

National Report for WP2, for P2 – Denmark

1. Description of the Danish educational system in regards to science

In Denmark, education is compulsory between the age of six and sixteen. Thus, Danish students attend school for 10 years in primary and lower secondary levels. There are four different strands of upper secondary schools in Denmark: The general upper secondary schools, the technical upper secondary schools, the commercial upper secondary schools, (all three year full-time programs) and the higher preparatory upper secondary schools (two year full-time programs). As stated in the *European Encyclopaedia on National Systems*, “[t]he Ministry of Children and Education is responsible for setting up the framework for curricula at primary and secondary level. However, the contents of the courses are finalised by the teachers themselves, with their students. The Ministry of Children and Education oversees the [public primary and lower secondary levels] in collaboration with the municipal councils”¹.

In the primary and lower secondary levels, Danish students are taught in the following science subjects²:

- Natural sciences/technology (in form levels 1-6).
- Geography (in form levels 7-9).
- Biology (in form levels 7-9).
- Physics/chemistry (in form levels 7-9).

In the secondary level, the far majority of Danish students select a specialized study subjects: “Each student chooses a specialized study programme consisting of a package with three subjects or – in certain packages - of two subjects. The packages, that are drawn up and offered by the individual school”³. These packages are complementary to the mandatory subjects that may vary from upper secondary school strand. Depending on strand and specialized study package, students can study Physics, Chemistry, and Biology on three different levels (C, B, A (highest));

¹ <https://webgate.ec.europa.eu/fpfis/mwikis/eurydice/index.php/Denmark:Overview>

² <http://eng.uvm.dk/Education/Primary-and-Lower-Secondary-Education/The-Folkeskole/Subjects-and-Curriculum>

³ [http://eng.uvm.dk/Education/Upper-Secondary-Education/Four-Upper-Secondary-Education-Programmes-in-Denmark/The-Gymnasium-\(stx\)](http://eng.uvm.dk/Education/Upper-Secondary-Education/Four-Upper-Secondary-Education-Programmes-in-Denmark/The-Gymnasium-(stx))

This project has been carried out with the support of the European Community and the Life Long Learning Programme. The content of this project does not necessarily reflect the position of the European Community, nor does it involve any responsibility on the part of the European Community.

and Natural geography at levels C and B. All students must study physics at C-level, together with at least two of the subjects biology, chemistry and natural geography at C-level, and, generally, students must study one science subject at B-level. It is mandatory for students to take a fundamental natural science subject during the first semester at upper secondary school.

One of the key weaknesses of the Danish school system seems to be the relatively weak research base of primary/lower secondary teacher education in Denmark (Nordic Council of Ministers, 2009). This is particularly problematic when considering that an OECD initiated survey – TALIS – found that a fourth of Danish teachers had not taken part in any form of professional development for the last 18 months – Denmark is among the bottom three countries concerning professional development of primary/lower secondary school teachers (Egelund, 2009). One of the strengths of the Danish school system is the markedly homogenous quality of Danish schools – Danish public schools are generally very similar with respect to the quality of teaching (EACEA, 2011).

2. SSI and everyday science in the curriculum and schools in Denmark

This section provides a description of SSI- and everyday science elements in the curricula (goal statements) of the following subjects:

- *Primary/lower secondary*: Natural sciences/technology, Geography, Biology, Physics/chemistry
- *Upper secondary*: Physics, Chemistry, Biology, Natural Geography, fundamental natural science.

While none of the Danish science curricula explicitly mention SSI, the end goals that are stipulated abound with aspects that can be seen as being related to SSI.

Natural sciences/technology (in form levels 1-6). This subject is the entry-level science subject in the Danish school system. It is a highly integrated and thematic subject in the sense that no real distinction is made between the different natural science disciplines. According to the curriculum, the subject takes outset in the students own experiences, inquiries and experiments; the key aim is to maintain the students' interest in natural phenomena while acquiring a specific (scientific) way of talking and thinking that “has value in everyday life” (Danish Ministry of

Children and Education, 2009a). The end goals of this subject stipulate that the student at the end of form level 6 should, among other things, (i) be able to “describe essential body functions and essential factors that affect these, as well as conditions that have significance for human health”; (ii) be familiar with “the concept of sustainability, and account for examples that human use of resources and technology affect the cycles in nature”; and (iii) assess examples of environmental problems locally and globally on the basis of own insight” (Danish Ministry of Children and Education, 2009a).

Geography, Biology, and Physics/chemistry (in form levels 7-9). The main focus of all these subjects is to develop a fundamental familiarity with scientific practice and the scientific way of thinking and talking. Beyond this, all these subjects have the aim of developing the students’ “responsibility towards nature and the use of resources” in a way that empowers them to trust their own “decision-making and action concerning the interaction between human and nature” (Danish Ministry of Children and Education, 2009b, 2009c, 2009d). All three subjects progress from students “own observations and inquiries” (ibid).

Geography comprises both cultural and natural geographical subjects. The aim is that students acquire “fundamental geographical knowledge” that can act as a backdrop for understanding “societies’ exploitation of [...] resources” (Danish Ministry of Children and Education, 2009b, p. 3). The end goals specific to this subject stipulate that the student at the end of form level 9 should, among other things, be able to “provide examples of human exploitation of the [existing nature] as seen in connection to sustainability” (Danish Ministry of Children and Education, 2009b, p. 4).

Biology: The end goals specific to this subject stipulate that the student at the end of form level 9 should, among other things, be able to reflect upon (i) “concurrent environmental problems and their significance for human health and [...] nature”; and (ii) “the use of biotechnologies and their significance for the individual, society, and nature” (Danish Ministry of Children and Education, 2009c, p. 4).

Physics/chemistry: The end goals specific to this subject stipulate that the student at the end of form level 9 should, among other things, be able to (i) “account for, discuss, and make decisions about society’s use of resources and energy”, (ii) “describe and explain examples of

product manufacturing and assess the production process' strain on the environment", and (iii) "describe the technics of everyday life and its significance for the individual and society" (Danish Ministry of Children and Education, 2009d, p. 4).

Beyond these aims and end goals, the three subjects *Geography*, *Biology*, and *Physics/chemistry* (in form levels 7-9) share a mandatory focus on the application of the subjects on everyday life and society. This has, for example, the consequence that all three subjects must thematize the topics of groundwater in Denmark, the water and carbon cycles, and the use of resources and sustainability (e.g. Danish Ministry of Children and Education, 2009d).

Fundamental natural science (first semester in upper secondary). The main focus of this subject is to develop the students' "knowledge about some central scientific issues and their societal, ethical or historical perspectives, so that they can express a knowledge-based opinion about issues and problems that have a scientific aspect" (Danish Ministry of Children and Education, 2010). The teaching "involves exemplary and actual issues in combination with an experience-based and experiential approach to the surrounding world" (ibid). The end goals specific to this subject stipulate that the student should, among other things, be able to "put contributions from science into the perspective of technological and societal development through examples" (ibid).

Physics (upper secondary C-, B, and A-level). One of the aims of this subject is to develop the students' understanding and ability to "discuss science- and technology-based arguments concerning issues of general human or societal interest" (ibid). The teaching involves work with "texts with technical/scientific contents so that they can reflect upon content and argumentation, whilst [being exposed to] instances of putting the subject into perspective" (ibid). The end goals specific to this subject stipulate that the student should, among other things, be able, "through examples and in collaboration with other subjects, to put the contributions of physics into perspectives concerning both the understanding of natural phenomena as well as technological and societal development". Besides the core scientific contents of physics, the teaching must involve supplementary content that "includes concurrent or societal issues, hereunder thematizations of physical or technological aspects of sustainable development" (ibid).

Chemistry (upper secondary C-, B, and A-level). One of the aims of this subject is to develop the students' "understanding that chemical knowledge and creativity finds applications that are beneficial for humans and nature, but that inappropriate applications can affect health and environment" (ibid). The end goals specific to this subject stipulate that the student should, among other things, be able to "become familiar with the scientific way of thinking and the scientific method, hereunder that the quantitative aspect is essential"; (2) know "that chemistry in collaboration with other subjects can thematise and solve problems"; and (3) "be reflective and responsible about concurrent issues with a scientific content" (ibid). Besides the core scientific contents of chemistry, the teaching must involve supplementary content that "relates to the students' everyday life and the concurrent debate"; provides "examples of the development of chemistry"; and reveals "the significance [of chemistry] for our standard of living" (ibid).

Natural geography (upper secondary C- and B-level). One of the key themes of this subject is the issue of "how man adapts, exploits, regulates, changes, and manages nature and [the] surrounding [world], hereunder the principles for sustainable development" (ibid). The end goals specific to this subject stipulate that the student should, among other things, be able to (1) "have a structured and coherent environmental understanding so that they can reflect upon geographical issues on a local and global level"; (2) "put geographical issues into a wider societal perspective and utilize geographical knowledge along with knowledge and competences acquired in other subjects"; (3) "collect and assess information from different [sources] ... and communicate disciplinary knowledge and argue logically... and be able to reflect upon the concurrent societal debate about geographical topics" (ibid). Besides the core scientific contents of natural geography, the teaching must involve supplementary content that "includes issues from the natural, social, and cultural science in relation to the core content" (ibid).

Biology (upper secondary C-, B, and A-level). One of the aims of this subject is (1) "through observations in nature and through experimental work, ... [to contribute] to the understanding of the significance of human activity, hereunder the principles of sustainable development" (ibid). Further, biology aims to contribute "to man's understanding of him/herself – as a biological organism and as citizen in society" (ibid). The end goals specific to this subject stipulate that the student should, among other things, be able to (1) acquire "a disciplinary

background for decision-making and action in relation to own and societal issues with a biological content” (ibid). Besides the core scientific contents of biology, the teaching must involve supplementary content that involves “issues within health, medicine, environment, biological production, and biotechnology” (ibid).

3. SSI and everyday science in teacher professional development in Denmark

In Denmark, teachers in primary and lower secondary school have a bachelor degree from a non-research-based university college, while upper secondary school teachers have a masters degree from a research university with 0-15 ECTS educational courses. In order to be tenured at an upper secondary school, upper secondary school teachers will have to participate in a national in-service educational program. Upper secondary school teachers have typically studied two academic disciplines at university (e.g. mathematics and physics). But in recent years many technical upper secondary schools employ engineers with engineering experience.

In 2006 the primary and lower secondary teacher education was changed so that science became one of three specialisations (worth 72 ECTS) (along with mathematics and Danish); and in 2010 it became possible for teacher students to choose a minor in science (worth 36 ECTS) (E, p. 110). The curriculum for the science subjects for pre-service science teachers generally stipulates that the student teachers should become able to (1) “discuss issues” that have a scientific content; (2) “be in charge of” science teaching in a way that (2a) takes outset in their “pupils’ own experiences”; (2b) gives their pupils the “desire” to preoccupy themselves with issues with a science content; and (2c) provides their pupils with a disciplinary background for “decision-making and action” concerning e.g. “the interplay between man and nature” (Danish Ministry of Children and Education, 2011).

During the education of upper secondary school teachers, there are significantly less SSI aspects. The few didactic courses that university students can opt for do not necessarily involve SSI aspects. At the faculty of Science at the University of Copenhagen, the two science didactic courses do have some SSI aspects. In the basic course, both the lectures and sample teaching experiences always include SSI. The assignments align to the Ministry guidelines previously discussed here for each subject area. For the advanced course, where participant create a regular

This project has been carried out with the support of the European Community and the Life Long Learning Programme. The content of this project does not necessarily reflect the position of the European Community, nor does it involve any responsibility on the part of the European Community.

series of science lessons taught both to peers and in schools, virtually all of the lessons incorporate some aspect of SSI. Since new teachers have themselves experienced Danish schooling and hence the close connection of science to SSI, they in turn naturally anchor their lessons around one or more Social Scientific Issue.

Teacher Professional Development in Denmark. A number of TPD programs offer some thematization of SSI:

- A master degree program for in-service (lower secondary school) science teachers at the University of Southern Denmark
- A network for new (upper secondary school) science teachers facilitated by the University of Copenhagen
- Various science teacher events facilitated by the universities and the NGO “Danish Science Communication”
- Courses on IBSE for science teachers on all levels by University of Copenhagen, University of Aarhus, University of Southern Denmark

4. Projects in Denmark related to SSI and everyday science

The following projects have some relation to SSI and everyday science:

- University of Copenhagen:
 - PROFILES (EU, FP7)
- University of Aarhus:
 - Quest (funded by the Lundbeck Foundation)
- Danish Ministry of Children and Education
 - “Application-orientation” (Structuring science teaching around the idea of applying the science content outside of science)

Of course, virtually every project can claim some relationship due to the pervasiveness of SSI in Danish education.

References:

This project has been carried out with the support of the European Community and the Life Long Learning Programme. The content of this project does not necessarily reflect the position of the European Community, nor does it involve any responsibility on the part of the European Community.

Danish Ministry of Children and Education (2009a). Fælles Mål 2009 Natur/teknik.

Undervisningsministeriets håndbogsserie nr. 15 – 2009.

Danish Ministry of Children and Education (2009b). Fælles Mål 2009 Geografi.

Undervisningsministeriets håndbogsserie nr. 16 – 2009.

Danish Ministry of Children and Education (2009c). Fælles Mål 2009 Biologi.

Undervisningsministeriets håndbogsserie nr. 17 – 2009.

Danish Ministry of Children and Education (2009d). Fælles Mål 2009 Fysik/kemi.

Undervisningsministeriets håndbogsserie nr. 18 – 2009.

Danish Ministry of Children and Education (2010). (Executive order) Bekendtgørelse nr 692 af 23/06/2010. <https://www.retsinformation.dk/forms/r0710.aspx?id=132647>

Danish Ministry of Children and Education (2011). (Executive order) Bekendtgørelse nr 562 af 01/06/2011. <https://www.retsinformation.dk/Forms/R0710.aspx?id=137397&exp=1#B1>

EACEA. (2011). *Science Education in Europe: National Policies, Practices and Research*.

Brussels: Education, Audiovisual and Culture Executive Agency.

Nordic Council of Ministers (2009). *Komparativt stadium af de nordiske læreruddannelser*.

København: TemaNord.

Egelund, N (2009). *TALIS – En international undersøgelse af undervisning og læring*. OECD *Teaching and Learning International Survey*. København: Skolestyrelsen.