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Methods For Developing Ecological Education Grounded In The Heritage Of Eastern Scholars And National Values

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Abstract: This article proposes and examines a methodology for developing school-level ecological education that draws substantively on the intellectual heritage of Eastern scholars and on living national values. While global frameworks for Education for Sustainable Development (ESD) emphasize competencies such as systems thinking, future thinking, and values-based decision making, their classroom realization often lacks culturally resonant anchors. To address this gap, we articulate a heritage-integrated model that translates core ideas from scholars such as Al-Farabi, Ibn Sina (Avicenna), Al-Biruni, Al-Khwarizmi, and Alisher Navoi into didactic strategies aligned with contemporary ESD outcomes. The model combines value-culturological and ethnopedagogical approaches with project-based learning, inquiry, and service-learning in community settings. A mixed-methods pilot with lower-secondary students tested a 12-week program embedded across technology, literature, and geography lessons. Quantitative measures included a curriculum-aligned knowledge test, an environmental attitudes scale, and a self-reported pro-environmental behavior index; qualitative sources comprised classroom observations, artifact rubrics, and student reflection journals. Results indicated statistically and educationally significant gains in knowledge and dispositions, with qualitative evidence of identity-mediated internalization of ecological norms. We discuss how heritage-based framing strengthened meaning, elevated ethical dimensions, and facilitated cross-disciplinary transfer, while also noting cautions against romanticization or essentialism. The paper concludes with implications for teacher professional

development, assessment design, and scaling within national curricula.

Keywords: Ecological education; Education for Sustainable Development; Eastern scholars; national values; ethnopedagogy; project-based learning; value-culturological approach; identity and learning.

Introduction: The ecological crisis is not solely a technical failure but also a cultural and ethical challenge. Education systems increasingly seek to cultivate ecological competence in ways that integrate knowledge, values, and behavior. Within the ESD movement, the emphasis on competencies—systems thinking, anticipatory and normative competence, collaboration, and action—offers a robust structure. Yet classrooms frequently struggle to render these capacities meaningful for learners whose identities are formed within particular historical and cultural traditions. When sustainability is framed only through generic scientific content or globalized slogans, students may perceive ecological practices as external obligations rather than internal commitments grounded in inherited wisdom.

Eastern intellectual traditions offer a rich archive for addressing this disjunction. The polymathic naturalism of Al-Biruni, the ethical anthropology of Ibn Sina and Nasir al-Din Tusi, Al-Farabi's reflections on the virtuous city and the common good, and Al-Khwarizmi's mathematical and observational rationality provide lenses for understanding nature, measure, moderation, and responsibility. Literary voices such as Alisher Navoi extend these themes into vernacular moral imagination, where stewardship, humility, and balance are cultivated through language and story. When these resources are translated into classroom methods—not as static quotations but as living epistemic and ethical tools—they can help students internalize ecological norms as part of who they are.

The present study develops and examines a methodology that operationalizes Eastern heritage and national values for ecological education in lower-secondary schools. We define national values pragmatically as the enduring moral-civic orientations enacted by families, communities (e.g., mahalla), and cultural institutions, including respect for elders, reciprocity, moderation, and care for shared resources. Our central research question is twofold: How can the heritage of Eastern scholars be pedagogically mobilized to form ecological competence without reducing cultural resources to decorative references? And what learning gains and forms of internalization emerge when such a model is enacted across disciplines?

The contribution of this article is threefold. First, it synthesizes a value-culturological and ethnopedagogical framework with ESD competencies, thereby offering a coherent rationale for heritage-integrated ecological education. Second, it designs a set of classroom methods—heritage-framed inquiry, project- and service-learning, culturally anchored reflection, and assessment rubrics—that translate that rationale into teachable practice. Third, it reports mixed-methods evidence from a 12-week pilot in which students engaged with local environmental issues through the conceptual lenses of Eastern scholars and the ethical language of national values. The findings illuminate how culturally resonant framing supports cognitive, affective, and behavioral dimensions of ecological competence.

We employed a convergent mixed-methods design to both measure change in ecological competence and interpret the processes underlying that change. The study was implemented with two parallel classes of lower-secondary students (grades 7–8; ages 13–15) in urban schools with comparable demographics. One class (n = 58) received the heritage-integrated ecological education program (intervention), while a second class (n = 56) continued with the existing curriculum (comparison). Parental consent and school approvals were obtained, and all procedures adhered to ethical guidelines for research with minors.

The intervention consisted of a 12-week cross-disciplinary sequence embedded in technology, literature, and geography lessons. It was co-designed with teachers in a two-day workshop that introduced the theoretical underpinnings: (a) value-culturological framing that situates sustainability concepts within the moral vocabulary of national values; (b) heritage mapping that aligns thematic ideas from Eastern scholars to curricular topics; and (c) activity structures—heritage-framed inquiry, project-based learning, and service-learning—through which students enact those ideas collaboratively. Teachers received lesson outlines, primary-source excerpts (translated or paraphrased in age-appropriate language), and assessment rubrics aligned to cognitive, affective, and behavioral indicators.

In technology lessons, for example, students investigated water and energy efficiency using measurement practices inspired by Al-Khwarizmi's orientation to quantification and verification. In geography, they conducted field observations following Al-Biruni's empirical ethos, documenting soil and water conditions around the school and neighborhood. Literature classes explored excerpts from Alisher Navoi

to elicit ethical reflection on care, moderation, and collective well-being, connecting literary themes to practical stewardship in school life. A service-learning component involved partnerships with local community councils to clean and redesign shared green spaces using native plants and low-water landscaping.

Quantitative instruments comprised a 30-item knowledge test aligned with national standards and intervention content; a 20-item environmental attitudes scale (five-point Likert) capturing normative commitments and perceived responsibility; and a 10-item self-report index of pro-environmental behaviors relevant to school and home (e.g., water conservation, waste sorting, care for shared spaces). Pre- and post-tests were administered to both classes in weeks 1 and 12. Reliability coefficients (Cronbach's alpha) were acceptable for all scales (≥ .78). We analyzed differences using independent-samples and paired-samples t-tests, reporting effect sizes (Cohen's d).

Qualitative data included structured classroom observations (two per subject per class), student reflection journals (weekly prompts linking heritage concepts to lived experience), and evaluation of project artifacts using a rubric calibrated to ESD competencies and to identity-anchored indicators such as value articulation and ethical reasoning. Thematic analysis followed an iterative coding process, with triangulation across data sources and member checks with teachers to validate interpretations. Fidelity of implementation was monitored via teacher logs and an external observer protocol; adherence to core components exceeded 85% across weeks.

The comparison class continued with standard lessons addressing environmental topics primarily through textbook exposition and short practical tasks, without heritage framing or service-learning. Both classes shared school-wide assemblies on general environmental awareness to minimize confounds arising from institutional initiatives.

The intervention class exhibited significant gains across all quantitative measures. Knowledge test scores rose from a pretest mean of 15.6/30 (SD = 4.1) to a posttest mean of 23.4/30 (SD = 3.8), representing a within-group improvement of 7.8 points ($t(57) = 15.21$, $p < .001$; $d = 1.99$). The comparison class showed a smaller increase, from 15.9/30 (SD = 4.0) to 19.1/30 (SD = 4.2), a gain of 3.2 points ($t(55) = 7.18$, $p < .001$; $d = 0.96$). An independent-samples t-test on gain scores indicated a significant advantage for the intervention ($t(112) = 9.07$, $p < .001$; $d = 1.70$). Environmental attitudes improved in the intervention class by an average of 0.63 standard deviations ($t(57) = 8.44$, $p < .001$), with particularly strong movement on items referencing shared responsibility and moderation; the comparison class improved by 0.21 SD ($t(55) = 2.77$, $p = .007$). Self-reported pro-environmental behaviors rose by 0.58 SD in the intervention ($t(57) = 6.91$, $p < .001$) versus 0.19 SD in the comparison ($t(55) = 2.33$, $p = .023$). These findings indicate that the heritage-integrated program not only strengthened knowledge acquisition but also supported dispositional and behavioral dimensions central to ecological competence.

Qualitative analyses illuminate the mechanisms behind these gains. Observations revealed that heritage framing functioned as a semantic and ethical scaffold that deepened students' sense-making. When measuring water flow rates in technology lessons, students invoked Al-Khwarizmi's insistence on clarity in procedures to justify repeated trials and unit conversions, transforming measurement from a rote exercise into an epistemic practice with moral overtones of honesty and precision. In geography fieldwork, the invocation of Al-Biruni's patient observation tempered the impulse to rush to conclusions, leading students to document anomalies—such as unexpected salinity in a runoff channel—and design follow-up tests. Literature-based reflections around Navoi facilitated articulation of values without moralizing, allowing students to connect themes of moderation and generosity to the mundane ethics of maintaining a shared school garden, picking up litter, and watering at cooler hours to reduce evaporation.

Student journals suggest that identity-anchored reflection enabled the internalization of ecological norms. Many entries reframed behaviors like turning off unused taps as expressions of respect and reciprocity learned in family life, not merely school rules. One recurring motif was the alignment between the communal ethic of the mahalla and stewardship of common resources, which students analogized to the "virtuous city" ideal associated with Al-Farabi. This translation of ecological responsibility into an already meaningful moral vocabulary appears to have supported durability and transfer; students reported reminding siblings at home about sorting waste "so our street stays beautiful," positioning action within both aesthetic and ethical registers.

Project artifacts further demonstrate integrative learning. In the school garden redesign, students combined native drought-resistant species with water-capture features measured and sited through basic trigonometry and flow calculations, creating a small but coherent system with signage quoting heritage sources in accessible paraphrase. Rubric scores showed competence growth across domains: systems reasoning, evidence use, collaborative planning, and

value articulation. Teachers reported that the heritage lens legitimized cross-disciplinary connections; technology teachers felt more comfortable discussing ethical considerations, and literature teachers found concrete entry points for discussing action.

At the same time, the study surfaced important boundaries. A small subset of students initially resisted heritage references, perceiving them as extraneous to "modern science." This resistance diminished when teachers presented the scholars not as authorities to be obeyed but as historical companions in inquiry whose methods and questions remain relevant. Another boundary concerns the risk of essentialism—portraying a singular, timeless "Eastern" perspective. We addressed this by foregrounding plural voices, acknowledging debates among scholars, and inviting students to compare heritage ideas with contemporary scientific consensus. A further challenge was assessment alignment; conventional tests did not fully capture identity-mediated learning. The addition of reflective prompts and rubric dimensions oriented toward value reasoning improved validity, but further refinement is warranted.

The results align with theoretical expectations from ESD literature that values-rich, identity-meaningful learning environments promote deeper internalization and transfer. The heritage-integrated approach contributed a culturally resonant path to such environments. By situating measurement, observation, and ethical reflection within recognizable cultural narratives, the program helped students construe ecological action as both rational and virtuous. This dual anchoring appears to underwrite the observed gains in attitudes and behaviors, not just knowledge.

Implications extend to curriculum and teacher education. Curriculum designers can embed "heritage windows" within existing units—short, well-scaffolded encounters with primary texts or paraphrased ideas that illuminate the epistemic virtues at stake in environmental inquiry. Teacher professional development should include strategies for dialogic engagement with heritage, avoiding hagiography and emphasizing critical interpretation, contextualization, and application. Partnerships with community institutions can create authentic arenas for service-learning where national values are actively practiced, reinforcing school-based learning through public, intergenerational collaboration.

Finally, scalability requires attention to material conditions. The school garden project succeeded partly because it leveraged low-cost, locally available resources and because teachers coordinated schedules to sustain continuity across subjects. Where such coordination is difficult, smaller-scale heritage-framed inquiries embedded within single subjects can still provide meaningful gains, provided that reflection connects classroom acts with learners' wider moral worlds.

This study developed and piloted a methodology for ecological education that mobilizes the intellectual heritage of Eastern scholars alongside living national values. The approach integrates value-culturological and ethnopedagogical perspectives with ESD-aligned practices—heritage-framed inquiry, project- and service-learning, and culturally anchored reflection—implemented across technology, literature, and geography. Quantitative results showed substantial gains in knowledge, attitudes, and self-reported behaviors compared to a standard curriculum, while qualitative evidence indicated identity-mediated internalization of ecological norms and enhanced cross-disciplinary meaning making.

The model's strength lies in treating heritage as a set of epistemic and ethical resources rather than decorative quotations, enabling students to see sustainability as consonant with who they are and wish to become. Limitations include potential essentialism, initial student skepticism, and assessment challenges for capturing value-laden learning. Future work should explore longer-term behavioral outcomes, teacher learning trajectories, and adaptations for diverse regional contexts. By aligning scientific inquiry with culturally resonant narratives of virtue, moderation, and communal responsibility, heritage-integrated ecological education offers a promising pathway for cultivating the competencies and commitments needed for sustainable futures.

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