direct communication with information sources with research objects at SDN 3 Nyerot.

#### 2.2.2 Techniques for Collecting Data

##### 1 Interviews

Interviews are a data collection technique through a direct question-and-answer process between researchers and respondents. Interviews are used to gather in-depth information, particularly in qualitative research (Moleong, 2017). Interviews will be conducted directly with teachers and students at SDN 3 Nyerot. Selected teachers have direct responsibility for designing and implementing the learning process, while students are selected to observe the effects of STEAM education on their participation and abilities. (Miles et al., 2020).

##### 2 Observation

Observation is a data collection technique that involves directly observing the research object. This technique is used to obtain data on behavior, activities, or phenomena occurring in the field (Sugiyono, 2019). Observation and direct communication with information sources and the research object at SDN 3 Nyerot.

##### 3 Documentation

Documentation is a data collection technique using written documents, images, or archives relevant to the research. Documentation data can include reports, photographs, recordings, or institutional data (Arikunto, 2013). This instrument serves as a complement to strengthen data obtained from interviews and observations (Sugiyono, 2019). Using this technique, the author explores data through photographs, documents, diaries, and other sources.

### **2.3 Data Analysis**

Data analysis in qualitative research is a systematic process of processing, interpreting, and finding meaning from data obtained through interviews, observations, and documentation. This process is inductive, dynamic, and ongoing, from before to after data collection, with the goal of identifying patterns, themes, and relationships relevant to the research focus (Qomaruddin & Sa'diyah, 2024). In this study, data analysis was used to understand how STEM learning practices contribute to student character development according to the dimensions of the Pancasila Student Profile.

In general, qualitative data analysis follows an interactive model that includes data reduction, data presentation, and conclusion drawing. Data reduction involves selecting and focusing important information, presenting data in narrative or tabular form for ease of understanding, and drawing conclusions continuously through verification until valid findings are obtained (Qomaruddin & Sa'diyah, 2024). Furthermore, analysis also involves coding, categorization, and theme discovery to deepen the interpretation of the phenomena under study. Thus, qualitative data analysis not only describes the data, but also produces an in-depth understanding of the implementation of STEM integration in forming the Pancasila Student Profile.

## **3. Results**

Classroom observations indicate that the implementation of STEM in elementary schools based on the Independent Curriculum (Curriculum Merdeka) is beginning to emerge, although it is still in its early stages. Teachers are striving to integrate various disciplines within a single learning theme. A clear example can be seen in the Environmental Care theme, where students not only learn scientific concepts regarding waste recycling but are also guided to utilize simple applications to record observations, design separate trash bins using recycled materials, and calculate the amount of domestic waste within a specific time period.

This practice aligns with research by Lee (2022), which states that STEM learning is more effective when linked to problem-based projects related to students' everyday situations. Therefore,

STEM not only focuses on cognitive aspects but also provides relevant and meaningful learning experiences.

However, an analysis of teachers' teaching materials indicates that planning still focuses primarily on science and mathematics. Technology has not been fully integrated. These results support the findings of research by Nurhayani et al. (2023), which showed that many elementary school teachers still struggle to balance the five elements of STEM, primarily due to limited references and linear thinking patterns in planning lessons.

Data from research and interviews indicate that students demonstrate a strong interest in STEM-related activities. For example, when asked to design solutions to waste management problems at school, many students actively participated in group discussions, boldly expressed their ideas, and even demonstrated creativity in creating posters and simple models. This level of engagement is significantly higher compared to traditional learning methods, which typically emphasize teacher lectures.

Furthermore, students expressed that they enjoyed learning more through hands-on methods. They felt that project-based learning made the material easier to understand and more engaging. This aligns with the findings of Ilma et al. (2021), which showed that STEM can strengthen students' active engagement, increase their intrinsic motivation, and help them develop social-emotional skills.

Interviews with several students also revealed that they felt more confident during group presentations. This increased confidence aligns with research by Febriawati et al. (2024), who found that STEM not only improves academic understanding but also strengthens students' soft skills such as communication, collaboration, and self-confidence.

Teachers participating in this study demonstrated strong enthusiasm for implementing the STEM approach. However, interviews revealed that they encountered several difficulties, particularly in developing interdisciplinary teaching modules. Teachers reported that designing STEM learning takes more time than conventional learning methods, as it requires integrating multiple disciplines simultaneously.

These findings align with research by Choi & Hong (2021), which highlights that successful STEM implementation is heavily influenced by teachers' pedagogical preparedness. Without appropriate training, educators generally implement only a portion of STEM elements. This situation is also evident in research by Nuragnia & Usman (2021), which noted that most teachers require more in-depth guidance to fully grasp the STEM learning framework. Furthermore, the lack of reference materials and applicable learning aids also poses a barrier. Teachers often rely on online resources or modify existing teaching guides. This illustrates the gap between the flexible Merdeka Curriculum regulations and the preparedness of teachers in the field.

Several key issues identified in this study include: first, limited infrastructure. Many practical activities cannot be implemented optimally due to a lack of learning media and digital resources. This finding aligns with research by Siregar (2022), which emphasized that the lack of digital devices is a major obstacle to the implementation of the Merdeka Curriculum in several elementary schools. Second, the length of time for teaching and learning activities. STEAM-focused initiatives require longer durations, while learning agendas are often difficult to change (Nurhayani et al., 2023). Third, the lack of specialized training. Educators acknowledged that they are still learning on their own, and therefore their understanding of STEM is not yet comprehensive. Febriawati et al. (2024) also emphasized the importance of a more regular teacher capacity development agenda to ensure effective implementation.

#### 4. Discussion

Regarding research findings, the implementation of STEM education in elementary schools based on the Independent Curriculum appears to have a positive impact on student capabilities, particularly in the areas of critical thinking, creativity, collaboration, and dialogue. This aligns with the view of Kim, Lee, & Park (2022), who stated that the STEM method can strengthen students' skills in problem-solving and group activities, as the learning method emphasizes the integration of various disciplines.

However, this study also identified challenges during the implementation process, particularly regarding teachers' limited understanding of STEM ideas and their ability to integrate technology and the arts into learning activities. This condition aligns with the observations of Nurhayani, Setiawan, & Fitriah (2023), who explained that educators still need regular guidance to master project-based teaching tactics aligned with the Independent Curriculum benchmarks. Therefore, despite policy support through government regulations (Kemdikbudristek, 2022), teacher preparedness is fundamental to success.

From a student perspective, STEM-oriented education can increase student participation. Students became more active in asking questions, conducting short experiments, and expressing original ideas during discussions. These results align with research by Ilma, Rahman, & Putri (2021), which showed that STEM-based thematic learning can strengthen students' inner drive through more realistic learning experiences. However, this study also revealed that not all students were able to absorb design-based learning easily. Some students required more focused assistance, particularly with basic literacy and arithmetic skills.

This research differs significantly from previous community service programs. The majority of existing community service programs prioritized providing educators with training on the Independent Curriculum (Siregar, 2022; Wahyuni & Hartati, 2022), while this study focuses on

examining direct STEM learning activities in the classroom. Therefore, this research not only presents a theoretical overview but also presents factual data regarding the development of STEM implementation at the elementary school level.

The novelty of this research lies in its connection to the Independent Curriculum (Kurikulum Merdeka), which emphasizes flexibility in learning and character building. By using a STEM approach, students develop not only cognitive skills but also social-emotional skills, which are characteristic of the Pancasila student profile (Kemdikbudristek, 2022). The results of this study reinforce the argument put forward by Febriawati, Pratiwi, & Susanto (2024) that integrating STEM into the Independent Curriculum can be a powerful strategy for preparing a generation capable of adapting to global challenges.

Furthermore, this analysis emphasizes the importance of support from school policies and collaboration with parents. Research shows that success in STEM learning is better when schools provide adequate facilities for experimentation and encourage parental participation in the learning process at home. This perspective aligns with the findings of Choi & Hong (2021), who revealed that a supportive learning environment, both at school and at home, significantly contributes to the successful implementation of STEM.

Overall, this research demonstrates that STEM learning within the Independent Curriculum framework has significant potential in producing creative, collaborative, and responsive students. However, to achieve the best impact, ongoing teacher professional development, the provision of supporting facilities, and close collaboration between institutions, parents, and government authorities are required. Based on these findings, this research contributes to the formulation of a relevant teaching framework that can be used as a guideline for the implementation of early childhood education in the Indonesian archipelago.

## 5. Conclusion

This research shows that the implementation of STEM learning at SDN 3 Nyerot, using the Independent Curriculum, has a positive impact on students' learning experiences, although several obstacles remain that require attention. Therefore, the following conclusions can be drawn:

The implementation of STEM is beginning to emerge in thematic learning, where teachers attempt to integrate science, technology, and mathematics through project-based activities. However, the arts and technology aspects are still not well integrated, so the balance between STEM elements needs to be continuously improved.

Student engagement in the STEM-based learning process is quite high. Students appear enthusiastic, creative, confident, and able to work well together during discussions and project

activities. This indicates that STEM learning not only improves academic abilities but also helps develop social and emotional skills aligned with the Pancasila Student Profile.

Teacher readiness is crucial for the success of STEM implementation. Even if teachers are enthusiastic, obstacles remain in creating modules that integrate various disciplines, mastering effective teaching methods, and lack of access to reference books and training. Therefore, teachers need to continue developing professionally so that STEM implementation can run smoothly and produce tangible results.

The main obstacles encountered include a lack of supporting facilities, limited time to complete assignments, and a lack of training in STEM disciplines. These issues must be addressed through regulatory support from educational institutions, adequate infrastructure, and the active involvement of parents and the school community.

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