

Reforming Primary Moral and Civic Education through Student Agency and the Spirit of Scientists

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Abstract: Focusing on primary education, this paper reports a curriculum reform that integrates the “scientist spirit” into inquiry-based learning while safeguarding both value-oriented education and student agency. The reform translates core value elements (truth-seeking, creativity, collaboration, responsibility) into observable learning behaviours and anchors them in a co-regulatory formative assessment mechanism that aligns disciplinary understanding, epistemic reasoning, and value construction. A five-phase learning cycle, which includes problem framing, evidence building, dialogic argumentation, public communication, and reflective transfer, is implemented through dialogic pedagogy and collaborative routines. Assessment is evidence-centred and closes the loop among teacher scaffolding, peer review, and self-regulation. The proposal responds to the evidence debate surrounding inquiry versus direct instruction by advocating “structured inquiry with strategic explicit teaching,” and offers an operational, reusable, and scalable model for value education in primary schools with potential transfer to interdisciplinary thematic learning and school-based professional development.

Keywords: Primary moral and civic education; Spirit of scientists; Value-oriented education; Student agency; Design-based research

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1. Introduction

Primary schooling is a critical period for the emergence of scientific interest and epistemic habits, as well as for the formation of values, responsibility, and socio-emotional capabilities. When value education is reduced to sermon-like indoctrination, students may “know the words but not own the values”; conversely, when classrooms prioritise engagement without evidence-based reasoning and concept building, learning risks becoming superficial. Recent work increasingly highlights that values can be embedded into everyday classroom routines through co-regulation in assessment, peer interaction, and task structures, rather than being appended as post-

lesson moral conclusions^[1]. Meanwhile, evidence syntheses on inquiry learning suggest that inquiry is not the opposite of direct instruction; effectiveness depends on appropriate scaffolding, attention to prior knowledge, and timely explicit explanations at critical junctures^[2]. Therefore, primary curriculum reform needs a coherent architecture and assessment mechanism that can operationalise value goals, cognitive goals, and methodological goals simultaneously.

The target curriculum in this reform is primary science (and the science strand within integrated practice or interdisciplinary thematic learning). The “scientist spirit” serves as a value spine, yet it is not treated as biographical storytelling; instead, scientific work practices—evidence, argumentation, collaboration, and social responsibility are transformed into learnable pathways and assessable evidence. The design pursues three integrated aims: (1) strengthening evidence-based explanation and argumentation to cultivate critical thinking in scientific contexts^[3]; (2) enhancing student agency through goal setting, strategic decision-making, and reflective regulation^[4,5]; and (3) embedding value orientation into the triad of task–interaction–assessment to reduce the burden of “add-on moral education” while improving transferability and scalability^[6,7].

2. Conceptual framework and design principles

2.1. Situated and process-oriented value education

The main challenge in primary value education is not vocabulary, but how values are understood in situations, experienced through action, and internalised via reflection. Empirical research on value transmission in primary schools shows that values emerge through multiple channels—classroom interaction, school ethos, and daily practices—where discussion, modelling, and opportunities for action play decisive roles^[6]. Accordingly, this reform decomposes the “scientist spirit” into operational classroom dimensions: for example, truth-seeking is evidenced by the quality and completeness of an evidence chain; collaboration is evidenced by division of labour and mutual verification; responsibility is evidenced by articulating boundary conditions and societal implications. These dimensions are built into task requirements and rubrics so that values function as part of learning quality rather than slogans.

2.2. Student agency: From participation to agentic regulation

Student agency is not merely “more talking and doing,” but taking responsibility for goal-monitor-adjust cycles. Research on learner agency in primary settings indicates that when students engage in goal setting, implementation, and reflection within projects or action research, their engagement and strategic learning become more sustainable and transferable^[8]. Formative assessment research further suggests that involving students in criteria co-construction, self-assessment, and peer assessment strengthens self-regulation and co-regulation^[5,9,10]. Therefore, this reform specifies student agency as evidence in three categories: goal evidence (self-articulated goals and negotiated targets), process evidence (records of observation, trials, dialogue, and revision), and reflection evidence (explanations of failure, improvement strategies, and value judgements).

2.3. Effectiveness of inquiry: Scaffolding, evidence, and strategic explicit teaching

Inquiry in primary classrooms is often misconstrued as “students discover everything by themselves.” Evidence-based syntheses argue that inquiry tends to support conceptual learning and transfer when it is scaffolded and complemented with explicit instruction at appropriate moments^[2]. Thus, this reform adopts “structured inquiry”: operational scaffolds and recording templates are provided for problem framing and evidence

building; argumentation sentence stems, and counterexample prompts support dialogic reasoning; and the consolidation phase includes explicit conceptual articulation and boundary conditions to prevent “doing without understanding.” Dialogic pedagogy is used to organise collective reasoning around evidence chains, fostering critical thinking in the scientific register^[3,11].

3. The reform design: A five-phase learning cycle and classroom routines

3.1. The five-phase learning cycle

- (1) Problem framing: Introduce a child-relevant yet socially meaningful phenomenon (e.g., “Why do plants grow differently across places?” “How can we design a more effective water-saving device?”). The problem must be observable, evidence-collectable, open to multiple explanations, and able to invite responsibility talk.
- (2) Evidence building: Groups generate testable hypotheses, design simple procedures, and record data. The teacher provides minimal safety and methodological scaffolds and foregrounds evidence quality.
- (3) Dialogic argumentation: Whole-class and cross-group dialogue interrogates whether evidence supports claims, whether alternative explanations exist, and where evidence chains are incomplete. Here, truth-seeking, constructive scepticism, and collaboration are enacted as classroom norms^[11].
- (4) Public communication: Students produce posters, mini-talks, or “letters of advice to the community,” explicitly stating boundary conditions and potential impacts so that responsibility becomes a communicative requirement^[6,7].
- (5) Reflective transfer: Students complete learning logs: the most decisive evidence, how/why they changed their mind, whether conclusions hold under changed conditions, and which elements of the scientific spirit were practised.

3.2. Dialogic pedagogy and collaborative structures

Dialogue is not unstructured chat; it is disciplined interaction around evidence and reasoning. Research suggests that dialogic professional development strengthens teachers’ capacity to facilitate high-quality classroom talk and that peer co-coaching can sustain pedagogical change^[11,12]. Accordingly, this reform incorporates an evidence-informed professional learning routine: classroom video is used for co-planning and debriefing focused on questioning sequences, uptake moves, and the quality of students’ argumentation rather than atmosphere alone.

3.3. Formative assessment as a co-regulatory engine

Formative assessment is not frequent testing, but continuous evidence-informed decision-making. From a co-regulation perspective, teachers, students, and peers jointly clarify goals, generate evidence, interpret it, and decide next steps^[1,13]. In practice, first, an evidence rubric (e.g., sufficiency of evidence, coherence of explanations, counterexample handling, collaborative contribution, and responsibility statements) is developed, with early-term instruction to help students understand rubric language^[10]. Second, “peer verification cards” require each group to pose at least one evidence-based challenge question and one improvement suggestion to another group, preventing superficial praise^[5]. Third, “strategic explicit teaching points” are reserved: when dialogue reveals systematic misconceptions, the teacher provides short explicit explanations and returns to evidence for re-application, enabling a teach-use-re-evidence loop that supports conceptual depth^[2].

4. Implementation pathways and quality assurance

4.1. Teacher support via design-based professional learning

Sustained implementation depends on teachers' capacity to iteratively refine tasks and assessments in real classrooms. Design-based research frames professional development as a cycle of co-design, enactment, evidence-based revision, and re-enactment, enabling simultaneous teacher learning and curriculum improvement^[12]. This reform recommends a semester-long cycle: two weeks of co-planning and pilot runs; weeks 3-12 for at least three inquiry projects; and an end-of-term school-based review using student artefacts, dialogue excerpts, and assessment evidence to package reusable project kits and rubric templates^[10,14].

4.2. Addressing diversity: Balancing structure and autonomy

Overly open inquiry can amplify disparities; overly rigid structure can suppress agency. Evidence suggests autonomy support and structure are complementary: when structure clarifies goals, provides attainable pathways, and preserves meaningful choice, student motivation and outcomes improve^[9]. Hence, this reform design “choice within structure”: shared problem frames and evidence standards, but student choice in materials, procedures, and genres of expression; shared assessment dimensions, but diverse evidence formats for demonstrating growth.

4.3. Scalability: Interdisciplinary themes and whole-school value systems

The design is scalable in three ways. First, it transfers to interdisciplinary thematic learning (e.g., science + labour education + digital technology) using evidence-dialogue-responsibility communication as a common grammar^[15,16]. Second, it can be embedded into whole-school moral education by shifting value goals from event-based activities to routine classroom practices^[6]. Third, it supports regional teaching research networks by sharing project kits, classroom dialogue clips, and evidence portfolios to reduce individual innovation costs and strengthen sustainability^[11,12].

5. Conclusion

The reform does not simply add activities; it re-centres formative assessment as a co-regulatory engine that translates the spirit of scientists into everyday indicators of learning quality. Three contributions are emphasised: (1) Value orientation is moved upstream into evidence and argumentation processes, making values observable and learnable; (2) Student agency is elevated from “participation” to agentic regulation through goal-evidence-reflection routines; and (3) The inquiry-direct instruction debate is addressed through evidence-informed hybridisation with strategic explicit teaching and dialogic scaffolds to secure conceptual depth. Future work should examine robustness across grade levels and school ecologies and explore extensions to learning analytics (e.g., annotating classroom dialogue and evidencing learning trajectories), while maintaining the non-negotiables of traceable evidence, interpretable assessment, and practicable values.

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