

VISION III: FRAMING STEM EDUCATION WITH MORAL- PHILOSOPHICAL-EXISTENTIAL-POLITICAL ALTERNATIVES

Jesper Sjöström¹

¹Malmö University, Malmö, Sweden

A decade ago Roberts (2007) suggested two visions of scientific literacy and science education. In this theoretical paper I develop the ideas behind a third vision, Vision III (Sjöström & Eilks, 2017), emphasizing moral-philosophical-existential-political alternatives in STEM education. For each of the three visions I suggest (for vision I and II based on previous publications, e.g. Sund, 2016; Lidar et al., in press) two subversions connected to different curriculum emphases. For Vision III this mainly means curriculum emphases not suggested by Roberts. One exception is the curriculum emphasis 'self as explainer', which can be interpreted as being about existentialism. I discuss and problematize the three visions especially in relation to different versions of 'Bildung' (Sjöström & Eilks, 2017), but also in relation to different philosophies of education and in relation to views on teaching and learning in and about science-technology-society-environment (STSE) and nature-of-science (NOS), respectively. I claim that science education based on the Bildung-version called reflexive Bildung can be seen as an alternative to science education based on Western modernism (Sjöström, in press). It integrates cognitive and affective domains and includes politicisation to address complex socio-scientific issues, but also moral-philosophical-existential alternatives. I discuss reflexive Bildung from post-human perspectives and also suggest and discuss implications of this Bildung-philosophy on science curricula, science teacher education and praxis of STEM education.

Keywords: Philosophy of science education; Transformative learning; Sustainability education

INTRODUCTION

My paper "Towards *Bildung*-oriented chemistry education" was published online in 2011 (Sjöström, 2013). Since then I have – together with co-authors – developed and contextualized the thoughts regarding chemistry education (e.g. Sjöström & Talanquer, 2014; Sjöström, Rauch & Eilks, 2015) and also broadening the perspective to deal with science education more in general (Sjöström, Eilks & Zuin, 2016; Sjöström & Eilks, 2017). We identified different versions of *Bildung* and connected them to Roberts' (2007) two visions of scientific literacy. For critical-reflexive *Bildung* we needed to introduce a third vision of scientific literacy (Sjöström & Eilks, 2017). I regard reflexive *Bildung* as a post-human version of *Bildung*, in contrast to most other versions which are highly influenced by Western modernism. Science education based on reflexive *Bildung* integrates cognitive and affective domains and includes politicisation to address complex socio-scientific and environmental issues, but also moral-philosophical-existential perspectives, including nature-of-science (NOS) aspects. Relations and responsibility are emphasized (Sjöström, in press).

THE NOTION OF *BILDUNG*

Before more in-depth describing the post-human version of *Bildung*, I will give a short introduction to the notion of *Bildung* more generally. It is definitely not a homogenous concept, but one can say that it has both objective and subjective aspects and both educational and political dimensions. Because there is no precise English translation of *Bildung*, the German term is used in the international educational literature (see e.g. Westbury, Hopmann, & Riquarts, 2000).

Bildung consists of two elements: "autonomous self-formation and reflective and responsible action in (and interaction with) society" (Fellenz, 2016, p. 273). It is about "the individual embedded in a world" (Løvlie & Standish, 2002, p. 319) and accordingly *Bildung* can be seen as an educational ideal for citizens. The concept was in its modern form coined in Germany in the late eighteenth century, with roots in both the Enlightenment and Romanticism (Reichenbach, 2014). Today at least five versions of *Bildung* are well-

established and all of them have transformed over time from a North European to a global focus (Gustavsson, 2014; Sjöström & Eilks, 2017). One of the most complex versions is critical-hermeneutic *Bildung* and I regard reflexive *Bildung* as a further developed variant of this version. In this paper it is developed even further.

During the last fifteen years the concept has been problematized by post-modern theorists. Some scholars have claimed that the concept should be abandoned, whereas others claim that *Bildung* still works as a critical concept in a post-modern world. Gur-ze'ev (2002, p. 405) writes: "As counter-education, today's *Bildung* can contribute greatly to the reconstruction of [...] subjectification". Instead of truth, *Bildung* should be about cultural respect and socio-political justice (Peukert, 2002). From post-human perspectives (Taylor, 2016), it can show us moral-philosophical-existential-political alternatives (Gur-ze'ev, 2002). Taylor (2016) uses the concept 'ethico-onto-epistemology' and writes: "I argue against the separation of the mind and body and propose, instead, a form of knowing-in-being in which learning as a materially embodied and emplaced sensory knowing enables us to ask new and different questions about ways of being, knowing and doing" (p. 10 a.o.p.). For her post-human *Bildung* and curricula is about interdisciplinarity, ecological relations, and knowledge uncertainty and pluralism. Which consequences does such a view have on STEM education?

CONNECTING TO ROBERTS' VISIONS AND CURRICULUM EMPHASES

During the last sixty years policy makers and science educators have argued for scientific literacy. Roberts (2007) distinguished between two main orientations: *Vision I*, which focuses mainly on learning about scientific content and scientific processes for later application, and *Vision II*, which focuses on understanding the usefulness of scientific knowledge in life and society by starting science learning from meaningful contexts. Other authors have described different subversions of Vision I and II (Lundqvist, Säljö & Östman, 2013; Ottander, 2015; Sund, 2016; Lidar, Karlberg, Almqvist, Lundqvist, & Östman, accepted). Roberts (2011, p. 14) connected four (of his seven empirically based) curriculum emphases (solid foundation; structure of science; correct explanations; scientific skill development) to Vision I and the other three (self as explainer; everyday coping; science, technology, and decisions) to Vision II.

As mentioned above, for reflexive *Bildung* I have suggested a third vision of scientific literacy and science education (Sjöström & Eilks, 2017), which I view as driven by post-human perspectives. The philosophy of this orientation can be characterized with e.g. the terms post-positivism, relationalism, embodied science, subjectification, eco-reflexivity, and reconstructionism (Sjöström, in press). It is interesting to note that there are no curriculum emphases among Roberts' that clearly emphasize socio-political actions, philosophical values and/or existential perspectives, which are in focus in science education framed by Vision III. Here I suggest a differentiation between two subversions of *Vision III*:

Vision IIIA: socio-political actions (see further: e.g. Sjöström & Eilks, 2017)

Vision IIIB: moral-philosophical-existential perspectives, including NOS-aspects

However, I think the curriculum emphasis 'self as explainer' can be interpreted as being about existentialism, but most often I suppose it is not. In the literature there are some papers arguing for the importance of 'holistic experience', emotional sensitivity toward nature, philosophical values, and the importance of wonder (e.g. Hadzigeorgiou & Schulz, 2014; Dahlin, Østergaard & Hugo, 2009). These ideas are in line with the moral-philosophical-existential perspectives emphasized in Vision IIIB and are also related to the ideas of many Eastern philosophies (Sjöström, in press).

DISCUSSION AND IMPLICATIONS

Bildung-oriented science education covers both Vision IIIA and IIIB (and to a large extent also Vision II and I) and can function as a bridge between activism-oriented science and technology education (Bencze & Alsop, 2014) on the one hand and traditional ideas of *Bildung* on the other hand. During the presentation I will problematize the theoretical underpinnings of reflexive *Bildung* and its implications for philosophy of science education, scientific literacy, curriculum development and praxis of STEM education.

REFERENCES

- Bencze, L., & Alsop, S. (Eds.). (2014). *Activist science and technology education*. Dordrecht: Springer.
- Dahlin, B., Østergaard, E., & Hugo, A. (2009). An argument for reversing the bases of science education – a phenomenological alternative to cognitionism. *Nordic Studies in Science Education*, 5, 185-199.
- Fellenz, M. R. (2016). Forming the professional self: Bildung and the ontological perspective on professional education and development. *Educational Philosophy and Theory*, 48, 267-283.
- Gur-ze'ev, I. (2002). *Bildung* and critical theory in the face of postmodern education. *Journal of Philosophy of Education*, 36, 391-408.
- Gustavsson, B. (2014). Bildung and the road from a classical into a global and postcolonial concept. *Confero: Essays on Education, Philosophy and Politics*, 2, 109-131.
- Hadzigeorgiou, Y., & Schulz, R. (2014). Romanticism and romantic science: Their contribution to science education. *Science & Education*, 23, 1963-2006.
- Lidar, M., Karlberg, M., Almqvist, J., Lundqvist, E., & Östman, L. (in press). Manner of teaching and teaching traditions in science education: What do teachers emphasize? *Scandinavian Journal of Educational Research*
- Løvlie, L., & Standish, P. (2002). Introduction: *Bildung* and the idea of a liberal education. *Journal of Philosophy of Education*, 36, 317-340.
- Lundqvist, E., Säljö, R., & Östman, L. (red.) (2013). *Scientific literacy – teori och praktik*, Malmö: Gleerups.
- Ottander, K. (2015). *Gymnasieelevers diskussioner utifrån hållbar utveckling: meningsskapande, naturkunskapande, demokratiskapande*. PhD thesis, Umeå universitet.
- Peukert, H. (2002). Beyond the present state of affairs: *Bildung* and the search for orientation in rapidly transforming societies. *Journal of Philosophy of Education*, 36, 421-435.
- Reichenbach, R. (2014). *Humanistic Bildung*: regulative idea or empty concept? *Asia Pacific Education Review*, 15, 65-70.
- Roberts, D. A. (2007). Scientific Literacy / Science Literacy. In S. K. Abell & N. G. Lederman (eds.), *Handbook of research on science education* (pp. 729-780). Mahwah: Lawrence Erlbaum.
- Roberts, D. A. (2011). Competing visions of scientific literacy: The influence of a science curriculum policy image. In C. Linder, L. Östman, D. A. Roberts, P.-O. Wickman, G. Erickson, & A. MacKinnon (eds.), *Exploring the landscape of scientific literacy* (pp. 11-27). London: Routledge.
- Sjöström, J. (in press). Science teacher identity and eco-transformation of science education. *Cultural Studies of Science Education*, DOI: 10.1007/s11422-016-9802-0.
- Sjöström, J. (2013). Towards *Bildung*-oriented chemistry education. *Science & Education*, 22, 1873-1890.
- Sjöström, J., & Eilks, I. (2017). Reconsidering different visions of scientific literacy and science education based on the concept of *Bildung*. In J. Dori, Z. Mevarech & D. Baker (eds.), *Cognition, Metacognition, and Culture in STEM Education* (accepted for publication). Dordrecht: Springer.
- Sjöström, J., Eilks, I., & Zuin, V. G. (2016). Towards eco-reflexive science education. *Science & Education*, 25, 321-341.
- Sjöström, J., Rauch, F., Eilks, I. (2015). Chemistry education for sustainability. In I. Eilks & A. Hofstein (eds.), *Relevant chemistry education – From theory to practice* (pp. 163-184). Rotterdam: Sense.
- Sjöström, J., & Talanquer, V. (2014). Humanizing chemistry education: From simple contextualization to multifaceted problematization. *Journal of Chemical Education*, 91, 1125-1131.
- Sund, P. (2016). Discerning selective traditions in science education: a qualitative study of teachers' responses to what is important in science teaching. *Cultural Studies of Science Education*, 11, 387-409.
- Taylor, C. A. (2016). Is a posthumanist *Bildung* possible? Reclaiming the promise of *Bildung* for contemporary higher education. *Higher Education*, DOI: 10.1007/s10734-016-9994-y, Published online: 23 March 2016.
- Westbury, I., Hopmann, S., & Riquarts, K. (eds.). (2000). *Teaching as a reflective practice: the German Didaktik tradition*. Mahwah: Lawrence Erlbaum.