

effective sustainability education is political education

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Sustainability in the Anthropocene

The anthropogenic nitrogen oxide and sulphur dioxide emissions are greater than natural sources, the atmospheric concentration of CO₂ and CH₄ has not been as high as it is today for at least 650,000 years. The average erosion rate of soils has increased thirty-fold due to human activity, the extinction rate of organisms is at least a hundred times higher than the natural extinction rate (Steffen, Broadgate, Deutsch, Gaffney, & Ludwig, 2015a; Steffen et al., 2015b; Waters et al., 2016). During the last decades humanity has become the strongest driver of geo-ecological processes changing the face and the fate of the planet. Observing these powers the atmospheric chemist and Nobel laureate Paul Crutzen proposed that we no longer live in the holocene but in the Anthropocene.

If we want the Anthropocene to become an epoch of sustainability, we need to take into account knowledge about the causes and mechanisms that lead into the Anthropocene as well as about strategies to transform societies. There is a broad consensus in sustainability research that these changes require groundbreaking changes in our mindsets, lifestyles, attitudes and the way we imagine industry and economy.

There is a broad consensus that education must play a major role in bringing about these changes. Consequently the UN in 2002 proclaimed the decade (2005-2014) of education for sustainable development. The decade was followed by the UN Global Action Program on Education for Sustainable Development. In these programs several educational concepts as well as thousands of initiatives to implement sustainability into educational programs were developed to transform society by reorienting education and help people develop knowledge, skills, values and behaviours needed for sustainable development (UN 2016).

Meanwhile, the first studies that examine the effects of commended and certified programs have appeared:

- Hallfreðsdóttir (2011) showed that students in Icelandic schools that took part in ecological programs increased their knowledge of environmental issues. However, there was no positive effect on students' attitudes. Krnel & Naglic (2009) collected similar evidence in Slovenian

environmental schools, Özsoy (2012) for Turkish schools.

- Boeve-de Pauw & Van Petegem (2011) studied 50 schools in Flanders, half of which had been certified as Eco-Schools for many years. These studies confirmed positive cognitive effects, but could not find any positive effects on attitude and behaviour.
- A large-scale study of the effect of a certification program for sustainable schools in Canada did not indicate any effect on the environmental behaviour of students (Legault & Pelletier, 2000).
- In large-scale studies in Sweden (Berglund, Gericke & Chang Rundgren, 2014), small positive effects were observed on the sustainability consciousness of students in year 6 and 12 in ESD-certified schools, but negative effects for learners in year 9.

In a nutshell: These large-scale studies mainly confirm a positive cognitive effect of sustainability education. But a consistent finding throughout the studies is, that neither students' attitudes nor their behaviour and associated values are significantly affected by school programs for sustainability.

While these results may be disappointing regarding all the efforts educators, program designers and educational institutions have put into those programs, a major question remains: Why and for what purpose are we doing sustainability education?

Education for sustainable mindsets?

Many – often politically driven – documents on education for sustainability argue, that a transition towards a sustainable future needs a change at the level of the individuals' attitudes and perceptions to enable behaviour that is in line with sustainable development. Behaviour and behavioural change of individuals are constructs that have been studied extensively in the social sciences, showing that they are correlated to the attitudes and knowledge of individuals. However, a closer look into people's attitudes towards nature and sustainability show that more than nine in ten Europeans (94 per cent) regard the protection of the environment as important to them personally, and among these, more than half (56 per cent) say it is very important (EU, 2017). There also is a high public support for sustainable actions: 93 per cent of German citizens agree that nature must only be used in such a way that biodiversity is secured and that nature must be preserved for future generations (BfN, 2016). These results indicate that, at least in Europe, there already is a high level of environmental consciousness: people are aware of the environmental challenges of the Anthropocene and at least rhetorically support political actions for a sustainable future.

However, the main challenge of focusing on pro-environmental and pro-sustainable attitudes is different: In a representative study with more than 1,000 participants from Germany, the Federal Environmental Agency (2016) assessed the resource consumption and the environmental awareness of people. Based on their income, lifestyle and values, the participants were grouped into different milieus (cf. Table 1).

Table 1: Attitudes towards nature and resource consumption.

	Mainstream milieus	Critical creative milieus	Low income milieus
Attitudes towards nature	0,92	1,20	0,87
Resource consumption	1,01	1,11	0,82

To compare the attitudes and resource consumption, the indicators are indexed. Values > 1 show above-average environmental attitudes, resp. resource consumption, values < 1 show below-average attitudes resp. consumption.

The data speak a clear language: there is no – in the worst case even a negative – correlation between pro-environmental attitudes and pro-environmental behaviour. People with a high level of environmental awareness do not necessarily have a good personal ecological balance sheet. People from poorer backgrounds, on the other hand, who have under-average positive attitudes towards nature, pollute the environment the least. Both environmental impact and pro-environmental attitudes increase steadily with rising income. In a nutshell: Any influence of pro-environmental attitudes is counterbalanced by the income effect. So, if it is not attitudes, consciousness or perception that make a difference: What then should be the aim of education for sustainability?

Skills and knowledge in the Anthropocene

While surveys show that issues such as climate change and environmental protection are considered important, the science education literature shows that people often hold insufficient understandings of key aspects of the Anthropocene:

- Niebert (2011) showed that lay people have great difficulty distinguishing between the hole in the ozone layer and climate change.
- Danielson & Tanner (2015) found that students of natural sciences often attribute ocean acidification to pollution and acid rain rather than CO₂.
- Fröhlich et al. (2013) showed that school students mostly have naive notions of agriculture that are far away from describing the industrial, intensive agriculture of western countries.
- Menzel & Bögeholz (2006) analysed school students' understandings of biodiversity and showed that they are influenced by a human centric world view and that students' protection requirements were aesthetic rather than focused on the ecosystem.
- Niebert (2015) conducted an intervention study and found that learners have great difficulty in developing effective strategies for mitigating climate change.

Of course, to make sustainability fruitful and a sustainable lifestyle attractive, it is necessary to do more than just impart conceptual knowledge about the scientific background of the environmental challenges. Kaiser, Roczen and Bogner (2008) have empirically shown that environmental knowledge has only a small – but crucial – impact on pro-environmental behaviour. But on which grain size, which level of abstraction, should this knowledge be communicated? Do the radiation balance, the principle of radical substitution, the acid-base balance or the absorption spectrum of CO₂ need to be understood to understand the Anthropocene? Not necessarily. To get an idea which knowledge should be communicated, we should have a look at how we dealt with other environmental challenges:

- After scientists recognised a growing depletion of ozone in the stratosphere in the early 1980s, public awareness rose by political campaigns – mainly driven by NGOs. Just two years after the publication of the report, almost 200 states decided in the Montreal Protocol to ban ozone destroying substances in the long term.
- The Fukushima disaster disrupted the world's nuclear industry: The share of nuclear energy has been falling for years and currently stands at around 13 percent worldwide. The glut of cheap green electricity makes nuclear power plants increasingly unprofitable.

- To fight air pollution, China implemented strict environmental policies within the last years: in 2017 alone, more than 176,000 factories and 44,000 coal-fired power plants across China have been shut down because they failed to meet their emission targets. These developments were driven by local uprisings and 1.6 million premature deaths due to air pollution.
- Climate change came to public awareness by a conjoint Action of climate scientists who pointed out the consequences of global warming and NGOs who demanded political changes like CO₂-pricing, and the forming of companies who show that green energy can be produced more cheaply than fossil energy. In Germany it have been the NGOs who pushed the government into an phase-out of coal burning.

These, like many other examples, show a clear tendency: the great environmental challenges are not addressed by individual change in behaviour or by green consumption – but by political and economic decisions. It is not the individual abandonment of CFC-containing deodorants, not the individual change of your electricity provider from nuclear to green energy and not our individual decision to buy an electric car instead of a fossil car, that drives the world into a green state. It is hard political and economic decisions that make a difference. These examples indicate that the interface between physical and social sciences should be an important part of an education that meets today's global challenges. In these terms education in the Anthropocene should take into account that science, technology, and society cannot be isolated from each other. Students have to understand the scientific, economic and cultural reasons for non-sustainable practices and its sustainable alternatives. In this sense knowledge about the socioscientific backgrounds of non-sustainable practices and possible leverage points to make the Anthropocene a (more) sustainable epoch should be placed at the centre of teaching in the Anthropocene.

From conceptions to participation

In Switzerland the regulations for secondary education (MAR 95) prescribe twofold objectives for education: Students shall attain the *personal maturity for university studies* and it shall prepare them for *demanding tasks in society*. The latter is an explicit task to shape students' participatory capacities. But what drives political participation? Studies on political education show that political interest is often driven by political knowledge, media and consumption and political discussions: better informed young adults are more interested in politics, which in turn increases their political participation. Obviously, some kind of knowledge seems to be necessary for political interest. This reflects findings from representative studies on environmental politics: Two thirds of German citizens believe that politics must become more involved in environmental and climate protection – and that this must reflect the actual scientific knowledge base (BMUB, 2015). But what happens if environmental topics get mixed up – as it is the case, for example, with climate change and the stratospheric-ozone depletion? O'Connor, Bord, and Fisher (1999) found that individuals who are misinformed about the causes of climate change are unlikely to support policies or take the right actions to reduce the burning of fossil fuels. Moreover, such confusions become problematic as it is expected that the ozone hole will close by 2050, while climate change will then have started to become a really serious problem. This may lead to a perception of a decrease in climate change, and consequently, to a public delegitimation of ambitious climate policy. Therefore, a basic understanding of sustainability-related issues may be less important in terms of personal decision-making, but it is crucial in regard to the facilitation of political decision-making processes.

Conclusions

The Anthropocene is not an educational concept. But the approach of a new geological epoch and the accompanying societal and political discussions pose an opportunity to reflect on our educational practices. The Anthropocene can act as a framework to contextualise the practices, competences and concepts that are prescribed in the school and university curricula. It can act as a framework to make education for sustainable development more concrete and tangible for teachers. By acknowledging that the main factor that can turn the Anthropocene into an epoch of sustainability are political decisions and not primarily changes in individual consumption and behaviour, we can also relieve educators from approaches aiming – usually unsuccessfully – at changes in behaviour. If we see citizens and students as political actors who can and must take responsibility for personal action and political decision-making, education in the Anthropocene should aim to equip students with competences to reflect on the consequences of global change and become active citizens in this sense. In democratic societies these competences are needed so that citizens support and shape policies necessary for a sustainable future like regulatory laws, changes in taxation (from taxation of goods like workforce to bads like carbon). Incomplete knowledge, unsureness, and risks are part of the process and make continuous reorientation necessary. Education that wants to support a sustainably changing society must both include global change and ensure the legitimacy of a sustainable society.

Science education in the Anthropocene, as it is understood in this paper, is not an instrument for the implementation of specific, predetermined targets, but rather capable of facilitating their discussion. Education for sustainability should enable and encourage students to question the mechanisms that have created the Anthropocene and make a sustainable Anthropocene conceivable – in this form, it stands in the tradition of enlightenment in the best sense.

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