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How Scientific Learning Shapes Creativity and Academic Achievement in Secondary Economic Education

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Abstract

This study examines how a scientific learning approach enhances student creativity and academic achievement in economic education within the Economic Education Program at Universitas Lampung. Moving beyond conventional outcome-focused classroom action research, it employs a reflective cyclical design across three instructional cycles to capture pedagogical transformation through planning, enactment, observation, and critical reflection. Data from learning engagement, academic performance, and student creative outputs reveal a consistent improvement in conceptual mastery, participation, and product originality. The findings demonstrate that structured inquiry and iterative feedback—rather than mere procedural repetition—function as key mechanisms enabling active knowledge construction and higher-order thinking. The study's novelty lies in conceptualizing scientific learning as an adaptive-reflective pedagogical system and providing context-sensitive evidence from economic education in the Global South, a setting underrepresented in prior research. Practically, the results suggest integrating inquiry-based cycles, reflective assessment, and creativity-oriented tasks into curriculum design, while strengthening teacher education through training in adaptive pedagogy, feedback literacy, and reflective instructional practice to improve learning quality and student creative capacity.

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INTRODUCTION

Education occupies a strategic position in shaping human capital capable of responding to economic, social, and technological transformation (Bambi & Pea-Assounga, 2025). In contemporary higher education, particularly within teacher education programs, learning is no longer expected to merely transmit disciplinary knowledge but to cultivate higher-order capacities such as creativity, critical inquiry, and adaptive reasoning (Ellerton & Kelly, 2022). Within economic education, these capacities are especially salient, as future teachers are required not only to master economic concepts but also to translate them into pedagogical practices that foster analytical thinking and innovative problem-solving among learners (Kozharinov et al., 2020). Consequently, creativity and academic achievement should be understood as interrelated learning outcomes that reflect the depth of conceptual understanding and the quality of pedagogical engagement, rather than as isolated performance indicators.

Despite this normative expectation, prior studies in economic education particularly in developing country contexts have tended to adopt outcome-oriented and procedurally descriptive approaches, often emphasizing short-term learning gains without sufficient attention to the pedagogical mechanisms through which such gains are produced (Kopnina et al., 2024; Deng et al., 2025). Much of the existing literature treats creativity as a by-product of instructional variation rather than as a cognitively mediated process shaped by inquiry, reflection, and structured knowledge construction (Ismailov, 2021; Krichevsky, 2023). This limitation is further compounded by the dominance of teacher-centered instructional practices in economics classrooms, where lecture-based delivery and surface-level discussion continue to prevail, even in higher education settings designed to prepare prospective teachers. As a result, students frequently demonstrate limited engagement in questioning, weak confidence in articulating economic reasoning, and difficulty in translating

abstract economic concepts into coherent and original explanations (Chew & Cerbin, 2021)

In response to these challenges, scientific learning has been increasingly promoted as a pedagogical orientation capable of supporting deeper learning processes (Darling-Hammond et al., 2020). Rooted in inquiry-based and constructivist learning traditions, scientific learning emphasizes systematic observation, question formulation, evidence-based reasoning, analytical association, and reflective communication (Soysal, 2021; Pinar et al., 2025). Rather than positioning learners as passive recipients of knowledge, this approach foregrounds epistemic agency by encouraging students to actively construct, test, and refine understanding through structured inquiry (Nieminen et al., 2025). While scientific learning has been widely endorsed at the policy level, empirical evidence regarding how it functions as a pedagogical mechanism within economic education particularly in teacher education programs remains fragmented and under-theorized (Löfgren, 2023; Peng & Li, 2025).

This gap is particularly evident in the context of the Economic Education Program at Universitas Lampung, where students are expected to integrate economic content mastery with pedagogical competence. Preliminary observations indicate that many students continue to rely on reproductive learning strategies, exhibit low confidence in expressing economic ideas, and struggle to generate creative representations of economic processes such as production activities. These patterns suggest a misalignment between instructional approaches and the cognitive–pedagogical demands of economic education, raising critical questions about how learning designs can better support creativity and academic achievement simultaneously.

Against this backdrop, the present study advances a novel contribution by reconceptualizing scientific learning not merely as a procedural teaching approach but as a reflective pedagogical mechanism that shapes creativity and academic achievement through iterative inquiry and feedback. Unlike prior

studies that focus narrowly on outcome improvement, this research foregrounds the processual dynamics through which scientific learning facilitates conceptual articulation, creative knowledge production, and sustained academic engagement among undergraduate students in economic education (Shen, 2023; Xiang et al., 2024; Köpeczi-Bócz, 2025). By situating the analysis within a teacher education context in the Global South, the study also responds to calls for more context-sensitive pedagogical research that moves beyond universalistic assumptions (Anderson, 2023).

Accordingly, the purpose of this study is to examine how scientific learning shapes student creativity and academic achievement within the Economic Education Program at Universitas Lampung. Specifically, the research seeks to elucidate the pedagogical processes through which structured inquiry and reflective learning cycles contribute to deeper conceptual understanding and creative engagement in economic learning. Through this lens, the study aims to contribute theoretically to the literature on economic education pedagogy and practically to the design of learning environments that better prepare future economics teachers for complex instructional challenges.

METHOD

Research Design

This study adopts a reflective pedagogical inquiry design grounded in classroom-based intervention research, commonly referred to as classroom action research (Kemmis et al., 2014; Cochran-Smith et al., 2022). Rather than treating this design as a purely technical cycle of instructional improvement, the study is framed epistemologically as an iterative inquiry into pedagogical mechanisms shaping creativity and academic achievement in economic education (Biesta, 2020). This positioning aligns with contemporary critiques of action research that emphasize analytical depth, theoretical reflexivity, and methodological transparency, particularly when such studies aim to contribute to broader pedagogical discourse (Cochran-Smith et al., 2022).

The research was conducted across three instructional cycles comprising instructional planning, pedagogical enactment, systematic observation, and critical reflection (Kemmis et al., 2014). These cycles functioned as progressive stages of pedagogical refinement rather than repetitive procedures, with insights from earlier cycles informing instructional design and analytical focus in subsequent iterations (Bradbury, 2022). This structure enabled examination of not only whether pedagogical change occurred, but how and why instructional adjustments influenced student engagement, creativity, and learning outcomes over time (Darling-Hammond et al., 2020).

The instructional intervention was organized around a scientific learning approach conceptualized as a coherent pedagogical framework rather than isolated activities (OECD, 2021). Learning design emphasized systematic observation, analytically grounded questioning, evidence-based exploration, associative reasoning linking empirical findings with economic concepts, and reflective communication of conclusions (Darling-Hammond et al., 2020). These stages were integrated with opportunities for creative knowledge production, enabling students to represent economic processes through original explanations and learning artifacts (Bradbury, 2022). Across cycles, instructional planning was progressively refined through reflective analysis, including recalibration of inquiry prompts, restructuring of collaborative tasks, and enhancement of feedback mechanisms, thereby strengthening internal coherence and alignment between pedagogical intentions and observed learning processes (Bradbury, 2022; Darling-Hammond et al., 2020).

Research Context and Participants

The study was situated within the Economic Education Program at Universitas Lampung, involving undergraduate students enrolled in a core instructional course related to economic learning and pedagogy. This context is particularly significant, as students in teacher education programs are simultaneously positioned as learners of economic content and

as prospective educators who will later enact pedagogical decisions in their own classrooms (Cochran-Smith et al., 2022). Consequently, the learning environment constitutes a dual-layered pedagogical space where content mastery, reflective practice, and pedagogical identity formation intersect (Biesta, 2020).

Participants were selected through intact class sampling, reflecting the naturalistic setting of instructional research (Creswell & Poth, 2018). All students enrolled in the selected course participated in the intervention as part of regular instructional activities, ensuring ecological validity and minimizing disruption to the academic process (Shadish et al., 2020). While the sample size was necessarily bounded by institutional context, the study prioritizes analytical depth and processual insight over statistical generalization, consistent with the methodological logic of reflective inquiry in higher education pedagogy (Bradbury, 2022).

Data Source and Collection Procedures

Data sources were employed to enable methodological triangulation and to mitigate limitations inherent in single-instrument classroom-based research (Fetters et al., 2020). This multi-source strategy reflects a deliberate commitment to capturing not only observable learning outcomes but also the pedagogical processes through which creativity and conceptual understanding in economic education are constituted (Sawyer, 2022). Systematic classroom observations constituted a primary data source and were conducted continuously across instructional cycles (Miles et al., 2020). These observations extended beyond documentation of instructional activities and were analytically oriented toward identifying patterns of epistemic engagement, inquiry enactment, and creative participation among students (Mercer et al., 2019). Observation protocols foregrounded theoretically salient indicators, including the frequency and quality of student-generated questions, depth of idea elaboration, peer-to-peer intellectual exchange, and reflective articulation of economic concepts (Mercer et al., 2019; Sawyer, 2022), thereby moving beyond

surface-level participation metrics that often obscure the qualitative nature of learning engagement (Biesta, 2020).

Learning outcomes were examined through a dual assessment strategy combining objective measures of conceptual understanding with structured evaluation of student-produced creative outputs (Beghetto & Kaufman, 2021). Conceptual assessments emphasized students' ability to explain, apply, and integrate economic concepts related to production activities rather than recall isolated facts (OECD, 2021). Creative outputs were assessed using explicit analytical criteria emphasizing originality, conceptual coherence, and substantive alignment with core economic principles (Beghetto & Kaufman, 2021), recognizing creativity as a cognitively grounded process embedded within disciplinary understanding (Sawyer, 2022).

To strengthen interpretive validity, instructional documents, lesson plans, reflective notes, and student learning artifacts were systematically archived as supplementary data sources (Miles et al., 2020). These materials enabled longitudinal tracing of pedagogical adjustments across cycles and contextualized observed changes in student engagement and performance (Bradbury, 2022; Darling-Hammond et al., 2020). Ethical considerations were treated as integral to methodological rigor rather than procedural formalities (BERA, 2018). Data collection was embedded within regular instructional practices, informed consent was obtained, data were anonymized, and particular attention was given to student agency, power asymmetries, and principles of fairness, transparency, and academic integrity (BERA, 2018; Biesta, 2020).

Data Analysis

Data analysis was guided by an integrative qualitative–quantitative analytical framework designed to capture both observable trends in learning outcomes and the pedagogical processes through which such trends emerged (Fetters et al., 2020). Quantitative data were analyzed descriptively to trace changes in student engagement, conceptual mastery, and creative performance across instructional cycles

(Miles et al., 2020). Rather than serving as evidence of causal effects, numerical indicators were used heuristically to signal directional movement, stability, and convergence over time (Shadish et al., 2020), reflecting a deliberate rejection of inferential claims that exceed the epistemic capacity of classroom-based inquiry and aligning the analysis with process-oriented research objectives (Biesta, 2020).

Qualitative data constituted the primary analytical lens for interpreting pedagogical dynamics and learner responses (Forbes, 2021). Observation records, reflective notes, and student learning artifacts were subjected to iterative interpretive analysis to identify recurring patterns of inquiry enactment, creative articulation, and reflective engagement with economic concepts (Miles et al., 2020). Analytical focus was directed toward moments of conceptual shift, changes in the quality of student reasoning, and evolving forms of peer interaction (Mercer et al., 2019), enabling an understanding of scientific learning as a pedagogical mechanism rather than a static instructional technique (Sawyer, 2022).

Analytical integration involved systematic comparison of qualitative insights with quantitative trends to assess consistency and explanatory alignment across data sources (Fetters et al., 2020). Convergence was treated as an indicator of analytical robustness, while divergence prompted critical re-examination of assumptions and interpretations (Miles et al., 2020). This triangulation strengthened internal coherence and mitigated confirmation bias in intervention-based research (Bradbury, 2022). To enhance rigor and trustworthiness, interpretations were subjected to iterative peer debriefing (Lincoln & Guba, 1985/2020), alongside the maintenance of reflective analytic memos documenting pedagogical decisions, interpretive shifts, and researcher positionality (Bradbury, 2022). This reflexive audit trail ensures transparency and supports assessment of the credibility and plausibility of the findings (Forbes, 2021).

RESULTS AND DISCUSSION

Development of Instructional Implementation Quality

Across the three cycles, a consistent improvement was observed in the quality of instructional implementation of the scientific learning approach. In the first cycle, instructional enactment was characterized by partial alignment with inquiry-based principles. Observation scores indicated a moderate level of fidelity, reflecting the instructor's transitional adaptation from conventional instruction toward structured inquiry facilitation. By the second cycle, substantial refinement in instructional orchestration was evident, particularly in scaffolding inquiry, managing collaborative interaction, and guiding reflective discussion. The third cycle demonstrated stabilization at a high level of pedagogical quality, suggesting that instructional competence had reached a mature and internally coherent phase.

Table 1. Descriptive Statistics of Instructional Implementation Quality Across Cycles

Cycle	Observed Score	Maximum Score	Percentage (%)	Interpretive Category
I	26	40	65.0	Moderate
II	35	40	87.5	Very High
III	36	40	90.0	Very High (Stable)

Source: Processed Primary Data

Table 1 presents a clear longitudinal pattern in the quality of instructional implementation across the three instructional cycles, reflecting a progressive consolidation of the scientific learning approach. In the first cycle, the observed instructional score reached 26 out of a maximum of 40, corresponding to 65.0 percent and indicating a moderate level of implementation quality. This result suggests that, at the initial stage, instructional practices were only partially aligned with the core principles of scientific learning, as the instructor was still adapting from conventional teaching routines toward a more inquiry-oriented pedagogical orientation. A substantial qualitative shift is evident in the second cycle, where the observed score increased markedly to 35, representing 87.5 percent of the maximum

possible score. This improvement signifies a transition from partial adoption to a very high level of instructional fidelity, particularly in terms of structuring inquiry activities, facilitating student engagement, and managing reflective learning processes. The magnitude of this increase underscores the role of reflective revision and pedagogical recalibration in strengthening instructional coherence rather than mere repetition of teaching procedures. In the third cycle, the observed score rose marginally to 36, equivalent to 90.0 percent, and remained within the very high interpretive category. The relatively small increment between the second and third cycles should not be interpreted as stagnation; rather, it indicates pedagogical stabilization at an advanced level of implementation. At this stage, instructional quality appears to have reached a saturation point, where further gains are incremental and primarily qualitative in nature. Overall, the pattern depicted in Table 1 demonstrates that sustained reflective practice and iterative refinement were central to achieving and maintaining a high-quality enactment of the scientific learning approach.

Evolution of Student Creativity

Student creativity exhibited a progressive and substantively meaningful increase across cycles. In Cycle I, creativity indicators remained at a moderate level. Students demonstrated limited epistemic agency, with questioning behavior dominated by recall-oriented prompts and minimal idea elaboration. This pattern reflects entrenched reproductive learning habits commonly observed in economics education contexts. By Cycle II, a marked increase in creative engagement was observed. A larger proportion of students actively generated questions and attempted original explanations, although confidence and conceptual precision remained uneven. The third cycle revealed qualitative transformation rather than mere quantitative increase: student questions became more problem-oriented, responses demonstrated greater conceptual integration, and creative articulation increasingly reflected economic reasoning rather than surface

expression.

Table 2. Student Creativity Scores Across Instructional Cycles

Cycle	Observed Score	Maximum Score	Percentage (%)	Interpretive Category
I	19	32	59.4	Moderate
II	24	32	75.0	High
III	26	32	81.3	High (Consolidated)

Source: Processed Primary Data

Table 2 illustrates a clear and progressive enhancement in student creativity across the three instructional cycles, revealing both quantitative growth and qualitative consolidation of creative engagement. In the first cycle, the observed creativity score reached 19 out of a maximum of 32, corresponding to 59.4 percent and falling within the moderate category. This initial level reflects a learning environment in which students were still largely constrained by reproductive learning habits, with creative expression emerging only sporadically and often limited to surface-level elaboration rather than substantive economic reasoning. A pronounced improvement is evident in the second cycle, where the observed score increased to 24, equivalent to 75.0 percent and classified as high. This shift indicates a significant expansion in students' willingness to articulate ideas, pose questions, and engage more actively in inquiry-oriented tasks. However, while the quantity of creative participation increased substantially, the quality of student contributions at this stage remained uneven, suggesting that creativity was beginning to emerge but had not yet been fully internalized as a habitual learning practice.

In the third cycle, the observed creativity score rose further to 26, representing 81.3 percent of the maximum possible score and remaining within the high interpretive category, now characterized as consolidated. The comparatively smaller gain between the second and third cycles signifies a transition from rapid growth to stabilization, where creative behaviors became more consistent and conceptually grounded. At this stage, student creativity was no longer episodic but increasingly embedded in

disciplinary understanding, with students demonstrating greater confidence in developing original explanations and integrating economic concepts into their reasoning. Overall, the pattern depicted in Table 2 suggests that creativity development followed a cumulative and threshold-based trajectory, requiring sustained pedagogical support before reaching a stable and meaningful level.

Academic Achievement and Learning Mastery

Academic achievement, measured through objective assessments of economic concept mastery, demonstrated a strong upward trend across cycles. While Cycle I outcomes indicated moderate mastery, subsequent cycles showed not only higher completion rates but also reduced dispersion between minimum and maximum scores, suggesting increased equity in learning attainment.

Table 3. Learning Achievement Statistics Across Cycles

Cycle	Completion Rate (%)	Mean Score	Min Score	Max Score	Gain from Previous Cycle
I	69	78	65	90	-
II	84	81	68	91	+15%
III	94	85	73	93	+10%

Source: Processed Primary Data

Table 3 presents a clear and systematic improvement in learning achievement across the three instructional cycles, indicating not only rising levels of academic mastery but also increasing consistency in student performance. In the first cycle, the completion rate stood at 69 percent, with a mean score of 78 and a relatively wide dispersion between the minimum score of 65 and the maximum score of 90. This distribution suggests that, at the initial stage of implementation, student understanding of the economic concepts under study was uneven, with a substantial proportion of students failing to achieve mastery despite the presence of high-performing individuals. A notable advancement is observed in the second cycle, where the completion rate increased to 84 percent,

representing a 15 percent gain relative to the first cycle. This improvement was accompanied by a rise in the mean score to 81 and a modest upward shift in both the minimum and maximum scores. The narrowing of the lower bound from 65 to 68 indicates that instructional refinement particularly benefited students who had previously struggled, thereby reducing performance gaps while maintaining high achievement at the upper end.

In the third cycle, learning achievement reached a high level of consolidation. The completion rate rose further to 94 percent, with the mean score increasing to 85 and the minimum score advancing to 73. Although the incremental gain of 10 percent from the second cycle is smaller than the previous increase, this pattern reflects a maturation phase in which learning gains became more evenly distributed rather than sharply accelerated. The upward movement of the minimum score is especially significant, as it signals enhanced baseline understanding across the cohort. Taken together, the data in Table 3 demonstrate that the instructional intervention supported not only overall improvement in academic achievement but also greater equity in learning outcomes, suggesting that the pedagogical approach facilitated more inclusive conceptual mastery over time.

Creative Product Assessment

To address the limitations of objective testing in capturing creativity, student learning was also assessed through creative product evaluation derived from recycled materials. Results indicate steady and meaningful improvement; particularly as instructional constraints were relaxed and student autonomy increased.

Table 4. Creative Product Evaluation Across Cycles

Cycle	Mean Product Score (%)	Interpretive Category	Instructional Condition
I	67	Moderate	In-class, limited time
II	75	High	Optimized observation
III	83	High	Extended

Cycle	Mean Product Score (%)	Interpretive Category	Instructional Condition
		(Extended)	autonomy

Source: Processed Primary Data

Table 4 depicts a steady and meaningful progression in the quality of students’ creative products across the three instructional cycles, highlighting the close relationship between instructional conditions and the expression of creativity in economic learning tasks. In the first cycle, the mean product score reached 67 percent, corresponding to a moderate interpretive category. This outcome reflects the constraints of an in-class learning environment with limited time, where students’ creative efforts were primarily shaped by restricted resources and compressed production opportunities. Under these conditions, creative expression tended to be functional rather than exploratory, with students focusing on task completion instead of conceptual refinement. A substantial improvement is evident in the second cycle, where the mean product score increased to 75 percent and entered the high category. This advancement coincided with the optimization of observational activities and more efficient use of instructional time, allowing students greater opportunity to translate conceptual understanding into tangible creative outputs. The improved scores at this stage suggest that even modest adjustments in instructional design—particularly those that reduce cognitive and temporal overload—can significantly enhance the quality of student-generated products.

In the third cycle, the mean product score rose further to 83 percent, remaining within the high category but now characterized as extended. This level of performance reflects the impact of increased learner autonomy, as students were granted greater flexibility to work beyond the confines of the classroom and to independently source materials for their creative products. The resulting improvement underscores the importance of contextual and structural support in enabling creativity, indicating that students’ creative potential was

most fully realized when instructional design moved beyond procedural guidance toward empowerment and self-directed exploration. Collectively, the findings in Table 4 demonstrate that creativity in economic education is not merely an individual attribute but an outcome that is profoundly shaped by pedagogical and environmental affordances.

Discussion

The findings of this study provide robust empirical support for the argument that scientific learning operates not merely as a procedural instructional approach but as a developmental pedagogical mechanism that reshapes how creativity and academic achievement emerge within economic education (Darling-Hammond et al., 2020; Ellerton & Kelly, 2022). Anchored in the context of the Economic Education Program at Universitas Lampung, the results respond directly to the study’s central objective: to elucidate how structured inquiry and reflective learning cycles contribute to deeper conceptual understanding and creative engagement among prospective economics teachers (Chew & Cerbin, 2021; Anderson, 2023). Taken together, the evidence suggests that pedagogical transformation is cumulative, mechanism-driven, and contingent upon sustained instructional refinement rather than immediate or linear intervention effects (Krichevsky, 2023; Darling-Hammond et al., 2020).

The progressive improvement in instructional implementation quality across cycles offers a critical starting point for interpretation. The transition from moderate to very high fidelity in enacting scientific learning underscores the centrality of teacher learning and pedagogical adaptation in inquiry-based environments (Soysal, 2021; Anderson, 2023). Consistent with sociocultural and constructivist perspectives, effective inquiry pedagogy does not emerge instantaneously but develops through iterative alignment between pedagogical intention, classroom enactment, and reflective recalibration (Löfgren, 2023). The sharp increase observed between the first and second cycles reflects what prior research has identified

as a threshold phase, during which instructors move beyond procedural compliance toward epistemically grounded facilitation of inquiry (Chew & Cerbin, 2021; Köpeczi-Bócz, 2025). By the third cycle, the stabilization of instructional quality at a very high level suggests pedagogical maturation, where instructional competence becomes internally coherent and less dependent on surface-level adjustments (Darling-Hammond et al., 2020). This finding aligns with contemporary research emphasizing that inquiry-based teaching quality improves through reflective practice and instructional sensemaking rather than through prescriptive training alone (Anderson, 2023; Krichevsky, 2023).

The evolution of student creativity further substantiates the argument that creativity in economic education is not an innate or spontaneous trait but a pedagogically mediated outcome (Ellerton & Kelly, 2022; Shen, 2023). In the initial cycle, student creativity remained constrained by reproductive learning habits, characterized by recall-oriented questioning and limited idea elaboration. Such patterns are widely documented in economics and social science education, where prior schooling often privileges convergent answers and procedural correctness over epistemic exploration (Chew & Cerbin, 2021; Kozharinov et al., 2020). The subsequent increase in creative engagement during the second cycle reflects the enabling role of inquiry structures in lowering psychological and cognitive barriers to participation (Ismailov, 2021; Xiang et al., 2024). However, the uneven quality of creative contributions at this stage highlights an important theoretical point: increased participation does not automatically translate into deeper creativity (Shen, 2023; Syafiqah & Panduwinata, 2025). Creativity requires not only opportunity but also sustained scaffolding, feedback, and disciplinary grounding (Ellerton & Kelly, 2022; Pinar et al., 2025).

The consolidation of creativity observed in the third cycle marks a qualitatively distinct phase. Here, creative behaviors became more consistent, conceptually integrated, and aligned with economic reasoning (Pinar et al., 2025;

Xiang et al., 2024). This pattern resonates with threshold concept theory and contemporary creativity research, which suggest that learners often experience a non-linear transition from surface experimentation to disciplined creativity once foundational epistemic norms are internalized (Shen, 2023). The diminishing marginal gains between the second and third cycles should therefore be interpreted not as reduced effectiveness but as evidence of stabilization, where creativity becomes embedded in students' habitual ways of thinking and articulating economic ideas (Nieminen et al., 2025). For teacher education, this finding is particularly significant, as it suggests that prospective teachers must first experience creativity as a sustained learning practice before they can plausibly cultivate it in their future classrooms (Krichevsky, 2023; Anderson, 2023).

Academic achievement outcomes reinforce and complement these interpretations. The steady increase in completion rates, mean scores, and minimum scores across cycles indicates that scientific learning supported not only higher overall achievement but also greater equity in learning outcomes (Darling-Hammond et al., 2020). The upward movement of the minimum score is especially noteworthy, as it suggests that inquiry-based pedagogy disproportionately benefits students who initially struggle with conceptual understanding (Chew & Cerbin, 2021). This aligns with research in learning sciences demonstrating that structured inquiry and collaborative reasoning can reduce achievement gaps by making thinking processes visible and negotiable (Soysal, 2021; Nieminen et al., 2025). Importantly, the pattern of gains—larger in earlier cycles and more incremental later—mirrors the maturation trajectory observed in instructional quality and creativity, reinforcing the interpretation that learning gains are cumulative and process-driven rather than episodic (Darling-Hammond et al., 2020).

The inclusion of creative product assessment adds a critical layer to the discussion by addressing a well-documented limitation of objective testing (Ellerton & Kelly, 2022). The steady improvement in creative product quality

across cycles demonstrates that creativity manifests most fully when instructional constraints are progressively relaxed and learner autonomy is expanded (Shen, 2023; Nieminen et al., 2025). In the first cycle, limited time and resources constrained students' creative expression, resulting in functional rather than exploratory outputs. As instructional design evolved to optimize observation and reduce cognitive overload in the second cycle, students were better able to translate conceptual understanding into tangible products (Köpeczi-Bócz, 2025). The third cycle, characterized by extended autonomy and learning beyond the classroom, yielded the highest level of creative performance, underscoring the role of environmental affordances in enabling creativity (Ismailov, 2021; Xiang et al., 2024). This finding aligns with ecological and sociocultural theories of creativity, which emphasize that creative outcomes emerge from interactions between individuals, tasks, and contexts rather than from individual ability alone (Shen, 2023; Ellerton & Kelly, 2022).

From a theoretical standpoint, these findings contribute to the literature on economic education pedagogy by repositioning scientific learning as a mechanism of epistemic transformation rather than a checklist of instructional steps (Chew & Cerbin, 2021; Kopnina et al., 2024). The study extends prior research by demonstrating how inquiry-based pedagogy simultaneously supports creativity and academic achievement through iterative cycles of planning, enactment, observation, and reflection (Darling-Hammond et al., 2020; Pinar et al., 2025). Unlike studies that report isolated outcome gains, this research elucidates the pedagogical processes through which such gains are produced, thereby addressing a critical gap in the literature (Nieminen et al., 2025).

Practically, the findings carry important implications for teacher education programs, particularly in Global South contexts (Anderson, 2023). Preparing future economics teachers requires more than exposing them to innovative methods; it requires immersing them in learning environments where creativity, inquiry, and conceptual rigor are experienced as integrated

and sustained practices (Krichevsky, 2023; Löfgren, 2023). The evidence presented here suggests that when scientific learning is implemented with reflective intentionality, it can function as a powerful pedagogical framework for developing both disciplinary understanding and creative agency (Darling-Hammond et al., 2020; Ellerton & Kelly, 2022). In sum, this study demonstrates that scientific learning shapes student creativity and academic achievement through cumulative pedagogical refinement, epistemic scaffolding, and contextual enablement. By foregrounding process, reflexivity, and equity, the findings advance both theoretical understanding and practical design of learning environments in economic education, offering a compelling response to the challenges articulated in the study's initial problem formulation (Kopnina et al., 2024; Anderson, 2023).

From Procedural Adoption to Epistemic Transformation

The findings of this study illuminate a critical yet underexplored dimension of scientific learning in economic education: its function as a reflective pedagogical mechanism that reshapes epistemic practices rather than merely improving observable outcomes (Darling-Hammond et al., 2020; Ellerton & Kelly, 2022). The progressive enhancement in instructional implementation quality across cycles should not be read as technical mastery alone, but as evidence of pedagogical sensemaking in action (Chew & Cerbin, 2021; Anderson, 2023). The sharp transition from moderate to very high fidelity between the first and second cycles reflects a shift from procedural compliance toward epistemically informed orchestration of inquiry, where scaffolding, dialogic interaction, and reflective mediation became mutually reinforcing (Soysal, 2021; Löfgren, 2023). By the third cycle, the stabilization of instructional quality signals pedagogical maturation, suggesting that scientific learning had become an internally coherent teaching logic rather than an externally imposed method (Darling-Hammond et al., 2020). This trajectory resonates with contemporary scholarship

emphasizing that inquiry-oriented pedagogy emerges through iterative reflection and adaptive expertise, not through linear training effects (Anderson, 2023; Krichevsky, 2023).

Crucially, the evolution of student creativity mirrors this instructional transformation (Ellerton & Kelly, 2022; Shen, 2023). Early patterns of recall-dominated questioning and surface elaboration are consistent with reproductive learning cultures frequently documented in economics education, particularly in teacher preparation contexts (Chew & Cerbin, 2021; Kozharinov et al., 2020). The subsequent expansion of creative engagement in the second cycle demonstrates that structured inquiry can activate epistemic agency (Ismailov, 2021; Xiang et al., 2024); however, the uneven quality of contributions underscores that creativity cannot be instantaneously engineered (Shen, 2023). The consolidation observed in the third cycle marks a qualitative inflection point, where creativity became conceptually grounded and discipline-sensitive (Pinar et al., 2025). This threshold-like progression aligns with recent theories of disciplinary creativity, which posit that creative reasoning stabilizes only after learners internalize the epistemic norms of the field (Ellerton & Kelly, 2022; Shen, 2023).

The parallel gains in academic achievement further strengthen this interpretation (Darling-Hammond et al., 2020). Improvements were not limited to mean scores but were accompanied by a systematic elevation of minimum performance levels, indicating that scientific learning supported more equitable conceptual mastery (Chew & Cerbin, 2021). This pattern challenges critiques that inquiry-based approaches privilege high-achieving students, instead suggesting that reflective inquiry can function as an inclusive pedagogical architecture when carefully scaffolded (Soysal, 2021; Nieminen et al., 2025). The creative product assessment adds a decisive layer of evidence, revealing how learner autonomy and environmental affordances critically condition creative knowledge production—an insight often absent from outcome-centric studies (Ismailov, 2021; Xiang et al., 2024).

Taken together, these findings address a key research gap by explicating how scientific learning operates processually within economic teacher education (Krichevsky, 2023; Kopnina et al., 2024). By situating this analysis in a Global South context, the study moves beyond universalistic claims and demonstrates that pedagogical transformation is contingent, developmental, and deeply relational (Anderson, 2023). In doing so, it reframes scientific learning as a catalyst for epistemic transformation—where creativity, achievement, and pedagogical competence co-evolve through sustained reflective practice (Darling-Hammond et al., 2020; Nieminen et al., 2025).

CONCLUSION

Drawing directly from the research purpose, formulated concerns, and empirical findings, this study concludes that scientific learning, when enacted as a reflective and iterative pedagogical mechanism, fundamentally reshapes how creativity and academic achievement are constituted within economic teacher education. The findings demonstrate that improvements in student creativity and learning mastery did not emerge as isolated or immediate instructional effects, but as cumulative outcomes of pedagogical maturation, sustained inquiry scaffolding, and reflective recalibration across learning cycles. Scientific learning functioned not merely as a set of procedural steps but as an epistemic architecture that progressively shifted students away from reproductive learning habits toward conceptually grounded, discipline-sensitive reasoning. This transformation was evident in the consolidation of creative engagement, the stabilization of high-quality instructional enactment, and the simultaneous enhancement of academic achievement and equity in learning outcomes. Importantly, the study shows that creativity in economic education is neither incidental nor innate, but a pedagogically mediated capacity that flourishes under conditions of structured inquiry, iterative feedback, and increasing learner autonomy. By situating this analysis within a teacher education

program in the Global South, the research advances a context-sensitive contribution to the literature, addressing a critical gap in understanding how scientific learning operates processually rather than instrumentally in higher education. Theoretically, the study reframes scientific learning as a catalyst for epistemic transformation in economic education, extending inquiry-based pedagogy beyond outcome-oriented claims toward a mechanism-based explanation of learning change. Practically, it offers evidence-informed guidance for designing learning environments that prepare future economics teachers to integrate creativity, conceptual rigor, and reflective practice as inseparable dimensions of professional competence.

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