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ARTICLE

Mainstreaming Climate in the Classroom: Teaching Climate Change Planning

ELISABETH HAMIN & DANIEL MARCUCCI

Abstract

Climate change planning, both mitigation (reducing greenhouse gasses) and adaptation (designing built environments for changed climate conditions), is an area of emerging importance in both planning practice and education. This research examines the uptake of climate issues in planning education programs primarily in the US, and compares course content to leading climate change planning practice and research concepts. Studio and seminar courses are emerging in various universities, and are addressing many of the key research concepts for mitigation and adaptation. Beyond stand-alone classes, the article argues the need to mainstream climate considerations in core planning curricula. Modeling this pedagogy will encourage our students to normalize climate considerations as they enter the profession.

Introduction

In the two decades since the passage of the United Nations Framework Convention on Climate Change (UNFCCC), the issue of accelerated climate change has permeated scientific investigation, policy debates, and planning practice. Local and regional responses have emerged as critically important (Ruth, 2006; Crane & Landis, 2010; Juhola *et al.*, 2012). By 2010, over 1,200 cities, towns, counties, and their associations worldwide had joined ICLEI, a non-governmental organization supporting municipalities in reducing their carbon footprints.¹ European countries are relatively well-advanced in their plans, at least at the national level (Biesbroek *et al.*, 2010), and increasing attention is paid to the topic in the global south (United Nations Human Settlements Programme (UN-Habitat), 2011), but the US is just beginning to address the issue at the national level. The American Planning Association provides very limited guidance on the issue through the development of its policy guide and attention to the topic in conferences and *Planning* magazine (Shuford *et al.*, 2010; American Planning Association, 2011).

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Climate change has been recognized as an important and valid aspect of planning practice, if one judges by the plethora of relatively new books on cities and climate change (Roaf *et al.*, 2005; Ruth, 2006; Ewing *et al.*, 2008; Girardet, 2008; Lerch, 2008 Bicknell *et al.*, 2009; Davoudi *et al.*, 2009; Newman *et al.*, 2009; Schipper and Burton, 2009; Calthorpe, 2011; Boswell *et al.*, 2012; Stone, 2012), special planning journal volumes (e.g. Blanco *et al.*, 2009b; Crane & Landis, 2010), and scholarly research and debate (see Betsill & Bulkeley, 2007; Sanchez-Rodriguez, 2009; Blanco *et al.*, 2009a; Wheeler *et al.*, 2009 for reviews of the field) or, perhaps more importantly, the growing body of local climate change plans (Wheeler, 2008; Bassett & Shandas, 2010). Still, most how-to information comes from non-profits or agencies in the white and grey literature (e.g. Shaw *et al.*, 2007; National Oceanic and Atmospheric Administration (NOAA), 2010; EEA, 2012; Gurran *et al.*, 2012).

Clearly, it is time that climate change planning, both mitigation (reducing greenhouse gasses) and adaptation (designing built environments for changed climate conditions), is included in planning curricula. This is starting to happen, as this article will demonstrate. But there is more work to do, as we will also discuss.

Our goal in this article is first to briefly highlight the critical need for planning practice and education to engage with climate. Second, the article will examine a sample of primarily US-based climate change planning courses to see where and how the topic is currently being taught. While the focus of this article is free-standing studios and seminars, we also suggest some of the ways that instructors are already integrating—or, in the climate terminology, mainstreaming (Halsinaes *et al.*, 2008)—climate into core planning courses dealing with urban environments. We conclude with observations about how to better align course content with both practice and scholarship in this area.

Urban Planning for Climate Change—A Brief Review

Climate change began to emerge (or re-emerge, after the initiatives of the 1970s) on the planning policy horizon in the mid-1990s, following the passage of the UNFCCC in 1992. The non-profit group ICLEI was an early leader in assisting communities in inventorying municipal emissions and identifying reduction opportunities, such as insulating municipal buildings or using more efficient street lighting. These Climate Action Plans (CAPs) have begun to have fairly wide adoption (ICLEI, 2006; Brody *et al.*, 2008; Wheeler, 2008; Boswell *et al.*, 2010), but perhaps because municipal emissions inventories are not core to most planning concerns, these CAPs on their own have not created much push for change in curricula.

The key insight that has moved climate change mitigation into the forefront of planning interests has been the realization that spatial form matters (Ewing *et al.*, 2008). One of the earliest observations of this was by Newman and Kenworthy (1988) who demonstrated quite clearly that denser cities used less gasoline per capita (see also Newman *et al.*, 2009). Extensive research has been undertaken to test and quantify this, summarized in a report by the US Transportation Research Board (National Research Council and Transportation Research Board, 2009 p. 4):

The literature suggests that doubling residential density across a metropolitan area might lower household VMT by about 5 to 12 percent, and perhaps by as much as 25 percent, if coupled with higher employment concentrations, significant public transit improvements, mixed uses, and other supportive demand management measures.

A key point is that it is not just density or public transit, but also the design of the street network, development nodes, and other core planning issues that matter (Ewing & Rong, 2008; Hamin & Gurran, 2008; Wheeler *et al.*, 2009). One of the benefits of changes to the development pattern is they can yield substantial emissions reductions for many years (National Research Council and Transportation Research Board, 2009).

Crane and Landis (2010) summarize the mitigation steps cities should take as:

- Ensuring that new buildings are energy efficient,
- Enacting zoning and regulations to ease the permitting of renewable energy and carbon sequestration,
- Zoning and business support to improve local access to food,
- Planning of transit and pedestrian-oriented land uses and development patterns that may reduce vehicle miles traveled.

For planners, what is particularly powerful about this is that these steps correspond well to basic livable city/smart growth principles (Kenney, 2008; American Planning Association, 2011; Hamin, 2011). The design and policy choices involved have been well laid out in several recent planning books that link urban form and mitigation (Lerch, 2008; Newman *et al.*, 2009; Condon, 2010; Calthorpe, 2011). Methods for municipal greenhouse gas accounting and related climate action planning are complex and technical, but are also rapidly being standardized (Boswell *et al.*, 2012).

Adaptation, in contrast, requires a more substantial shift in perspective and its centrality and importance are only starting to be fully recognized. A key adaptation challenge is that assumptions of stable regional climate are no longer appropriate (Füssel & Klein, 2006). As a result, adaptation requires a decision-process that is more explicit about uncertainty and the need for flexibility and long-term planning (IPCC, 2012). The science of climate change tells us that given the build-up of greenhouse gases in the atmosphere to date, some level of change is unavoidable already, so some level of need for adaptation is already entrained. Absent drastic action on emissions, climate changes will become significantly more severe (IPCC, 2007). There is uncertainty about the timing and how much change will occur in total, but the general global and regional directions are pretty clear (Karl *et al.*, 2009; IPCC, 2012). Precise determination of local manifestations is more difficult, because downscaling global climate models significantly increases uncertainty.

There are many anticipated effects of climate change: more frequent and intense heat waves, water supply fluctuations, food system disruptions, and endemic species shifts, to name a few. One of the most anticipated and dramatic effects is expected to be coastal inundation with sea level rise. McGranahan *et al.* (2007)

analyzed data for all nations on the number and proportion of urban dwellers living in coastal zones less than 10 meters above sea level. They estimate that this 2% of global land area contains 10% of the world's population (over 600 million people), and almost two-third of the world's large cities (more than 5 million inhabitants) fall at least partly in this vulnerable zone. Even a rise of 1–2 meters will inundate the shorelines of many coastal cities and create ripples of impacts throughout the metropolis. Sea-level rise also has significant impacts on non-urban land uses such conservation, agriculture, estuaries, and resorts.

Specific planning actions for adaptation should be targeted to the identified vulnerabilities of a particular area, but might include items such as resizing pipes to address a future of more intense storms (Kirshen *et al.*, 2004, 2008) using more green infrastructure to provide for cooling and on-site stormwater management (Ashley *et al.*, 2007; Gill *et al.*, 2007), anticipating the effects of climate on transportation systems (Suarez *et al.*, 2005), mapping anticipated sea level rise (Frumhoff *et al.*, 2007; Rosenzweig *et al.*, 2007), encouraging building only outside of the zone of likely flooding and designing buildings for maximum natural cooling (Hacker & Holmes, 2007; Smith & Levermore, 2008), anticipating urban heat waves (Stone, 2005, 2012), and seeking to understand how a changed climate also changes the meaning of a place (Hunter, 2008). Economics of policy choice also plays an important role, as persuasively demonstrated by the widely reviewed report by Stern (2007), and legal questions are beginning to be framed (Nolon, 2009; Wold *et al.*, 2009). A planning challenge is that policies that support mitigation may or may not support adaptation, and as a result cities need to consider multiple criteria when reviewing proposed policies for fit and efficacy (Hamin & Gurrán, 2008; Howard, 2009).

There is (or ought to be) a strong justice component in adaptation planning, as the worst climate impacts both internationally and in US cities tend to co-locate with poverty, because the poor have typically been marginalized to the least-safe lands and because they have the least social capacity to avoid or bounce back after disaster (Agyeman, 2006). Vulnerability analyses, which map demographic and social constraints overlaid by likely climate effects (e.g. new floodplains), have become a significant component of adaptation planning (Turner, 2003; Leary, 2008). The spatial concepts of vulnerability analysis have great promise for highlighting and enabling equity in planning practice. Some additional key concepts form the backbone of epistemology of climate planning. Resiliency, which first emerged as a concept in the ecological fields (Holling, 1973), has become an increasingly important theoretical frame for adaptation (Newman *et al.*, 2009). And the use of scenarios and visualizations to reach out to the public has become much more important given the pressing need to make the future more palpable (Quay, 2010; Sheppard *et al.*, 2011).

The general processes recommended for adaptation varies somewhat from the typical comprehensive planning approach, but should still be recognizable to most planners. The US National Academy of Sciences, for example, recommends the process shown in Figure 1. Risk is highlighted more than in typical comprehensive planning processes, but otherwise the similarity between this and typical planning processes is clear, and suggests why planners in particular have so much to contribute to these discussions (see also UN-Habitat, 2011).

FIGURE 1. Representation of the planning process. *Source:* National Research Council (2010, p. 9).

Climate Change Pedagogy

With a subject area this big and in flux, selecting exactly what to teach is a challenge. The first task in many cases may be to increase students' familiarity with and belief in the science of climate change. Climate science has not been particularly well taught in the US school systems at least (see Jeffries *et al.*, 2001; McCaffrey & Buhr, 2008) and thus instructors may need to start with some basic climate science. When it comes to belief, a 2011 Gallup poll found that worldwide, 42% of people believe that global warming is a serious threat, and on average this stayed stable from the prior year, while increasing in Latin America and Africa and decreasing in the US and Europe (Pugliese and Ray, 2011). Interestingly, when Leiserowitz *et al.* (2011) surveyed US residents on climate change belief, the differences appeared to be more an issue of the respondents' sense of when climate change was coming—already started versus decades from now—rather than belief in climate change *per se*. Students are interested in the social science aspects of climate change. In a survey of over 1, 200 students worldwide, Leal-Filo (2010) found a higher level of university student interest in social aspects of climate change than any other area. That research also supports the importance of climate change to students, finding that over 60% of the sampled students regard climate change as either essential or very important to their studies, while almost half of the sample believes the topic is important for their careers.

Initial pedagogy findings suggest that providing a vivid focusing event (Moser & Dilling, 2007), practical demonstration such as a 'climate summit' (Rebich & Gautier, 2005), personal ecological footprinting (Cordero *et al.*, 2008) or other active learning practices (Bardsley & Bardsley, 2007), helps students develop a personal connection to the issue. Also essential is a sense of empowerment in the face of what can be an overwhelming problem; courses should highlight practical available solutions to encourage action instead of passivity (Moser & Dilling, 2007). Given the wealth of web-based climate information, multi-media approaches are fairly easy to incorporate into classes (Snow & Snow, 2009).²

A contentious issue in climate change planning is whether the topic should be addressed via stand-alone plans, or be ‘mainstreamed’ directly into departmental guidelines and regulations. This has a corollary in how climate is taught: should it be in stand-alone seminars? Or should a ‘climate lens’ (Robinson *et al.*, 2006) be used in existing core classes, so that climate becomes another variable to be considered just like population projections, equity, or fiscal outcomes? This is a question we return to in our conclusions.

In planning education, substantive information and practical skills can be taught via seminars or studios, with studios defined here to mean courses whose main goal over the course term is the production of a particular report or project usually for external clients, while seminars are more reading, lecture, and discussion based and use project work only secondarily. One of the challenges of climate planning is that it has substantial technical knowledge requirements as well as epistemological grounding requirements as described above, which would tend to argue for its treatment in seminars where more substantive and teacher-led learning tends to occur. On the other hand, methods for planning, particularly for adaptation, are not well bounded and the overall problems tend to be ‘wicked’ (Rittel & Webber, 1973; Crane & Landis, 2010), and wicked problems can be very good for studio learning. In addition, communities really need assistance with both adaptation and mitigation, meaning there is a strong service role that studios can fill while testing out planning approaches. Clearly both seminars and studios have appropriate roles.

Research Method

For this review, we focused primarily on North American educational programs to afford a more consistent institutional landscape, thereby enabling comparisons. The North American educational system and planning institutions may be distinctive, but the need to link climate change in planning practice and education is global. To identify courses and instructors we used multiple methods. We sent out through the PLANET listserv two requests (in Fall 2010 and Spring 2011) for those who have taught climate-related studio projects, classes, or student-engagement projects to contact us and share their syllabi. We then reviewed the program websites of all programs listed in the 2010 Association of Collegiate Schools of Planning (ACSP) Guide to Schools website, and searched on the keywords ‘climate’ and ‘global’ and ‘greenhouse’ for related classes, and when a potential class was identified, we contacted the named instructor via email for a syllabus. A key choice here was to exclude the 11 web-identified courses that focused on the broader issues of energy planning. This is clearly a topic that is important to mitigation, but is sufficiently different that it should be addressed in a different paper. We also searched the 2010 Guide to Planning (Association of Collegiate Schools of Planning, 2010) for faculty members who reported ‘climate’ as one of their research interests, and emailed them directly. All of those requested provided a syllabus for their course, which constituted the primary data for our analysis.

These methods combined yielded 32 distinct syllabi. We grouped these into three categories: (1) our primary analysis group: climate change studios and seminars that have week-by-week readings/topics listed in their syllabi indicating

that climate is the topic for 9 or more weeks of the term ($n = 24$); (2) ‘mainstream’ classes that have other primary learning objectives but include climate as a significant part of their focus ($n = 5$); (3) a few courses we excluded from extended analysis for lack of week-by-week course content in the syllabi ($n = 3$). Table 1 identifies each Category 1 course and its key characteristics.

Following (approximately) the methods of Pezzoli and Howe (2001) and Krizek and Levinson (2005), we used content analysis of syllabi to empirically review the content of courses. Studio courses often had very brief syllabi, so we analyzed these separately below. For the Category 1 seminars, we used emergent analysis to code each week’s topic and any stated learning objectives; in other words, we developed the matrix columns based on the observed content of the reviewed syllabi, rather than any particular expectation, creating columns for all topics that appear as a weekly focus in any seminar. To identify the topic/learning objective of a week, we began with the instructor’s listed topic for the week and also reviewed the assigned readings, using their content to support the categorization and assure that we had accounted for the week’s learning as fully as possible. Generally, the instructor’s stated topic for the week and the readings were well aligned; when there were assigned readings that went beyond the stated topic for the week, we added a count mark to the table, choosing to err on the side of inclusiveness if there was a question. Some weeks had more than one topic, and some topics cover more than one week for any particular course. After each course’s content was coded, we grouped the topics (the columns in the Table 2) into emergent themes that helped make sense of what was included in courses, and what was not. These themes are the first line in Table 2.

The sample of studio courses ($n = 5$) and the relative brevity of their syllabi meant that we could not utilize the same content analysis method for them. Instead, we read carefully through the project descriptions, which were generally quite well developed, and used that to inform the discussion below. As a result of the small sample and looser method, outcomes here are more exploratory than definitive. For Category 2 classes (existing courses adding a climate component, $n = 5$), we reviewed their syllabi and used this to inform our discussion in the ‘mainstream’ section below. We also received a number of emails regarding ways that climate is addressed in courses without being the central topic of the course, and these are attributed in the discussion below.

Findings

As Table 1 shows, 22 different schools reported relatively free-standing climate change planning courses, with two schools having multiple courses. The courses tend to be located at Carnegie Research 1 institutions, perhaps because faculty members there have more flexibility in what they teach, or are able to more closely align their teaching with emerging research. Still, one can hardly call this saturated—there are 120 planning programs in US and Canada associated with ACSP (Association of Collegiate Schools of Planning, 2010). The most common course type is a graduate seminar teaching both mitigation and adaptation, but adaptation-focused courses are almost equally represented. The seminars are all taught as electives typically in an environmental planning concentration, while the

TABLE 1. Category 1 courses (full semester adaptation and/or mitigation courses with weekly information)

University	Course Name			
Arizona State Univ.	Human and Social Dimensions of Global Climate Change	0	B	G
Cal Poly San Luis Obispo	Com. Planning Lab: San Luis Obispo Climate Action Plan	X	M	U
Cal Poly San Luis Obispo	Climate Action Planning	0	B	U
Cal Poly Pomona	Municipal Climate Change Policy	X	B	U
Florida Atlantic Univ.	Seminar in Cities and Climate Change Adaptation	X	B	U
Florida State Univ.	Planning for and Mitigating Global Climate Change	X	B	G
George Mason Univ.	Climate Change Governance and Policy: Governance for the Long Term	X	A	G
Harvard	Seminar on Urban Climate Adaptation	X	A	G
Univ. of Kansas	Energy, and Community in Kansas	X	M	G
MIT	Urban Climate Adaptation	X	A	G
MIT	Urban Climate Vulnerability, Adaptation, and Justice	X	A	G
MIT	Sustainability in a Changing Climate	X	A	G
NYU	Water Sourcing and Delivery in an Era of Climate Change	X	A	G
Ohio State Univ.	Adaptation to Climate Change: Strategies to Increase Urban Regional Resilience	X	B	U
Univ. of Pennsylvania	Adaptation to Climate Change in the Delaware River Basin	0	A	G
Rutgers	Climate Change Adaptation: Economics, Policy and Governance	X	A	G
Univ. at Buffalo (SUNY)	Urban Planning and Climate Change Management	X	B	G
Temple	Planning Studio	0	M	U
Tufts	Climate Change Policy, Planning and Action	X	B	G
UC Davis	Landscape and Regional Planning Seminar & Studio	0	M	U
UMass Amherst	Planning for Climate Change	X	B	G
Univ. of Texas Arlington	Project Planning: Campus Carbon Footprint Reduction	0	M	G
Univ. of Texas Austin	Building a Sustainable Region	X	M	U
Univ. of Washington	Climate Change and Infrastructure	X	B	G
Univ. of Queensland	Creating Climate Adaptable Settlements: Building Resilience through Adaptive Planning	X	B	C
22 Universities, 25 courses		X = 5, 0 = 20	M = 6, A = 9, B = 10	7 = U, 18 = G, 1 = C

Note: 0, Seminar; X, Studio; M, Mitigation; A, Adaptation; B, Both; U, Undergrad, G, Graduate, C, Continuing Ed.

TABLE 2. List of themes/topics covered in seminars

Code	Science			Policy, law, economics		Adaptation topics and skills			Mitigation topics and skills					Focus areas					Pedagogy				
	Ghg science	Climate impacts	Forecasts/Models	Federal and state laws	Public role	International Policy	Economics	Design	Equity, justice, ethics	Vulnerability analysis	Risk and resilience	Climate action	Carbon Acct/GHG Invent.	Energy (renewable)	Land use	Transportation	Health	Development	Species + Habitat	Food	Water	Read IPCC reports	Use case studies
A	1	1			1				1			1	1	1	1	1						1	1
C	1		1	1	1							1	1	1	1	1						1	1
D				1		1						1		1	1	1				1			1
E	1	1		1		1	1		1		1			1	1	1	1				1		1
F	1	1	1	1		1		1			1	1		1	1	1	1			1		1	1
G	1	1		1	1	1			1		1	1					1					1	1
H				1	1	1		1		1	1	1					1					1	1
I				1	1				1			1	1	1		1							1
J				1	1				1	1	1						1						1
K				1	1	1		1	1	1	1						1		1			1	1
L	1	1		1	1	1			1	1	1	1					1		1			1	1
M	1	1				1	1		1		1						1			1	1		1
N				1			1				1	1				1							1
P			1	1		1	1			1	1	1						1		1	1		1

(continued)

TABLE 2. (Continued)

Code	Science			Policy, law, economics			Adaptation topics and skills			Mitigation topics and skills					Focus areas					Pedagogy			
	GhG science	Climate impacts	Forecasts/Models	Federal and state laws	Public role	International Policy	Economics	Design	Equity, justice, ethics	Vulnerability analysis	Risk and resilience	Climate action planning	Carbon Acct/GHG Invent.	Energy (renewable)	Land use	Transportation	Health	Development	Species + Habitat	Food	Water	Read IPCC reports	Use case studies
Q	1	1		1		1			1	1	1	1			1		1	1				1	
S		1		1	1	1			1		1	1	1			1							
U	1	1	1		1			1		1		1			1	1						1	1
W	1	1	1	1		1						1	1	1	1	1		1					1
X			1	1		1	1		1				1		1		1	1		1	1	1	1
Y											1											1	1
20	10	10	6	15	9	13	5	4	8	7	11	11	6	6	7	8	8	7	1	4	4	10	15

studios are elective or core. Courses tend not to have prerequisites, and tend to be listed as high course numbers, suggesting they are intended to be taken toward the end of the student's matriculation. Studios address only mitigation or adaptation, not the two together. The studio separation of mitigation and adaptation is likely a pragmatic decision in the design of a one-semester (usually 16 week) studio. The data and knowledge required for each are distinctive, and the task of producing a final report for either objective is challenging given limited time.

Seminar Content

The seminars being offered are diverse in their readings, approaches, and content. This is evidenced in Table 2, which identifies the weekly focus for each seminar for which content was broken out at this level ($n=20$). The most commonly taught topic is federal and state laws regarding climate, followed by international policy, community action planning (mitigation plans), and risk and resilience.

Mitigation seminars in planning curricula focus on the spatial and land use opportunities to reduce emissions via land use and transportation or municipal energy requirements, and renewable energy zoning and permitting. More skill-oriented courses tend to include emissions counting, carbon footprinting, and climate action (emissions reduction) planning.

Adaptation seminars, in contrast, have a broader and more idiosyncratic content. Core concepts for adaptation courses include urban design and spatial layout for preparing cities for coming weather patterns. Most adaptation courses include consideration of international policy and its role, and the role of public bodies in planning for adaptation. Other key ideas are vulnerability and resilience, the first of which is a way to equitably prioritize investments in adaptation toward the least resourced, and the second of which prescribes the goal that investments should achieve. Justice and ethics, central ideas for planning, are explicit only in the adaptation courses.

One way that courses can potentially address both mitigation and adaptation, thereby presenting the complexity of their interactions, is by working sectorally. For example, one can examine ways to reduce the greenhouse gas emissions of farming while also adapting food systems to the stresses of a changing climate, and then analyze where these policies support each other and where they may conflict. This appears in Table 2 as 'focus areas'; water is the most common sector addressed. Interestingly, while climate change is quintessentially an environmental issue, the topic of species and habitats is only included in one seminar's syllabus.

Two consistent pedagogical approaches are present. The first is the use of case studies, which 15 out of 19 seminars do. The second is reading from the original IPCC reports in the seminars, as shown in the penultimate column of the table. We reviewed the syllabi readings lists to identify core readings, but there was very little overlap from one course to another.

An important caveat here is that the general topics for a week do not represent the extent of discussion for those days, as all instructors know. A day whose topic is health and climate might very well have significant content on the justice implications of differential access to health, and that would not necessarily be captured in this content analysis.

Studio Content

Studio syllabi in general tend to present less information on course content and skills as compared to seminar syllabi, and more on expectations for student work and review of the overall process. Nevertheless, some themes can be identified even with a small sample ($n = 5$).

Mitigation studios (climate action planning). Mitigation studios tend to use the ICLEI process to inventory campus or municipal emissions. Course content trains students in the general concept of emissions planning, uses the ICLEI software to do municipal or campus inventories, and then allows some time to reflect on what the municipality/university should do. That appears to be what can be accomplished in one semester. Some instructors have been able to do a second semester for the same client, in which the draft climate action plan is developed. This two-semester organization allows students in the first semester to develop strong analytic skills and the second semester to utilize the fuller planning process to connect information to outcomes.³ It is, however, obviously very time intensive, and given semester to semester turn over of students, the build up of skills may not be possible.

Adaptation studios. There were even fewer examples of studios devoted to adaptation, even though adaptation is clearly a local and land-use related phenomenon. An early example was held at the University of Pennsylvania, where Jon Barnett lead an adaptation studio funded by the William Penn Foundation. Students combined climate projections for sea level rise with urbanization trends in the greater Philadelphia/Delaware River basin area, and then proposed site-level design interventions that would better align infrastructure (e.g. air terminals) with future climate realities.⁴

'Mainstreaming' climate change into existing courses. Faculty contributed several syllabi that included climate as one among several areas of inquiry. These provided several weeks on climate change during an environmental planning, energy, sustainability, or infrastructure course, or a course that investigated oncoming global changes more generally. The inclusion of climate into a range of courses is an important approach given limits on the number of courses any one program can offer or require, as further discussed in our findings.

Discussion: The State of the Field and the State of the Courses

University-level training has a responsibility to both describe new approaches to problems and to train students in standard methods and ideas that they can use in practice. It is therefore important that courses represent both the most important ideas in research, and the skills and knowledge needed for practice. Some indication of an emerging 'essential knowledge' for practice is suggested by

Climate Change Pedagogy in Planning

TABLE 3. Comparisons of course topics and current literature/practice approaches

APA ^a	UN habitat proposed modules ^b	Findings: course content (with <i>n</i>)
Introduction; role of planners; climate change science; climate change impacts	Introduction: basic climate science, emissions, models	Public role (9), Climate Impacts (10), Forecasts and models (6)
The greenhouse effect and carbon dioxide	Urban greenhouse gas assessment	GhG Science (10), Carbon accounting (6), Climate Action Plans (11, mitigation)
Smart growth, sustainability, and climate change responses	Adaptation and mitigation planning	Included in land use??
Social equity and climate change	Climate Justice; CC and Gender	Equity, justice, ethics (8)
	Urban vulnerability assessment—biophysical and social	Vulnerability analysis (7), Risk and resilience (7)
Federal, state, and local structure	Climate change governance	Federal and state laws (15), International policy (13)
Land use	Land use planning	Land Use (7, mitigation), Design (4, adaptation)
Green development	Shelter/housing/building construction; urban design	
Economic development	Economic development	Economics (5), Development (7)
Public health	Urban health	Health (8)
	Food security	Food (4)
Hazards management	Disaster risk reduction	
Transportation	Transport planning	Transportation (8)
Energy	Urban energy	Energy (6)
Public infrastructure	CC and the urban water cycle; CC and solid waste management	Water (4)
Natural resources	Urban ecosystems/biodiversity	Species + Habitat (1)

^aAmerican Planning Association 2011. Policy Guide on Planning and Climate Change. Chicago: American Planning Institute; ^bAvailable at <http://www.unhabitat.org/content.asp?cid=9340&catid=657&typeid=34&subMenuId=0>. The total proposed number of modules is 20—this list collapses some to better match the APA list. Semi-colon indicates two modules in one line.

reviewing two disparate sources: the APA policy on climate change (American Planning Association, 2011), which is a normative listing of the policy responses and analytic approaches that the APA supports, and the list of instructional modules under development by the UN Habitat program, with expected release in 2013 (UN-Habitat, 2009). The APA guide is clearly oriented to US use, while the Habitat publication is primarily designed to train planners in developing countries. In Table 3 we compare both of these to our findings on the topics contained within the climate change seminars.

There is agreement on many areas of basic contents, but there are several differences as well. Legal frameworks in general are well covered in the courses. The lack of inclusion of greenhouse gas accounting and/or assessment methods in the APA guide may be a peculiarity of the language and organization they use, as the guide advocates mitigation planning, while the lack of discussion of planners' roles in the UN guide is likely a function of the wide variety of institutional situations its intended audience may experience.

Climate-oriented recommendations for built form tend to be very copasetic with smart growth principles—an argument very strongly made in the APA policy guide. Denser, transit-friendly communities are among the most important contribution that planners can make toward reducing greenhouse gas emissions. Similarly, adaptation is best served in many situations by increasing the green infrastructure of the city and requiring stronger building codes and more environmentally informed permitting—policies also highly associated with smart growth. Planners are seeking convincing reasons to do good planning, and climate change provides that, so linking the two more concretely seems a very clear win for good planning and for the globe.

Comparing course content to the key ideas identified in the literature review suggests that classes are doing fairly well at presenting the most recent, more important concepts. Basic science begins most classes, IPCC reports are referenced, both mitigation and adaptation are addressed, built form and design policy solutions are studied, and equity is at least introduced as an important topic in most classes. Emerging theoretical and analytic frameworks are also beginning to be addressed, as demonstrated by the inclusion of vulnerability analysis and risk and resilience, but at least in the week-to-week readings, scenarios and visualization techniques have not yet moved into coursework. Many of these skills and ideas may be particularly appropriate for inclusion in curricula through mainstreaming, as discussed below.

Three areas of difference are of particular concern. Based on what is in their syllabi, very few classes are explicitly, directly making the connection between livable cities/smart growth and climate change discussed above, which is an obvious role for planners. Only one class had a specific segment on species and habitat, and given that in many regions species will need south–north migration corridors to respond to changes in their habitat, and this may be a crucial oversight in regional planning. Finally, very few courses have separate discussions about the roles of planners *per se*, although they do address governance and adaptation or mitigation plans.

This analysis is limited in its geography based on who reads and responds to the PLANET listserve and which programs are listed with ACSP—in other words, primarily US educators. It would be extremely useful to have comparative research on climate change planning education in the UK, Europe, and countries from the global South. One of the challenges in education and practice is that global responsibility for and opportunities to mitigate greenhouse gasses and adapt to climate change vary dramatically with geography and social capacity, so that it is virtually impossible to talk meaningfully about mitigation or adaptation measures without differentiating context. Balancing the need to train students in locally relevant measures while also discussing

international responsibilities and alternative contexts is essential, and having more knowledge of how climate change is being taught in other countries will help in this.

Enhancing Pedagogy

Time in curricula is a scarce and contested resource; climate needs to fit in if it is to be included. One approach is to integrate the topic into typical core planning classes: law courses can examine property rights in planned coastal retreat, for instance; introduction to planning courses can introduce mitigation and adaptation as appropriate planning goals; theory seminars can address climate justice, vulnerability and resilience; GIS courses can include exercises in social vulnerability and risk mapping; public participation courses can include scenario planning as a workshop method. To make the smart growth-climate change connection explicit, spatial courses can use one of the new prescriptive land-use planning books addressing climate and smart growth (e.g. Lerch, 2008; Calthorpe, 2011; Condon, 2010), providing an opportunity for students to think through policy outcomes of climate as a normal consideration in land use planning. Programs then should provide elective courses to encourage proficiency in the topics for those who are most interested. For these electives, we suspect that it is better to separate adaptation and mitigation so that each can be fully considered. In particular, greenhouse gas inventories require extensive training, so programs that want to provide this will likely need to offer a skill-oriented mitigation course.

In summary, we suggest an appropriate pedagogic goal for climate change might be:

To develop a broad knowledge among planning students about the basic scientific principles of climate change, the opportunities for planning to reduce the causes and impacts of climate change, and the complexity of problem-solving approaches and ethical dimensions (e.g. poverty, social and environmental justice, security), while encouraging students to take personal and professional action in order to insure the survival of people, species, and habitats (adapted from Leal-Filo, 2010).

Effectively addressing climate change in planning curricula is not optional; it is an essential duty of the profession. Planning strives to influence the future towards desired directions. To do this, we have to understand the forces that are pushing events one way or another, and in terms of human health and urban function, environment and the climate are certainly among the most important forces for this century. Climate change planning is roughly where equity in planning was in the 1970s—emergent, exciting, novel, becoming essential. Equity is now widely understood to be a cross-cutting issue that needs to be addressed in all areas of planning. Climate, given the inevitability and rapidity of the current pace of change and its important justice implications, also needs to be treated as a cross-cutting issue. This means that it should be addressed in standard core courses, as well as in offerings for specialty areas that provide for deeper knowledge for students who chose this as their professional specialty.

Connecting to Practice

The rapidity of development of climate change planning suggests that a very close interaction between education and practice is essential to assure that students are gaining the most relevant and up to date knowledge and that practice has the benefit of the breadth and depth of view that research and pedagogy can provide. One approach would be for the relevant national planning organizations in each country to organize specific partnerships with secondary and professional education faculty, to establish an on-going climate conversation. Within the academy, the most effective way for climate planning to become a mainstream issue is for textbook writers to treat it that way. The next versions of *Comprehensive Planning 101* need chapters that lay out clear methods for planners to map sea level rise and urban heat island effects, to identify populations vulnerable to intensified droughts or floods, to incorporate these into land use, housing, and other elements, and communicate effectively with the public about uncertainty and climate. These chapters need to come early in the books and in the planning process, so that the implications of those climate trends are part of the basic information that frames decision making. Climate change planning needs to be normalized in planning curricula so that new practitioners will in turn treat it as a normalized part of practice. It is essential that planners and planning academics are engaged in the development of responses to climate change, both to maintain the relevance and importance of our field, and because we are uniquely placed to provide leadership in bringing these issues to implementation at the local and regional level. Academic accreditation boards should consider requiring that climate be addressed in curricula.

As climate planning courses and research develops, it will be helpful if meta-research (state of science, state of planning, state of teaching) occasionally ascertains that we are not wandering too far astray from how other fields address the key challenges of the day. For now, we note that planning has adapted rapidly to the rise of climate change as a valid planning concern, and that, while there is a long way to go, planners have begun in earnest to train ourselves and our students in how to bring this knowledge into the wider world.

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Notes

1. From the ICLEI website: <http://www.iclei.org/index.php?id=global-members>, accessed 10/17/2010.
2. For instance, one author used the 'scenarios' available from Forum for the Future (<http://www.forumforthe-future.org/projects/megacities-on-the-move>) in a one-credit freshman seminar on planning for climate change, and the students enjoyed working with them and creating their own scenarios.

3. Of the syllabi we collected, none used more sophisticated land use/transportation modeling for emissions, but this may be a limit to the data collected rather than a reflection of all studio teaching. It seems logical and appropriate that this sort of studio be undertaken under the rubric of mitigation planning.
4. Charles Hoch reported that UIC also undertook a sea level rise studio in 2010 with 90 students, 6 faculties, 2 TAs, developing plans to prepare for sea level rise on the Lake Michigan coast.

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