

# *Improving Spatial Thinking Skills Through Contextual Teaching And Learning (CTL) Integrated With An Ecological Approach*

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**Resume**—This study examines the effectiveness of the *Contextual Teaching and Learning* (CTL) model integrated with an ecological approach in improving junior high school students' spatial thinking skills. Using a quasi-experimental design, the experimental class showed better results compared to the control class. Learning through ecological-based CTL encouraged students to be more active, relate concepts to real-life experiences, and better understand spatial and environmental relationships. In conclusion, this model proved more effective than conventional methods in enhancing spatial thinking skills, learning participation, and is relevant to supporting the implementation of the Merdeka Curriculum.

**Keywords:** spatial analysis, teacher distribution, learning quality, social studies, education policy.

**Abstract**—Social Science (IPS) learning using conventional approaches often lacks active student involvement, especially in understanding geographical concepts that require spatial thinking skills. This study aims to analyze the effect of implementing the Contextual Teaching and Learning (CTL) model based on an ecological approach on students' spatial thinking ability. The research employed a quasi-experimental method with a two-group pretest-posttest control group design. The subjects were seventh-grade students divided into experimental and control groups. Data were collected through spatial thinking ability tests and classroom activity observations, then analyzed using a quantitative approach. The findings indicate that the CTL model with an ecological approach is more effective than conventional learning. This model enhances student engagement, strengthens spatial concept comprehension, and encourages learners to connect classroom learning with real-life environmental experiences.

**Keywords:** CTL, ecological approach, spatial thinking, social science learning.

## I. INTRODUCTION

Social Science (IPS) learning at the junior high school level plays a strategic role in shaping students' ability to think critically, analytically, and contextually about social and geographical phenomena around them. Through IPS education, students are expected not only to master cognitive aspects but also to develop social awareness and problem-solving skills in everyday life [1], [2]. However, the reality shows that IPS learning is still dominated by conventional methods that are teacher-centered, causing students to be passive during lessons [3]. This condition affects learning outcomes, particularly in applying, analyzing, and evaluating geography concepts. Many students tend to memorize facts without being able to connect them with real-life contexts. In fact, higher-order thinking skills are needed to respond to social and environmental dynamics [4], [5]. The inability of students to link academic material with real experiences indicates the necessity for innovative learning models that are contextual and meaningful [6], [7].

One promising alternative is the Contextual Teaching and Learning (CTL) model. Recent studies emphasize that CTL fosters meaningful connections between classroom content and students' daily lives, enabling them to construct knowledge through authentic learning experiences. Thus, CTL not only facilitates knowledge transfer but also strengthens critical and reflective thinking [8], [9], [10], [11]. In addition, the ecological approach has become increasingly relevant in IPS learning. This approach highlights the use of the environment as a source of learning. Field-based activities are proven to enhance environmental literacy and spatial reasoning, while also motivating students to engage in inquiry-based exploration [12]. Such learning strategies also align with findings that place-based and environmental education positively influence sustainable attitudes and responsible behavior [13]. The integration of CTL with the ecological approach has the potential to provide contextual, interactive, and spatially oriented learning. CTL offers a pedagogical framework to link material with real-life experiences, while the ecological approach provides a concrete context for students to explore. Together, these approaches enable students to understand theoretical concepts and apply them in authentic contexts [14], [15].

Previous studies have confirmed the effectiveness of CTL in increasing student engagement. Recent evidence indicates that contextual and ecological-based learning strengthens student motivation, independence, and environmental awareness, but empirical studies focusing on the development of spatial thinking skills remain limited [16]. This gap indicates the importance of further research. Spatial thinking itself is an essential competence in geography education. It is widely recognized as the ability to recognize, interpret, and visualize spatial relationships between objects. Such skills are crucial for map interpretation, analyzing geosphere phenomena, and understanding human-environment interactions. Yet, research shows that many junior high school students still struggle with spatial reasoning, making it necessary to develop explicit strategies to reinforce these competencies [17].

Furthermore, Indonesia's Merdeka Curriculum emphasizes student-centered learning, where teachers are expected to become facilitators of active, creative, and critical learning. Within this framework, CTL combined with the ecological approach aligns with curriculum directions, as both prioritize real-world, student-driven learning [18]. Applying CTL based on the ecological approach is expected to overcome the shortcomings of conventional learning. By involving students directly in environment-based activities, they gain concrete learning experiences, develop spatial reasoning skills, and foster environmental awareness. This model can thus contribute to improving the quality of IPS education in schools [19].

Based on this rationale, the present study aims to examine the effectiveness of the CTL model with an ecological approach in enhancing students' spatial thinking ability at SMPN 11 Pesawaran. This research is expected to provide theoretical contributions to the development of innovative learning models, as well as practical insights for teachers to design contextual and meaningful IPS learning.

## II. RESEARCH METHOD

This study employed a quantitative approach with a quasi-experimental design. According to Creswell [20], quasi-experimental research allows researchers to test causal relationships through the manipulation of independent variables without full control over external factors. The design used was a two-group pretest-posttest control group design, in which both groups were given a pretest, followed by the experimental group receiving treatment through CTL with an ecological approach, while the control group was taught using conventional methods. After the treatment, both groups were given a posttest to examine differences in learning outcomes.

The population of this research comprised all seventh-grade students of SMPN 11 Pesawaran in the 2024/2025 academic year. The sample was selected using purposive sampling, considering the academic equivalence of classes so that the results would be comparable [21]. The total sample consisted of 66 students, divided into two groups: 33 students in the experimental class and 33 students in the control class. A proportional sample size ensured that the findings more accurately represented the effect of the intervention [22].

The research instrument was a spatial thinking ability test developed based on the indicators proposed by the National Research Council (2006). The instrument was tested for validity, reliability, difficulty level, and discriminating power to ensure its feasibility. The validity test using Pearson's product-moment correlation indicated that 25 out of 30 items were valid, with correlation

coefficients ranging from 0.312 to 0.694, exceeding the critical r-value of 0.300. The reliability analysis conducted using Cronbach's Alpha yielded a coefficient of 0.876, into the high reliability category. The difficulty indices ranged from 0.32 (moderate) to 0.72 (easy), while discriminating indices ranged from 0.31 to 0.68, showing that the items were appropriate for measuring spatial thinking ability.

Data were collected through tests and observation. The tests measured students' spatial thinking skills before and after the treatment, while observation sheets were used to record student learning activities during lessons. Two observers were involved to enhance objectivity. According to Sugiyono [21], quantitative data collection can be strengthened with observational techniques to complement information about the learning process that may not be fully reflected in test results. Data analysis was conducted in several stages. First, prerequisite tests including normality and homogeneity were carried out to ensure that the data met parametric assumptions. Second, an Independent Sample t-Test was applied to examine the differences in learning outcomes between the experimental and control groups. Third, learning effectiveness was analyzed using N-Gain scores, which were categorized into low, medium, and high effectiveness.

### III. RESULTS AND DISCUSSION

#### Results

Prior to hypothesis testing, prerequisite analyses were conducted to ensure that the data met the assumptions for parametric statistical procedures. The normality test results indicated that both the experimental and control groups obtained significance values greater than 0.05, confirming that the data were normally distributed. This finding suggests that the data were suitable for further analysis using parametric tests.

Table 1. Normality Test Results

| Class                | Sig. Value | Conclusion                |
|----------------------|------------|---------------------------|
| Experimental Class   | 0.200      | Data normally distributed |
| <b>Control Class</b> | 0.180      | Data normally distributed |

In addition, the homogeneity of variance was tested using Levene's Test. The obtained significance value was 0.267, which is greater than the threshold of 0.05. This result demonstrates that the variances between the experimental and control groups were homogeneous, thereby fulfilling another assumption for conducting the *Independent Sample t-Test*.

Table 2. Homogeneity Test Results

| Levene Statistic | Sig. Value | Conclusion           |
|------------------|------------|----------------------|
| 1.243            | 0.267      | Homogeneous variance |

The subsequent *Independent Sample t-Test* revealed a statistically significant difference between the two groups. The experimental class, which received instruction through CTL with an ecological approach, achieved a mean score of 82.45, while the control class, taught through conventional methods, obtained a mean score of 70.15. The calculated t-value of 11.145 exceeded the critical value of 1.999, and the Sig. (2-tailed) of 0.000 was below the significance threshold of 0.05. These results confirm that the intervention had a significant positive effect on students' spatial thinking ability.

Table 3. Independent Sample t-Test Results

| Class              | Mean  | t-value | Sig. (2-tailed) |
|--------------------|-------|---------|-----------------|
| Experimental Class | 82.45 | 11.145  | 0.000           |
| Control Class      | 70.15 | —       | —               |

Further analysis using the N-Gain Score provided insights into the relative effectiveness of the instructional models. The experimental class achieved an average N-Gain of 58.74%, which is categorized as moderately effective. Conversely, the control class only reached 31.62%, falling into the ineffective category. This indicates that CTL with an ecological approach not only led to statistically significant gains but also provided meaningful improvement in terms of instructional effectiveness.

Table 4. N-Gain Score Results

| Class              | N-Gain (%) | Category             |
|--------------------|------------|----------------------|
| Experimental Class | 58.74%     | Moderately Effective |
| Control Class      | 31.62%     | Ineffective          |

Observational data reinforced these statistical results by highlighting differences in classroom engagement. Students in the experimental class demonstrated a higher level of participation, with activeness recorded at 66% and categorized as active. In contrast, students in the control class only reached 52%, categorized as quite active. This pattern suggests that CTL with an ecological approach not only improved learning outcomes but also fostered greater involvement in classroom activities.

Table 5. Observation Results of Student Activeness

| Class              | Activeness (%) | Category     |
|--------------------|----------------|--------------|
| Experimental Class | 66%            | Active       |
| Control Class      | 52%            | Quite Active |

Taken together, the findings from prerequisite tests, hypothesis testing, N-Gain analysis, and classroom observations provide robust evidence for the effectiveness of the CTL model with an ecological approach. The model proved to be superior to conventional methods in enhancing spatial thinking, ensuring instructional effectiveness, and stimulating active student engagement. These results underscore the potential of CTL with an ecological approach as a viable instructional strategy for geography-based IPS learning in the junior high school context.

## Discussion

The study findings demonstrate that the implementation of the CTL model with an ecological approach significantly improved students' spatial thinking ability. This aligns with Piaget's constructivist theory, which emphasizes that knowledge is actively constructed through contextual experiences that directly engage learners with their environment. In this study, the ecological context became a medium for students to build meaning through observation and analysis, thereby strengthening their capacity to interpret spatial relations. Similar results were reported by Memmase, Sumarmi, and Purwanto [19], who found that the Earthcomm learning model improved spatial thinking ability and fostered environmental care. Thus, CTL integrated with an ecological approach provides a concrete framework for translating constructivist principles into practice.

Connecting subject matter with real-life contexts enabled students to more easily grasp abstract spatial concepts. CTL served as a pedagogical bridge that allowed learners to link classroom knowledge with authentic environmental experiences, thereby creating meaningful and long-lasting learning outcomes. This is consistent with Kosassy, Gistituati, and Montesori [8], who showed that the contextual learning approach enhances students' critical thinking, as well as Amirudin [9], who demonstrated that CTL strengthens tolerance and reflective learning attitudes. By situating knowledge within students' lived realities, CTL reduces the gap between theory and practice, enabling learners to visualize and apply spatial concepts with greater ease and relevance.

Activities such as environmental observation, simple mapping, and analysis of real phenomena in the experimental group reinforced the idea that experiential learning is more effective than teacher-centered lectures. Authentic learning activities not only foster curiosity but also provide students with opportunities to practice inquiry, problem-solving, and spatial reasoning in realistic contexts. This finding resonates with Tsai, Chuang, and Lin [12], who showed that technology-integrated environmental literacy learning

promotes curiosity and critical thinking, and with Ardoin, Bowers, and Gaillard [13], who confirmed that environmental education fosters sustainable attitudes.

These findings are also consistent with research showing that field-based approaches positively affect both cognitive development and environmental awareness. For instance, McCrone and Kingsbury [14] emphasized that ecological perspectives help students navigate complex learning contexts, while Li, Abrar-ul-Hassan, and Gao [15] found that an ecological perspective supports meaningful and sustainable learning. Both studies highlight that ecological integration not only improves academic outcomes but also develops responsible attitudes aligned with sustainability goals.

When compared to the control group, the experimental class clearly demonstrated greater engagement. Unlike conventional methods, which rely heavily on teacher-centered lectures and limit opportunities for exploration, CTL with ecological integration encourages active involvement through inquiry-based activities. This is in line with Alazmi [16], who showed that web-based GIS-supported inquiry enhances spatial thinking and participation, and Danlami et al. [17], who confirmed that collaborative learning strategies significantly improve geometry and spatial performance.

Student motivation was also positively influenced by the CTL model. Learning experiences that are connected to students' local environments tend to foster greater interest and enthusiasm, as students can immediately see the relevance of what they learn. This is consistent with Hidayat et al. (2023), who highlighted that problem-based learning strengthens social intelligence in IPS, and with Arviani, Wahyudin, and Dewi [2], who showed that innovative contextual models improve higher-order thinking skills. Moreover, Aristin et al. [3] demonstrated that problem-based geography learning increases learning outcomes and participation, proving that contextual relevance is key to sustained engagement.

Beyond motivation, CTL with an ecological approach also cultivated essential social skills, particularly collaboration and communication. By engaging in group activities such as mapping, analyzing local phenomena, and discussing ecological issues, students developed the ability to cooperate, share perspectives, and collectively solve problems. This aligns with Niles [10], who highlighted that contextualized curriculum fosters collaboration across cultures, and Le and Nguyen [11], who showed that social constructivism-based learning develops critical and collaborative thinking in classroom contexts.

Nevertheless, the study also revealed that improvements in spatial relationship analysis were relatively lower compared to other indicators. This finding suggests that while CTL with an ecological approach effectively develops basic spatial skills, more advanced spatial reasoning may require complementary strategies. For example, digital mapping technologies and GIS-based platforms could provide deeper scaffolding. Supporting this, Alazmi [16] confirmed that GIS-supported inquiry enhances higher-order spatial thinking, while Memmase, Sumarmi, and Purwanto [19] emphasized that contextual environmental models strengthen ecological literacy alongside spatial reasoning.

Conceptually, CTL with an ecological approach aligns with Indonesia's Merdeka Curriculum, which emphasizes contextual, collaborative, and student-centered learning. By situating lessons within students' real environments and promoting active exploration, this model fits seamlessly into curriculum reforms that prioritize competence-based and meaningful education. Haq and Wakidi [18] underlined that the Merdeka Curriculum pushes teachers toward innovative approaches, contextual learning models improve student outcomes under curriculum reforms.

#### IV. CONCLUSION

The findings of this study conclude that the application of the Contextual Teaching and Learning (CTL) model integrated with an ecological approach is significantly more effective than conventional methods in improving students' spatial thinking abilities. The experimental class not only achieved higher test scores and better N-Gain effectiveness but also demonstrated greater classroom

activeness compared to the control class. By situating learning within real-life environmental contexts, CTL facilitated meaningful knowledge construction, encouraged inquiry-based exploration, and fostered motivation as well as collaboration among students. These results confirm that ecological-based CTL strengthens both cognitive and social dimensions of learning, aligning with the principles of the Merdeka Curriculum which emphasizes student-centered, contextual, and competence-based education. Therefore, CTL with an ecological approach can be recommended as an innovative instructional strategy for Social Science learning, particularly in geography education, to enhance spatial reasoning, environmental literacy, and active participation in line with 21st-century learning goals.

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