Proceedings Series on Social Sciences & Humanities, Volume 25
Proceedings of International Conference on Social Science (ICONESS)
ISSN: 2808-103X

Analyzing Effective Learning Models for Developing Problem-Solving Skills in Primary School Students

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ARTICLE INFO

Article history:

DOI:
10.30595/pssh.v25i.1676

Submited:
July 22, 2025

Accepted:
August 11, 2025

Published:
August 24, 2025

Keywords:

Problem-Solving Skills; Learning Models; Elementary Students; Student-Centered Learning; Problem Based Learning; Qualitative Case Study; Educational Effectiveness

ABSTRACT

Given the challenges of the Interconnected era, problem-solving skills play a vital and indispensable role in the development of individuals in academic, professional as well as everyday life.This study investigates effective learning models that foster these skills among elementary students at SD Negeri Kasmaran, Banjarnegara, Indonesia. Employing a qualitative case study design, the research draws from classroom observations, interviews, and documentation to identify the characteristics and impacts of various pedagogical approaches. Findings indicate that student-centered learning models, particularly Project-Based Learning (PjBL), Problem-Based Learning (PBL), Cooperative Learning, and Inquiry-Based Learning, significantly enhance students' problem-solving capabilities. The study further discusses implementation challenges and proposes strategic solutions to optimize learning outcomes.

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1. INTRODUCTION

Problem-solving skills are core competencies in the digital era that are needed to adapt and contribute effectively in a complex and dynamic global society[1]. These skills include the ability to think critically, creatively, and reflectively in identifying, analysing, and responding to various unstructured situations and challenges in various fields of life. Therefore, the development of these skills from an early age, especially at the basic education level, is very important as a cognitive, metacognitive and affective foundation to support lifelong learning[2].

Philosophically, the urgency of developing thinking and problem-solving potential is in line with various pedagogical views and universal values. In an Islamic perspective, for example, the use of reason (‘al-’aql') and individual responsibility for endeavour are forms of developing self-capacity enabled by God (Q.S. Al-Baqarah:

[1] Rose Luckin and Kim Issroff, ‘Education and AI: Preparing for Future and AI, Attitudes and Values.’, *Future of Education and Skills 2030: Conceptual Learning Framework*, November 2018, 2021, 1–29.
[2] John Larmer, John R Mergendoller, and Suzie Boss, *Setting The Standard For Project Based Learning*, *Engineering*, 2015 <www.bie.org>.

286). This view resonates with modern social constructivism theory, which views students as active agents who construct knowledge through interaction with the environment and meaningful experiences [3].

Various innovative student-centred learning models have been developed to foster problem-solving skills, including Problem-Based Learning (PBL), Project-Based Learning (PjBL), Contextual Teaching and Learning (CTL), Cooperative Learning, and Inquiry-Based Learning. Although they have been widely applied and researched, the relative effectiveness and implementation challenges of these models, especially in the context of Indonesian basic education, still require in-depth empirical studies [4].

This study aims to comprehensively examine the practice of implementing student-centred learning models in developing problem-solving skills at SD Negeri Kasmaran, Banjarnegara. The study is expected to provide empirical contributions relevant to the development of innovative learning practices as well as adaptive and sustainable basic education policies in Indonesia. Explicitly, the objectives of this study are as follows:

1. To identify student-centred learning models implemented by teachers to develop primary school students' problem-solving skills.
2. Analysing the implementation characteristics of these learning models in classroom practice.
3. Exploring teachers‘ and students’ perceptions of the effectiveness of these models in improving problem solving skills.
4. Describe the challenges faced in the implementation and the strategies used to overcome them.

Through this case study approach, it is hoped that an in-depth understanding of the dynamics of implementing innovative learning models in a local context can provide practical and conceptual benefits for the world of education at the primary school level.

1.1. Definition and Importance of Problem Solving Skills in Primary Schools

Problem solving ability is a high-level cognitive process that includes problem identification, solution search and evaluation, and reflection on the solution process [5]. At the primary school level, these skills are realised through the ability to understand the context of the problem, gather relevant information, design a strategy, implement the plan, and reflect on the results [6]. The development of these skills is fundamental as a basis for cross-disciplinary learning, adaptation to change, and application of knowledge in everyday life.

1.2. Student-Centred Learning Model and its Relationship with Problem Solving Problem solving

The transformation of the learning paradigm from teacher-centred to student-centred has become the main focus of modern education. Learning models that emphasise active engagement, real contexts and collaboration have been shown to be more effective in building deep understanding and complex skills such as problem solving than traditional passive and rote approaches [7].

Some of the learning models that are widely studied and implemented to develop elementary school students' problem solving skills include:

1. Problem-Based Learning (PBL)

PBL places students in complex authentic problem situations as a learning stimulus. Students are required to identify existing and new knowledge, encourage independent inquiry, logical reasoning, and co-operation in finding [8] Research by [9] reinforces the finding that PBL effectively improves critical thinking and problem solving skills.

2. Project-Based Learning (PjBL)

PjBL engages students in long-term projects relevant to the real world, integrating multiple sources and disciplines. This process trains planning, time management, collaboration, as well as presentation of results which

[3] Robert E. Slavin, ‘Cooperative Learning and Achievement: Theory and Research’, *Handbook of Psychology, Second Edition*, 2012 <https://doi.org/10.1002/9781118133880.hop207008>.
[4] (Harefa & Surya, 2021; Halimatus Sa’diyah et al., 2024)
[5] Halimatus Sa’diyah and others.
[6] Luciana Pereira Brito, Leandro Silva Almeida, and António José Meneses Osório, ‘Reasoning Abilities and Learning Math: A Möbius Strip?’, *International Electronic Journal of Mathematics Education*, 15.2 (2019) <https://doi.org/10.29333/iejme/6259>.
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[8] Nurlaela and others; Woei Hung, ‘Problem-Based Learning: A Learning Environment for Enhancing Learning Transfer’, *New Directions for Adult and Continuing Education*, 2013.137 (2013), 27–38 <https://doi.org/10.1002/ace.20042>.
[9] Hung (2013)

are important in complex problem solving [10]. A study by[11] showed PjBL improved motivation and learning outcomes through active student engagement.

3. Contextual Teaching and Learning (CTL)

CTL links learning materials to students' life experiences and contexts. This approach facilitates deep cognitive meaning and the transfer of learning to new situations, thus increasing the relevance and motivation of learning [12]. [13] emphasises the importance of authentic experiences in the learning process.

4. Co-operative Learning

This model structures social interaction in small groups to achieve a common goal. Discussion, idea sharing and assistance between students develop communication, argumentation, negotiation and metacognitive reflection skills that are essential in collaborative problem solving [14].

5. Inquiry-Based Learning

Inquiry encourages students to conduct scientific investigations ranging from formulating questions, designing experiments, collecting and analysing data, to drawing conclusions. This model develops independent thinking, investigative skills, and evidence-based problem solving [15].

1.3. Global Trends and Indonesian Context

Global trends of the last decade show an increasing adoption of integrative and transdisciplinary learning models, such as STEAM that combines PBL with arts and technology fields [16]. The use of digital technologies, such as game-based learning and adaptive learning environments, has also become a focus to support interactive problem-solving skills [17].

In Indonesia, Curriculum 2013 and Merdeka Curriculum encourage the implementation of student-centred learning that is relevant to the demands of the digital age. Local studies show the positive potential of models such as PBL and PjBL in improving student learning outcomes and problem-solving skills, although implementation challenges such as teacher capacity and resource support are still significant [18]; [19].

2. RESEARCH METHODOLOGY

This research uses a qualitative approach with an instrumental case study design as proposed by [20]. This approach was chosen to explore in depth the implementation of effective learning models in the specific context of one primary school, with the aim of gaining an understanding that can be contextualised for the development of learning practices more broadly. SD Negeri Kasmaran, Banjarnegara, was purposively selected as the research site because it has prominent characteristics in implementing student-based learning innovations and commitment to pedagogical development.

2.1. Location and Participants

The research was conducted at SD Negeri Kasmaran, a public primary school in Central Java that has demonstrated consistency in implementing innovative learning models. The participants consisted of four teachers (two from low grade, two from high grade) and nine students with diverse academic characteristics. The

[10] John Larmer, John R Mergendoller, and Suzie Boss, *Setting The Standard For Project Based Learning*, *Engineering* (Buck Institute for Education, 2015) <www.bie.org>; Chenyue Zhou, *The Impact of the Project-Based Learning Method on Students*, *BCP Education & Psychology ERHSS*, 2023, MMXXIII.

[11] Zhang & Ma (2023)

[12] Robert G Berns and Patricia M Erickson, 'From Behaviorism to Constructivism and Contextual Teaching and Learning', *The Highlight Zone Research @ Work*, 5, 2001, 1–9 <http://www.nccte.com/publications/infosynthesis/index.>; Markus Harefa and Edy Surya, *BEBERAPA MODEL PEMBELAJARAN YANG EFEKTIF UNTUK MENINGKATKAN KEMAMPUAN PEMECAHAN MASALAH MATEMATIKA SISWA*, 2021 <https://www.researchgate.net/publication/351624168>.

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[18] Harefa and Surya.

[19] Rokhimawan, Badawi, and Aisyah.

[20] Dick Stapert, 'No Title על העיוורון', *Journal of Geotechnical and Geoenvironmental Engineering ASCE*, 120.11 (1995), 259; Zhang and Ma.

participants were selected through purposive sampling technique by considering their experience, involvement in innovative learning, and openness to reflective and collaborative activities.

2.2. Data collection techniques

To ensure the depth and validity of the data, triangulation of sources and techniques were used, which included:

1. Non-participatory observation of the learning process in maths and science classes. Observations were conducted three to four times in each class to record the dynamics of learning interactions, problem-solving strategies, and student engagement.
2. Semi-structured interviews with teachers and students. Interview guides were developed to explore participants' perceptions, understandings, and reflections on the learning process and the development of problem solving skills.
3. Documentation study, including analysis of lesson plans, student portfolios, and formative assessment results relevant to problem solving indicators.

All data were collected by considering the principles of research ethics, including informed consent, confidentiality of participants' identity, and validation of findings through member checking.

2.3. Data Analysis Technique

Data were analysed using a thematic analysis approach [21], which included the following steps: (1) data familiarisation through repeated readings; (2) open coding of transcribed data and field notes; (3) identification and grouping of codes into initial themes; (4) reviewing and refining themes; (5) conceptually defining themes; and (6) writing thematic syntheses relevant to the research questions. The analysis process was iterative and reflective, through gradual and iterative iterations to deepen understanding by dynamically moving between raw data, codes, themes and literature references.

2.4 Data validity and veracity

Data validity was maintained through triangulation strategies (method, source, and time), member checking (confirmation of data interpretation to participants), and audit trail (recording the research decision-making process in detail). The researcher also applied the principle of reflexivity to maintain awareness of potential bias and minimise the influence of subjectivity in the interpretation process.

3. RESEARCH RESULTS

Analysis of data from the case study at SD Negeri Kasmaran revealed that teachers at this school have implemented various student-centred learning models to develop problem-solving skills. The main findings are grouped according to the learning models identified, along with implementation characteristics, challenges and adaptive strategies used by teachers.

3.1. Implementation of Effective Learning Models

Four main learning models were identified in teachers' practices:

1. Project-Based Learning (PjBL)

This model is most prominent in encouraging active student engagement through real projects, such as the creation of an eco-school model or waste recycling activities. The teacher acts as a facilitator guiding students in the planning, implementation and evaluation of the project. Observations show students engaged in meaningful discussions, technical problem solving and collaboration. Student portfolios show a variety of strategies and reflections that indicate a deep understanding of materials and processes.

2. Problem-Based Learning (PBL)

PBL is implemented through authentic scenarios related to students' daily lives, such as determining the fastest route on a map or school waste management solutions. Teachers create an open inquiry space, guiding students to formulate questions, gather information and evaluate alternative solutions. Student interviews indicated a sense of challenge as well as emotional involvement in solving the problem.

3. Co-operative Learning

This strategy is integrated in various forms of group tasks with structures such as Think-Pair-Share and team discussions. Students are trained to work together, explain concepts to each other, and correct peers' understanding. Teachers provide adequate scaffolding to keep group interaction focused and productive. Its

[21] Saraswati Dawadi, 'Thematic Analysis Approach: A Step by Step Guide for ELT Research Practitioners', *Journal of NELTA*, 25.1–2 (2020), 62–71 <https://doi.org/10.3126/nelta.v25i1-2.49731>.

effectiveness can be seen in the improvement of students' communication skills, academic empathy, and logical argumentation.

4. Inquiry-based Learning

Scientific inquiry is implemented especially in science lessons, through simple experiments such as the growth of sprouts or observing changes in the form of objects. Although still largely structured inquiry, this approach fuels students' curiosity and independent exploration. More experienced teachers showed a tendency to give more space for students to formulate their own questions.

3.2. Implementation Challenges

Although the four models show great potential, teachers face several challenges:

1. Authentic task design

Teachers admitted to having difficulty designing challenging problems or projects that are still aligned with the curriculum and students' abilities.

2. Assessment of complex skills

Not all teachers feel confident in assessing the problem-solving process, especially in the metacognitive and collaborative aspects.

3. Limited resources

The availability of tools, materials, and access to technology is still limited, especially for the implementation of PjBL and open inquiry.

4. Parental support

Some parents are still orientated towards conventional academic outcomes and do not understand the importance of problem or project-based learning.

3.3. Adaptive strategies

Several local strategies have been developed by teachers to overcome the above barriers, including:

1. Informal collaboration between teachers in designing lesson plans and sharing innovative teaching materials;
2. Utilisation of local resources and used materials for project activities;
3. Parent education through class meetings and online communication on the purpose and benefits of innovative learning;
4. Modification of assessment to be more formative and portfolio-based to monitor students' overall learning process.

4. DISCUSSION

The findings of this study support international literature that emphasises the importance of contextualised, collaborative and student-centred learning approaches in developing problem-solving skills in primary education[22]. The implementation of PjBL and PBL at SD Negeri Kasmaran showed that students' engagement in authentic tasks increased their sense of responsibility, critical thinking capacity, and transferability between contexts.

Consistency between empirical findings and social constructivism theory is evident in teacher practices that provide space for exploration, collaboration and reflection. This reinforces the argument that problem solving is not a skill that is taught directly, but rather developed through rich and meaningful learning experiences [23].

However, systemic challenges such as teachers‘ professional capacity, limited resources, and non-educational stakeholders’ (especially parents) perceptions of innovative learning, suggest that the successful implementation of this learning model is strongly influenced by the support of the overall learning ecosystem [24]

This finding is in line with the results of a meta-analysis by [25] in the International Journal of STEM Education which showed that project-based approaches consistently contribute to improving critical thinking and problem-solving skills at the primary school level. Similarly, [26] [27] revealed that the success of PjBL in developing complex skills depends on systematic scaffolding, including teacher support and appropriate digital learning

[22] Syaiful Syaiful and others, ‘Identifiying of Problem Solving Abilities in Mathematics among Junior High School Students’, *Journal of Education and Learning (EduLearn)*, 14.2 (2020), 176–82 <https://doi.org/10.11591/edulearn.v14i2.14861>; Brito, Almeida, and Osório; Slavin; Joseph Krajcik and others, ‘Assessing the Effect of Project-Based Learning on Science Learning in Elementary Schools’, *American Educational Research Journal*, 60.1 (2023), 70–102 <https://doi.org/10.3102/00028312221129247>.

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[24] Rokhimawan, Badawi, and Aisyah; Harefa and Surya.

[25] Rahmania (2021)

[26] Muyassaroh et al. (2022)

[27] and Anggraini & Wulandari (2020)

resources. Meanwhile, [28] emphasised that the successful implementation of inquiry-based learning at the primary level demands consistent school system support and continuous training for teachers.

In the context of SD Negeri Kasmaran, implementation challenges such as time constraints, assessment and engagement especially parental literacy towards innovative learning reflect the need for such systemic support. This strengthens the argument that structural interventions are crucial to realising the sustainability of learning innovations oriented towards the development of essential competencies in the digital era.

5. CONCLUSION

The case study research at SD Negeri Kasmaran confirms that the implementation of student-centred learning models, particularly Project Based Learning (PjBL), Problem Based Learning (PBL), Co-operative Learning and Inquiry Based Learning, is effective in developing problem solving skills in primary school students. These models provide an authentic, collaborative and inquiry-promoting learning environment that significantly enhances the cognitive, affective and social dimensions of the problem-solving process.

While the potential success of these models is evident, their implementation faces substantial challenges such as teachers' limited professional capacity in designing appropriate tasks and assessments, lack of adequate learning resources and variability in support from the home environment. Therefore, the effectiveness of this innovative learning model is highly dependent on continued systemic support from the school, government and community.

Thus, this study not only confirms the importance of student-centred learning models as key to the development of problem-solving skills, but also underscores the need for comprehensive strategies to overcome implementation barriers to achieve optimal learning outcomes in the digital era.

6. IMPLICATIONS

6.1 Policy and implementation implications

The results of this case study provide important insights for stakeholders in the basic education system, especially in facing the challenges and opportunities of the digital era:

1. For teachers and schools

It is important to build and strengthen professional learning communities (PLCs) to support teachers‘ collaboration in sharing experiences, developing innovative lesson plans and designing comprehensive authentic assessments to develop students’ problem-solving skills. Continuous training that focuses on the application of student-centred learning models such as Project-based, Problem-based, Cooperative and Inquiry-based Learning should be a priority to strengthen teachers' pedagogical capacity.

2. For Local and Central Government

Policies that support teachers' continuous capacity building as well as the provision of relevant learning resources and adequate access to digital technology in primary schools are crucial. Investment in active learning infrastructure development and digital literacy programmes for teachers and parents should be prioritised to create a supportive learning ecosystem.

3. For Parents and Communities

Strengthening the partnership between school and home is essential in building a conducive learning environment. Increased parental awareness and understanding of the value and purpose of innovative learning will support students' independent and collaborative learning, extending the positive impact of learning that takes place in schools.

6.2 Academic Implications and Future Research Directions

Conceptually, this research affirms the role of social constructivism as a framework in designing effective learning environments to develop problem-solving skills in early childhood learners. The findings emphasise the importance of social interaction and meaningful experiences as key mechanisms in the complex process of cognitive construction. Some recommended research directions for further development include:

1. The use of quantitative or mixed-method approaches to measure the impact of the learning model on specific cognitive aspects, such as transfer of learning and student self-regulation.
2. Comparative studies between schools with different levels of innovation implementation to identify determinants of success and constraints in learning practices.
3. Development and evaluation of practice-based teacher training programmes that are effective in improving teachers' ability to implement student-centred learning models and conduct optimal assessment of problem-solving skills.

[28] Zhang & Ma (2023)

4. Further exploration of the role of parental support and community interventions in strengthening school-home partnerships as a strategy to strengthen the sustainability of learning innovations at the primary school level.

With cross-stakeholder collaboration and ongoing research, it is hoped that basic education practices can continue to be refined to equip students with problem-solving skills that are relevant and adaptive to the demands of the digital era.

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