

# Sustainability education in chemistry

Sakari Tolppanen

*Education for sustainable development (ESD), or sustainability education, should be an important part of education, especially chemistry education. However, sustainability education presents new challenges to education, as the teacher needs to find new ways to deal with multidisciplinary issues and the emotions it evokes. This article presents some of the challenges of sustainability education and gives guidelines on how to overcome these challenges. The article is based on a PhD thesis, by Sakari Tolppanen. In the thesis, students' questions, actions and expectations for sustainability education were studied.*

If everyone on the earth would consume as much resources as people living in Finland, over three planets would be needed to satisfy the needs of the global population (Global footprint network, 2016). Therefore, it is clear that humanity's consumption habits are not sustainable. Due to overconsumption, the planet is warming, oceans are acidifying and the biodiversity is decreasing (Rockström et al. 2009). In order to stop overconsumption, humans need to change the way we consume and how we see the world. Education plays a key role in achieving this goal.

The importance of Education for Sustainable Development, or Sustainability Education, has been noted and discussed for decades (Jickling & Wals, 2008; Wals, 2013). However, there is still much to develop in sustainability education. For example, recent studies show that students ask multidisciplinary questions on issues of sustainability (Tirri, Tolppanen, Aksela & Kuusisto, 2012), but teachers lack the skills to answer these multidisciplinary questions (Ratinen, 2016). Therefore, in order to improve sustainability education, educating teachers and increasing multidisciplinary teacher collaboration play a key role.

In order to advance sustainability, global issues need to be examined through multidisciplinary collaboration. For this reason, it is not enough that in schools sustainability issues are addressed only from the viewpoint of certain subjects. Rather, education needs to be holistic and cross-disciplinary. Some (of the) challenges of multidisciplinary education can be overcome through collaboration with different subject teachers, but in addition, it is important that each teacher understands some general challenges involved in sustainability education. Three of these are presented below.

## ***Sustainability is a wicked problem***

Firstly, teachers need to acknowledge the fact that no simple solutions exist to overcome sustainability issues. For this reason, sustainability issues are commonly referred to as wicked problems (Rittel & Webber, 1973). Achieving sustainability requires political will, technological

advancements, a decrease in the price of new technology, and individuals who are willing to change their consumer behaviour and lobby for environmental causes (Commoner, 1972). Oversimplifying the complex issues involved may even have negative effects on sustainability education (see Sterling, 2010). Examples of oversimplifying are seen in the discourse on recycling and on technological advancements: Schools tend to talk much about the importance of recycling, even though waste is not even among the ten biggest environmental challenges (Rockström et al., 2009). Teachers and students may also believe that technological advancements will solve humanity's environmental problems. History, economics and social sciences, however, show that this is unlikely because as technology advances, consumptions usually also increase due to feedback loops (Hynes, 1993).

Therefore, sustainability education should encourage students to take action, but also to evaluate and develop their action (Tolppanen 2015). In his thesis, Tolppanen (2015) presents ways on how to accomplish this in schools. It is also important to remember that the so-called "low barrier" actions are important in increasing motivation (Skamp, Boyes, & Stanisstreet, 2013). However, only doing these "low barrier" actions might not have a big enough impact compared to what is needed. Therefore, examining the impact of actions is crucial.

### **Environmental knowledge does not increase action**

Teachers need to be aware of the gap between environmental knowledge and action. Research shows that the majority of people are willing to take environmentally friendly action, even though increase in knowledge does not necessarily result in an increase in action (Kollmuss & Agyeman, 2002).

So which aspects have an effect on environmental action? Steg and Vlek (2009) have shown that actions are more likely if they do not require much time or money. Furthermore, environmentally friendly behaviour is affected by how actively one thinks of the environment (Kallgren & Wood, 1986). Therefore, students should be given opportunities to examine how environmentally friendly behaviour could be made easier and how they could be more aware of their surroundings. As an example, students could try to impact the timetables of public transportation, think of ways to reduce the time spent in warm showers and make a plan to reduce the consumption of meat, especially beef.

### **Challenging topics are connected to challenging emotions**

Teachers should also take into consideration the fact that discussing environmental challenges with students, may lead to negative emotions, such as fear, sorrow, guilt, hate and hopelessness (Chhokar, Dua, Taylor, Boyes, & Stanisstreet, 2012). Teachers may also have such emotions, possibly leading to ignorance and a lack of action (Ojala 2012; Hermans 2016). This is

challenging, as teachers may feel that dealing with students' emotions belongs to a therapist, rather than to a teacher (Pihkala 2016).

In order to lower the barrier of talking about emotions, researchers have suggested that arts and drama should be incorporated into environmental education (Lehtonen & Cantell, 2015). In addition, students should be given the opportunity to seek and share positive examples on how environmental challenges are tackled in different parts of the world (Tolppanen & Aksela, under review), and to reflect on their own environmental behaviour (Tolppanen, 2015). A recent study shows that young people already take action to solve environmental problems both in schools and at home (Vesterinen, Tolppanen & Aksela, 2016). In order to make sustainability education more relevant, education should encompass these students' actions into education and help them develop their actions further.

## Sakari Tolppanen

Ph.D. (teacher in chemistry and physics)

Lecturer of chemistry and physics (2016-2017), Päiviönsaari lower secondary school, Varkaus

[sakari.tolppanen@gmail.com](mailto:sakari.tolppanen@gmail.com)

**Specialization:** developing education on sustainability and on climate in chemistry education. Defended his doctoral dissertation in The Unit of Chemistry Teacher Education in 2015. The topic of the doctoral dissertation: students' questions, actions and expectations of sustainable development and education.

## References

- Chhokar, K., Dua, S., Taylor, N., Boyes, E., & Stanisstreet, M. (2012). Senior Secondary Indian Students' Views about Global Warming, and Their Implications for Education. *Science Education International*, 23(2), 133-149.
- Commoner, B. (1972). A bulletin dialogue on "the closing circle," response. *Bulletin of the Atomic Scientists*, 28(5), 42-56. Ehrlich & Holdren, 1971
- Global footprint network. (2016). Footprint data and results. Retrieved 9/2016 from: [http://www.footprintnetwork.org/en/index.php/GFN/page/footprint\\_data\\_and\\_results/](http://www.footprintnetwork.org/en/index.php/GFN/page/footprint_data_and_results/)
- Hermans, M. 2016. Geography teachers' and Climate change: Emotions about consequences, coping strategies, and views on mitigation. *International Journal of Environmental and Science Education* 11(4), 389-408.
- Hynes, P. (1993). *Taking population out of the equation: Reformulating I= PAT*. USA: North Amherst Massachusetts Institute on Women and Technology. Retrieved from <http://www.readingfromtheleft.com/PDF/IPAT-Hynes.pdf> on 11/2014.
- Jickling, B., & Wals, A. E. (2008). Globalization and environmental education: Looking beyond sustainable development. *Journal of Curriculum Studies*, 40(1), 1-21.
- Kallgren, C. A., & Wood, W. (1986). Access to attitude-relevant information in memory as a determinant of attitude-behavior consistency. *Journal of Experimental Social Psychology*, 22(4), 328-338.
- Kollmuss, A., & Agyeman, J. (2002). Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research*, 8(3), 239-260.
- Lehtonen, A. & Cantell, H. 2015. Ilmastokasvatus osaamisen ja vastuullisen kansalaisuuden perustana [Climate education as the pillar of understanding and responsible citizenship]. Suomen ilmastopaneelin raportteja 1/2015.

- Pihkala, P. (2016). Environmental Education After Sustainability: Hope in the Midst of Tragedy. Submitted article for "After Sustainability" Theme number of *Global Discourse* (2017).
- Ojala, M. (2012). Hope and climate change: The importance of hope for environmental engagement among young people. *Environmental Education Research*, 18(5), 625-642.
- Ratinen, I. 2016. Primary student teachers' climate change conceptualization and implementation on inquiry-based and communicative science teaching: A design research. University of Jyväskylä. Jyväskylä Studies in Education, Psychology and Social Research.
- Rittel, H. W., & Webber, M. M. (1973). Dilemmas in a general theory of planning. *Policy sciences*, 4(2), 155-169.
- Rockström, J., Steffen, W., Noone, K., Persson, Å., Chaplin, F. S., Lambin, E. F., & Foley, J. A. (2009). A safe operating space for humanity. *Nature*, 461, 472-475.
- Skamp, K., Boyes, E., & Stanisstreet, M. (2013). Beliefs and willingness to act about global warming: where to focus science pedagogy?. *Science Education*, 97(2), 191-217.
- Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of environmental psychology*, 29(3), 309-317.
- Sterling, S. (2010). Learning for resilience, or the resilient learner? Towards a necessary reconciliation in a paradigm of sustainable education. *Environmental Education Research*, 16(5-6), 511-528.
- Tirri, K., Tolppanen, S., Aksela, M., & Kuusisto, E. (2012). A cross-cultural study of gifted students' scientific, societal and moral questions concerning science. *Education Research International*. 2012, 1-7 [673645].
- Tolppanen, S. (2015). Creating a better world: questions, actions and expectations of international students on sustainable development and its education. (PhD thesis). University of Helsinki. Retrievable from: <https://helda.helsinki.fi/handle/10138/155121>
- Tolppanen, S. & Aksela, M. (under review). Addressing students' questions on climate change. *Journal of Environmental Education*.
- Vesterinen, V-M., Tolppanen, S., & Aksela, M. (2016). Towards Citizenship Science Education: What Students do to make the World a Better Place? *International Journal of Science education*.
- Wals, A. & Dillon, J. (2013). Conventional and emerging learning theories: Implications and choices for educational researchers with a planetary consciousness. In R.B. Stevenson, M. Brody, J. Dillon & A. Wals (Eds). *International handbook of research on environmental education*. New York: Routledge