# EXPANDING ENVIRONMENTAL LITERACY THROUGH APPLIED OBSERVATIONS IN URBAN ECOLOGY

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## ABSTRACT

This case study examines an urban ecology seminar developed within a Master of Landscape Architecture program, drawing upon five years of course implementation and student reflections. Initially created to expand ecological literacy in design education, the course has been incrementally updated in response to landscape architecture's recent designation as a STEM discipline, and growing urgency around climate action. It aims to support students - particularly those without prior training in environmental science - in building critical observational skills, expanding systems thinking, and cultivating capacity for regenerative design.

The seminar is framed around field-based, place-specific inquiry, structured around eight ecological modules, including six core modules focusing on landscape ecology, climate, soils, hydrology, vegetation, and wildlife. Through these modules, students engage in weekly site visits, evaluate landscape performance metrics, and synthesize findings into an Urban Ecology Field Guide that includes site analysis, reflections, and regenerative design strategies.

Using thematic analysis of 56 student reflections gathered over five years, the study identifies six consistent learning outcomes which include enhanced observation, ecological literacy, interdisciplinary synthesis, systems thinking, professional transformation, and environmental stewardship. The results highlight the value of cumulative, experiential learning, applied to design thinking through both scientific understanding and lived experience.

The study offers a potentially replicable pedagogical framework that bridges technical competencies with critical and creative thinking. In the greater context, it reaffirms the role of landscape architecture as a vital discipline for addressing climate resilience and urban ecological challenges through site-responsive, inquiry-driven design.

## Keywords

Environmental Literacy, STEM, Experiential Learning, Pedagogy, Urban Ecology

# 1 INTRODUCTION

In 2023, Landscape Architecture was formally recognized as a STEM discipline in the United States (ASLA, 2023). This designation highlights the profession's growing need and responsibility to address climate and other environmental challenges through systems-based thinking and science-informed design. Prior to this, LAAB Accreditation Standards (2016 & 2021) were updated, calling for stronger integration of environmental literacy, performance-based metrics, and sustainable design across landscape architecture curricula. Additionally, this shift is echoed in the ASLA Climate Action Plan (ASLA, 2022), which emphasizes the need for educational knowledge and experience that prepares designers for meaningful action on climate resilience and urban ecological health.

While this call for greater rigor and action in the profession is widely agreed upon, many students entering Master of Landscape Architecture (MLA) programs lack prior education or experience in environmental science, natural resources, horticulture, or agriculture. This critical gap presents a challenge for educators. How can we help students build ecological understanding and systems thinking skills without turning them into scientists? Can students learn to approach today's challenges with scientific rigor without compromising the creativity and cultural depth that can be fostered through design education?

This case study shares insights from an urban ecology seminar developed and taught at the University of New Mexico. Designed to meet both recently updated accreditation standards and evolving student learning needs, the course uses field-based inquiry, interdisciplinary tools, and place-based assignments to expand students' capacity for ecological literacy. Rather than simply delivering technical content, the course aims to enhance students' ability to observe, question, and interpret landscape systems - supporting them as they learn to bridge scientific knowledge with site-responsive, regenerative design strategies. While many lessons focus on environmental challenges and opportunities of the arid southwest, course lectures, discussions, and case studies also examine regional differences across the United States and around the world.

## 1.1 STEM & Landscape Architecture Education

STEM is best understood as an inquiry-driven approach that links science, technology, engineering, and math through curiosity-led, real-world problem solving and interdisciplinary teamwork (Glancy & Moore, 2013; Leung, 2020; Li et al., 2019; Mohr-Schroeder, 2015; Hubinsky, 2022). Design-Based Science (DBS) adapts the same logic to studio work - students test scientific ideas through collaborative, project-based assignments - essentially the landscape architecture studio in practice (Mohr-Schroeder, 2015). While some studios may integrate lessons and projects to build more advanced scientific skills, a working grasp of STEM concepts is now crucial for reading ecological systems, measuring performance, and guiding implementation across the discipline (ASLA, 2023; Hubinsky, 2022).

Landscape architecture has always blended scientific rigor with humanistic and cultural insight. However, its 2023 reclassification as a STEM field has triggered debate about safeguarding that STEM–HASS balance (Grose & Frisby, 2023; Hubinsky et al., 2022). The concern is amplified by students' preparation levels. In a survey of all graduates who took the urban ecology course featured in this study, only 25 % had any environmental-science coursework and just 10 % had prior field experience - figures that echo national ASLA graduating-student trends (Lewis & Clark, 2013–2023). This gap in skills raises questions about new professionals' readiness to interpret ecological data and make evidence-based design decisions.

## 1.2 Ecological Thinking Through Place-Based Learning

Urban ecology reveals how people, place, and ecosystem processes intersect in cities and other designed settings (Carlisle & Pevzner, 2018). Yet, despite mounting climate pressures and LAAB's call for stronger ecological competencies, most MLA curricula weave ecology unevenly through stand-alone courses, paired studio–seminar formats, or scattered modules, leaving many graduates with only a cursory grasp (Mendenhall 2023). Tools such as the Landscape Performance Series expand what can be measured, but we know little about how students learn to translate those measures into design decisions.

This gap persists even as collaborations between landscape architects and ecologists grow. Some firms now provide their own ecological training (Mendenhall 2023), underscoring the tension between STEM-driven analysis and the aesthetic, cultural, and intuitive sides of design (DeKay, 1996; Güeç Özer &

Turan, 2015; Xi & Wang, 2022). However, few studies compare teaching models or document gains in ecological literacy, echoing broader calls for evidence-based landscape education (Brown & Corry, 2011).

To address the growing need for more scientific and ecological rigor, this case study introduces a stand-alone urban ecology seminar grounded in place-based, experiential learning. Drawing on the instructor's two decades in ecological restoration and planning, the course favors immersive fieldwork, direct sensory observation, and iterative reflection over abstract theory. Each student selects a familiar urban landscape - often a neighborhood or daily route - and explores it through on-site measurements, spatial pattern mapping, and critical questioning of the systems that shape urban ecologies. The course structure follows Kolb's Experiential Learning Cycle (Kolb, 1984), which offers a foundational model for experience-driven learning in four iterative phases:

1. **Concrete Experience** – Weekly fieldwork immerses students in a site of personal significance.
2. **Reflective Observation** – Discussion posts and class dialogue support reflection on what they saw, heard, felt, and questioned.
3. **Abstract Conceptualization** – Lectures and readings introduce ecological concepts, systems frameworks, and case studies.
4. **Active Experimentation** – Students apply insights to regenerative design strategies and a cumulative Urban Ecology Field Guide.

This approach evolved from a teaching philosophy that frames ecological learning as both an intellectual and ethical journey. In *Ecological Literacy: Education and the Transition to a Postmodern World*, Orr (1992) emphasizes that ecological literacy must emerge from direct engagement with place and an understanding of environmental responsibility. From this perspective, students do not simply study the landscape, rather, they are in a direct physical relationship with the land, cultivating awareness through care and critical inquiry.

This approach echoes Schön's (1983) concept of the reflective practitioner, where students develop understanding by engaging directly with design problems and reflecting as they go. Cognitively, this process strengthens professional judgment, allowing students to synthesize ecological understanding with informed design thinking in complex, real-world settings.

Together, these approaches foster a way of learning that's grounded in the body, rooted in relationship, and attuned to systems, core capacities for landscape architects working to meet the ecological and social challenges of our time. Comparable experiential approaches are also found in environmental education and architectural design-build studios. For example, Ballantyne and Packer (2009) emphasize the role of immersive, place-based learning in developing environmental responsibility, while Salama (2015) describes how project-based design education fosters applied problem-solving and systems thinking in architecture. Both models center direct engagement with context, iterative reflection, and interdisciplinary inquiry – paralleling the pedagogical goals of the urban ecology seminar presented here.

## 1.3 Research Objectives

Over the past five years, the urban ecology seminar has served as a testing ground for integrating ecological thinking into a landscape architecture curriculum. This case study aims to document the evolution of the course and evaluate the outcomes, while reflecting on how a STEM-integrated, inquiry-driven learning can enhance environmental literacy, observational capacity, and regenerative design thinking. To evaluate the effectiveness of this pedagogical approach, the study draws upon a thematic analysis of student reflections, extracted from the final assignment, to determine how experiential learning aligns with the seminar's stated learning outcomes and broader professional competencies.

The hypothesis guiding this inquiry is that students engaging in field-based ecological observation within familiar urban landscapes will lead to measurable gains in environmental literacy. This is evaluated by observing their increased ability to translate ecological knowledge into context-sensitive design strategies.

Beyond evaluating course outcomes, this study aims to also offer a replicable framework for integrating ecological science, place-based learning, and landscape performance assessment into design education - advancing a pedagogy that is experiential, cumulative, and responsive to today's environmental challenges.

## 2 METHODS

This research paper uses a pedagogical case study methodology to examine the development, implementation, and refinement of a graduate-level urban ecology course over a five-year timeframe. Within this specific context, the methodology is particularly well-suited in exploring educational innovation, allowing for deep engagement with curriculum design, student experience, and iterative change (Merriam, 2009; Yin, 2018).

### 2.1 Course Context & Structure

Integrated into a standard 16-week semester, the Urban Ecology seminar is a core course within the MLA program at the University of New Mexico. The seminar is open to graduate and undergraduate students enrolled in community and regional planning, architecture, and historic preservation. Initially offered in Fall 2019, the course curriculum draws upon the instructor's two decades of professional experience in ecological restoration, environmental monitoring, and landscape planning. After this first iteration, it was restructured to integrate a more dynamic format and adapt to remote learning challenges during the pandemic. Since 2020, there have only been incremental refinements in response to student feedback, observed learning outcomes, STEM integration, and aligning modules for optimal seasonal conditions.

Structured around eight interrelated modules that run for two weeks, each module is designed to build a holistic understanding of ecology in, of, and for the city, and are sequenced to move from foundational systems thinking to more focused ecological processes.

Each module includes four primary components:

1. a lecture to introduce key concepts and readings,
2. a student-driven discussion of the readings and relevant topics,
3. a place-based experiential field exercise, and
4. a structured assignment that prompts synthesis and application of observations.

The first module emphasizes and evaluates students' baseline awareness and centers on human–environment interactions, using walking transects and introductory observation techniques to ground students in place-based learning. Building upon this, Modules Two through Seven explore six core ecological topics: landscape ecology, climate and microclimate, geology and soils, hydrology, vegetation, and wildlife communities (Figure 1).

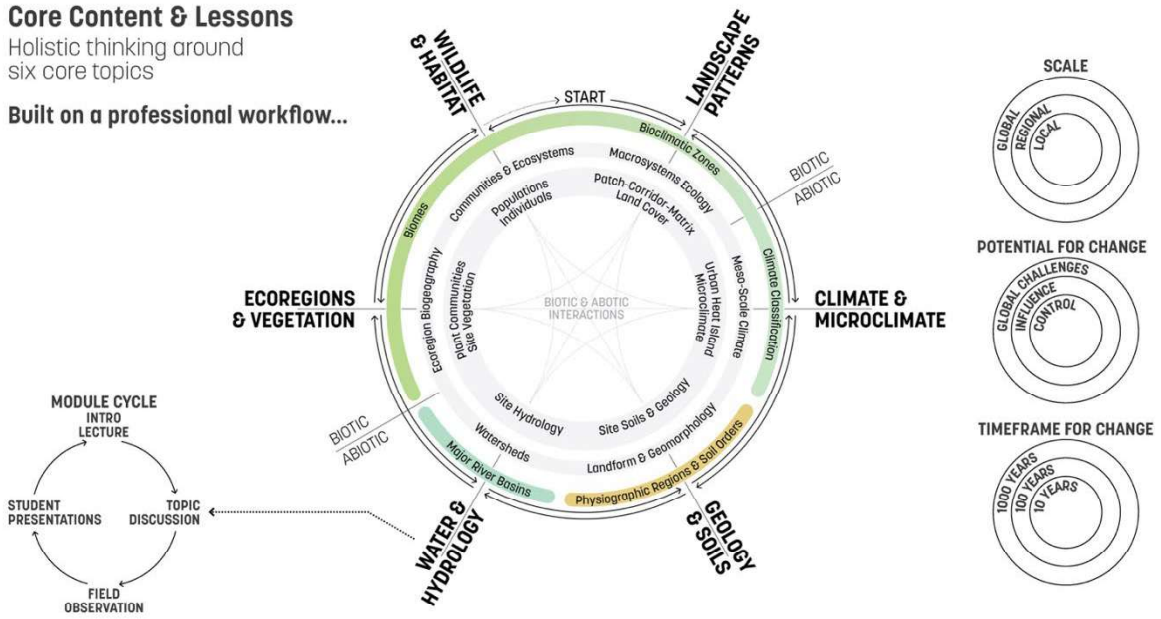


**Figure 1. Holistic thinking around six core modules and key concepts. Diagram by the author.**

Each module introduces key spatial and temporal concepts, classification hierarchies, and ecological dynamics specific to urban environments. Students are encouraged to investigate both ecological patterns and underlying processes, to develop an understanding of how site-level observations reflect broader systems. The course concludes with a synthesis module that supports reflection and the creation of a cumulative Urban Ecology Field Guide.

## 2.2 Assignments & Pedagogical Innovations

Each module in the course is structured around a three-part learning framework designed to help students make meaningful connections between ecological theory, observed site conditions, and design thinking.

Assignments guide students through the following process (module examples in Table 1 below):

1. **Identify** a contemporary urban ecological challenge and justify why action is needed
2. **Observe & Define** relevant metrics or indicators to assess site-specific conditions
3. **Integrate** regenerative design strategies, while situating the issue within broader ecological systems and interrelated module topics.

To support the assignment process, students are required to engage in weekly discussions - either by responding to assigned readings, asking critical questions, or sharing related articles and media. For each module, students apply the concepts to an urban landscape of their choice, typically a familiar or personally relevant place. Through the fieldwork, students document any site-specific challenges they encounter, analyze patterns they see in the landscape, and suggest context-sensitive interventions.

**Table 1. Core module topics and high-level student tasks.**

| Core Module | Identify | Observe & Define | Integrate |
|---|---|---|---|
| **Landscape Ecology** | Disruptions to ecosystem processes, services, and species movement due to fragmentation | Walking transects and mapping exercise to note patch, matrix, corridor conditions, edge effects | Identify ways to facilitate connectivity in the study area and minimize edge effects |
| **Climate & Microclimate** | Factors that influence thermal comfort and how land use/cover impacts urban microclimate | Measure surface temps and microclimate variations due to changes in land cover and material | Propose ways to mitigate the urban heat island effect through design interventions |
| **Geology & Soils** | Geomorphological influence on soil and common challenges with urban soils | Identify soil texture, quantify infiltration, and observe impacts of soil health on vegetation | Propose ways to amend/improve challenging urban soils to improve soil health |
| **Hydrology** | How urbanization and impervious surfaces negatively impact water quality and flooding | Note historical drainage patterns and relate to flood-prone areas today; define design storm | Propose ways to slow, spread, and soak rainwater into the landscape (and quantify) |
| **Vegetation** | Ecoregion characteristics; native vs. non-native vegetation and impacts on ecosystem services | Identify vegetation, plant communities, and benefits; iTree canopy survey and calculations | Propose ways to regionally appropriate and climate-ready plant species; note benefits |
| **Wildlife** | What is habitat; benefits & ecosystem services; urban exploiters, adapters, and avoiders | Wildlife commonly observed; trophic levels; ecosystem services | Propose ways to enhance urban wildlife habitat and note benefits |

This iterative structure reflects many similarities with Kolb's experiential learning cycle (1984), which integrates through hands-on experience, reflection, concept development, and testing ideas through action. Each module walks students through this sequence by integrating direct engagement with the landscape, guided reflection, ecological analysis, and design application (Figure 2). Select assignments are presented in class during the final session of each module, creating opportunities for dialogue, peer learning, and feedback before final submission.

Course assignments have been refined over the past five years to improve content, delivery, workload pacing, and accessibility of resources. Modifications have included streamlining lecture content, expanding bi-weekly online discussion prompts, and strengthening the scientific rigor of fieldwork methods. In recognition of the diverse academic backgrounds of students, assignment prompts now offer tiered options for beginner, intermediate, and advanced skill levels - ensuring that all students are both challenged and supported in developing new competencies.

Connecting the threads of thought from the module and assignment lessons, students compile an Urban Ecology Field Guide, which serves as both a reflective portfolio and a practical resource in their academic and professional careers. The final Field Guide deliverable includes:

- A 300-400 word reflective statement summarizing the student's learning experience
- Synthesized documentation of module observations and findings
- Five regenerative design principles developed from their site work
- A precedent case study of a high-performing urban ecological project
- A reference section containing readings, tools, and field methods used throughout the semester

The Field Guide allows students to consolidate their learning, while also producing a reference document they can carry forward into future studios, internships, and professional practice.

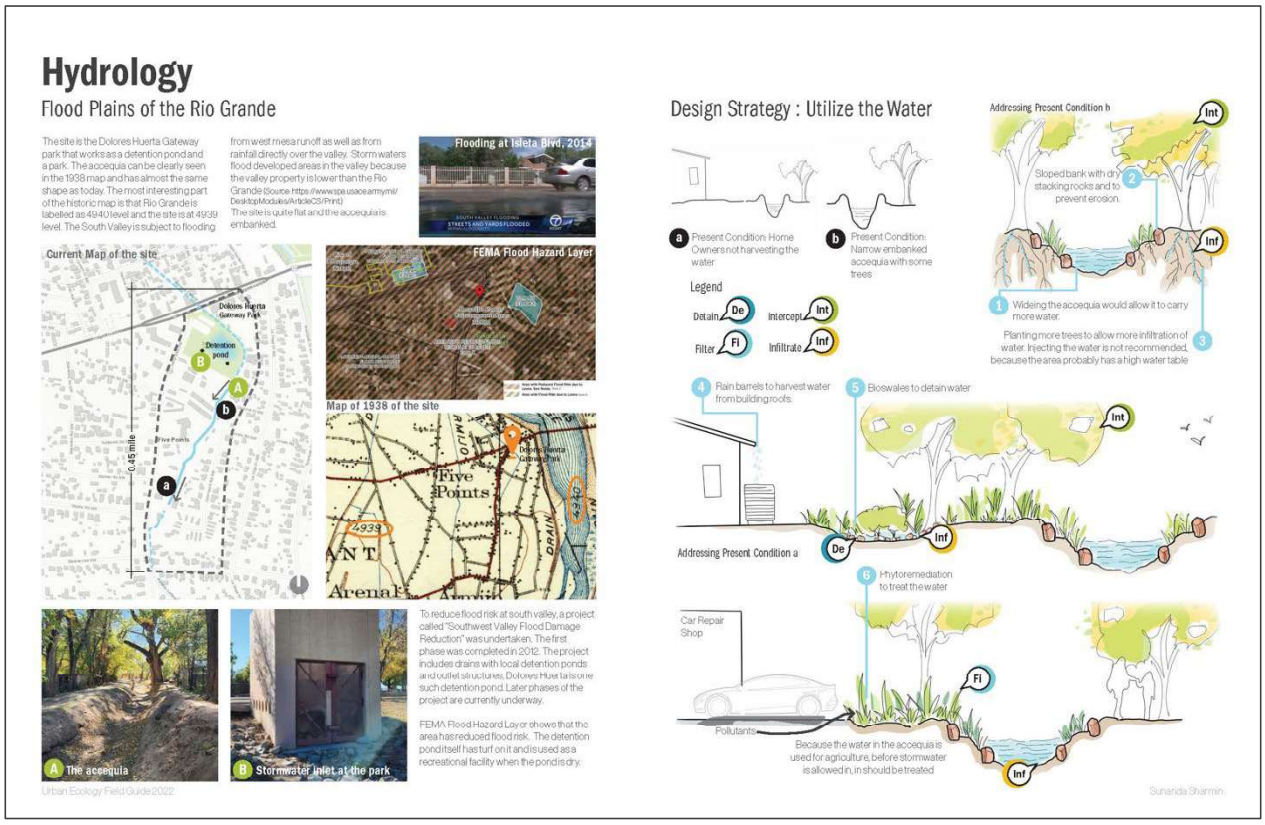


**Figure 2. Student work studying the Rio Grande floodplain and potential design strategies. Diagram by the author.**

## 2.3 Data Sources & Methodology

To understand the seminar's impact this study draws on three main sources of qualitative data: student reflection statements, the instructors teaching journal, and course materials. Collectively this offers a layered perspective on student learning, teaching effectiveness, and how the curriculum has evolved.

Since Fall 2020, the instructor has maintained a bi-weekly teaching journal to support ongoing reflexive analysis. From a dual perspective of instructor and researcher, the journal captures nuanced observations of student engagement, instructional effectiveness, content clarity, and classroom dynamics as the course progressed. Entries include challenges encountered as the course was being taught, immediate student feedback, moments of insight, and content identified for improvement. As part of an iterative process, recurring themes informed refinements to the course content, structure, and assignments.

Students' final reflection statements, integrated into their final Urban Ecology Field Guide deliverable, have proven to be insightful in assessing course learning outcomes. These reflections were part of the final Urban Ecology Field Guide and were written in response to prompts asking students to describe their learning process, key takeaways from field-based assignments, and how the experience shifted their understanding of urban landscapes and ecological systems.

To evaluate topics and trends, a thematic analysis was conducted on 56 final reflection statements submitted between 2020 and 2024. All reflection statements were compiled into a composite document to facilitate analysis and maintain student anonymity. Each entry included machine-readable metadata (year, student code, degree program) followed by the reflection text and a standardized block delimiter. This formatting supported consistent processing during computational analysis.

The thematic analysis followed Clarke and Braun's (2013) six-phase framework using an inductive, semantic (explicit) coding approach:

1. Data familiarization
2. Initial code generation
3. Theme identification
4. Theme review and refinement
5. Theme naming and definition
6. Final reporting and synthesis

To support and streamline the coding process, a large language model (LLM), ChatGPT-4, was used to assist with organizing and analyzing text-based data in a consistent manner. LLMs are an advanced artificial intelligence (AI) tool trained to recognized patterns in language that can be given structured prompts to carry out tasks. The prompt for this analysis was refined through multiple iterations to ensure that the model focused exclusively on the provided content and did not rely on model memory or prior knowledge, drawing conclusions exclusively from the uploaded composite document.

Key components of the prompt included:

- Contextual overview of course goals and learning objectives
- Explicit methodological instructions based on Clarke & Braun's (2013) framework
- Anonymized input formatting (e.g., year, student code, text)
- Required semantic-only coding (no inferred or latent analysis)
- Stepwise analysis with confirmation pauses at each phase to verify accuracy

The analysis was conducted independently on three separate systems using identical prompts to test replicability. Results were compared across runs for inter-rater consistency and were verified through manual review and quality control measures.

To reveal more nuanced insights, a quantitative frequency analysis was also performed to evaluate the relative prevalence of each emergent theme. Additional comparative analysis was conducted across academic year and degree program to identify potential patterns in student learning based on disciplinary background or cohort context.

All student data was anonymized, and reflections were used in accordance with institutional guidance for pedagogical research. The use of LLM-supported analysis was transparently documented, with additional

validation measures taken to ensure ethical, accurate, and replicable results. This method reflects a growing emphasis in the field on evidence-based landscape architecture, where design decisions - and pedagogical strategies - are supported by data and evaluated for effectiveness (Brown & Corry, 2011).

## 3 RESULTS

The thematic analysis of the student reflections, collected from final Urban Ecology Field Guide submissions between 2020 and 2024, revealed six emergent themes (Table 2). The identified themes align with the stated learning objectives of the course and were supported by observations noted in the instructor's journal.

Reflections were coded semantically in the LLM using an inductive approach, with thematic categories generated from the students' explicit language. Representative quotes provide important insights regarding how students internalized course content, developed new ways of seeing, and applied ecological thinking in real-world contexts.

**Table 2. Emergent themes, definitions, and example quotes.**

| Emergent Theme | Definition | Example Quote |
|---|---|---|
| Enhanced Observation and Place-Based Awareness | Students explicitly emphasize newfound skills in close observation of their immediate surroundings, noticing site-specific details and subtle environmental patterns they had previously overlooked. | "Taking time to slow down and observe my surroundings helped me notice details I'd overlooked before… I've gained a deep appreciation for my surroundings that I wouldn't have developed without this experience." (MLA Student, 2024) |
| Environmental Literacy and Ecological Concepts | Students often cite learning explicit scientific or environmental terms (e.g., "urban heat island," "hydrology," "soil composition") and show an understanding of how these concepts apply to real-world conditions. | "My understanding of Urban Ecology was limited... I feel that the relationality of all these ecological processes was made abundantly clear in an intuitive, visual way." (Planning Student, 2024) |
| Interdisciplinary STEM Integration | Reflections explicitly reference how diverse fields—landscape architecture, planning, architecture, soil science, hydrology—come together in urban ecology, highlighting the need for cross-disciplinary approaches. | "As a landscape architecture student, I've learned that designing outdoor spaces isn't just about making things look nice… it's about understanding the environmental challenges a site faces." (MLA Student 2024) |
| Connection to Broader Ecological Systems | Many reflections highlight a recognition of how local sites tie into regional ecosystems, focusing on water flow, wildlife corridors, and larger environmental networks. | "Prior to learning about matrixes, corridors, and mosaics, I wouldn't have understood how much an urban neighborhood can stifle or enhance the mobility and survival of species contained in it or passing through (Planning Student 2022) |
| Personal and Professional Transformation | Students frequently mention shifting mindsets, personal growth, or a sense of empowerment for future professional work, referencing how these explicit insights changed their design or planning perspective. | "Throughout my analysis I shifted from perceiving the area as neglected to valuing its unique ecological potential." (MLA Student 2022) |
| Social Responsibility and Stewardship | Explicit references to taking responsibility for the urban environment, improving environmental health, and acknowledging the social context and equity factors in design/planning. | "My greatest fear for the North Valley—further urbanization—may be inevitable… This expertly constructed course provided me a look into the data and knowledge needed… to start thinking about possible solutions." (Historic Preservation Student 2024) |

## 3.1 Quantitative Summary of Theme Frequency

A frequency analysis (Table 3) was conducted to assess the relative prevalence of each theme across the 56 reflections. Each reflection was coded for the presence of strong, moderate, or no reference to the six themes. A strong reference indicates the theme was explicitly central to the student's reflection; a moderate reference indicates it was mentioned or implied but not a focus.

**Table 3. Theme Reference Frequency by Strength**

| Theme | Strong Reference (%) | Moderate Reference (%) | No Reference (%) |
|---|---|---|---|
| Enhanced Observation and Place-Based Awareness | 68% | 25% | 7% |
| Environmental Literacy and Ecological Concepts | 73% | 24% | 6% |
| Interdisciplinary STEM Integration | 54% | 32% | 14% |
| Connection to Broader Ecological Systems | 63% | 29% | 8% |
| Personal and Professional Transformation | 61% | 35% | 4% |
| Social Responsibility and Stewardship | 44% | 41% | 15% |

Total Sample Size: n=56,
Standard Deviations – Strong Reference ~10.3, Moderate Reference ~7.2, and No Reference ~4.5

These results suggest that environmental literacy and place-based observation were the most strongly referenced themes, with over two-thirds of students demonstrating a clear grasp of ecological concepts and applied field awareness. Themes of personal transformation and systems thinking were also prevalent. Social responsibility, while frequently mentioned, appeared with less emphasis in some student responses.

## 3.2 Examples of Student Learning Outcomes

Beyond thematic frequencies, the results reveal a range of specific learning outcomes that illustrate how students integrated course content into their own thinking and practice. Across the reflection statements, students noted a shift in how they perceive urban environments, greater confidence in how they interpret ecological patterns, and a deeper sense of professional purpose.

Examples from the final Urban Ecology Field Guides highlight a range of student learning outcomes, from conceptual thinking to practical skill development. Many students articulated regenerative design principles grounded in their fieldwork, such as: "Design for cohabitation - create space for both humans and urban wildlife" and "Recognize impermanence - adapt design strategies to evolving ecological conditions." Others demonstrated systems-thinking awareness, noting, for example: "Water doesn't stop at property lines. I had to think across boundaries - city infrastructure, community patterns, natural flow." Reflections also pointed to clear skill-based learning, including improved classification of soils and vegetation using field guides, the application of urban heat island mapping in their own neighborhoods, and the identification of wildlife pathways within fragmented urban environments. Overall, these outcomes reflect the course's emphasis on cultivating ecological insight, observation, and responsive design, and reflect the goal of not only building ecological literacy but also sparking curiosity, deepening place-based awareness, and supporting the development of site-responsive, regenerative design thinking.

# 4 DISCUSSION

The results of this study demonstrate that the Urban Ecology Seminar effectively supports ecological literacy, systems thinking, and place-based observational skills within a design education context. Insights gained from the student reflections aligned with instructor observations to provide clear evidence that the course fosters a deeper understanding of ecological processes and how they relate to urban form and function.

The most referenced theme - Environmental Literacy and Ecological Concepts - confirms the course's success in building students' fluency with scientific terms and concepts through direct application. Similarly, the high frequency of Enhanced Observation and Place-Based Awareness suggests that students developed new ways of seeing the built environment, aligning with Boehnert's (2021) call for embodied ecological knowledge. These outcomes affirm the course's alignment with Kolb's experiential learning model and support calls for more applied, interdisciplinary STEM education in design (Mohr-Schroeder, 2015; Li et al., 2019).

One particularly interesting finding was that Personal and Professional Transformation appeared most strongly in the 2020 cohort, despite the course being fully online during the pandemic. This suggests that the course structure - centered on self-directed fieldwork and reflection - can support meaningful learning even without a physical classroom. The transformation theme was especially pronounced among planning and preservation students, indicating its interdisciplinary resonance.

While Social Responsibility and Stewardship were less frequently emphasized, it remained present in most reflections. This may indicate that students first internalize ecological insight before fully connecting it to broader civic or ethical dimensions. Future iterations could address this by more explicitly integrating environmental justice and decolonial perspectives.

From a pedagogical perspective, the course benefited from a mix of quantitative and qualitative approaches to evaluating urban landscapes, flexible assignments that supported diverse skill levels, and an iterative structure that was responsive to student feedback. Although the depth of content occasionally presented challenges, students consistently valued the seminar's depth and relevance.

Key takeaways include:

- Allowing students to choose familiar sites increases engagement and observational depth
- Scaffolded assignments accommodate diverse disciplinary backgrounds
- Structured reflection deepens learning and supports long-term integration
- Field-based, cumulative approaches support systems thinking and ecological awareness
- Instructor flexibility facilitates iterative improvements

The alignment of observed outcomes with course objectives supports a broader call for evidence-based strategies in both design and design education (Brown & Corry, 2011). Embedding structured reflection and learning assessment into the curriculum helps educators not only document success but also iteratively improve pedagogy in response to real-world challenges.

Overall, this case study offers a tested and potentially replicable model for integrating STEM competencies into design education while valuing students' personal experiences and diverse perspectives. It demonstrates how environmental literacy, critical observation, and regenerative design thinking can be woven together in meaningful ways that support both professional readiness and transformative learning.

## 5 CONCLUSION

This case study demonstrates the value of integrating place-based, observation pedagogy into landscape architecture education to strengthen ecological literacy, systems thinking, and regenerative design awareness. Through field-based assignments, reflective synthesis, and interdisciplinary framing, the Urban Ecology seminar offers a replicable model for how MLA programs can meet evolving accreditation standards, respond to the profession's STEM designation, and prepare students for the challenges we face today and into the future.

Analysis of student reflections, both individually and through the thematic analysis, confirms that this approach cultivates both technical understanding and a deeper relational awareness of landscape. It is important to note that the seminar is not trying to make scientists out of designers. Moreover, it aims to cultivate designers who can ask intelligent and impactful questions, observe more deeply, and translate ecological insight into site-specific design strategies. The course also affirms the importance of honoring multiple ways of knowing - analytical, intuitive, embodied - which supports not only STEM integration, but the broader decolonization of design education (Agyeman et al., 2003; Tuck & Yang, 2012).

Furthermore, the pedagogical model presented here contributes to a growing body of scholarship advocating for experiential and systems-based learning in landscape architecture and allied design fields. It provides a tested structure for weaving scientific knowledge with creativity, agency, and personal reflection - qualities essential to addressing the complex challenges of 21st-century cities.

As this research continues, more inquiry is needed to understand how this model could be adapted across institutions and regions. Research will continue to explore pre/post environmental literacy assessments of students, longitudinal tracking of student outcomes, and comparative studies across disciplines. Nonetheless, as landscape architecture education continues to evolve, this case study offers a grounded, flexible framework for empowering the next generation of ecologically literate and socially responsive designers.

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