

# **Citizenship, Inquiry and Responsibility in socio-scientific issues, an analysis of Swedish biology curriculum.**

## **Introduction**

During the last years the so called 21<sup>st</sup> century skills have been emphasized in both policy documents and science education research. Educators, education ministries and governments, employers, and researchers refer to abilities with terms that include “21st century skills,” “higher-order thinking skills,” “deeper learning outcomes,” and “complex thinking and communication skills” (Saveedra & Opfer, 2012). These skills are expressed in different ways in different documents but are mainly focused against skills the citizen is supposed to possess in different situations. Many lists include life skills (flexibility and adaptability), workforce skills (collaboration and responsibility), applied skills (accessing and analyzing information and determining alternative solutions to problems), personal skills (curiosity, critical thinking, and problem solving), interpersonal skills (cooperation and teamwork) (McComas, 2014; Saveedra & Opfer, 2012). The development of these skills among citizens in Europe has been supported by the European Union through different education and research programmes (EU, 2015). However, how much these projects and in the extension the 21<sup>st</sup> century skills and core concepts connected to these skills have been integrated in the different school systems and in the end curricula around Europe is not yet clarified. Some of these skills or aspects can be regarded as extra relevant for science education. Earlier research has demonstrated the difficulties for individuals to analyze information and think critically in issues where science knowledge is involved (e.g. Author, 2011).

This paper analyzes if four aspects (citizenship education (CE), inquiry-based science education (IBSE), responsible research and innovation (RRI) and socio-scientific issues (SSI)) from a theoretical framework in one of those EU-funded projects (PARRISE) are integrated in the Swedish biology curriculum in lower secondary school (NAE, 2011).

The project framework (PARRISE, 2014) combines the educational value of the four concepts described above to the concept SSIBL (Socio-Scientific Inquiry-Based Learning). SSIBL deploys the following pedagogical and learning characteristics: The framework describes how scientific principles can be understood in social and ethical contexts and what differ scientific, social and ethical propositions. Individuals should have the ability to draw on the skills and procedures of dialogue, reasoned discussion and argumentation in articulating and persuading for and against certain points of view to confer RRI. The framework is not an attempt to cover all 21<sup>st</sup> century skills, it mainly focus skills connected to science and science education.

Research question: To what extent are CE, IBSE, RRI and SSI integrated in the national biology education curriculum in Sweden?

## **Background**

The biology curriculum in Sweden consists of three main parts. In the first part the aims of teaching biology are expressed. This part ends with three abilities the students will develop during their biology studies:

- Use knowledge of biology to examine information, communicate and take a view on questions concerning health, natural resource use and ecological sustainability
- Carry out systematic studies in biology
- Use concepts of biology, its models and theories to describe and explain biological relationships in the human body, nature and society.

In the second part of the curriculum the core content of the subject is described. For instance should the teaching in biology deal with nature and society, body and health, biology and world views and biology, its methods and ways of working. These over aiming core content themes are then divided to 4-5 subjects. As example are biotechnology, historical discoveries, scientific theories about the origins of life and usefulness of theories and models of biology mentioned as subjects in the biology and world views theme.

The third part of the curriculum consists of knowledge requirements. These requirements are descriptions of what the student should be able to do after year 9 (end of compulsory school). These knowledge requirements are connected to the three abilities mentioned above, even if the core content is mentioned in the requirements. As one knowledge requirement connected to biology and worldviews the student can put questions, and put forward and respond to views and arguments in a way which to some extent takes the discussions forward.

### **Methods**

The curriculum in biology for lower secondary school in Sweden has been analyzed. In focus for the content analysis of the curriculum has been the four major aspects; CE, IBSE, RRI SSI. Each aim, core content theme and knowledge requirement has been classified in regard to these four major concepts. The content analysis was in form of a conceptual analysis (Patton, 2001). In conceptual analysis, a concept is chosen for examination, and the analysis involves quantifying and tallying its presence. The curriculum's aim, core content and knowledge requirements have been analyzed with regards to the four aspects. A coding scheme was made, where words and phrases from the curriculum were categorized to the different aspects. Some examples from the categorisation:

- CE - critical thinking, expressing own arguments
- IBSE - put questions, be tested, evaluated
- RRI - interaction with experiences from studies, current research
- SSI - knowledge of biology is of importance, use concepts of biology to explain relationships in body, nature and society.

It was not uncommon that some words and phrases were coded to more than one aspect. For instance can the sentence develop knowledge and tools for expressing their own arguments and examining those of others both be seen as CE and SSI. Some of the core content was not clearly connected to any of the aspects, for instance where different key concepts were mentioned (energy flow, organs, how organisms are identified). These concepts are of importance for understanding the four concepts, however not coded in this analysis.

### **Results**

The four aspects from the project framework are to large extent expressed in the Swedish

biology curriculum. The aspects IBSE and SSI dominate the curriculum. Both of these aspects can be found explicitly in three of the four over-arching themes (nature and society, body and health plus biology, its methods and ways of working) of the core content. The exception is the theme biology and world view. The first ability mentioned above where biology should be used to examine information, communicate and take a view on different questions, is in line with CE, SSI and to certain extent to RRI. CE and SSI aspects are richly expressed in the core content. However, the RRI aspects are not explicitly expressed as the others in the core content. Just one core content subject is obviously connected to RRI; current research in biology, such as biotechnology. The second ability; carry out systematic investigations is closely connected to IBSE. It is represented with an own theme in the core content; biology, its methods and ways of working.

### **Discussions and conclusions**

The Swedish biology curriculum is well-adapted to the thoughts connected to science education that are expressed in the 21<sup>st</sup> century skills and articulated in the project as four aspects. The aim and core content of biology are dominated by these aspects, especially IBSE and SSI. But the RRI-aspect is not so explicitly expressed as the others. This is something both the biology education in Sweden and upcoming project must deal with, for instance by bringing more science researchers in to the project.

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