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Integration Design Thinking to Develop Empathy, Collaboration, and Environmental Responsibility Character in Elementary School

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ABSTRACT

This study aims to explore the implementation of the Design Thinking approach in cultivating empathy, collaboration, and environmental responsibility among elementary school students. Conducted at SDN Purwokerto 1, Tayu District, Pati Regency, Central Java, this qualitative case study involved a fifth-grade teacher and students in IPAS (Science and Social Studies) learning. Data were collected through participatory observation, in-depth interviews, and documentation, and analyzed using an interactive model. The findings reveal that the teacher successfully integrated the five stages of Design Thinking empathize, define, ideate, prototype, and test into contextual and collaborative learning activities. Students actively addressed real-life environmental issues, particularly waste management at the school, which fostered critical thinking, creativity, and emotional engagement. Evaluations were conducted formatively and reflectively, emphasizing student collaboration, creativity, emotional involvement, and the development of environmental responsibility. The implications of this study suggest that Design Thinking not only enhances conceptual understanding but also nurtures students' empathy, teamwork, and environmental responsibility. The teacher's role as a designer of meaningful, student-centered learning experiences that connect classroom learning to authentic contexts is crucial. Future research could explore the long-term effects of Design Thinking on character development and its broader application in diverse educational settings.

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1. INTRODUCTION

Elementary school plays a foundational role in shaping not only students' academic capabilities but also their character and social attitudes. At this early stage of education, students begin to develop core values that influence how they interact with others and with the environment. The cultivation of empathy, collaboration, and environmental responsibility is crucial, as these values form the basis of a socially aware and ecologically responsible generation. In many elementary schools, Science and Social Studies (IPAS) learning provides a unique opportunity to instill these values, as it deals with real-world contexts and daily life phenomena. However, the reality at SDN Purwokerto 1, located in Tayu District, Pati Regency, Central Java, reveals several empirical challenges in the implementation of IPAS learning. The teaching practices at this school, as in many others, are still largely teacher-centered, with an overemphasis on rote memorization and standardized methods of instruction. These practices fail to engage students in active exploration or problem-solving, thus limiting their ability to develop critical thinking and key character values such as empathy and environmental responsibility (Hattie, 2016).

The teacher-centered approach at SDN Purwokerto 1 often overlooks students' agency, curiosity, and reflective thinking, limiting their opportunities to connect learning with personal or societal issues. As a result, students struggle to develop empathy and a sense of responsibility toward environmental challenges. This concern becomes more pressing in the face of global issues such as climate change, social inequality, and interconnectedness, which demand a shift toward student-centered, inquiry-based learning models (D. Fisher & Frey, 2018; OECD, 2019). In response, Design Thinking (DT) emerges as a promising instructional model, offering a structured yet flexible framework that fosters creativity, collaboration, and empathy. Integrating DT into IPAS (Science and Social Studies) at SDN Purwokerto 1 offers a potential solution to these instructional gaps by promoting both cognitive skills and character development.

Design Thinking, widely used in innovation and problem-solving contexts, has increasingly influenced educational practices due to its focus on contextual, meaningful, and student-driven learning. DT consists of five key stages: empathize, define, ideate, prototype, and test (Dam & Siang, 2025; Gonen, 2019), which help students engage deeply with real-world issues while cultivating critical and affective competencies. More than a teaching method, DT is a mindset that encourages exploration, experimentation, and reflection (Liedtka, 2018). When applied effectively, DT transforms the classroom into a dynamic space where students act as active problem-solvers, empathize with others, co-create solutions, and reflect on their learning experiences, leading to intellectually and emotionally engaging education. However, studies examining the implementation of Design Thinking in elementary education, especially within the IPAS context, are still limited. Existing research tends to focus more on academic outcomes such as creativity or critical thinking, with less attention given to how Design Thinking fosters character values like empathy and collaboration (Montero, 2022). Moreover, the voices of teachers and students, who are central to the success of any pedagogical innovation, are often underrepresented in such studies.

To address these gaps, this study investigates how Design Thinking is applied by elementary school teachers in the planning, implementation, and evaluation of IPAS learning. It explores how DT-based learning activities are designed to develop students' empathy, teamwork, and environmental awareness. In doing so, this research emphasizes not only what students learn but how they learn and how this process contributes to their holistic development. Furthermore, this study gives equal attention to students' experiences (Jardinez & Natividad, 2024). It examines how they perceive and engage with learning activities based on the Design Thinking model, how they collaborate with peers, and how they respond to environmental issues presented during learning. Understanding these experiences provides insight into how Design Thinking supports character education in a real classroom context, beyond theoretical frameworks (Rusmann & Ejsing-Duun, 2022).

By employing a qualitative case study approach, this research explores the implementation of Design Thinking in IPAS (Science and Social Studies) learning at SDN Purwokerto 1. The study seeks to capture the complexities of social interactions, learning dynamics, and developmental processes that

are often overlooked by quantitative methods (Merriam & Tisdell, 2016). Through in-depth observations, interviews, and analysis, the research provides valuable insights for educators and policymakers on how Design Thinking can be effectively applied in elementary education to enhance both cognitive skills and character development.

The primary objective of this study is to assess the impact of Design Thinking on fostering key character values such as empathy, collaboration, and environmental responsibility in elementary school students. In doing so, this research offers concrete strategies for integrating character education into daily classroom practices. By examining the practical application of Design Thinking, the study contributes to the growing academic discourse on innovative teaching methods and provides actionable recommendations for improving the quality of education in elementary schools.

2. METHODS

This study employed a qualitative approach using a case study design to gain an in-depth understanding of the implementation of the Design Thinking approach in Science and Social Studies (IPAS) instruction for Grade 5 at the elementary school level. A qualitative approach was chosen as it allows the researcher to explore experiences, strategies, and the dynamics of implementing Design Thinking-based learning in a contextual and holistic manner, without focusing on quantitative outcomes such as direct skill improvements. The primary subject of this study was the Grade 5 teacher at SDN Purwokerto 1, Tayu Subdistrict, Pati Regency, Central Java Province, who was directly responsible for implementing Design Thinking in the classroom. Supporting informants included the principal of SDN Purwokerto 1, who provided insights into institutional policies and support for innovative teaching practices, as well as several Grade 5 students who participated in the learning process.

The research was conducted at SDN Purwokerto 1 based on purposive considerations, as the school demonstrated openness to pedagogical innovation and provided access to relevant data for analysis. The study was carried out from January to May 2025, covering the stages of instructional planning, direct classroom observation, in-depth interviews with the teacher, principal, and students, as well as systematic data analysis. Data collection techniques included participatory observation, in-depth interviews, and documentation (Rutakumwa et al., 2020). Participatory observation was conducted to directly observe the learning process in the classroom, including teacher-student interactions, the implementation of Design Thinking stages, and students' responses to learning activities (Creswell, 2014). In-depth interviews with the classroom teacher, school principal, and several Grade 5 students aimed to explore their perceptions, experiences, and evaluations regarding the implementation of Design Thinking-based learning (Merriam & Tisdell, 2016). Documentation involved the collection of teaching modules, instructional materials, student work, photos of learning activities, and teacher notes taken throughout the learning process.

For data analysis, an interactive analysis technique was employed, which involved three key stages: data reduction, data display, and drawing conclusions. These stages were carried out simultaneously and iteratively from the beginning of data collection through to the final analysis (Miles et al., 2019). Data reduction involved the process of selecting, focusing, and simplifying the collected data to highlight the most relevant information. Data display referred to the organization and presentation of the data to facilitate understanding and interpretation. Finally, drawing conclusions involved identifying patterns, themes, and insights from the data, which were continuously refined throughout the study. To ensure the validity and reliability of the data, triangulation of sources and techniques was employed. This involved comparing and cross-checking data from different sources, such as observations, interviews, and documentation, to confirm consistency and credibility. Additionally, member checking was performed, where the research subjects were asked to review and validate the findings, thus ensuring the accuracy of the data and enhancing its trustworthiness (Patton, 2015).

3. FINDINGS AND DISCUSSION

Findings

The Relationship Between Design Thinking Stages and Students' Character Development

The implementation of Design Thinking stages in IPAS learning at SDN Purwokerto 1 shows a strong linkage to the development of students' character. In the empathize stage, students were invited to observe real environmental issues in their school, particularly waste management. This encouraged the growth of empathy, environmental awareness, and curiosity, as students were able to identify concrete problems and respond sincerely to what they observed. In the define stage, students collaboratively formulated more specific problems, such as the lack of waste separation. This stage trained their analytical thinking and solution-focused mindset through structured group discussions based on field findings. In the ideate stage, students explored diverse and creative solutions, such as educational posters and user-friendly trash bin designs. This phase fostered creativity, collaboration, and openness, reflected in their active participation and varied ideas. During the prototype stage, students created tangible models of their proposed solutions, strengthening their sense of responsibility, teamwork, and creative engagement. Finally, in the test or evaluation stage, students presented their prototypes and reflected on the learning process. This helped them develop confidence, self-awareness, and openness to feedback. Teacher and student reflections emphasized that learning was not only about the final product but also about valuing the process. Altogether, each stage of Design Thinking significantly supported meaningful character growth through contextual and collaborative learning.

Table 1. The Relationship Between Design Thinking Stages and Students' Character Development

Design Thinking Stage	Learning Activities at SDN Purwokerto 1	Developed Character Traits	Empirical Evidence from Findings
Empathize	Observing the school environment; discussing the condition of trash bins and waste disposal habits	- Environmental awareness - Empathy - Curiosity	Observations and interviews showed that students were able to identify real environmental problems and respond to them emotionally
Define	Identifying specific problems related to waste management (e.g., lack of waste separation)	- Critical thinking - Analytical skills - Solution - focused mindset	Group discussions resulted in structured problem statements based on field data
Ideate	Brainstorming solution ideas: creating posters, designing creative trash bins, recycling campaigns	- Creativity - Collaboration - Open-mindedness	Documentation revealed a variety of ideas and active engagement among group members
Prototype	Creating tangible models such as trash bin prototypes made from used gallons or awareness posters	- Responsibility - Teamwork - Enthusiasm for creating	Field notes and photographs showed students' enthusiasm and teamwork during product creation
Test (Evaluate)	Presenting prototypes, receiving feedback from teachers and peers, reflecting on the learning process	- Confidence - Self-reflection - Openness to feedback	Student and teacher reflections indicated that the evaluation focused not only on outcomes but also on students' thinking and learning processes

Planning of IPAS Learning Based on Design Thinking

The findings of this study reveal that the planning of IPAS (Integrated Science and Social Studies) learning at SDN Purwokerto 1, based on the Design Thinking approach, was conducted systematically and contextually. Observations and interviews with the teacher and principal indicated that the teacher made an effort to tailor the learning to the students' real-life context by addressing local environmental issues, specifically focusing on waste management within the school.

Based on field observations, the teacher selected a relevant learning theme centered around waste problems in the school environment. Documentation of the teacher's lesson plans showed that the stages of Design Thinking empathy, problem definition, ideation, prototyping, and evaluation were incorporated into the module. During the empathy phase, the teacher engaged students in observing the current state of waste management at the school, which included assessing the condition of trash bins and identifying areas of concern. Interviews with students confirmed that they participated in discussions about waste issues and expressed their feelings about the environmental challenges they observed (Gonen, 2019).

In the problem definition phase, students were guided to identify specific waste management problems, such as the lack of proper waste separation. Through participatory observation, it was noted that students worked in groups to formulate problem statements and brainstorm potential solutions. Documentation of student work, including notes and sketches, revealed the collaborative nature of the activity. As for the ideation stage, students actively participated in generating ideas for addressing waste issues, with several groups suggesting innovative solutions such as creating posters to raise awareness or designing better waste disposal systems. Observations indicated that the ideation process was interactive, with students sharing ideas and building on each other's contributions. The teacher facilitated this process by encouraging creative thinking and ensuring that all voices were heard.

The prototyping stage involved students creating physical models of their proposed solutions, such as recycling bins made from recycled materials. Field notes from classroom observations highlighted that students were highly engaged in this stage, showing enthusiasm in constructing prototypes and working together as a team. Documentation of these activities, including photos of student prototypes, further demonstrated the hands-on, collaborative nature of the learning process.

Finally, during the evaluation phase, students presented their prototypes and received feedback from both peers and the teacher. Observation and student reflections during the evaluation stage indicated that students not only assessed the final products but also reflected on their learning process. Interviews with the teacher revealed that the evaluation focused on students' critical thinking, creativity, and teamwork throughout the Design Thinking process, rather than merely the final outcomes. The following is the module designed by the teacher:

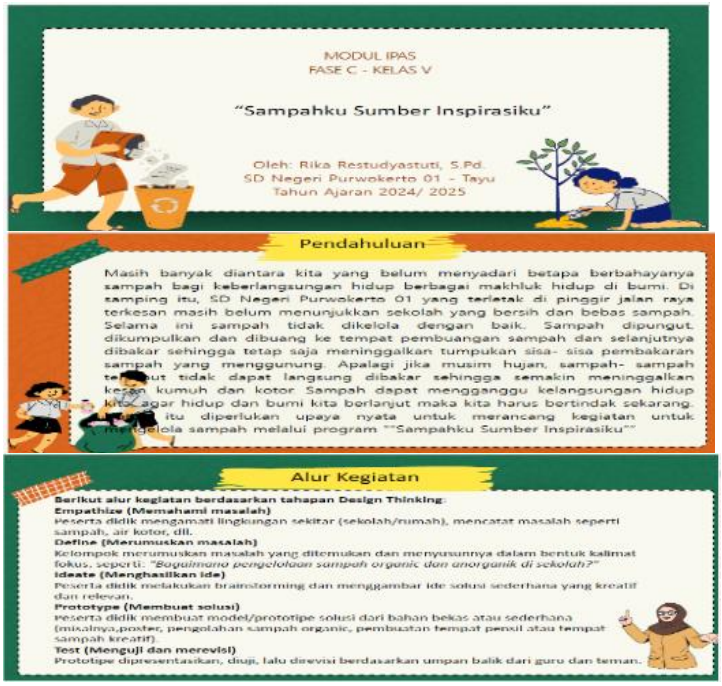

Figure 1: Design Thinking Module

Scientifically, placing empathy as the starting point enables students to connect IPAS learning with real experiences and conditions. This approach supports the concept of situated learning, in which learning becomes meaningful because it is rooted in students' social context. The teacher did not design learning activities in a linear sequence but developed open-ended and exploratory student worksheets, allowing students to generate ideas based on their observations of the school environment. This planning illustrates a pedagogical shift from the teacher as a knowledge transmitter to a learning designer, in line with the demands of competency-based and student-centered curricula (Hmelo-Silver et al., 2007).

These findings align with previous research (Noweski et al., 2012), which indicates that applying Design Thinking in elementary education fosters creative and participatory mindsets when teachers design learning activities that go beyond procedural instruction toward problem-based and reflective approaches. This transformation occurred because the teacher engaged in early reflection on students' needs and adapted the instructional approach according to human-centered design principles. Such an approach is essential, as conventional methods often remain normative and content-focused rather than emphasizing deep learning processes (Abdulraheem et al., 2025).

Support from the school principal for pedagogical innovation enabled the teacher to design materials, media, and activities without the constraints of traditional methods. The teacher also demonstrated adaptability in integrating values from the Pancasila Student Profile, particularly collaboration, critical thinking, and creativity. Similar conclusions have been drawn in other studies, which argue that Design Thinking facilitates a reflective approach to interdisciplinary curriculum planning when teachers possess both the necessary understanding and the autonomy to innovate (Henriksen et al., 2020). The results of this study reinforce that perspective, as the teacher not only implemented the Design Thinking framework but also internalized its core values throughout the planning process.

In conclusion, the planning of IPAS learning based on Design Thinking at SDN Purwokerto 1 illustrates an innovative effort to connect the demands of a 21st-century curriculum with the real conditions of elementary school students. This approach establishes a strong foundation for active and participatory learning, enhances problem-solving skills, and signifies a pedagogical shift from a traditional instructional model toward a social constructivist approach.

Implementation of IPAS Learning Based on Design Thinking

The implementation of IPAS (Integrated Science and Social Studies) learning based on the Design Thinking approach at SDN Purwokerto 1 demonstrated a dynamic, participatory, and contextual learning process. The fifth-grade teacher applied all five stages of Design Thinking empathy, problem definition, ideation, prototyping, and evaluation by integrating them into a thematic lesson on "The Environment," with a specific focus on waste management issues around the school.

In the empathy stage, the teacher began the lesson with an observation activity of the school environment, guided by a student worksheet. Learners were asked to observe the condition of trash bins, drainage systems, and the area around the school canteen. The results of these observations became the basis for a class discussion about real-world problems they encountered, such as the abundance of plastic waste, the lack of separated waste bins, and the habit of littering.

Figure 2. Environmental Observation

This process demonstrated that students were actively engaged in identifying issues relevant to their daily lives. This finding supports the view that the empathy stage in Design Thinking is not merely about collecting information, but about fostering an emotional connection between learners and the problems they aim to address (Kim et al., 2023). In this stage, the teacher served as a facilitator, encouraging students to express their feelings and thoughts through open-ended and reflective questions. During the problem-definition stage, the teacher guided students to refine the issues they had identified into more specific and actionable forms. For instance, one guiding question was, *"How can we manage organic and non-organic waste in the school environment?"* This stage was conducted through small-group discussions supported by structured guidance, enabling students to filter their observations and transform them into well-defined problem statements.

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Figure 3. Students Formulating the Problem

In the ideation stage, the teacher encouraged students to generate a variety of creative ideas. Each group was asked to illustrate their proposed solutions, such as creating posters to promote proper waste disposal, designing fun and child-friendly trash bins, or launching a plastic bottle recycling

campaign. This activity reflected the importance of providing space for free thinking. The ideation phase should initially activate the imagination without constraints, and only afterward should ideas be refined through discussion (Fotaris & Mastoras, 2022).

Figure 4. Presentation of Creative Ideas

Next, in the prototyping stage, students created tangible products based on their selected ideas, such as prototypes of trash bins made from used water gallons or cardboard, or persuasive posters. This activity was carried out collaboratively in the spirit of teamwork. The teacher provided the tools and materials but did not offer a finished model. This aligns with the principles of constructivism, in which learning is built through experience and social interaction.

Figure 5. Prototype

Finally, in the evaluation stage, each group presented their prototype to the class and received feedback from other groups and the teacher. The evaluation focused not only on the final product but also on students' critical thinking, creativity, and collaboration throughout the process. This evaluation was primarily formative and reflective in nature. Evaluation in Design Thinking should emphasize the iterative process and students' ability to adapt and refine their solutions (Gunter & Kenny, 2021).

Figure 6. Evaluation

These findings indicate that the implementation of Design Thinking in IPAS instruction provides ample opportunities for students to become active agents in their own learning. They do not merely consume knowledge but actively construct understanding through direct experiences, discussions, idea exploration, and product creation. The teacher successfully shifted their role into that of a facilitator, guiding the learning process rather than simply transferring information. This marks a significant contrast to conventional teaching methods, which are often one-directional. In line with the findings of the application of Design Thinking fosters rich cognitive dialogue between students and teachers, as well as among students, contributing to the development of higher-order thinking skills (HOTS) (Kwangmuang et al., 2021).

Moreover, the results demonstrate that Design Thinking can be an effective approach for teaching IPAS at the elementary level, as it connects learning to real-life contexts students encounter daily. This aligns with the perspective of (Kotsis, 2025), who emphasized the value of authentic experiences in primary education to cultivate problem-solving mindsets from an early age. Therefore, the findings from the implementation stage suggest that the use of Design Thinking in IPAS learning not only deepens content understanding but also enhances students' creative, collaborative, and reflective thinking skills, making learning more engaging, relevant, and meaningful.

Evaluation of IPAS Learning Based on Design Thinking

The evaluation of IPAS learning based on Design Thinking at SDN Purwokerto 1 was conducted comprehensively and formatively, emphasizing the process and student engagement throughout all learning stages. The teacher did not merely assess the students' final products but also evaluated their thinking processes, collaboration, and reflection during the learning activities. The evaluation was carried out through various methods, including: (1) classroom observation during the learning process, (2) assessment of students' prototypes, (3) reflective discussions at the end of lessons, and (4) attitude and skill assessment sheets. The teacher documented student engagement during the empathy stage, logical problem formulation, creative ideas in the ideation phase, collaboration in prototyping, and critical thinking during evaluation and presentation stages.

The main findings indicate that the assessment model within the Design Thinking approach emphasizes holistic learning processes rather than just final outcomes. This aligns with the view that the success of Design Thinking in education depends on how explicitly thinking processes and iterations are assessed (W. P. Fisher et al., 2021). Consequently, students receive feedback that not only evaluates correctness but also guides them in improving their thinking and practice.

In practice, the teacher used a rubric-based assessment that included indicators such as the ability to identify contextual problems, creativity and relevance of ideas, teamwork, accuracy in building prototypes, and confidence in presenting ideas. The rubric was designed to reflect the dimensions of Design Thinking and the integrated characteristics of IPAS learning.

Evaluation was also conducted reflectively through class discussions. Students were invited to reflect on the process they had gone through, what they learned, challenges they faced, and new ideas that emerged. This method proved effective in enhancing students' metacognitive awareness, as reflection is a critical part of Design Thinking that helps students understand their own thinking and learning processes (Rivas et al., 2022).

The study also found that Design Thinking-based evaluation contributes to shaping a culture of open and adaptive learning. Students learned from failure, accepted critique as constructive input, and showed progress in critical thinking skills from one stage to the next. The teacher acted not only as an assessor but also as a learning partner who guided and facilitated students' understanding (Doyle et al., 2021).

This phenomenon is further supported by the argument that evaluation in Design Thinking fosters a resilient learning mindset, especially when students are engaged in complex and open-ended problem-solving tasks (Seevaratnam et al., 2023). Therefore, evaluation in the Design Thinking approach to IPAS learning not only assesses cognitive aspects but also measures affective and psychomotor dimensions in a contextual and in-depth manner. This process provides constructive

feedback and builds a culture of learning rooted in reflection, collaboration, and continuous improvement.

Discussion

The Relationship Between Design Thinking Stages and Students' Character Development

The findings of this study illustrate how Design Thinking stages particularly *empathize* and *define* play a vital role in developing students' empathy and environmental responsibility. This aligns with (Jamal et al., 2021) who emphasize that embedding Design Thinking within real environmental contexts cultivates emotional awareness and deepens students' commitment to sustainability. In the *empathize* stage, students observed waste issues within their school environment, which allowed them to connect emotionally with the problem and articulate their concerns through reflective dialogue (Henriksen et al., 2020). The structured identification of problems in the *define* stage further nurtured environmental responsibility, as students transitioned from emotional responses to actionable, solution-oriented thinking. This demonstrates how Design Thinking not only supports cognitive development but also encourages affective learning dimensions essential for sustainable education.

In addition, the *ideate*, *prototype*, and *test* stages strongly contributed to the development of collaboration among students. Recent research by Babalola, 2024 in the *Journal of Applied Research in Higher Education* highlights that when students are given the opportunity to co-create solutions through Design Thinking, their interpersonal skills including communication, negotiation, and mutual respect are significantly enhanced. In this study, collaboration was evident as students brainstormed creative ideas together, built prototypes with shared responsibilities, and provided constructive feedback during peer evaluation. The iterative nature of Design Thinking fostered a safe space for open dialogue, peer learning, and resilience in responding to criticism. These experiences reflect what (Nolan, 2022) refer to as "collaborative creativity," where students generate novel ideas not in isolation, but through meaningful interaction. Overall, the implementation of Design Thinking in IPAS learning provided a transformative experience, enabling students to embody core values such as empathy, teamwork, and environmental stewardship hallmarks of character education aligned with 21st-century learning goals.

Planning of IPAS Learning Based on Design Thinking

The planning of IPAS (Integrated Science and Social Studies) learning at SDN Purwokerto 1, based on the Design Thinking approach, was carried out systematically and contextually. Through direct observations and interviews with the teacher, it became evident that the teacher designed the learning activities not only by adhering to the IPAS curriculum but also by considering the characteristics of the students and local environmental issues, particularly the waste management problem within the school. The teacher designed a learning module that integrated all five stages of the Design Thinking model: empathize, define, ideate, prototype, and test. This approach was aimed at providing a comprehensive and experience-based learning process for the students (Wang, 2024).

This planning strategy aligns with UNESCO's refreshed interpretation of the four pillars of education, particularly *learning to do* and *learning to live together*, which emphasize practical action, cooperation, and care for the common good (Ismail et al., 2024). The focus on student-centered design also resonates with contemporary learner-centered pedagogies that prioritize real-world relevance and active student engagement. By adopting this approach, the teacher moved beyond traditional knowledge transmission to cultivate 21st-century competencies in students. Furthermore, recent reviews of Design Thinking in education articulate how its five stages empathize, define, ideate, prototype, and test foster critical thinking, creativity, and problem-solving in young learners (Liu et al., 2024).

In essence, the planning of IPAS learning based on Design Thinking at SDN Purwokerto 1 marked a departure from traditional, content-based approaches toward a more innovative, problem-solving-driven learning environment. It underscores the importance of contextualizing education and making learning more relevant to students' lives, preparing them for challenges in a rapidly changing world.

Implementation of IPAS Learning Based on Design Thinking

The implementation of IPAS learning at SDN Purwokerto 1 was marked by active student engagement and collaboration throughout all stages of the Design Thinking model. In the empathy stage, students were directly involved in observing the waste management issues within the school. Through participatory observation, students identified problems such as the improper disposal of waste and the lack of recycling facilities. Interviews with students indicated that they not only observed the issues but also shared personal thoughts on how these problems affected their daily lives, thus building an emotional connection to the problem.

This approach to the empathy stage aligns with the assertion that empathy is essential for understanding user needs and forms the foundation for innovative problem-solving (Mccurdy et al., 2020). By actively engaging students in environmental observations, the teacher encouraged them to connect with the problem on a deeper level, fostering environmental awareness and responsibility. This hands-on approach provided students with the opportunity to see firsthand the challenges surrounding waste management, which contributed to the development of their critical thinking skills in identifying real-world problems.

In the define and ideate stages, students worked together to narrow down specific issues related to waste management and brainstorm possible solutions. Observations revealed that these stages allowed students to engage in divergent thinking, exploring multiple solutions without immediate judgment. The process of brainstorming ideas enabled students to see the value of creativity in problem-solving, reinforcing the principles of divergent thinking as highlighted by Guilford, which emphasizes the importance of exploring a wide range of solutions before refining ideas.

Moreover, the prototyping stage was an essential part of the implementation process. Students created models of waste bins using recycled materials, enabling them to transform abstract ideas into tangible solutions. This hands-on activity demonstrated the principles of project-based learning, in which students engage in authentic, practical projects that enhance conceptual understanding and develop practical skills (Malik & Zhu, 2023). As students worked collaboratively, they not only applied their ideas but also strengthened teamwork and communication skills. This collaborative aspect aligns with the view that Design Thinking fosters collaboration, communication, and confidence through project-based tasks (Jiang & Pang, 2023).

In the final evaluation stage, students presented their prototypes and received feedback from peers and the teacher. The evaluation process focused not only on the final product but also on reflecting on the learning journey. Teachers observed students' ability to think critically about their prototypes and participate in reflective discussions, which supports the argument that process-based assessments are essential in the Design Thinking approach (Zhang et al., 2024).

Evaluation of Student Learning in IPAS Based on Design Thinking

In this study, the evaluation phase of IPAS learning was characterized by a holistic and authentic assessment framework, in which teachers used observations, rubrics, and peer/self-assessments to capture not only students' critical thinking, creativity, and collaboration but also their engagement throughout the Design Thinking process. This approach resonates with the findings of previous research showing that real-world performance assessment can significantly improve student literacy and motivation in Indonesian classrooms (Samsudin et al., 2024). At SDN Purwokerto 1, valuing how students learn through exploration and iteration reinforced their metacognitive awareness and deepened their learning experiences.

A key element of the evaluation was structured reflective practice, where students reflected on their cognitive processes, emotional responses, and collaborative actions. This practice aligns closely with recent educational research on reflective journaling, which found that regular reflective journal writing substantially improves undergraduates' metacognitive awareness and task performance (Alt & Raichel, 2020). In the current IPAS context, students regularly reflected on their challenges such as

uncertainty during prototyping and successes, internalizing a growth mindset and developing self-regulatory skills, which are crucial outcomes of effective reflective frameworks (Nur & Sabur, 2025).

From the students' perspective, the evaluation process especially during the test stage served as a source of intrinsic motivation and empowerment. They reported increased confidence, engagement, and emotional investment in addressing real environmental issues such as waste management. These findings are consistent with research highlighting that reflective, empathy-driven evaluations in design-based learning can boost student purpose, engagement, and environmental stewardship (Avsec et al., 2024). In sum, the evaluation phase in IPAS Design Thinking not only assessed outcomes but also catalyzed students' cognitive, affective, and social-emotional development, exemplifying best practices for 21st-century education.

4. CONCLUSION

The integration of Design Thinking into IPAS learning at SDN Purwokerto 1 has proven to be an effective strategy for cultivating students' character, particularly in the areas of empathy, collaboration, and environmental responsibility. Each stage of the Design Thinking process contributed meaningfully: the empathize and define stages helped students emotionally connect with real-world environmental issues, fostering awareness and a sense of responsibility; while the ideate, prototype, and test stages enhanced creativity, teamwork, and problem-solving through collaborative engagement. These findings are supported by recent research that emphasizes the role of design-based learning in nurturing not only cognitive skills but also affective and interpersonal competencies essential for 21st-century learners.

Furthermore, the planning, implementation, and evaluation of IPAS learning demonstrated a shift from conventional to student-centered pedagogy. Teachers acted as facilitators who designed contextual and meaningful learning experiences based on students' real-life challenges. The use of authentic and reflective assessment further enriched the process, promoting metacognitive awareness and intrinsic motivation among students. In conclusion, this study affirms that Design Thinking offers a transformative approach to elementary education by linking academic content with character development and environmental action, providing a strong foundation for lifelong learning and civic engagement.

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