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Beth Sweeney
University of Oregon

Ann Scheerer
University of Oregon

Vicki Elmer
University of Oregon

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by: Beth Sweeney
Student Affairs Officer, Oregon Leadership in Sustainability Program
Planning, Public Policy and Management
University of Oregon
1209 University of Oregon
Eugene, OR 97403-1209
(541) 346-8227
esweene3@uoregon.edu

Ann Scheerer
Adjunct Instructor, Oregon Leadership in Sustainability Program
Planning, Public Policy and Management
University of Oregon
1209 University of Oregon
Eugene, OR 97403-1209
(541) 346-8979
scheerer@uoregon.edu

Vicki Elmer, PhD (*Corresponding Author*)
Program Director, Oregon Leadership in Sustainability Program
Planning, Public Policy and Management
University of Oregon
1209 University of Oregon
Eugene, OR 97403-1209
(541) 346-8227
velmer@uoregon.edu

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Beth Sweeney
Ann Scheerer
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University of Oregon

ABSTRACT

This paper describes a pilot graduate sustainable transportation course developed at the University of Oregon to provide hands-on project experience for students studying sustainability. New approaches to sustainability and transportation pedagogies will provide a galvanizing force for tomorrow's graduates, who must respond to concerns about climate change and the environment, social equity, and an uncertain economy. They will require an aptitude for both technical skills and collaborative leadership and communication skills.

The course was guided by a framework founded in five themes from the literature on sustainability education and transportation planning and engineering education: (1) leading with sustainability's cornerstones of people, prosperity and planet, (2) sponsoring a systems thinking approach to analyze transportation issues and potential solutions, (3) incorporating knowledge from interdisciplinary resources, (4) promoting "softer" skills including communication and leadership, and (5) emphasizing applied learning. The themes aim to overcome institutional barriers and to better prepare students for the rapidly evolving challenges they will encounter in the sustainability and transportation fields.

Although the purpose of the project was to develop a framework and institutionalize a sustainable transportation class at the graduate level, the student projects had unforeseen impacts upon the community in furthering innovative technologies and policies. Ultimately, the class was featured in the local progressive weekly newspaper as starting a "sustainable transit revolution." This paper documents the process, the projects, and puts the experience in the context of literature on the framework themes and sustainability and transportation education.

FRAMING TRANSPORTATION PLANNING PEDAGOGY FOR SUSTAINABILITY GENERALISTS

INTRODUCTION

Global climate change poses an unprecedented challenge to the field of transportation. Business as usual will not satisfy the need to significantly reduce greenhouse gas emissions in the United States, nor will it address the complex goal of making our cities and residents more able to adapt to the consequences of a warmer planet. This challenge requires not just resilient behaviors, policies and programs within existing transportation agencies, but a new paradigm that is interdisciplinary, interagency and holistic in its approach. This radical change must be reflected in the educational practices that are being used to people the organizations of the future.

As awareness of climate change, equity concerns and sustainable business and government practices mount, new approaches to sustainability and transportation pedagogy will provide a galvanizing force for tomorrow's graduates. The literature addresses these trends with a call for curriculum adaptations that promote a breed of transportation professionals, versed in sustainability, with technical skills and a broad systems perspective along with responsive and collaborative leadership and communication. Forward-thinking universities are beginning to educate their students in the new paradigm; however, the majority of these courses are aimed at planners and engineers, leaving a void in the field that could be filled by the emerging array of sustainability generalists who are well suited to bridge disciplinary gaps and build collaborative responses to pressing transportation problems.

With this in mind, the University of Oregon's Oregon Leadership in Sustainability (OLIS) Program set out to develop and test a framework that would steer process and curriculum for a graduate-level Sustainable Transportation class geared toward sustainability generalists. Students trained in a range of sustainability theories and practices along with collaborative approaches and systems thinking shape the program's definition of "sustainability generalists." Many of these graduates will soon become change agents guiding the policies and practices that influence future transportation planning in roles such as local government and transit sustainability management. The course curriculum is focused on enhancing transportation planning and engineering pedagogy in the context of sustainability. The methods are suitable for emerging sustainability generalists and also complement traditional transportation planning and engineering curricula.

This paper describes the five themes culled from national research, the resulting framework, and the methods and recommendations derived from implementing a 10-week course on Sustainable Transportation at University of Oregon.

LITERATURE REVIEW

Five themes emerge from the literature on sustainability and transportation education that are recommended to guide the pedagogy. Research suggests that implementing these themes will help overcome institutional barriers and better prepare students for the challenges they will encounter in the sustainability and transportation fields. OLIS synthesized these themes into a framework that shaped its pilot Sustainable Transportation course. The themes are outlined in Table 1.

TABLE 1 OLIS Sustainable Transportation Framework Themes

Theme	Description
Sustainability Foundation	The sustainability paradigm's triple bottom line emphasizes environment, economy and social equity.
Systems Thinking Approach	Systems thinking provides a frame through which to view system connections and influences.
Interdisciplinary Basis	Interdisciplinary education unites a variety of academic disciplines with the goals of providing a well-rounded education and preventing information "silos."
Collaborative Leadership	Collaborative leadership builds consensus through a more equitable and open approach to decision making.
Applied Learning	Applied learning emphasizes practical experience.

Source: OLIS, University of Oregon, 2013

The following synopsis describes current thinking on institutional barriers to a new pedagogy and further detail on the research that shaped the OLIS framework for sustainable transportation education.

Sustainability Education Research

Academic interest continues to rise in developing new sustainability-oriented programs and encouraging innovative ways to teach them. Educators aim to cultivate a deep and empathetic curiosity in their students that allows them to envision issues from different perspectives, understand and relate to the people affected by those issues, question the values that contribute to global and local systems, and develop solutions that promote a healthy community and planet (*1*).

In July 2013 the Association for the Advancement of Sustainability in Higher Education (AASHE) Academic Programs database contained 1377 sustainability-focused academic programs at 456 campuses in 63 states and provinces in North America (*2*). But along with the burgeoning programs come conflicting theories and practices regarding their delivery. Several barriers have been identified that present a challenge to developing a new sustainability pedagogy: institutional disciplinary silos, locating well-trained educators and classroom settings, and legitimizing sustainability as complementary to

existing programs. It will be critical to overcome these barriers so that a guiding sustainability pedagogy and accompanying skill set can be developed and shared (*3*).

This call necessitates action as the field continues to grow, shaping both new disciplines and the ones from which it sprung. Sustainability serves as a potential guiding paradigm for developing curricula that fulfill environmental education program managers' perceptions of core competencies for their students (*4*). It is also a driving force behind a new generation of transportation professionals (*5*). Opportunities such as University of Oregon's Sustainable City Year Program capitalize on this movement with an approach that promotes multidisciplinary, applied learning-based frameworks and allows students to confront challenging local sustainability issues. Applied study of local and regional transportation systems and issues is a meaningful way to package relevant theories and practices (*6*). This and other innovative teaching methods nurture interdisciplinary, collaborative learning and critical thinking.

Transportation Planning and Engineering Education Research

Climate change considerations, the global relationship between equity and mobility, shifts in the economic base of the United States and the explosion in information technology require and invite a more sustainable paradigm for transportation systems. This new paradigm has evolved over the past twenty years, and is well articulated (*7, 8, 9,* among others) by forward-thinking analysts in research institutions, academic and grassroots organizations.

However, many mainstream practitioners and decision makers in existing transportation institutions are either not versed in these new concepts, or they meet extraordinary resistance within their organizations and communities (*10*). Although cutting-edge researchers, advocates and agencies promote more sustainable alternatives (*11,* among others), transportation decision making in many communities is, for the most part, still silo-based and has a technical orientation eschewing community values, relying instead on level of service standards rooted in the automobile era (*12*).

Academic establishments are also beginning to educate planners and engineers in the new paradigm (*6*). The field's leading thinkers have called for a fresh approach to transportation planning and engineering pedagogy that employs more effective methods and encompasses a broad skill set to better prepare graduates for the transportation system challenges they will encounter.

In addition to the "hard" skills associated with transportation planning and engineering, "softer" skills, including an aptitude for communication and leadership, comprise what a significant number of professionals find they need once in the field. A survey of transportation professionals found that proficiency in public involvement and interpersonal communication were among the skills most readily identified as being important but lacking in the graduate programs attended by the survey participants (*13*). The researchers recommended that future transportation education include the following: communication skills training, enhancing educator-professional connections, resolving tension between teaching theory and practice, critical thinking training for students and educators, recognizing and working within different political contexts, and providing multi-disciplinary connections. Similar findings have highlighted the need to integrate sustainability, ethics and communication in transportation planning pedagogy (*14*).

Researchers emphasize the need to break down silos within the field using an interdisciplinary approach that specifically integrates planning and engineering program administrators' and educators' delivery of land use and transportation education (*15*). The authors cautioned against graduating planners with exclusive knowledge of one specialization, but who lack education in closely-related subfields. Later studies expanded the land use-transportation interdisciplinary connection to recommend that educators convey an even broader sweep of transportation systems' laws, policies and topics (*6*). Bicycle and pedestrian planning and design are being promoted more extensively in many regions; as such, transportation planning programs can better prepare their students by integrating these topics into their curricula (*16*).

Transportation engineers as well as planners will benefit from a collaborative approach toward transportation projects that values and integrates community and environmental considerations. Proficiency in context-sensitive solutions will be critical for new graduates, although the need is not being driven by the transportation engineering job market, which appears to deemphasize this skill set in its hiring (*17*).

A NEW PEDAGOGICAL MODEL FOR SUSTAINABLE TRANSPORTATION

Oregon Leadership in Sustainability Program

The Oregon Leadership in Sustainability (OLIS) program is an intensive one-year, cohort-based graduate certificate program at the University of Oregon designed for students from diverse backgrounds who want to prepare for emerging careers leading sustainability efforts in the public, private, and nonprofit sectors. The program was inspired in part by a speaker at the 2008 Oregon University System (OUS) Sustainability Summit who called for the restructuring of OUS programs in order to foster interdisciplinary thinkers who could be "archineers/engitects" (a combination of the fields of architecture and engineering), civil scientists, and "environomists" (environmentalists and economists) (*18*) who are versed in sustainability.

Housed within the University's Department of Planning, Public Policy and Management and its School of Architecture and Allied Arts, OLIS provides an interdisciplinary learning community with an emphasis on practical experience through applied research projects. In addition to coursework in key sustainability components such as sustainable transportation, energy and climate change, urban ecological design and social justice, students participate in a leadership track that provides them with tools and practice in leadership, communication and effecting change in their organizations and communities. The OLIS model differs from other sustainability graduate certificate programs in that it is a full-time cohort-based program grounded in public policy and planning.

Early in OLIS' inaugural year, the program recognized a need for a broad-based interdisciplinary educational effort in sustainable transportation concepts and skills that targeted generalists training for a career in sustainability. Many prominent transportation programs, including ones that are beginning to educate their students within more sustainable paradigms, gear their courses solely toward those studying transportation engineering and planning. In a 2004-2005 Nationwide Survey of Transportation Planning Courses, planning and engineering students comprised the majority in the classrooms.

Markedly, the study reported that a mere 5% of the 40 classes surveyed included students from other backgrounds (*6*). However, sustainability professionals from educational backgrounds other than transportation planning and engineering may well influence future sustainable transportation systems through policy, advocacy and research.

With financial support from the National Institute for Transportation and Communities, a program of the Oregon Transportation Research and Education Consortium, OLIS researched and developed a sustainable transportation curriculum. The pilot class was offered in Winter Quarter 2013.

OLIS Framework

OLIS created a framework for its sustainable transportation pedagogy that addresses the aforementioned institutional barriers confronting sustainability education: sustainability's interdisciplinary nature, its need for content and methods that are different from established curricula, and the perception of sustainability as an imposition on already established programs and curricula. This framework can serve as a model for interdisciplinary sustainability integration in other University of Oregon departments and as a case study for courses under development in other institutions. The framework guiding the sustainable transportation curriculum is founded in five themes from the literature, based on a national scan of research on sustainability and transportation planning education.

These themes led the program administrators to create a course that (1) was built on sustainability's cornerstones of people, prosperity and planet, (2) sponsored a systems thinking approach to analyze complex transportation problems and potential solutions, (3) incorporated knowledge from interdisciplinary resources, (4) promoted "softer" skills including communication and leadership, and (5) was motivated by applied learning. OLIS strove to create an experience where students could apply theory to local practice and create useful products for the community. The themes' bearing on transportation planning education and institutional barriers are described below in greater detail along with the pedagogical strategies OLIS used to implement the framework in the classroom.

Sustainability Foundation

Transportation choices are one of the main determinants of the sustainability of the urban environment. Legacy transportation system decisions from the industrial era have influenced the urban form of our cities (*19, 20*) and are now considered a major factor contributing to climate change (*21*). Any effort to reform transportation planning and engineering pedagogies must be centered on a paradigm of sustainability to face climate change and population growth and cultivate cities' livability and their inhabitants' quality of life. This theme addresses the barrier of integrating sustainability concepts with existing curriculum.

Pedagogical Strategies:

- Couched the discussion of transportation within the framework of sustainability's 3P's: people (meeting the basic needs of all citizens and improving their

quality of life), prosperity (promoting sound economic development), and planet (doing so in a way that minimizes environmental impact and promotes environmental benefits).

- Cultivated a forward-thinking, nimble and responsive approach to studying current situations, proposed alternatives and cutting-edge innovations.
- Analyzed current best practices in sustainable urban design and transportation, including Smart Growth, complete streets, multimodal transportation, scenario planning and demand management.

Systems Thinking Approach

Transforming transportation from an automobile-centered system to one founded on myriad accessibility and mobility options ultimately requires a paradigm shift to a new system. Systems thinking will help students better work with transportation as it exists today, shape it to meet future needs and recognize the opportunities it presents (*22*). This theme addresses the barriers of disciplinary silos and alternative content.

Pedagogical Strategies:

- Analyzed how prior and current theory, policy, economy and practices created today's transportation systems and their guiding paradigms.
- Studied and suggested alternative paradigms that address health, the environment and economic opportunity through the lens of transportation.
- Reviewed the elements, interconnections and purposes of transportation systems.
- Considered sustainable transportation's role in urban resilience.
- Discussed system diversity via multimodal transportation options.

Interdisciplinary Basis

Transportation is inherently an interdisciplinary field, but one which has historically been reduced to an approach that aims to pave its way out of urban problems (*23*). But the transportation challenges our cities, regions, nation and world face cannot be met with concrete alone. They require new solutions that will be revealed by learning from and with other disciplines. This theme contends with barriers from disciplinary silos and current program integration.

Pedagogical Strategies:

- Examined the confluence of land use and transportation.
- Engaged with economists, advocates and government representatives from public, private and nonprofit agencies to better understand their diverse roles related to transportation.
- Integrated planning, engineering, economics, behavioral science and policy disciplines into curriculum.

Collaborative Leadership and Communication Emphasis

Collaboration renovates historical top-down approaches to generating solutions and instead builds consensus through planning and management processes involving

stakeholders and the public (*24*). Collaborative leadership and communication require skills germane to today's sustainability and transportation fields. This skill set can be summarized through the lens of "Gestaltungskompetenz," which means, among other things, the ability to see the world from different vantage points and involve multiple communities in decision-making processes, to be open-minded, to be able to participate, motivate, plan and implement, and to feel empathy and solidarity (*25*). This theme in the framework attempts to overcome barriers related to sustainability's interdisciplinary nature and its pedagogical content and methods.

Pedagogical Strategies:

- Required prior coursework in leadership and a simultaneous class in effective communication for cohort members.
- Emphasized group projects within course design to facilitate students' experience in working with varied skill sets and encourage open communication, task delegation and shared problem solving.
- Introduced behavior change strategies, which were pursued in greater detail in a subsequent required class in leading sustainable change.
- Required individual student-led classroom facilitation to foster critical understanding of readings and to develop public engagement skills.

Applied Learning Priority

The process of learning is as important as the product (*26*). Applied projects get students out of the classroom and provide an opportunity for meaningful work that offers community benefit. In so doing, students gain respect for process and recognize that they can shape the way in which their work unfolds. This concept is well established in technical fields such as medicine. In transportation planning and engineering education, collaborative methodologies such as active, cooperative and project-based learning have been established as effective techniques that improve outcomes for students both in and outside the classroom (*27, 28, 29*). This theme grapples with barriers related to sustainability's demand for innovative curriculum and delivery.

Pedagogical Strategies:

- Partnered with City of Eugene, Lane Transit District and University of Oregon staff to provide real-world projects that let students apply learned skills and knowledge to municipal and academic transportation scenarios.
- Provided benefits to partner organizations by taking on projects that could not otherwise be pursued due to fiscal or time constraints.

Curriculum Synopsis

The class was co-taught by two adjunct instructors with expertise in urban design and planning, public administration, leadership and transportation. The instructors also facilitated project management for the 20 students' applied learning projects. The students ranged in age from early 20s to mid 40s and came to the program with diverse

backgrounds in fields from engineering to art. Approximately 90 percent were enrolled full time.

The course design offered a combination of instructor lectures, guest lectures from the public, private and nonprofit sectors, and student-led facilitation. The required text was Jeffrey Tumlin's *Sustainable Transportation Planning: Tools for Creating Vibrant, Healthy and Resilient Communities*, which "aims to reunite transportation with its sister fields to fill the largest remaining gap in urban sustainability strategies" (*23*). Coursework included readings, classroom facilitation, take-home quizzes, a transportation-related policy brief and an applied learning project, which comprised 30% of the students' grades. The applied learning projects synthesized the other four framework themes by providing students with an opportunity to put their interdisciplinary understanding of sustainability and systems theory, and their skills in leadership and communication, to the test.

The course introduced a broad range of sustainable transportation and land use planning and design concepts to enable students to understand land use and transportation's sustainability impacts, review current best practices and innovations, recognize analytical tools and performance measures used in local transportation decision making, and examine sustainable transportation case studies, policies and programs. A synopsis of the curriculum is illustrated in Table 2 below.

TABLE 2 OLIS Sustainable Transportation Curriculum

Week	Topic
1	A highly mobile planet and its challenges: automobile dependence, equity and inequity, congestion, urban sprawl, zoning, car culture and property rights
2	Why sustainable transportation is vital to cities: land use and transportation planning, smart growth and the compact city
3	Sustainable transportation strategies: transportation demand management and scenario planning
4	Multi-modal transportation system design: complete streets, context-sensitive solutions, walkable communities, biking safety and design
5	Multi-modal transportation system design (continued): motor vehicles and transit, transit-oriented development
6	Transportation and public health: reforming street design, active transportation, air and water quality concerns
7	Transportation and social sustainability: social and environmental justice, behavior change
8	Transportation funding and economics: strategies, jobs and growth
9	Innovations in sustainable transportation: collaborative consumption models, cutting-edge technologies
10	Case studies of exemplar sustainable transportation systems

Source: OLIS, University of Oregon, 2013 (*30*)

Applied Learning Projects

For the applied learning portion of the class, groups of 3-5 students undertook research projects with the City of Eugene, Lane Transit District, and the University of Oregon's Office of Sustainability, Bike Program and LiveMove Program (an advocacy group focused on issues surrounding livability and active transportation). Each project represented a local sustainable transportation opportunity or challenge that reflected issues being considered in communities around the world: commuting, bike sharing programs, fuel consumption trends, pay-as-you-drive automobile insurance, bicycling economies, and multi-family development parking infrastructure trends (*31*). The synopses below describe the projects and summaries of the findings.

Biking Up, Driving Down: UO 2013 Commuter Survey

The University of Oregon's commuter survey is conducted every three years and results are used to revise the University's Climate Action Plan and determine ways to improve transportation programs and infrastructure. A student team updated and distributed the 2013 Commuter Survey to 40% of the University community, including students, faculty and staff. Results revealed that 28% of respondents drove alone to campus, while 22% biked. The team found that student bike commuting had increased since the last survey in 2009, and 2% fewer staff and faculty members drove alone to campus. Recommendations to reduce the number of staff and faculty single occupancy vehicle commuters included incentives such as providing shower facilities for bike commuters, allocating free one-day parking passes to those who regularly commute using alternative transportation modes, and developing a smart phone mobile application for users to find real-time local bus routes and schedules (*32*).

Expanding Bike Sharing to the City of Eugene

The City of Eugene is pursuing funding for a 10-station, 100-bicycle sharing program to complement University of Oregon's emerging on-campus bike share. A team of graduate students researched bike-sharing models in Chicago, Washington, D.C. and Denver to determine the feasibility of a Eugene-based program. Analyzing installation costs, siting, business models, numbers of bikes and stations, and potential financing sources and program revenue, the group determined which combination would be most appropriate for Eugene. They recommended that the City adopt a city-owned and managed business model, in which the City partners with Lane Transit District to define the boundaries of the bike-sharing stations and integrate the program with public transit (*33*).

Fuel Consumption in Eugene Declines; Vehicle Miles Traveled Stay Consistent

Between 2003 and 2011, the City of Eugene's gasoline and diesel consumption dropped by 15%, while vehicle miles traveled (VMT) remained fairly steady. Over the same time frame, neighboring Springfield saw a 5% reduction and statewide gas and diesel receipts fell by 1%. Armed with Oregon Department of Motor Vehicles (DMV) data on vehicles registered in Eugene, Springfield and Tigard, students attempted to discover how and why the decline occurred. Initial theories ranged from high fuel-efficient and hybrid vehicle adoption rates to gas station closures, diesel emissions reduction efforts and car scrapping programs. To investigate the fuel efficiency theory, the team used fleet age as a

proxy for fuel economy, consolidating and calculating the fleets' age mix by registration year for the three cities. Contrary to what might be expected in a community with declining fuel consumption, the researchers found that the percentage of "middle-aged" cars (11-20 years old) was higher in each respective city in 2011 than in 2003. The trend is logical based on the changes in the economy during the study period, but it does not explain the fuel consumption reduction. The study is a starting point for more detailed fuel economy research, and another step toward piecing together Eugene's puzzle (*34*).

Pay-As-You-Drive Insurance Feasibility for University of Oregon

MetroMile offers a cutting-edge business model that incentivizes reductions in driving by offering pay-as-you-drive (PAYD) insurance, a program developed for people who drive fewer than 10,000 miles per year. PAYD insurance rewards low-mileage drivers with a monthly rate based on calculating the amount a customer drives, as opposed to lump-sum insurance pricing. Students hypothesized that offering PAYD insurance for University of Oregon's staff and faculty may provide motivation to use alternative modes of transportation, including carpooling, and reduce single occupancy vehicle commutes to campus. The insurance team collaborated with the commuter survey group, incorporating survey questions to determine the interest in and feasibility of the University developing a PAYD pilot program. About half of the respondents who drove approximately 8,000 miles or less per year were interested in learning more. Based on the results of their research, the students recommended that the University pursue a pilot program (*35*).

Bikes Mean Business to the Silicon Shire

Students researched the role bicycling commuting and infrastructure play in the Silicon Shire, a Eugene-Springfield association of technology-related businesses. They analyzed whether central Eugene Silicon Shire members considered biking in their everyday operations or when making business decisions regarding location, employment, and storefronts. Students found that an overwhelming majority of businesses supported the local bicycle community. The team also found that 66% of companies surveyed believed a bike share located near their businesses would have a positive impact. Student recommendations for the City of Eugene's transportation planning department included continuing to improve bicycle infrastructure downtown, marketing the City's planned bike sharing to demonstrate the positive impact it has on businesses, and educating businesses on opportunities to integrate biking to work with employee health insurance plans (*36*).

Study of Parking Characteristics in Eugene

Students researched the parking characteristics of multi-family developments throughout Eugene and met with developers to gain their perspectives. The team analyzed the relationship between developments' parking infrastructure and their distance to public transit and considered whether parking maximums could mitigate the impact of future development. Findings from case studies in cities throughout the United States were used to determine best practices for maximum parking limits, and were applied to Eugene's developments and community characteristics. The group recommended that Eugene establish parking maximums along transit corridors to increase public transit ridership and reduce vehicle miles traveled. Recommendations for the City of Eugene's

planning department also included incentivizing car sharing programs and transit near new multi-family developments, better managing infrastructure, and prohibiting surface/above-grade parking (*37*).

PRELIMINARY IMPACTS OF NEW MODEL

Pedagogical Impact

OLIS gathered a series of qualitative responses to the course and its framework to gauge its influence on those involved, including students, educators, the Department and University, and the project clients. Students found that the projects were a strong component of the course and appreciated the real-world application they provided. Educators found the co-teaching arrangement beneficial to the applied learning project and discovered that it created more flexibility for project facilitation and management.

The Department of Planning, Public Policy and Management responded to the course's success by ensuring that Sustainable Transportation is integrated into its ongoing curriculum for OLIS students and others pursuing their graduate studies. Every new endeavor offers success stories and room for improvement in subsequent iterations. Table 3, below, provides a snapshot of these outcomes for the OLIS Sustainable Transportation pilot course based on feedback from student evaluations, instructor interviews, and program and client observations.

TABLE 3 Course Outcomes and Responses

Outcomes	Feedback (sorted by framework theme)
Successes	*Sustainability Foundation* • Curriculum offered a broad perspective and useful introduction to transportation planning through the lens of sustainability. *Interdisciplinary Basis* • Guest speakers provided insight and networking opportunities. • Class projects built bridges between the OLIS program and City departments working on climate change, planning and transportation. • Clear and well-researched curriculum facilitated the class's integration into UO's Department of Planning, Public Policy and Management. *Applied Learning Priority* • Applied learning projects were relevant and provided a useful snapshot of the many facets of sustainable transportation planning. • Co-teaching arrangement allowed educators to spend more time as needed on project facilitation.

Opportunities for Improvement	*Systems Thinking Approach* • Students would benefit from additional critical thinking about the roles that accessibility and mobility play in a community's resilience. *Collaborative Leadership and Communication Emphasis* • Student-led classroom facilitation was a worthwhile goal, but overall, students lacked classroom engagement techniques. • Some students encountered unclear directions from their clients during the project work. *Applied Learning Priority* • Group projects provided a rich opportunity for learning, but presented some of the common issues that arise when working with teams, such as inequities in team member participation and communication barriers. • Program and student ambition must occasionally be tempered by the realities of what can be accomplished during a project that comprises only one piece of students' demanding graduate schedules. • Original project scopes may have been better suited to a semester schedule than the University's fast-paced 10-week quarters. • Students were not equipped with resources to handle heavy statistical analysis, slowing some projects down and creating confusion about assigned tasks.
Recommendations	*Collaborative Leadership and Communication Emphasis* • Facilitate or encourage frank initial group discussions of expectations and work styles as soon as project teams are set up to reduce potential friction and improve teamwork by encouraging empathy, understanding and respect. • Promote frequent program-client communication at an organization's various levels to help relieve burden placed on students receiving conflicting information from their clients. • Include public engagement and facilitation strategies in OLIS leadership track to improve student-led collaborative learning experiences.

Source: OLIS, University of Oregon, 2013

Community Impact

Selecting these particular projects for student investigation supported the efforts of local transportation managers who have been promoting them within their agencies and the community. Positive responses from community members, the media and professional collaborators validated the inclusion of sustainable transportation into the OLIS curriculum. Each student group presented its findings to individual client panels and took

part in a large group presentation that was marketed to the University, organizations and the community. Approximately 30 representatives from local agencies, nonprofit organizations and advocacy and advisory groups, including the City of Eugene, Lane Transit District, Safe Routes to School, Greater Eugene Area Riders (GEARs), University of Oregon's LiveMove Program, and Eugene's Bicycle and Pedestrian Advisory Committee attended the student presentations.

The local progressive newspaper, *Eugene Weekly*, featured the class projects as a lead story and credited the students with launching a "sustainable transit revolution"(*38*). While transportation agencies and advocates in Eugene have in fact been making great strides toward sustainability for some time, this press response does indicate a growing interest in sustainable transportation and highlights the opportunities that academic institutions and their students have to contribute to raising awareness and igniting behavior change in their local communities.

In the months that have passed since the student projects were completed, their impact continues to unfold on campus and with the City of Eugene and Lane Transit District. The University of Oregon Office of Sustainability is using the commuter survey as part of its update to the campus Climate Action Plan, and is exploring pay-as-you-drive insurance as a potential behavior change strategy to encourage UO faculty and staff to reduce their driving. The City of Eugene will incorporate the results of the municipality-oriented student projects into the next iteration of its transportation plan. Student findings will also help the City inform the grant-seeking process for its bike share program and supplement its previous research to tease apart the fuel consumption/VMT conundrum.

DISCUSSION

This course and its guiding framework attempted to surmount the previously-identified barriers to developing and implementing a new pedagogy for sustainability. It encouraged both students and educators to reach beyond disciplinary silos and adopt a holistic worldview that allowed them to envision a range of reasons for and solutions to real-world problems. Working with formal educators in the classroom and informal educators outside of the classroom through the applied learning projects acknowledged the challenges both physically and pedagogically built into in a university setting. These relationships moved the students out of campus facilities that were less conducive to active learning and into a more expansive learning environment. In sharing the successful outcomes of the sustainable transportation course, OLIS can provide other departments and disciplines with an on-the-ground success story and a replicable model.

An additional barrier to consider is the need for a paradigm shift for students who are accustomed to a lecture-style learning environment and who find themselves troubled by collaborative learning models. Part of the expectations and expense of graduate school are tied to the opportunity to learn from educators with a wealth of research and resources, and students may be required to change their expectations when facing an experience where they are learning from their peers. Educators and their students would benefit from testing and reflecting on different methods by which to focus and implement active, student-led learning.

As a framework for an emerging pedagogy in sustainable transportation, in many ways the class validated the thinking in the current literature. Each of these students joined the program because of his or her personal belief in the goals of **sustainability** and its potential to build more resilient communities. This type of student will likely become only more prevalent as today's youth look to themselves as change agents for a swiftly evolving planet. It became obvious that teaching transportation as a whole and complex **system** made for a broader perspective on the paradigm that has led to its current state. Analyzing problems and solutions **across and outside the discipline**, students reported garnering a more expansive understanding of the connections between land use, transportation, health, the economy and the environment. Based on interactions with their professional collaborators, the students found that being able to communicate effectively with stakeholders from a full spectrum of disciplines was of paramount importance. Capably building and presenting convincing arguments, while being open to feedback and change, will help make these students strong and **collaborative leaders** in their agencies and communities. The eager reaction from University and City staff as willing project participants, the appearance of many community, University and local government representatives at the student presentations, and the media response suggest that the **applied learning** projects and their process were indeed current and relevant.

Viewed through the "Gestaltungskompetenz" lens, the framework may have benefited from an empathy theme that emphasized building deeper connections with the local community. To be relevant to this course, specific subsets of the community might include those most affected by accessibility and mobility concerns that can be addressed by the realm of sustainable transportation. Whether empathy can in fact be taught is a difficult question, but training students in matters of equity and bringing them out of academia and into the public realm via applied learning projects would be a valuable starting point.

CONCLUSION

The OLIS framework for the Sustainable Transportation course provided the cohort of sustainability generalists with an understanding of technical tools and, along with other programming, helped them to become responsive and collaborative leaders and communicators. Both the sustainability and transportation academic fields would benefit from encouraging students from diverse backgrounds to take their courses, fostering greater interdisciplinary connections and filling out the field so that students pursuing other disciplines will later include transportation concerns in their decision making. OLIS found working within the framework to be beneficial to its program development and will apply the model to the program's other courses.

Further refining the sustainability and transportation pedagogies has broad implications for higher education. Teaching requires significant advance preparation, great capital investment and excellent tools. Primary, secondary and even undergraduate educators have access to tools that help guide the delivery of their curricula. Graduate programs are required to be state-of-the-art, and program emphasis is on content. But there are fewer explicit techniques that describe the methodology with which to impart the knowledge and skills graduate students will need to meet the increasingly complex demands of the workplace and the world.

As financial crises continue to affect university systems and students, universities must promote internal systemic resilience by adapting their methods and endorsing lower cost, higher return investments that offer a sustainable experience for their educators along with applied learning for their students and products their communities can use. Applied learning projects such as the ones these students undertook galvanize support within agencies, energizing projects and bringing them to the forefront of community attention. Program frameworks that promote sustainability, systems thinking, interdisciplinary connections, collaborative leadership, and applied learning merit further investigation. The field would also benefit from an in-depth look at specific graduate-level tools for active and collaborative learning, appropriate ways to develop facilitation skills through regular curricula, and approaches for shifting student and educator paradigms about new pedagogical experiences.

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P.O. Box 751
Portland, OR 97207

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