Society's Response to Environmental Challenges:
Citizenship and the Role of Knowledge

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Introduction

As human beings we ultimately depend on the services that ecosystems provide, such as food production, nutrient recycling and flood buffering[1], hence, current losses of such ecological goods and services and necessary ecological conditions constitute a real threat[2]. The interdependence of society and nature, the inherent complexity of such social-ecological systems[3] and the rapid deterioration of ecosystem services across the globe provide the

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[1] Millennium Ecosystem Assessment, *Ecosystems and Human Well-being: General Synthesis* (Washington, DC: Island Press, 2005).
[2] Johan Rockström, Will Steffen, Kevin Noone and Åsa Persson … J. Foley, "A Safe Operating Space for Humanity," *Nature* 46 (2009).
[3] Fikret Berkes and Carl Folke, *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience* (Cambridge, United Kingdom: Cambridge University Press, 1998).

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rationale for a growing body of literature focused on sustainability[4] and the importance for societies to build capacity in dealing with these issues[5].

Consequently, current times are demanding in that they ask us and our societies to address these challenges the best possible way, and also at some speed. It is against this background that I will discuss the concept of citizenship and knowledge and point to a need for addressing societal (economic and political) along with ecological understanding, while also raising concern for understanding of the relation between society and nature as being unpredicted, non-linear and complex.

The paper is outlined as follows. It starts with picturing environmental education and learning, its aims and purpose, followed by particular work relating to environmental education, learning and citizenship. How societies different 'actors' are dependent on each other in responding to environmental challenges is described and specific focus is on the interactions of government, business and the individual (as citizen, voter and consumer). The paper then addresses what knowledge could help citizens understand environmental problems and society's ways of responding.

Environmental education and learning

Environmental education developed during the 60's and 70's in response to a growing awareness of environmental deterioration of that time. A book that became en eye opener for many was *Silent Spring* by Rachel Carson in 1962. Since its start, environmental education has developed in many different directions and is today a diverse field (see for an overview see Lucie Sauvé[6]), which serves different goals and purposes and has increasingly generated interest as sustainable development and acute issues such as climate change are on the agenda. The interest dates back to the 1977 UNESCO conference in Tbilisi to the current Decade of Education for Sustainable Development, which in 2009, reached mid term. In recent years there is evidence of a growing research interest in environmental education and learning, which is reflected in publications such as *Participation and Learning: Perspectives on education and the environment, health and sustainability* (Reid, et al. 2008); *Environmental Learning. Insights from research in to the student experience* (Rickinson, Lundholm and Hopwood 2009), and *Resilience in Social-Ecological Systems: the Roles of Learning and Education* (Krasny, Lundholm and Plummer, 2011).

It is noted that environmental learning has many different objectives and a *range of foci and outcomes*. William Scott and Stephen Gough, for example, identify 'nine categories of interest which capture, albeit in a rather tentative way, a range of different focuses and

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[4] Sustainability and Sustainable Development are used as synonyms in this article, and defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs (World Commission on Environment and Development, 1987).
[5] Carl Folke, Steven Carpenter, Thomas Elmqvist, Lance Gunderson, Crawford Holling and Brian Walker, "Resilience and Sustainable Development: Building Adaptive Capacity in a World of Transformations," *Ambio* 31 (2002).
[6] Lucie Sauvé "Currents in Environmental Education: Mapping a Complex and Evolving Pedagogical Field," *Canadian Journal of Environmental Education* 10 (2005).

objectives of those who espouse and promote environmental learning'[7]. This can be seen as clarifying some of the foci (e.g., nature, conservation and social change) and desired outcomes (e.g., values and feelings, understanding, skills, behaviors, social justice and democratic citizenship skills) of learning associated with different kinds of environmental education.

Paul Vare and William Scott identify two complementary approaches to 'learning for a change' in education for sustainable development[8]. The first (ESD 1) promotes learning that focuses on informed and skilled behaviors and ways of thinking in circumstances where needs are clear and agreed. The second (ESD 2) is described as 'building capacity to think critically about what experts say and to test ideas, exploring the dilemmas and contradictions inherent in sustainable living'[9]. The authors stress that both the approaches are necessary and are not incompatible. On the one hand, without knowing the facts, one cannot cast value judgments or critically analyze what measures are appropriate to take at a specific time and place. On the other hand, the 'uncertainty' of facts in light of a future that is largely unknown, highlights the need for critical thinking and open-ended learning. The later relates to the complexity and uncertainty of ecological systems; we are dealing with planetary systems, along with local ecological systems, their inter-linkages, and the many variables (known and un-known) that have non-linear effects. However, while stressing complexity and uncertainty, we must also acknowledge environmental problems (causes and effects) that are known, and identify possible and adequate responses in terms of governmental policies, regulations and other means, and I will return to this aspect later.

Looking at environmental education, its aims and purpose, other writers have distinguished between education with vocational purposes from more general fostering of knowledge and understanding[10]. It is suggested that environmental learning serves purposes of raising awareness, promoting moral understanding and developing meta cognitive skills (and systems dynamics thinking), or, intellectual developments alongside more activist outcomes, hence aiming at developing students' knowledge and critical thinking so as to enable them to participate and take action as citizens, voters, and consumers. Such ideas have, for example, informed Bjarne Jensen and Karsten Schnack's notion of 'action competence' in environmental education[11]. Louise Chawla and Debra Cushing provide an overview of research on education aiming at enhancing behavior or action that decrease individual's / individuals' negative impact on nature and increases life sustaining actions (including new procedures and management). The authors present a typology of different foci within this body of research and conclude on the emphasis in environmental education to focus on the 'private sphere': "[…] environmental education, as well as measures of behavior in environmental education research, typically emphasize private sphere environmentalism at the

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[7] William Scott and Stephen Gough, *Sustainable Development and Learning: Framing the issues.* (London: Routledge, 2003), 54.
[8] Paul Vare and William Scott, "Learning for a Change: Exploring the Relationship Between Education and Sustainable Development," *Journal of Education for Sustainable Development* 1 (2007).
[9] ibid., p. 191
[10] See for example Karsten Schnack, "Participation, Education, and Democracy: Implications for Environmental Education, Health Education, and Education for Sustainable Development," in *Participation and Learning: Perspectives of Education and the Environment, Health and Sustainability*, edited by Alan Reid, Bjarne Jensen, Jutta Nikel, and Venka Simovska (London: Springer, 2008).
[11] Bjarne Jensen and Karsten Schnack, "The Action Competence Approach in Environmental Education," *Environmental Education Research* 3 (1997).

expense of preparing students for public action, and environmental educators often fail to engage students in a strategic analysis of the most effective way to address problems. Because such an analysis shows that big institutions like Government and industry are major sources of solid waste, pollution and the consumption of nonrenewable resources, as well as structural barriers against more conserving lifestyles, it is critical for schools and out-of-school environmental programs to prepare students for political action" [12].

Citizenship, environmental education and learning

Given this introductory summary of the field of environmental education and learning, I discuss the connections among the concepts of citizenship, education and the environment. Joel Westheimer and Joe Kahne pose the question of *What kind of citizen do we need to support an effective democratic society?* as a starting point for elaboration on three different typologies in relation to visions for teaching and learning: the *personally responsible,* the *participatory citizen,* and the *justice-oriented citizen*[13]. They conclude that teachers' different conceptions of what citizenship means has consequences as these conceptions are related to the outcomes of students' learning. The findings show that teaching with a vision of citizenship as being participatory did not raise students understanding of root causes - i.e. structural, economical, political - to social problems, while a justice-oriented vision did. These results can be compared to Stephen Gough and Williame Scott's discussion of citizenship in relation to environmental education[14], where type 1 and 2 (cf. ESD 1, Paul Vare and William Scott 2007) and type 3 (cf. ESD 2, Paul Vare and William Scott 2007) of environmental learning can be compared with the terminology used by Joel Westheimer and Joe Kahne. Education aiming at the 'participatory citizen' corresponds with ESD 1 in that students take part in actions that enhance or sustain the environment, but does not mean that they understand the 'rote causes' of environmental problems in terms of them being economical, political or social. ESD 2 and 'justice-oriented' citizen highlights both a knowledgeable and reflective view of environmental problems, and the governance thereof, but, I would add, stresses that problems (causes and effects) are not clear-cut and the relation between individual(s), society and nature is complex (as is nature and society *per se*).

When looking at the field of environmental education it is worth noticing current debates on what role environmental education can play[15]. Discussions concern for example

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[12] Louise Chawla and Debra Cushing, "Education for Strategic Environmental Behavior," *Environmental Education Research* 13 (2007), p. 448.

[13] Joel Westheimer and Joe Kahne, "What Kind of Citizen? The Politics of Educating for Democracy," *American Educational Research Journal* 41 (2004); ibid., p. 239

[14] Stephen Gough and William Scott, "Promoting Environmental Citizenship Through Learning: Towards a Theory of change," . in *Environmental Citizenship,* edited by Andrew Dobson and Bell (Boston: MIT Press, 2005).

[15] William Scott, Environmental Education Research: 30 Years On From Tbilisi," *Environmental Education Research* 15 (2009); Marianne Krasny, "A Response to Scott's Concerns About the Relevance of Environmental Education Research: Applying Social-Ecological Systems Thinking and Consilience to Defining Research Goals," *Environmental Education Research* 15 (2009); Marianne Krasny, Cecilia Lundholm and Ryan Plummer. *Resilience in Social-Ecological Systems: the Role of Learning and Education* (London: Routledge, 2011); Cecilia Lundholm and Ryan Plummer, "Resilience and Learning: A Conspectus for Environmental Education. Special issue Resilience in Social-Ecological Systems: the Role of Learning and Education," *Environmental Education Research* 16, no. 5-6 (2010).

education as 'behavior change vs. democratic participation'[16]. The interest in the topic of (democratic) participation and environmental education has mainly attracted scholars in Northern Europe[17]. However, with the term 'civic ecology' used by Schusler, Tania, M.arianne Krasny, Scott Peters and Daniel Decker proponents enquire into, and sustain practices, which engage youth in for example gardening projects, enhancing their understanding of the ecological and societal dimensions of environmental issues, along with creating knowledge of 'action' (as citizens). This leads to a *direct* influence of sustaining nature, and, also learning about the society and ways of dealing with environmental problems. Another example of environmental education that includes this participatory and learning aspect is where students are involved in local environmental projects such as watershed management.

Society's response to environmental challenges - understanding interdependence for action

In order to understand the nature of responses and actions that are appropriate when facing environmental problems, we need to recognize that we are dealing with the 'tragedy of the commons'[18], which Elinor Ostrom has researched extensively[19]. Also, in social-psychological terms, environmental problems are 'social dilemmas'[20]. A social dilemma means that people attach more weight to their private interests than to what is best for the common good in a long-term perspective; hence, private interests are at odds with common interests. They are also examples of 'prisoner's dilemma' as each individual and citizen probably wonders whether others are taking action or not, and pondering: 'well, if no one else is taken action, my change of behavior will not have any impact'. The other problem is the so-called 'sucker effect'; a person deciding not to fly for holidays in order to reduce carbon emissions find that friends and others still are[21]. Thus s/he is looses out on a holiday abroad, while also ending up being alone in doing something positive with regard to the environment; hence the term 'sucker effect'. These dilemmas and problems need to be highlighted in the times we are living in; trying to raise awareness and mitigate climate change in the context of international (COP 15) and national negotiations and strategies for moving forward.

More fundamentally, there is also a clear need for critical discourses about difficult tradeoffs. Robin Grove-White writes about social learning in times which "signal that we are now well and truly into Burke's era of the '*hard* politics' of the environment - an era in which meaningful initiatives aimed at correcting destructive trends will incur costs to, and hence strong resistance from, major groups in society. /.../ The creation of political consensus around

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[16] Tania Schusler, Marianne Krasny, Scott Peters and Daniel Decker, "Developing Citizens and Communities Through Youth Environmental Action," *Environmental Education Research* 15 (2009); Jeppe Læssøe, "Education for Sustainable Development, Participation and Socio-Cultural Change," *Environmental Education Research* 16 (2010).

[17] See for example Alan Reid, Bjarne Jensen, Jutta Nikel and Venka Simovska, *Participation and Learning: Perspectives on Education and the Environment, Health and Sustainability* (Dortrecht: Springer, 2008).

[18] Garret Hardin, "Tragedy of the Commons," *Science* 162 (1968).

[19] See for example Elinor Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (Cambridge: Cambridge University Press, 1990).

[20] Samuel Komorita and Craig Parks, *Social Dilemmas* (Boulder: Westview Press, 1996).

[21] ibid.

meaningful government action on matters of central environmental policy significance is becoming ever more difficult"[22]. Andreas Duit observes that democracy may be hard pressed to make these decisions because "There is somewhat of an environmental protection Catch 22 at work here, or perhaps an institutional paradox - institutions are required to create norms, but these institutions can only be established if they are considered normatively appropriate"[23]. This point can be illustrated by recent governmental policy in Europe (Sweden, England and the Netherlands) on congestion charges, which unfortunately has not yielded much positive response among the public, on the contrary, despite the fact that a congestion charge is a successful mean to enhance collective action. Figure 1 illustrates this point: governments (2 in figure 1) in democracies need the support of the citizens for such policy decisions to be made, and, individuals (1 in figure 1) as citizens need governments to take such decisions in order to create action that has real positive (or reduces negative) environmental impact. Also, when considering the environment in relation to production and consumption, business (3 in figure 1) need clear defined goals from the government, possible subsidies, etc., while simultaneously being dependent on the knowledgeable consumer' making informed decisions and purchasing environmentally-friendly goods and services.

Figure 1

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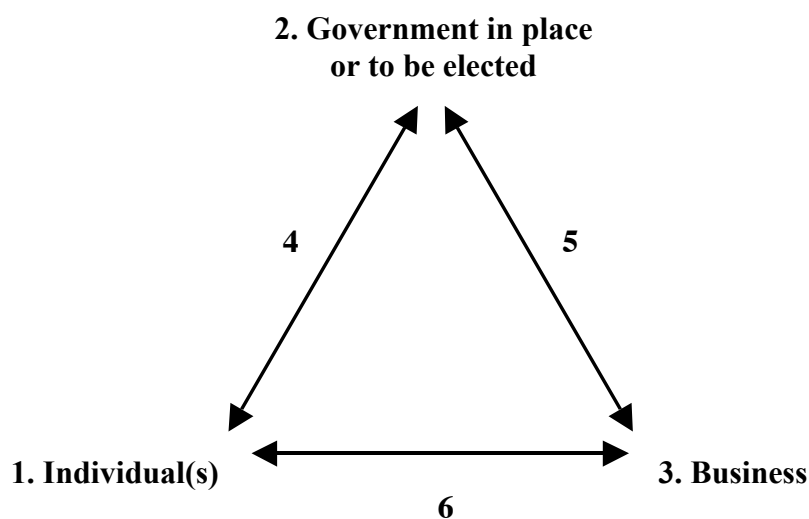
[22] Robin Grove-White, "Uncertainty, Environmental Policy and Social Learning. *Environmental Education Research* 11 (2005), p. 22.

[23] Andreas Duit, "Staten och hållbarheten/The State and sustainability. I Att handla rätt från början. En kunskapsöversikt om hur konsumtions- och produktionsmönster kan bli mer miljövänliga," In *Doing the right thing. A review of environmentally friendly ways for consumption and production* (Stockholm: Environmental Protection Agency, 2002), p. 31.

Figure 1. The relationships and interdependence of the individual (as citizen, voter and consumer), the government and business in dealing with environmental problems and sustaining nature's services in democratic states.

Thus, in democracies, in relation to the description above of research and interest in participation and environmental education, it is not enough to pursue an agenda that i) describes and talks of the environment (or environmental problems) in very simplistic, stable ways, or, in a general sense; bundling all kinds of problems together (local water problems, climate change, recycling, etc); and, ii) does not consider the wider political and economical context of participation, and, iii) advocates a simplistic discourse where top-down equals bad, and bottom-up equals good[24]. Naturally, this does not mean that social movements or bottom-up initiatives are not needed, on the contrary, they might be the actors on the societal stage making governments push such agendas, or help the public realize and understand important issues. But, 'democratic participation' must include the many various forms in which a society and its citizens take measures in dealing with environmental problems and sustain its resources. Naturally, taking account of context suggests that other ways for change would be prevalent or necessary in for example communist countries with a one-party system and a communist economic system and not a market economy[25].

It is equally important to recognize that individual(s)' behavior change due to environmental education is not straight forward, on the contrary[26], and, also, it is difficult to see as a way for change resulting in reasonable *environmental impact* (because of the prisoner's dilemma that people find themselves in). However, some environmental issues seem to be solvable with information alone (as in recycling batteries, etc.) while others, demanding that we pay (more), seem challenging in that people are caught in the social and prisoner's dilemma, and, may lack necessary economic understanding to grasp the reasons and rationales for taxations.

'In what circumstances should something be made available to people for free?' is, for example, a question of relevant interest to ask in the context of governments struggling with their responsibilities in the face of environmental pressure and the aftermath of the global financial crisis. As mentioned, transport costs illustrate this point. Economic growth is accompanied by a greater than proportionate use of roads which produces a range of social and environmental costs (congestion and pollution) that are not borne by the individual road user. Hence, government actions in the face of this problem are taken in the light of the reactions of the median voter. It therefore matters how citizens judge the circumstances in which goods and services should be made available for free, and what knowledge they have in assessing such issues. With an interest in students' understanding of price and the question posed initially, *'In what circumstances should something be made available for free',* Davies

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[24] Cecilia Lundholm, "Review of Participation and learning: perspectives on education and the environment, health and sustainability by Alan Reid, Bjarne Jensen, Jutta Nikel and Venka Simovska. Eds.," *Children, Youth and the Environment* 19, no. 1 (2009).

[25] Li Sternäng and Cecilia Lundholm, "Climate Change and Morality: Students' Conceptions of Individual and Society," *International Journal of Science Education* (2010)*;* Li Sternäng and Cecilia Lundholm, "Climate Change and Costs. Investigating Students' Reasoning on Nature and Economic Development (under review).

[26] Anja Kollmuss and Julian Agyeman, "Mind the Gap: Why Do People Act Environmentally and What are the Barriers to Pro-Environmental Behavior?" *Environmental Education Research* 8 (2002).

and Lundholm investigated 11 to 23- year olds reasoning on these issues in England[27]. Students discussed the question in relation to private and public goods (roads), and natural resources like water and beach. The results show that the majority of the students either answered, 'yes/no, it should, because that's the way it has been', hence, the questions were answered in relation to what was perceived as 'normal'. The students who elaborated on price in terms of, for example, merit good (people need water, hence it should be free) or as an incentive for behavior (water should be priced or it will be over consumed) retreated to the government when considering who should pay and cover the costs. The students seem to lack an understanding of the relationship between taxation and government spending, which is in line with a previous investigation by Davies et al showing that students' understanding of the relationship between taxation and government spending is poor[28].

Although there are studies of students' political understanding and political socialization[29]few studies have paid particular interest to the economic understanding of students, yet this is of importance in regards to the understanding of society; the individual and the collective – and the social, economical and environmental consequences. Drawing on earlier work on empirical studies on students' economic understanding by Davies et al. (2002), the authors conclude that: "Citizens who understand how their own economic interests are bound up with the interest of other citizens are more likely to support government actions that take all citizens' economic interest into account. They are also more likely to appreciate longer-run implications of economic policy and this may reduce scope for governments to secure short-term support at the expense of long term disadvantages"[30].

Implications for teaching

In the following I discuss what I see as implications for teaching with regards to citizenship, environmental education and knowledge. The section starts discussing content and subject knowledge, followed by considering environmental education that provide students with situations where their actions have a direct and positive effect on nature. Finally, some words on the aspect of complexity and systems understanding.

Content and subject knowledge

It is necessary that environmental education aims at helping students gain societal understanding (the interdependence of different actors as outlined above and the social dilemma of environmental problems) and the ways society can respond to environmental challenges. This entails economical and political domain specific knowledge. It should be noted, however, that the vast majority of studies of students' understanding in environmental education have focused on natural scientific understanding, in for example understanding

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[27] Peter Davies and Cecilia Lundholm, "Students' conceptions of price: some issues in the development of understanding of socio-economic phenomena," unpublished manuscript.
[28] Peter Davies, Helen Howie, Jean Mangan and Shqiponja Telhaj, "Economic Aspects of Citizenship Education: An Investigation of Students' Understanding," *The Curriculum Journal* 13 (2002).
[29] See for example Lawrence Saha, Laurence, Murray Print and Kathy Edwards, *Youth and Political Participation* (Rotterdam: Sense Publishers, 2007).

[30] Peter Davies, "Educating Citizens for Changing Economies," *Journal of Curriculum Studies* 38 (2006), p. 20.

climate change as a problem in the natural sciences[31] and thus not as a societal, economical or moral problem.

Firstly, *economics understanding* is an important aspect as it allows students to understand the 'relationship between the private and social well-being'[32] and I would add, the environment. I concur with Davies in that economics for citizenship includes two dimensions: "It should focus on *choices in the way that markets, government, and other means of social engagement are deployed.* Secondly, students should be taught to understand the *relationships between private and social benefits and costs* and to evaluate *outcomes in terms of the relationship between social costs and benefits"*[33]. However, economics understanding can help students assess and elaborate on means for dealing with environmental problems and sustain resources, thus not only *social benefits or social costs* needs to be considered, but also the *environmental benefits and costs.*

Secondly, *ecological understanding* is of importance. The understanding of for example photosynthesis and chemical processes are necessary for coming to understand natural science and successfully progress in the subjects. However, from a citizenship point of view, detailed understanding of nature might not serve the purpose of helping students understand how nature works and *why* we need it. It is therefore important to consider nature in terms of the services it provides and develop an understanding of why nature is essential, and, how we affect ecosystem services in different ways (e.g. climate change). This focus generates another way of entering, and possibly 'categorizing', nature, as in looking at 'eco systems services' that are *supporting* (e.g. nutrient cycling), *provisioning* (e.g. food, fiber, fuel), *regulating* (e.g. climate, flood), and *cultural* (e.g. recreational, aesthetical).[34]

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[31] For example, Björn Andersson and Agneta Wallin, "Students' Understanding of the Greenhouse Effect, the Societal Consequences of Reducing CO2 Emissions and the Problem of Ozone Layer Depletion," *Journal of Research in Science Teaching* 37 (2000); Debbie Batterham, Martin Stanisstreet and Eddie Boyes, "Kids, Cars and Conservation: Children's Ideas About the Environmental Impact of Motor Vehicles," *International Journal of Science Education 18* (1996); Eddie Boyes and Martin Stanisstreet, "The Greenhouse Effect: Children's Perceptions of Causes, Consequences and Cures," *International Journal of Science Education* 15 (1993); Daniel Shepardson, Dev Niyogy, Soyoung Choi and Umarporn Charusombat, "Seventh Grade Students' Conceptions of Global Warming and Climate Change," *Environmental Education Research* 15 (2009).
[32] Davies "Educating Citizens for Changing Economies."
[33] Ibid., pp. 20-21, italics in original
[34] www. millenniumassessment.org

Figure 2

2. Nature

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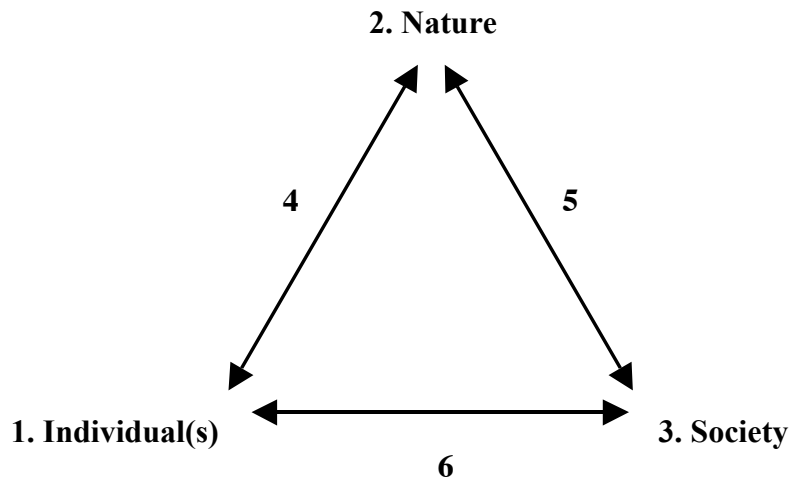
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1. Individual(s)

3. Society

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Figure 2. Different aspects and relations of environmental and sustainability issue (Lundholm, 2008; see also Rickinson, Lundholm and Hopwood, 2009. Adapted from Steiner, 1993).

In sum, environmental knowledge for citizenship is comprised of different aspects, and relations, that are illustrated in figure 2. These include:

- *Individual* – this aspect focuses on the individual; human behavior, interest, and moral views. (Behavioral sciences, education). (1 in figure 2).
- *Nature* – this aspect focuses on nature. (Ecology, biology, chemistry, geology, physics, meteorology). (2 in figure 2).
- *Society* – this aspect concerns societal systems and structures, as in economic systems, political organization and the functioning of institutions, as mentioned. It also includes prevalent norms, worldviews and discourses. (Political science, economics, geography). (3 in figure 2).
- The relationship between *individual and nature* includes students' conceptions of how individuals' attitudes and behavior affect nature, and, in turn, how environmental changes affect individuals, their attitudes and behaviors. (4 in figure 2).
- The relationship between *nature and society* includes the students' conceptions of both societal effects on nature, and the effect of nature on society. For example, students' conceptions of the way institutional decisions affect nature, and, ways of institutional adjustments due to environmental changes. (5 in figure 2).
- The relationship between *individual and society* focuses on how the students perceive issues such as responsibility and democracy, in relation to themselves and other

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people, and how they perceive that individuals are influenced by society's norms and regulations, and vice versa. (6 in figure 2).

In the context of discussing citizenship, environmental education and knowledge, it is of interest to consider environmental education that aims at creating interactions among environmental education, youth development and sustainable development. As mentioned, Tania Schusler and colleagues, and Krasny and Roth provide nice examples of students gaining knowledge of both the ecological and societal aspects (and their linkages) when working in gardening projects or water management[35]. However, with regards to the framework introduced by Westheimer and Kahne on citizenship, it is necessary to realize that such sustainable action might be limited to the 'here and now' (the present and local environment), whereas much of our environmental impact as citizens today is global (due to international consumption and production), and also that climate change is a global and planetary process and phenomena, which is caused by local action and will have different impact locally.

Uncertainty and complexity - systems dynamics and meta cognition

Climate change has been mentioned in this paper as a challenging problem, not the least because we are unsure of the exact consequences. We know of draught, the melting North Pole, drastic reduced effect of bio-diversity, but, since there are so many variables interacting with regards to the climate, there is great uncertainty as to what will really happen. In Sweden, we hear of warmer summers, and the possibility of harvesting twice. But, that is if all other aspects stay the same (same amount of rain, same soil conditions, etc.). However, our ecological system might change more dramatically (flip in to a new state), and, more importantly, it would be difficult to know if we were close to such a threshold.

This suggests that what we know at present is uncertain, and, what we know of the future as well. Understanding systems dynamics in general, which is part of both ecology and economics, has raised increasing interest in recent years[36]. Understanding that causal relations are non linear and work in dynamic ways in complex systems can be helpful, but not necessarily an easy way of looking at and considering this uncertainty. This also leads to the aspect of meta cognition – our thinking about our thinking – and considering what we know, and how we view knowledge, that is, our epistemological understanding[37].

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[35] Tania Schusler, Marianne Krasny, Scott Peters and Daniel Decker, "Developing Citizens and Communities Through Youth Environmental Action," *Environmental Education Research* 15 (2009); Marianne Krasny and Wolff-Michael Roth, "Environmental Education for Social-Ecological System Resilience: A Perspective From Activity Theory," *Environmental Education Research.* Special issue Resilience in Social-Ecological Systems: the Role of Learning and Education 16, no. 5-6 (2010).

[36] See for example Anne Dale and Lenore Newman, "Sustainable Development, Education and Literacy," *International Journal of Sustainability in Higher Education* 6 (2005); David Wheat, The Feedback Method: A System Dynamics Approach to Teaching Macroeconomics. PhD diss., University of Bergen (2007). https://bora.uib.no/handle/1956/22Wheat 2007; Diana Garavito and Cecilia Lundholm, "Systems dynamics thinking and conceptual development: a case of fishermen's understanding of eco systems." Paper presented at the 7th international conference on Conceptual Change, European Association for Research in Learning and Instruction, Leuven, Belgium, 24-26 of May, 2010

[37] Lucia Mason and Fabio Scirica, "Prediction of Students' Argumentation Skills About Controversial Topics by Epistemological Understanding," *Learning and Instruction* 16 (2006).

Conclusion and discussion

Current times are demanding, in that they ask us and our respective societies to address environmental challenges the best way possible and also at some speed. It is against this background that I have discussed citizenship and knowledge and in particular the role of socioeconomic understanding, and, also raised concern for understanding relationship between society and nature as being unpredictable, non-linear and complex. In this final section I summarize the main points and provide recommendations for environmental education.

- *Student perspective*. As part of any recommendation on education and teaching it is important to take a student perspective and view students as subjects of education, thus considering environmental learning from the perspective of those who are doing it. Rickinson, Lundholm and Hopwood provide a comprehensive description of students' environmental experiences and learning and summarize empirical work in the field. Their findings stress the need to acknowledge that students enter educational settings with experience, knowledge, interests and concerns. Baring this in mind, environmental issues - often contested and complex - will have different meanings, and result in differences with regard to engagement and interest on the students' part.
- *Content*. An overview of the different aspects that environmental education deals with is provided in figure 2; for further elaboration on the figure please consult Rickinson, Lundholm and Hopwood (2009). It highlights the necessity of considering nature, society, and the individual in environmental instruction. As I have argued in this paper, it is particularly necessary to bring into focus a societal and economic content as part of environmental education. This is important as it allows students to recognize what are *best possible solutions* and a *'societal toolkit',* in dealing with various environmental problems. Figure 1 highlights the interdependent nature of the relationships between individuals and institutions within society. This needs to be part of a curriculum that aims to help students understand the complexity of dealing with environmental problems. Looking at solutions is in focus when considering the relationship between society and nature; however, it is important to acknowledge *what* kinds of environmental problems are considered - and what kinds of solutions or management is required in each case. For example, it is necessary to consider the difference between local, regional and global environmental effects (ecosystems/services) and resource depletion (oil, minerals, etc).
This paper has also pointed to the fact that we are facing problems that are inherently complex and un-predictable. It is therefore recommended that students are introduced to systems dynamics thinking, which is at the core of subjects like ecology and economics, helping them generate insights that the worlds works in non-linear and unforeseen ways.
- *Pedagogy*. The term pedagogy is here used to address the design - the *how* - of environmental education. Research findings conclude that dialogue, among peers and teacher-student, is an important way for enhancing learning. As environmental topics are contested and complex, allowing for multiple perspectives in the classroom is important. However, as Rickinson, Lundholm and Hopwood show, students can be reluctant to share their views with teachers and peers for various reasons. This, along

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with the fact mentioned, that students are different, and the importance of being attentive to this aspect, calls for variation and use of multiple tasks and design. It is further recommended that education be provided that engages students in current, local (but with global consequences) societal issues that student find meaningful (cf. Schusler et al. 2009; Krasny and Roth, 2010) (See also Scott 2010, for further recommendations congruent with these).

- *Time.* A few words on the aspect of time are warranted. Learning is in itself a complex, difficult and unpredictable process. If we further acknowledge that what is to be learnt in environmental education is often challenging (because of emotionally charging topics and being abstract as in multiple perspectives and complex relations) we need to allow for the learning process to take time. A recommendation, although general for much of today's curricula, is therefore to design environmental education so it considers the longitudinal aspect, that is, instruction that takes into account conceptual development over 12 years of compulsory education and beyond. This means that important environmental content should be considered and introduced with a long time perspective in mind, allowing for real progression due to both education and maturation[38].

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[38] Cf. Stella Vosniadou, Xenia Vamvakoussi and Irini Skopelti, "The Framework Theory Approach to the Problem of Conceptual Change," in *International Handbook of Research on Conceptual Change*, ed. Stella Vosniadou (London: Routledge, 2008).

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