Emerging ideas in Sustainability Science: Critical thinking and lifelong environmental learning

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Abstract: This paper addresses critical thinking in teaching and learning and in particular Caroline Kreber's ideas about lifelong learning. It sets these thoughts in communication with one of the greatest challenges facing present-day sustainability science, namely ecological literacy and the extinction of environmental experience. It ends by discussing how universities could boost affective environmental learning through the formation of 'Communities of Practice (CoPs), targeted at environmental stewardship.

Keywords: Critical thinking; Lifelong learning; Affective learning; Ecological literacy; Sustainability Science; CoP

1. Introduction

For long, teaching theorists of higher education have argued that we run the risk of losing sight of the larger purposes of education (e.g. Boyer 1996; Kreber 2005). As many theorists argue, higher education institutions (HEIs) should not only provide surface and deep-level learning, but lifelong learning. Boyer, for example, pledges for universities and colleges to become more vigorous partners in the search for answers to our most pressing social, civic, economic, and moral problems. Accordingly, academic environments need to affirm their historic commitment to what he calls the 'scholarship of engagement' (1996:18). Boyer criticized higher education for serving merely private benefits, rather than a public good, and that HEIs promote the view of the campus as a place where students get credentialed and faculty get tenured, while the overall work of the academy does not seem particularly relevant to our most pressing societal challenges.

In the same vain, Kreber (2005), brings forward the notion that the scholarship of university teaching should foster 'lifelong learning' and conceptualizes such scholarship as "the intellectual, practical and critical work done by college and university teachers that facilitates student development toward significant educational goals" (ibid:389). Besides having the goal to foster students' development of self-management, autonomy and social responsibility, Kreber argues that universities also have a role to play in protecting our planet and contribute to sustainable development. In her paper, Kreber asks how 'environmental' or 'ecological literacy' could be promoted in the higher education community. Until the 1990's, the contribution of HEIs to local, regional, and global environmental problems was largely ignored (Eagan and Orr 1992). However, universities are slowly emerging as valuable partners in the sustainable development of cities and local communities, e.g. through co-creation of knowledge and services (Mores et al. 2019).

This paper discusses Kreber's ideas in the light of coming to grip with the increasing ecological illiteracy in today's society. Finding adequate solutions to address ecological illiteracy, are arguably one of the greatest challenges facing Sustainability Science today (Andersson et al. 2014). The paper theorizes around how universities and colleges can help direct students' motivation for 'lifelong learning' toward goals that benefit both nature and society, proposing a revitalization of Blooms taxonomy of affective learning by way of environmental stewardship through the formation of 'Communities of Practice (CoPs)'.

2. Ecological illiteracy and the extinction of experience

Plentiful studies demonstrate that urban lifestyles and the choices people make in their daily lives are disconnected from the effect they have on the natural environment (Folke et al. 1997; Turner et al. 2004; Sörqvist and Langeborg 2019). A typical example of this disconnection is anthropogenic climate change (Stoknes 2014). Disconnection from the dependency of nature is often masked in our societies of today by the support from socioeconomic infrastructures (Berkes et al. 2000). Climate change unawareness is also often reinforced by cognitive barriers (Holmgren et al. 2019; Sörqvist and Langeborg 2019).

Research also reveals that environmental illiteracy is higher in urban settings than in rural environments (McDaniel and Alley 2005). Children are also interacting less regularly with nature in cities; hence, leading to reduced nature experiences. That children tend to play around less in natural settings today than previously is not simply due to a loss of natural environments in cities, but also involves changes in a wide diversity of activities and experiences, including time spent in urban greenspaces (Soga and Gaston 2016). Japanese children, for example, spend much less time in nature than a decade ago, and 12% of English children never visits a natural environment on an annual basis (Soga et al. 2016).

Another reason for the disconnection of nature experiences in cities is that urbanization cuts off perceived and experienced relations between people and nature as modern life-styles are adopted and access to green areas is reduced (McKinney 2002; McDaniel and Alley 2005; Bendt et al. 2013). This alienation process has been termed the 'extinction-of-experience' (Pyle 1978) and represents a sort of ongoing generational amnesia among city people about their relationships to, and dependence on ecosystems (Pilgrim et al. 2008; Bendt et al. 2013). Samways (2007) argues that when people in cities fail to reconnect to local ecosystems, they also fail to understand their dependency on them. With increased digitalization, humans risk becoming even more disconnected from their dependency on natural systems (Colding and Barthel 2017).

Without environmentally concerned citizens it might be hard to gain support for necessary public policies to reach the 2015 Paris climate agreement (Holmgren et al. 2019). Suffice to say, climate-change mitigation cannot primarily be based on investments in energy-efficient technologies but needs also be based on investments in innovative solutions that address human cognitive barriers for understanding why climate change is occurring and why nature is worth

protecting. Given the massive loss of global biodiversity on Earth today, it is urgent to reconnect humans to the Biosphere and promote a more active stewardship of urban ecosystems (Colding and Barthel 2013).

3. Lifelong learning

While it may be difficult to give a precise definition of what lifelong learning entails, Kreber (2005) relates it to learning that contains self-management, personal autonomy and social responsibility. A learning theory closely related to the notion of lifelong learning is constructivism that asserts that knowledge is not discovered passively of the world, or taught by authoritative sources, but "constructed by individuals based on experiences" (Yilmaz 2008:62). Constructivism as a pedagogic approach has the goal to deepen understanding in a specific subject matter and to nurture habits of mind that will aid in future learning (Richardson 2003). While lifelong learning encapsulates the notion of critical thinking, it also has the aim to nurture future learning. In this way it is a type of self-directed critical learning by being not only a goal in itself but also a process to manage a person's own learning outside the academic setting (Kreber 1998). Candy (1991) refers to such learning outside formal institutional settings as 'autodidaxy', which arguably qualify as the highest form of critical thinking.

According to Kreber (1998:2), lifelong learning is especially important to nurture due to that "rapid social, political, and technological change will render much of the knowledge taught in schools today obsolete tomorrow." Or, put differently: it is important so that students are able to "constantly adapt to cultural, technological and economic changes" (Kreber 2005:393). To this list of adaptations, one could add the challenges related to environmental degradation and climate change. Kreber discusses this in terms of 'environmental' or 'ecological literacy' that represent a significant goal of lifelong learning (Kreber 2005:398) and makes reference to the notion of Eagan and Orr (1992) of turning higher education institutions toward a twenty-first century environmental agenda.

Many educators emphasize that a university must act more environmentally responsible before its faculty can teach an environmental ethic. For example, Pike et al. (2003:2) argue that an "emphasis on sustainability in practice, rather than solely in theory", is a way forward to make HEIs more credible when it comes to environmental teaching. David Orr (1992) argues that no institutions in modern society are better able to catalyze the necessary environmental transition than colleges and universities. Making environmental problem-solving part of the curriculum

can improve education as well as make education more relevant and more interdisciplinary (Orr 1994). In her 2005-paper, Kreber discusses community-based education as a promising approach to foster skills and attitudes associated with "self-management, autonomy and social responsibility" (Kreber 2005:398). Among others she draws on the writings of Ehrlich (2001) that suggests that it is critical for students to go out in the community and solve real problems in teams. This idea parallels Boyer's notion about the 'scholarship of engagement' in which campuses could be viewed by both students and staff as "staging grounds for action", having a larger societal purpose (Boyer 1996:27).

4. CoP and Lifelong environmental learning

Communities of Practice (CoP) is a concept developed in educational theory as an approach for engaging people in groups, or social communities, originally coined by Lave and Wenger in 1991. In a CoP learning takes place as participation in a practice shared by a group of people with a common concern or passion for something and is viewed as the collective creation of knowledge through interaction among group members (McGrath et al. 2019).
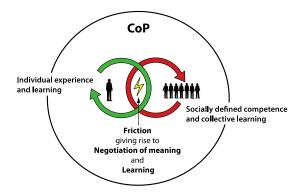

Fig 1. Renewal of social learning through boundary interaction. Friction in boundary interaction arises as individuals outside the CoP meet the socially defined competences of the members in a CoP. This may or may not renew individuals social learning. If individual experience and social competence diverge too much, there will be no common ground upon which to negotiate meaning, thus this will inhibit novel learning. Repeated interaction facilitated by boundary processes may create new spatially extensive communities and constellations. Source: Modified and adapted from Bendt et al. (2013).

The defining elements of a CoP are (i) a 'joint enterprise' of learning about a particular enterprise (e.g. gardening), (ii) 'mutual engagement' through which people bond and build social capital, and (iii) a 'shared repertoire' of rules, jargon, and metaphors that enable the

group or social community to reflect upon and understand its own state of development and to move forward (Wenger, 1998, 2000). These elements, formed as a result of continued collaboration in the enterprise, make up the boundaries of a CoP, which in turn determine whether one belongs to the CoP or not (Bendt et al. 2013). Experiences brought in from outside the CoP through boundary interaction (Fig. 1) generate friction as they encounter the socially defined competence of the group, giving rise to a negotiation of meaning as individual experiences and socially defined competences intertwine, or fail to intertwine, through practice (Bendt et al. 2013). Hence, social learning is ideally the result of boundary interaction.

Lave and Wenger (1991) use the term 'situated learning' for the kinds of social engagements in CoP that provide the proper context for learning to take place. Because the world is in constant flux, and conditions always change, any practice must be revived and reinvented, even as it remains 'the same practice'. While power dynamics, issues of trust, size, and spatial reach represent important challenges that may limit what should qualify as a CoP (Roberts 2006; McGrath 2019), there exist several accounts of autodidaxy-oriented CoPs geared at environmental learning (Boyer and Roth 2006; Muro and Jeffrey 2008; Krasny and Tidball 2009a, 2009b; Barthel et al. 2010; Bendt et al. 2013). In these, environmental knowledge is not learned in abstract ways, but through practice, comprising tacit, explicit and codified knowledge (Polanyi 1966; Leonard-Barton and Sensiper 1998). Bendt et al. (2013) and Barthel et al. (2010) studied CoP in relation to environmental learning among diverse groups of urban gardeners, such as allotment holders and public-access community gardeners, and found that learning among these groups did not only entail knowledge about gardening and local ecological conditions, but also about urban politics and social entrepreneurship.

5. Affective environmental learning

While Kreber's call for lifelong environmental learning has been proposed as a goal by many university administrators and faculty, this has not yet come about as reflected in real changes in the process of higher education teaching (Kreber 1998). Lozano et al. (2013) and Lozano (2011) found that in spite of an increasing number of universities becoming engaged with sustainable development, most HEIs are still lagging behind private companies in helping societies become more sustainable. While it may be difficult to change environmental attitudes and values in society (Alaimo and Doran 1980; Iozzi 1989; Gifford 2011), universities have a pivotal role of fostering coming generations of humans by training and educating students and due to that universities participate in governance at the national and regional levels (Sedlacek

2013). In this sense they represent pivotal socio-cultural arenas for practical change in navigation towards a more sustainable future (Colding and Barthel 2017).

There is plentiful evidence of that universities, colleges and other higher education communities could play a more active role in speeding up pro-environmental attitudes and behavior in society where critical thinking is pivotal. Brookfield (1987; 1990), for example, argues that critical thinking has an emotive or affective component that is central to the process of learning; hence, affective learning appears to be key in such transition. Affective learning (Fig. 2) is part of Bloom's Taxonomy of learning, and characterizes the emotional area of learning reflected by the beliefs, values, interests, and behaviors of learners (Krathwohl et al. 1964; Boyle et al 2007). Affective learning is concerned with how learners feel while they are studying, as well as with how learning experiences are internalized so they can guide the student's attitudes, opinions, and future behavior (Miller 2005). This type of learning complements cognitive learning that involves the construction of knowledge and how the learner describes, understands, uses, analyzes, synthesizes, and assesses this knowledge (Boyle et al. 2007; Shephard 2008).

Researchers in environmental education have for long recognized the important role that affective learning has in promoting environmental attitudes and values (Iozzi 1989). Blasco and Moreto (2012) argue that because people's emotions play a specific role in environmental learning, educators cannot afford to ignore students' affective domain since it is difficult to refine attitudes, acquire virtues, and incorporate values without critical reflection (see e.g. Buissink et al. 2011). Research also show that there exist a number of affective learning approaches that can be adopted at HEIs for boosting pro-environmental attitudes and behavior among students. Examples include outdoor education and recreation (Davis et al. 1980; McDaniel and Alley 2005), active land management (e.g. Theodori et al. 1998; McKinney 2002), campus recycling programs (Ching and Gogan 1992), and collectively managed green- and blue infrastructure at university campuses (Colding and Barthel 2017). Moreover, different types of course-embedded community-work, trans-disciplinary case studies and project-based learning seem particularly potent in enabling students to tackle complex real-world problems (Shephard 2008).
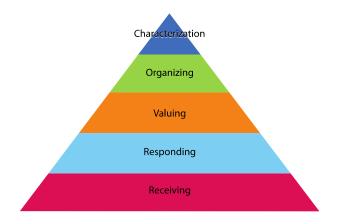
Fig. 2. Affective learning involves five stages in a progressive hierarchy. It includes 1) an ability of the individual to passively receive information from others, to being able to choose and direct attention towards a specific information; 2) the individual actively attends and respond in voluntary interactions with others, which can be seen as a proxy for an emotional response to learning; 3) the individual is able to internalize a set of values or attitudes that result in active control of behavior and motivation to act out the behavior; 4) the individual is able to internalize a multiplicity of values leading to a need to organize values into a system and from this being able to differentiate among values and to establish values that are robust and pervasive; and 5) the individual has now reached the stage of being able to internalize the values that has become a system of attitudes that control the individual's behavior, resulting in a set of beliefs and a more wholistic world view. Modified and adapted from Krathwohl et al. (1964).

While not considered central in environmental science education, Boyles et al. (2007) found that fieldwork leads to significant effects in the affective domain with student responses heightened prior to fieldwork and with students becoming more positive to fieldwork as a result of the field experience. Fieldwork comprises any component of the curriculum that involves leaving the classroom and learning through first-hand experience. Since fieldwork tend to be more common in subject fields such as geography, earth sciences and the environmental sciences (Boyles et al. 2007), students not involved in those subjects may be devoid of affective environmental learning, suggesting that teaching perhaps at a minimum need to comprise social and economic field works geared at sustainable development.

6. CoP and environmental stewardship at the university setting

In congruence with other studies demonstrating that active land management boosts environmental learning, universities could form smaller CoP that promote 'environmental stewardship'. Eagan (1992) has pointed out that the word stewardship is rarely heard in educational institutions. He goes on contending that:

"a perspective on stewardship makes eminent sense in schools, colleges, and universities: places where we transmit what is important about our cultures and our world. It is an idea with powerful implications for what we value, how we live, and, notably, how we educate" (Eagan 1992:67).

In an ecological context, stewardship is about getting involved and implies taking care of a place, whether a natural area or an urban location or scenery (Orr 1992; Andersson et al. 2014). Drawing on Aldo Leopold's idea of "all-campus teaching" based on the principles of wildlife ecology as an integral part of liberal education, Orr (1992) argues that the university setting lends itself for students to enroll in "local projects" that could provide "vital local facts and questions."

While Communities of Practice were originally presented as evolving spontaneous due to the members' common self-interest in a particular domain or area (Lave and Wenger 1991), later work suggests that it can be deliberately created to gain knowledge in a specific field (Wenger 2000; Wenger et al. 2002). Hence, CoP have lately been formed in a wide variety of organizational contexts (Roberts 2006), even so at higher education institutions (see e.g. Moore 2008; Smith et al. 2017; McGrath et al. 2019).

Colding and Barthel (2017) provide examples of environmental stewardship taking place at university campuses, ranging from river wetland management through basic and applied research, to community-managed forests, conservation of endangered species and practical biodiversity management. Hence, a university or college could form CoP that promote environmental stewardship on their own campus settings, or alternatively, at natural sites outside the university. The campus setting could in this way become an arena for research and environmental stewardship. Students could, for example, by way of case-study based projects document various outcomes of hands-on management practices and even organize such an activity as yearly, reoccurring learning relays to monitor change in sustainability indicators such as shifts in biodiversity over time and space (ibid). This, however, requires that a university or college consider students as co-creators of knowledge, gatekeepers to community development and as lifelong environmental learners. Hence, a revitalization of Blooms taxonomy of affective learning could be a way forward for universities and colleges to help restore humans' emotional affinity with nature.

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