

Comparing discovery and conventional learning for elementary students epistemic curiosity

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Abstract: *This study aimed to compare the effectiveness of the Discovery Learning model and conventional learning in enhancing fifth-grade elementary students' epistemic curiosity in science. A quantitative quasi-experimental design with a nonequivalent control group was employed. The experimental group (n = 9) received Discovery Learning instruction, while the control group (n = 15) received conventional learning on the Water Cycle topic. Data were collected using a validated and reliable pre-test and post-test questionnaire assessing three dimensions of epistemic curiosity: observation, consultation, and directed thinking. Data were analyzed using the N-Gain test and independent samples t-test. Results showed that Discovery Learning produced greater improvement in all epistemic curiosity indicators than conventional learning. Discovery Learning was categorized as fairly effective, whereas conventional learning was ineffective. The findings indicate that Discovery Learning is a more effective approach for fostering epistemic curiosity in elementary science education.*

Keywords: *epistemic curiosity; discovery learning; conventional learning; science education; elementary school*

Introduction

Curiosity is a key factor in the learning process, particularly in elementary school science education. Epistemic curiosity, defined as the cognitive drive to seek knowledge or fill information gaps, encourages exploration, active engagement, and reasoning in scientific activities. Wandansari & Hernawati (2021), affirm that epistemic curiosity is the type most strongly associated with learning success in academic contexts, as it motivates students to bridge knowledge gaps and engage with complex problems.

Several studies have reported the pivotal role of epistemic curiosity in learning. Wandansari and Hernawati, (2021) demonstrated that curiosity influences metacognitive processes when students encounter uncertainty. Recent research by Kim, Harris, and Néher (2025) also shows that curiosity can influence metacognitive processes, particularly when students face uncertainty that prompts them to explore information more deeply. showed that stimulating curiosity through learning media improves problem-solving abilities. (Barata et al., 2023). further found that problem solving tasks in STEM contexts can evoke epistemic curiosity by triggering astonishment as a motivational entry point. Despite these findings, studies that explicitly examine epistemic curiosity within the context of Discovery Learning in elementary science remain limited, constituting the research gap addressed by the present study.

The learning process in Indonesia continues to be dominated by conventional, teacher-centred models. Empirical evidence from This condition is supported by the findings of Ghafar (2023), shows that such models are linked to reduced student engagement, limited critical thinking, and slower development of scientific attitudes. Critically, conventional instruction characterised by one-way knowledge delivery and rote memorisation restricts students' opportunities to experience uncertainty, a condition that.

In contrast, the Discovery Learning model positions students as active discoverers who observe phenomena, formulate hypotheses, conduct experiments, and draw conclusions, with the teacher acting as a facilitator. Previous studies have directly supported the relationship between this model and students' curiosity and exploratory behaviour. Similarly demonstrated that it encourages curiosity through direct experiential activities. The model emphasises authentic tasks and problem-based processes that stimulate information need and novelty-seeking two key components of epistemic curiosity as conceptualised (Rahmawati, Masykuri, & Sarwanto, 2021). confirmed that hands-on engagement is positively correlated with epistemic curiosity and *discovery learning* career interest.

Although Discovery Learning has been widely studied in relation to learning outcomes (Maran, Puang, & Hero, 2025), critical thinking (Rahmawati, Sutarni, & Muhammad, 2023), and motivation (Pramesti et al., 2024), very few studies have explicitly measured epistemic curiosity as a distinct dependent variable. The novelty of this study, therefore, lies in its specific focus on epistemic curiosity measured across three theoretically grounded indicators using a validated instrument and in its direct controlled comparison with conventional instruction in an elementary school science context.

Based on the foregoing, this study aims to compare the effectiveness of the Discovery Learning model and conventional learning in enhancing fifth-grade elementary school students' epistemic curiosity in science. The research questions are: (1) How does epistemic curiosity develop across all three indicators in students taught using Discovery Learning compared to conventional learning? and (2) Which learning model is more effective in increasing epistemic curiosity? Theoretically, this study contributes to the literature on epistemic curiosity by providing empirical evidence about the role of instructional model characteristics in shaping specific dimensions of curiosity in elementary learners. Practically, findings are expected to guide teachers and curriculum designers in selecting more effective instructional approaches for elementary science.

Method

This study employed a quantitative approach with a quasi-experimental design. Specifically, a nonequivalent control group design was adopted a design characterised by the use of pre-existing, intact class groups that are not randomly assigned (Creswell, 2014). This design was selected because the natural class settings were preserved to ensure authentic learning outcomes and to maintain ecological validity of the study. The non-random nature of sampling is acknowledged as a limitation.

Participants were two groups of fifth-grade students from two different public elementary schools in Blitar Regency: the experimental group from UPT SD Negeri Minggirsari (n = 9) and the control group from UPT SD Negeri Karangsono 02 (n = 15). The experimental group received science instruction using the Discovery Learning model, while the control group received the same topic the Water Cycle through conventional lecture-based instruction. The research design is presented in Table 1.

Table 1. Research Design

Group	Pre-test	Treatment	Post-test
Experimental	O1	X1: Discovery Learning (Y1: epistemic curiosity)	O2
Control	O3	X2: Conventional Learning (Y2: epistemic curiosity)	O4

Note: O1 and O3 = pre-test epistemic curiosity scores; O2 and O4 = post-test epistemic curiosity scores; X1 = Discovery Learning; X2 = Conventional Learning; Y1 = experimental group; Y2 = control group.

Epistemic curiosity was measured based on D. E. Berlyne's (1966) theoretical framework, which classifies epistemic curiosity into three indicators: epistemic observation, consultation, and directed thinking. The research instrument was a questionnaire consisting of 21 statements with binary response options ("Yes"/"No"), developed based on theoretical sub-indicators drawn from Berlyne's (1966) taxonomy and adapted for elementary school contexts, as shown in Table 2.

Table 2. Indicators and Sub-Indicators of Epistemic Curiosity

Type	Indicator	Sub-Indicator	Items
<i>Epistemic Curiosity</i>	<i>Epistemic Observation</i>	Desire to observe phenomena or objects carefully	3
		Engaging in experimental or investigative activities	4
	<i>Consultation</i>	Asking questions to clarify understanding	4
		Requesting opinions or explanations from others	4
		Searching for information from various sources	3
	<i>Directed Thinking</i>	Applying reasoning directed toward solving problems	3
Total			21

Before data collection, the instrument underwent validity testing (point-biserial correlation with t-test, t-count > t-table) and reliability testing (Cronbach's Alpha = 0.78, exceeding the threshold of 0.60) on 30 elementary school students from a different school. The instrument was thus confirmed to be valid and reliable. Descriptive analysis compared mean scores and percentage improvements between groups. Effectiveness was analysed using the normalised gain (N-Gain) test with categories: high (N-Gain > 0.7), medium (0.3 ≤ N-Gain ≤ 0.7), and low (N-Gain < 0.3), and corresponding effectiveness percentages: effective (>76%), fairly effective (56–75%), less effective (40–55%), and not effective (<40%). To test for significant differences in epistemic curiosity improvement between groups, an

independent samples t-test was conducted following normality verification (Shapiro-Wilk test).

Comparison of Students' Epistemic Curiosity Based on Learning Models

Table 3 presents the mean pre-test and post-test epistemic curiosity scores for both groups, along with percentage improvement calculated as: $[(\text{post-test} - \text{pre-test}) / \text{pre-test}] \times 100\%$.

Table 3. Students' Epistemic Curiosity Scores by Group

Group	Model	Pre-test Mean	Category	Post-test Mean	Category	Improvement (%)
Experimental	Discovery Learning	44	Moderate	74	High	66.7%
Control	Conventional	51	Moderate	60	Moderate	17.4%

The Discovery Learning group showed a markedly greater improvement (66.7%) compared to the conventional group (17.4%). While both groups began in the moderate category, only the Discovery Learning group progressed to the high category post-intervention, whereas the conventional group remained in the moderate category. An independent samples t-test confirmed that the difference in improvement between groups was statistically significant ($t(22) = 3.47, p < 0.05$), supporting the conclusion that Discovery Learning produced greater gains in epistemic curiosity than conventional instruction.

From a theoretical perspective, epistemic curiosity is an internal drive to acquire new knowledge by bridging information gaps (Dwijantie & Nurishlah, 2025). The Discovery Learning model structured around observation, hypothesis formulation, experimentation, and conclusion drawn directly stimulates this drive by presenting students with genuine cognitive challenges and knowledge gaps. This aligns with the broader finding by Stuppan et al. (2025) that problem solving situations in evoke astonishment, which positively correlates with epistemic curiosity and motivates students to explore new information. In contrast, conventional instruction provides students with pre-resolved knowledge, thereby reducing the information gap that drives epistemic curiosity.

Table 4 presents a comparison of epistemic curiosity improvements by indicator across both groups.

Table 4. Comparison of Epistemic Curiosity Indicators (Experimental vs. Control)

Indicator	Group	Pre (%)	Post (%)	Gain (%)	Pre (%)	Post (%)
Indicator	Discovery Learning Pre (%)	DL Post (%)	DL Gain (%)	Conventional Pre (%)	Conv. Post (%)	Conv. Gain (%)
Epistemic Observation	52.4	73.0	39.3	56.2	68.6	22.1
Consultation	42.4	75.8	78.8	51.5	60.6	17.7
Directed Thinking	33.3	70.4	111.4	37.8	37.8	0.0

Table 4 reveals that the Discovery Learning model produced higher percentage gains than conventional learning across all three epistemic curiosity indicators. Directed thinking showed the most dramatic improvement under Discovery Learning (111.4%), while recording no improvement at all under conventional instruction (0.0%). This differential pattern warrants theoretical explanation.

Directed thinking understood as a purposeful, sequential chain of reasoning steps aimed at resolving a knowledge gap is the epistemic dimension most closely aligned with hypothesis formulation, experimental reasoning, and evidence evaluation (Zetterqvist & Bach, 2023). The Discovery Learning model explicitly demands these cognitive operations: students must formulate questions, design observations, test hypotheses, draw conclusions, and evaluate evidence. These activities systematically train directed thinking as an epistemic habit (Hariyanti & Budayasa, 2025; Jirout, 2020). By contrast, conventional instruction positions students as passive recipients, providing pre-structured information and requiring reproduction rather than construction of knowledge. Under such conditions, García-carmona (2025) notes that students are rarely called upon to engage in self-directed scientific reasoning, which explains the complete absence of improvement in directed thinking under conventional instruction. Assessment in conventional settings also tends to reward final answers over reasoning processes (Sidik & Wulan, 2025), further inhibiting the epistemic dimension of directed thinking.

Conventional instruction, however, produced the comparatively greater improvement in epistemic observation (22.1% vs. 39.3% for Discovery Learning). Although Discovery Learning still outperformed conventional instruction on this indicator, it is pedagogically interesting that structured, explicit conventional instruction can support basic observation skills. Ginting, Limiansih, and Hadiyanti (2023), Kraus (2024), and Sa'adah, Andini, and Yusup (2024) collectively explain that teacher led demonstrations reduce cognitive load, provide clear observational templates, and allow repeated modelling of accurate observation procedures. These affordances can scaffold basic observation behaviours, though not to the depth achieved through active Discovery Learning.

Table 5. Comparison of Epistemic Curiosity Sub-Indicators (Experimental vs. Control)

Indicator	Sub-Indicator	DL	DL	DL	Conv	Conv	Conv
		Pre	Post	Gain	Pre	Post	Gain
<i>Epistemic Observation</i>	Desire to observe phenomena carefully	51.9	77.8	49.9	64.4	73.3	13.8
	Engaging in experimental activities	52.8	69.4	31.4	50.0	65.0	30.0
<i>Consultation</i>	Asking questions to clarify understanding	50.0	80.6	61.2	60.0	75.0	25.0
	Requesting opinions/explanations from others	33.3	66.7	31.4	45.0	56.7	26.0
	Searching for information from various sources	44.4	81.5	83.6	48.9	46.7	-4.5
<i>Directed Thinking</i>	Applying reasoning to solve problems	33.3	70.4	111.4	37.8	37.8	0.0

At the sub indicator level (Table 5), the most notable finding is that 'searching for information from various sources under the Consultation indicator recorded the highest post-test percentage in the Discovery Learning group (81.5%, gain of 83.6%). This reflects a pedagogically important outcome: Discovery Learning prompted students to go beyond single sources and actively seek diverse information to address their knowledge gaps, consistent with the epistemological goals of the model. Suryani, Yasir, and Sidik (2023) reported that multimedia-oriented learning resources receive highly positive responses from students and stimulate curiosity, while Khattak et al. (2023) found that multiple source engagement enhances learning experiences and motivates continuous inquiry. The open-ended nature of discovery tasks creates information gaps that motivate students to seek answers from various sources a behaviour that is rarely triggered by the closed-answer format of conventional instruction (García carmona, 2025; Kim et al., 2025).

In contrast, the same sub-indicator showed a 4.5% decline in the conventional group. This decline is theoretically consistent with the passive instructional environment: when all necessary information is provided by the teacher, students have little incentive to seek additional sources independently (Kim et al., 2025). This finding underscores the pedagogical importance of designing learning tasks that create genuine information gaps, as these function as the cognitive trigger for information-seeking behaviour.

Effectiveness of Learning Models in Enhancing Students' Epistemic Curiosity

Table 6 presents the N-Gain results for both learning models.

Table 6. N-Gain Test Results for Both Learning Models

Measure	Discovery Learning	Conventional Learning
N-Gain Score	0.56	0.20
N-Gain Category	Moderate	Low
N-Gain Percentage	56%	20%
Effectiveness Category	Fairly Effective	Ineffective

The Discovery Learning model achieved an N-Gain score of 0.56 (moderate; fairly effective), while the conventional model scored 0.20 (low; ineffective). The independent samples t-test further confirmed that the improvement in the Discovery Learning group was significantly greater than that in the conventional group ($p < 0.05$). Together, these quantitative results provide converging evidence that Discovery Learning is the more effective instructional model for enhancing epistemic curiosity in elementary science education.

These results are consistent with findings by Martina, Wardarita, and Rukiyah (2022), who reported that Discovery Learning fosters curiosity through direct, real-world experiential activities. Oktavioni, Chan, and Turrohmah (2020) similarly found that Discovery Learning led to greater enthusiasm for information-seeking and more active questioning, resulting in significantly higher curiosity scores. The effectiveness of Discovery Learning can also be explained from the perspective of self-determination theory: the model increases student autonomy and competence by allowing students to identify problems and discover solutions

independently, thereby intrinsically motivating curiosity-driven exploration (Rahayuningsih et al., 2024; Novitasari, 2021). Safitri et al. (2022) further demonstrated that providing students with strategic choices such as selecting their own experimental approaches amplifies curiosity compared to the predetermined steps of conventional instruction.

Conclusion

This study demonstrated that the Discovery Learning model is significantly more effective than conventional instruction in enhancing fifth-grade elementary school students' epistemic curiosity in science. Discovery Learning produced greater gains across all three indicators of epistemic curiosity epistemic observation, consultation, and directed thinking with directed thinking showing the most pronounced improvement. The conventional model, while showing modest improvements in epistemic observation, was categorised as ineffective overall and produced no improvement in directed thinking. These findings position Discovery Learning as a theoretically coherent and empirically supported approach for fostering the epistemic dimensions of curiosity in elementary science contexts.

The limitations of this study include a small sample size ($n = 24$) and the use of intact, non-randomly assigned groups, which constrain external validity. Future research should replicate these findings with larger, randomly assigned samples, explore the long-term stability of epistemic curiosity improvements, and investigate how teacher training in Discovery Learning affects implementation quality. It is also recommended that educational institutions systematically support Discovery Learning through structured professional development programmes for teachers.

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