

## CROSSING DISCIPLINARY BORDERS: PERSPECTIVES ON LEARNING ABOUT SUSTAINABLE DEVELOPMENT

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### **Abstract**

*With regard to education, traditional environmentally-related issues have been intertwined with courses in natural sciences, which could entail opportunities as well as difficulties. The study concerns two knowledge matters that are usually divided into two different subject traditions – water and justice. In this article, we focus on the way teachers consider instruction within the frameworks of these two discourses and how teaching is related to sustainable development. The findings suggest that water and justice are two examples that are suitable for the problematisation of sustainable development with respect to holistic education. Current educational policies in Sweden advocate a tendency towards a more closed and subject-centred discourse, which means that the ability to successfully teach about sustainable development is made even more problematic.*

**Key words:** *content, teaching, learning, civic science, socio-scientific, sustainable development*

### **Introduction**

*Global environmental change and a new agenda for teaching and learning*

The industrialised world has developed into a production and consumption society with a highly advanced level of industrialisation. This process has led to markedly increased demands for energy, water and other natural resources. In developing countries, there is an increasing demand for a standard of living and consumption that is similar to that in the Western world. Until the 1960s, an awareness of environmental changes as a result of the industrial society was relatively low, and the first warnings of environmental changes crossing national borders did not emerge until they were related to the use of dichloro-diphenyl-trichloroethane and mercury in agricultural pesticides (Carson, 1962/2002). Another example is the acidification of water systems due to coal and oil combustion, especially in Scandinavia. Attempts to solve these problems have been made, while others have emerged. For instance, the radically increasing energy consumption in the Western world and, now, in several de-

veloping countries has contributed to huge emissions of greenhouse gases which are quite unambiguously regarded as a major cause of global warming. In this way, global warming is a result of human's usage of natural resources, which indicates that the changes are global and can be related to climate change (Mitchell, Lowe, Wood, & Vellinga, 2006), which is no longer a national, European, a North American issue; demands and increasing resource use are now parts of a global perspective. One estimation of the so-called ecological footprint shows that humankind overconsumes natural resources by approximately 30%. If, for instance, all inhabitants of the world consumed as much as the Swedes, humankind would require three globes with the same production level as the one we have today (World Wide Fund, 2008). Many organisations and interest groups are, currently, mobilised to draw attention to and fight different threats to the earth's environment and resources. One way to describe this mobilisation is to base it on the term 'sustainable development' which means that humankind is ensured a good environment as well as economic and social justice. In order to increase awareness, participation and the prerequisites for sustainable development, the vision of a sustainable future is increasingly explicitly formulated in the agenda of the educational institutions of several nations. With regard to education, traditional environmentally-related issues have been intertwined with courses in the natural sciences, which can entail opportunities as well as difficulties. The question is whether students really observe, take a stand for and care about the environment merely by the possibility of experiencing nature or learning about ecological processes. According to Anderson (2007), paradoxically, education does not facilitate the development of an understanding of the natural sciences for a larger number of students, and they are often not interested in this subject (George, 2006). In relation to teaching natural sciences, sustainable development as a teaching component is interesting since the term is marked by a heavy rhetorical frame. Normally, sustainable development is taught in a disciplinary organisation (Osborne & Dillon, 2008), which in itself can be an obstacle, but sustainable development can also be regarded as an interdisciplinary element. However, difficulties establishing interdisciplinary fields in education and research are often shown in terms of institutional obstacles caused by protecting disciplinary borders as well as the lack of organised points of contact.

In academia, several international reviews of interdisciplinarity draw attention to the fact that academic subject and department divisions can constitute powerful obstacles for its establishment. Here, this generally prevailing subjectivism means that one's own subject is regarded as the most important and other subjects are seen as bi- or support subjects. Thus, there are reasons to assume that a more integrative and interdisciplinary approach to conducting education may be more successful than the traditional ways (Persson, 2008). For instance, several studies have emphasised integrative perspectives, knowledge definitions and holistic approaches to sustainable development in education (Björneloo, 2004; Cullingford 2004; Jonsson, 2007; Nyberg, 2009). The question is whether studying this is relevant, especially at a time when it seems that subject centrism is being strengthened, and there is a tendency that students, to a larger extent than before, refer to their environmental knowledge

from the media rather than education in school (Reiska & Dahncke, 2008).

### **Research in the field**

In present-day Sweden, it is relatively difficult to attract upper secondary and university students to education that includes scientific topics, that is, to studies that traditionally contain general issues on humankind and natural resources. An explanation is that students experience scientific education as objective without questioning its value (Gustafsson, 2007). Moreover, there is a tendency that teachers in elementary school have doubts when teaching natural sciences (Appleton, 2008). We can also argue that this is a response to upper secondary school and university teachers' traditional and non-reflective ways of structuring and arranging education in other forms than separated topics (Dimenäs, 2007; Solaug, 2008). There have, however, been many attempts to change this, and much progress has been made during the last decades. Ernst (2009) shows positive effects for teachers who use the environment as a context in education. Other examples include projects which integrate science and technology both in and for actual issues (Stringer, 1992). This has been developed in a way that is sometimes referred to as civic science, in which an aspect of democracy is integrated (Clark & Illman, 2001; Bäckstrand, 2003; Gustafsson, 2008; Ljunggren, 2008; Englund, 2009). Researchers have found evidence for the conclusion that students' learning is supported by similar aspects and that they become engaged in societal issues (Kahne & Spurte, 2008). Recent projects draw on socio-scientific issues of ethics in the context of science education (Sadler, Amirshokoohi, Kazempour, & Allspaw, 2006a; Sadler, Barab, & Scott, 2006b; Öhman, 2006; Lundegård & Wickman, 2007). Current examples include genetic engineering as well as questions of global warming and the greenhouse effect (Hewitt, 2002). The latter means that an interdisciplinary perspective is applied to controversial subjects with ethical aspects in focus. Examples of similar areas are environmental issues, stem cell research, genetic manipulation (Lewis & Leach, 2006) and biodiversity (Harris & Ratcliffe, 2005; Lindemann-Matthies, Constantinou, Junge, Köhler, Mayer, Nagel, Raper, Schüle, & Kadi-Beltran, 2009).

In a study by Sadler et al. (2006a), teachers in primary and upper secondary school had different approaches to the idea of integrating ethical aspects when teaching natural sciences. In their study, one group of teachers completely refrained from the idea claiming that there is no connection between ethics and natural sciences. Another group believed that it was not their responsibility to integrate this issue while a third maintained the importance of ethical aspects in teaching natural sciences, which is being used by some in their current research (Sadler et al., 2006a; Arnesen, 2008). There are also critics who underline the importance of students' drawing attention to and challenging both traditionally subject-specific aims as well as social-humanistic ones (Zeidler, Sadler, Simmons, & Howes, 2005; Popov, 2008). According to Lundegård and Wickman (2007), there is no doubt that divergent aspects enhance teaching about the environment with regard to sustainable development. In fact, they maintain that it is fruitful to include values in relation to sustainable development at an early stage in order to relate them to 'facts'. They argue that education is not a matter of merely focusing

on facts. If so, students cannot discuss values and only discover the divergent perspective until afterwards. Instead, a consensus should be the driving force of all dialogues.

### *Content and content organisation from an interdisciplinary perspective*

The question about content and content organisation is constantly in focus as long as access to new information and knowledge is continuously increasing through societal changes, such as innovations through research and development work. This, in turn, leads to questions of how educational access to an increasing amount of subject matter can be prioritised in relation to, say, the knowledge field of sustainable development. With regard to higher education, Olausson (2005) claims that, in Sweden, changes in content and the amount of content have become a field so vast that the present subject structure needs to be changed. Also, in natural science education, it seems that societal changes may result in reforms due to the fact that the subject matter is growing and continually changing. This often leads to discussions which raise different suggestions for priorities, such as in the curricula, study resources and choice of subject content in a concrete teaching situation (Rutherford, 1990; Andersson, 2001; Dimenäs, 2007). In discussions about natural science didactics, the question of what particular subject content to choose and why has, far too seldom, been problematised since natural science is so much more than a set of constitutions, principles and theories (Östman, 1998; Roberts, 1998; Solomon, 1998). Latour (1987) and Kolstö (2006) note that there is a risk when offering students 'pre-packed knowledge' in contrast to activities where their experiences and questions form the basis for learning. In their study, Oscarsson, Jidesjö, Karlsson and Strömdahl (2009) draw attention to the fact that students are interested and optimistic about the future, for instance, in technology as an important part of social development. In reality, however, the students' interest in these questions is not being met in their education. Aikenhead (2006) as well as Roberts (2007) open up for a humanities perspective in natural science teaching. In a similar way, educational foci draw attention to natural science per se and construct a more outward citizen perspective. Clark and Illman (2001) claim that it is of interest for natural science content to be appropriately illuminated, such as in terms of different social contexts. Vikström (2005) demonstrates in a study how teachers use ecological issues to provide students the possibilities of enhancing the meaning of sustainable development. Swedish syllabi and course plans include similar contents that concern education about the environment. For instance, it is a requirement in all teaching that certain overall perspectives on ethics, health or the environment are discussed.

In terms of higher education, Jonsson (2007) has examined in what way pre-service teachers understand the meaning of sustainable development and how it can be materialised in education. He (Jonsson, 2007) means that the pre-service teachers' perceptions of the term sustainable development can be described in varying complexity. Some statements are categorised as action-oriented, such as waste separation and developing new technology, while others are categorised as content-related normative, which is expressed in comments where natural resources are included in a future perspective. In his study, the pre-service teachers

also expressed their perception of what is unfair or just. When Jonsson (2007) followed five pre-service teachers in their teaching of the world's water supply, he found that four of them structured the topic in a linear form based on the water supply problem in which each subsequent part had the water cycle as its primary focus. The fifth pre-service teacher organised the topic using an integrative, complex approach where different perspectives were given space in relation to a context. According to Jonsson (2007), the factors that affect the possibility of a more integrated teaching are, among others things, how pre-service teachers perceive the entirety of the contents in relation to their students. In turn, the whole is not defined by its parts, but from the relations between them.

In current Swedish educational policies, subject identity is being strengthened through new guidelines. There is, however, an ongoing discussion whether these can be seen as objectives in themselves or as fundamentals which are a basis for school activities (Swedish Government Official Reports, 2007). Also, the term 'sustainable development' is included in the Swedish Higher Education Act. Strengthening subject roles seems to draw on the belief that, if students are provided with and learn subject matter in separate subjects, they are able to integrate specific subject-related knowledge. So, what are the consequences of giving students the possibility of meeting central aims on sustainable development?

### **The empirical study**

In an empirical study, we tried to explore emergent patterns relative to teachers' perceptions of water and justice. As discussed above, water and justice can be perceived as naturally disparate. In traditional interpretations and, at first sight, water as content is included in the sphere of natural sciences whereas justice is a part of social sciences. How do teachers perceive this relation? Are there, for instance, justice aspects in water content, and are there aspects of water in justice? Can views of sustainable development be discerned in teachers' perceptions of the two issues? If there is an internal relation, this gives rise to questions of consequences for teaching. Are there other ways that could make students find such a matter meaningful and engaging? If so, how are such points of contact to be found? Is there any, at all, relation between the two contents of water and justice?

The participants in the study were teachers from different levels in the educational system. In total, fifty-eight teachers who sometimes taught the topics of justice (33) and water (25) participated in the study. Through semi-structured interviews with the following categories of teachers, we tried to explore emergent patterns relative to their perceptions of water and justice.

The teachers were chosen on the basis of qualitative methodology aspects where the various participants represented different fields of teaching, values, gender, age and educational backgrounds. In the interviews regarding justice, four of the teachers taught students in the forms 4–6 and five taught in the forms 7–9. Among the older students, there were teachers representing natural sciences as well as the societal subjects. The main fields of the university teachers were economic history, chemistry, physics, hydrology, environmental knowledge, re-

ligion and zoology. The data material comprised transcribed interviews where the teachers' comments formed a basis for the analysis of the study. Furthermore, the essence of the interviews was thematised through work on the basis of the material as a whole: firstly, identifying similarities and differences in the interviews and, then, organising these similarities and differences into themes. The data material was described in qualitatively different categories using a phenomenographic research approach (Alexandersson, 1994, 1998; Johansson, 2009). In the analysis of the data, three major categories were identified: an internal perspective, a holistic perspective and a relational perspective.

### *The internal perspective*

In the following excerpts of teacher perspectives, the knowledge matter of water is described as an internal perspective that is water per se becomes a natural demarcation through its focus on properties and its prevalence in nature. Here, we identify a focus in terms of traditional subject-specific objectives. We find that it is often primary school and secondary school teachers who emphasise the internal dimension. For instance, these teachers point out that the water molecule is a part of the matter with special polarity, which makes it extra important for the life processes of organisms and an important part of physical processes in different cycles of nature.

*Well, it is the prerequisite of all life ... and has existed for a very, very long time on the Earth as a reaction medium for all life processes, and it is a limited amount of water that circulates in this system, so, my fascination is that a limited amount of matter can play this important part, millennium after millennium, be cleansed, destroyed, circulated ... the prerequisite for all life processes in your cells and in my cells, yeah, water solutions are a key (primary school).*

*They have to understand the structure of water, how it is formed and what properties of polarity it has, the positive and negative poles of the water molecules to understand how it works. Each and every water molecule can be part of an organic molecule ... come up with something, do something, start a degradation processes or something like that, add something and then change the behaviour of the molecules (secondary school).*

These aspects can be related to previous discussions of how water is regarded in the sphere of natural science with its focus on specific parts (Östman, 1998; Roberts, 1998, 2007; Solomon, 1998). This aspect can also be related to the dimension of subjects or multi-disciplinarity (Sjöberg, 2005; Vikström, 2005; Nyberg, 2009).

What thoughts do teachers express about justice from an internal perspective? In the following (translated) quotations of teachers' comments, they assert that the knowledge matter of justice can also be regarded as an internal perspective; in other words, the teachers limit the term 'justice' by use of definitions and concrete examples.

*Yeah, what does justice stand for? I was raised in the Marxist tradition so for me. Justice is to meet everyone's needs (secondary school).*

*Justice gives everybody the same opportunities and possibilities of expression, irrespective of their circumstances. That, I think, is justice (pre-school).*

The aforementioned examples, justice for all or justice as an opportunity, can be related to the teachers' beliefs about what justice really is. Their beliefs are based on both an ideological standpoint and the individual's personal prerequisites and abilities. The teachers seem to regard justice as an object that can be defined. As with the internal dimension of water, there is a tendency that justice can be understood as a 'fact' in itself (Latour, 1987; Kolstö, 2006).

### *The holistic perspective*

In the following comments, water is regarded from a holistic perspective. Water is related to humankind and its actions as well as something that raises different kinds of emotions that can be related to fascination, romance, religion, historical memories. Water is also associated with everyday life and with its focus on water as a solvent or conveyer and the consequences of such aspects. While these comments may focus on several different aspects, water is always an important part.

*I love the ocean. I have always been drawn to water and currents. It unites the whole world, it seems ... it raises romantic feelings, sorrow and tragedies ... relatives have passed away in the sea ... The water I drink today could have been drunk by Cleopatra or anyone ... rain and solvent. I mean, I couldn't imagine anything more important for body and soul than water (secondary school).*

*There's also this religious dimension in one way or another ... Baptising, for example, yeah, water is part of religion (pre-school).*

*In the south of Sweden, the worst environmental water problem is, probably, the issue of water distribution where the same sewerage treatment plant is being used to pump both drinking water and waste water (university).*

In these comments, water is being related to emotionally, as there are religious aspects and environmental consequences associated with humans' use of water. In this dimension, we see, in the light of what has been put forward, that the natural sciences raise other aspects than constitutions, principles and theories (Östman, 1998; Roberts, 1998; Solomon, 1998).

The knowledge matter of justice can also be viewed in the light of the holistic perspective. Justice is no longer the limit, but the teachers relate its contents to external phenomena.

*But it has something to do with, or how shall I put this? How everything is united, how everything works, the universe and everything, I think (primary school).*

*I can see this very easily from a historical perspective where a term such as justice has changed over time, of course, but also have differences from culture to culture, from legal justice, of course, to some sort of social justice (secondary school).*

In the aforementioned comments, the teachers express that justice can be seen in terms of a



normative values perspective and that it can also be related to historical and societal perspectives. Furthermore, the meaning of the definition changes in relation to the time period to which it is associated, so that the teachers move beyond the term. In a hypothetical teaching situation, the holistic perspective of both water and justice would provide a basis for discussions about the possibilities of supporting meaningful teaching and, in that way, contribute to students' interests in societal issues and standpoints (Kahne & Spurte, 2008). The prerequisites for an integrative understanding lie in the external dimension, as the contents are described from a holistic perspective (Clark & Illman, 2001). It should be noted that Roberts (2007) found two perspectives where the focus is on natural science per se, but there is also a more external citizen perspective that could be compared to the two aforementioned outlooks.

### *The relational perspective*

We have studied the teachers' comments of the two contents separately. It is, however, particularly interesting to consider whether there is any common ground in the comments about the two contents since we have, until now, studied the comments about the separate contents. The following quotations show that the two contents, justice and water, are perceived as being related to each other.

*It's like, I think, having empathy with people who have a hard time and suffer from water deficiency ... I think the basic thing in this is that you think that we, in the rich part of the world, can't sit and watch people go under in developing countries (university).*

*Yeah, I think very much in terms of, yeah, natural sciences, and it's all about natural resources and so on that I come to think of, and, I think, we have a demand for justice here ... (primary school)*

*It's very much about justice, distributing natural resources evenly ... (pre-school).*

*In the natural sciences, we have, for example ... you bring up the idea of the water cycle, that there's only a limited amount of all matter, and, there, resource distribution comes into the picture (secondary school).*

In the quotations above, the teachers' comments about water and justice are from an integrative perspective. Also, we understand that these comments reflect a pedagogical dilemma when the teachers, for instance, refer to a demand for justice and the question of distribution with regard to the issues of water, the environment and natural resources. In one of the comments above, water and justice are clearly perceived as connected since water deficiency has been placed in a justice perspective. Therefore, the teacher has to relate to the two knowledge matters at the same time, which could be regarded as increasing the complexity. This is also found in more existential comments.

*It's so we can keep it ... feel good and exist ... so I think everybody has the right to the quality of life (pre-school).*



The complexity deepens even more as the pedagogue describes how the two contents emerge in an educational context. Here, learning objectives are expressed in more general terms.

*It's so we can argue for things, to have some sort of a grip of what it's all about. You teach, so you can understand the world mainly so that you can handle it ... so you hope that this mindset will make you do the right thing (secondary school).*

*Yeah, the point of knowledge, I guess, is that it'll make you reflect about your own actions, that you can use your knowledge. I guess you need certain basic facts in order to draw conclusions and really be able to reflect if something is right (university).*

In these comments, the teachers express the conflict inherent in the knowledge matter for water and justice when put in relation to the learner. As Lundegård and Wickman (2007) reason, this would be a relevant starting point for instruction that relates to the environment and thoughts about a sustainable society. The comments expressed can, thus, be understood as a dilemma for teachers when they consider knowledge matter as a starting point for students' positions or if they use values as an integrative beginning that includes knowledge matter (Sadler et al., 2006a, 2006b; Arnesen, 2008). The study of the content dimension of justice begins in the question of what relationships the different categories of teachers have towards the knowledge content of justice. The results point towards the fact that teachers' relation to justice can, on the one hand, be described as problematic and complex, but, on the other hand, as simple and taken for granted. Generally, it is difficult for teachers to view justice as something to relate to, so they might have difficulties in stating what is peripheral or central. The study shows that teachers find it hard to describe justice in scientific terms and explain how it can be structured in relation to teaching. Some of the examples regarding justice are related to practising religion, distributing resources and how to construct a fair society. Among the secondary school teachers, it is obvious that the respective examples are related to the respective subjects. In addition, the secondary school teachers believe, for instance, that issues about values will be discussed in natural sciences subjects, whereas the teachers of these subjects believe that this is a task for social scientists. The contents are regarded as something that is 'there', which has always been worked with and does not need any analysis. Newer aspects of justice are gradually added to the teaching. Thus, it is the ways of working that are superior when the teachers describe their teaching. The university lecturers' descriptions are somewhat different since they convey a connection between a deep knowledge of the subject and demonstrating different aspects of the term. However, all the teachers relate to justice at an overall societal and at an everyday level.

In the study of the content-related dimension of water, we also investigated how the different categories of teachers perceive water as a content of education. One motive for the subject of water occurring in education is that we all have a personal relationship to water. For instance, water is not only a necessary part of everyday life, but also an element we can experience as a beautiful dimension of nature or as a part of religious rites, such as in Christian baptism. Water, in education, is also regarded as a traditional subject matter whose properties

relate to biological, chemical, physical and natural processes. A third aspect is shown where the instruction begins with the environmental issues as a consequence of the human use of water. Here, discussions can be initiated regarding, for instance, water as an obvious resource in the industrialised world, but, in certain developing countries or with regard to distribution issues, water is a vitally important commodity in sustaining life. The fourth aspect can be understood in terms of water being limited for the existence of humans and other organisms in what we call the biosphere. Finally, the knowledge matter of water is perceived to contribute to the learners' ability to make their own decisions. This way of discussion by the teachers means that water becomes an essential incitement to problematising different aspects of teaching in order to give the learner the ability to develop a holistic view as well as an ability to position themselves. The result of the study shows that most of the teachers describe water from a significant subject perspective. However, the university teachers and the pre-school teachers differ from the others in that they tend to incorporate the starting point of the learner as a part of their own understanding of the knowledge matter of water.

## **Conclusion**

In the study, we found some teachers clearly expressed a connection between water and justice. Thus, it seems that water and justice are two suitable examples for the problematisation of contents about sustainable development. From the teachers' perceptions, several dimensions are identifiable in the two knowledge matters of water and justice. The issues that seem to be central for the interviewed teachers are the traditional subject-specific objectives (internal dimension) and the socially humanistic objectives (holistic dimension) as well as the possibility of integrating the two (relational dimension). In the data, there is also a consensus with the modern educational research in civic and scientific disciplines, the results of which support the idea that students experience teaching as more meaningful when it touches upon overall issues such as democracy or ethics (Sadler et al., 2006a, 2006b). With regard to these aspects, the materialisation of education can also be enabled through a view of knowledge as constructive, contextual as well as functional. Therefore, we argue that, in order to conduct meaningful teaching about sustainable development, we need to ask ourselves whether an integrative view of knowledge is not a must in order to promote students' understanding and critical positioning.

In the introduction of this article, we demonstrate that the tendency in modern-day Sweden is directed towards a more subject-organised management of education. We ask ourselves the critical question whether subject-centred teaching solves the problem regarding educational contents, for instance, sustainable development, where an integrative view of knowledge among teachers seems to be a prerequisite. One hindrance for such education could be that teachers are limited to different foci: some have a narrow focus, others have more of a multidisciplinary perspective, and there are those that unite these two views. The different starting points partially emerge when teachers describe how they plan their teaching. Our understanding is that a knowledge-competent teacher with a holistic view (Jonsson, 2007)

can handle multidisciplinary complexity (Zeidler, Sadler, Simmons, & Howes, 2005; Popov, 2008). If that is so, the opposite would be found among teachers with an inverse focus, which would resemble a more subject-centred view. Most of the teachers' comments, however, can be understood as expressions of a sustainable perspective, that is, the perception that natural resources are limited and, in a justice perspective, poorly distributed among the population of the earth. In an educational context, this means that children/students need to be able to handle situations based on thoughts and standpoints that require knowledge. In this case, the two contents of water and justice can be described as contents that in combination can provide a more profound understanding of thoughts about sustainable development. Thus, the two contents of water and justice become central and can exemplify an understanding of a perspective of the term 'sustainable development' as well as make students debate, handle, reflect and draw conclusions. The teachers' expressions strive to encourage the learner to develop an understanding at a complex as well as at a general level. In the present study, it has been demonstrated that some teachers think in a more integrative way than others and are seemingly able to move beyond what could be perceived as the rhetoric behind sustainable development. This, however, is not enough. They could also create favourable conditions for conducting successful education for sustainable development. In the line with present-day educational policies in Sweden, a tendency towards a more closed and subject-centred discourse has been implemented (Skolverket, 2011), which could make conducting successful teaching about sustainable development even more problematic in the future. Consequently, this is in contrast to what we have found in this study as spontaneously integrative perspectives on a sustainable society from the two examples of water and justice, which was also identified in previous research of civic and socio-scientific disciplines.

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