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Teaching for competence in science education in Denmark

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Introduction

The main interest in this paper is to engage with the concept of competence, particularly in primary and early-secondary science education in Denmark. A basic starting assumption is that the idea of competence is useful in thinking about the learning goals of science teaching, but there are many challenges to address both in formulating and using the idea.

We briefly discuss the current historical situation in Denmark about the use of the competence concept in the national school curriculum, and then discuss some difficulties in understanding the meaning of the concept. We do not diverge into critical evaluation of other approaches. Rather we introduce some ideas from developmental teaching, particularly the concepts of germcell and theoretical thinking (Davydov, 2008), which we believe are useful for developing a sufficiently concrete understanding of a competence concept that could be in developing specific instructional approaches.

Historical overview

Starting in school year 2015-2016, the notion of competence will become part of the national school law for the comprehensive school (grades one to nine). The intention is to establish a competence-oriented school instruction. A focus on learning outcomes was introduced into the Danish school law already in 1993, and the notion of competence appeared briefly in the Danish curriculum (1997-1999), before this new appearance. Discussions about ‘competence’ in science education have proceeded since at least the beginning of the century (e.g., Andersen, Busch, Horst, & Troelsen, 2003).

Meaning of “competence” in the Danish school law

The meaning of competence in the coming Danish school law is difficult to ascertain, both theoretically and substantively. The appearance of this term as a central structuring principle in the new national curriculum can be traced primarily to the fact that the national curriculum document is
grounded in the “Danish Qualifications framework for lifelong learning” (formulated in 2009). This framework draws centrally on the European Qualification Framework (EQF), which is meant to facilitate comparison of formal educational qualifications between countries.

The EQF chose to use a distinction between knowledge, skills, and competence to describe learning outcomes after “discussions between technical experts from all countries involved in the development of the EQF” (European Commission, 2008, p. 5). This decision by consensus is consistent with the lack of any reference to a particular theoretical or conceptual foundation for these concepts. This interpretation is supported by their own description: “The EQF’s differentiation between knowledge, skills and competence can therefore be seen as a pragmatic agreement between the various, widespread approaches and does not oblige countries to do the same.” (European Commission, 2008, p. 5).

The Danish framework adopts the tripartite distinction between knowledge, skills, and competence proposed in the European Qualifications Framework, and the learning outcomes in the new national curriculum are described in terms of knowledge, skills, and competence.

The definition of competence given in the presentation of the Danish framework is supplemented in an appendix of central concepts, which gives more detailed differentiations of competence. In all of these discussions, there is no reference to any conceptual or theoretical source that underpins these distinctions and definitions (Undervisningsministeriet, 2010).

None of the elaborated meanings of competence found in the national framework are found in the current guidance materials that the Education Ministry provides in relation to the new competence-based curriculum. Similarly, no reference is given to any theoretical or conceptual sources that underpin the use of the term competence in the new school curriculum.

While it is possible to identify the likely origin and reasons for the use of competence to describe learning outcomes in the coming Danish school curriculum, it is not possible to find any indication that these terms are grounded in a particular theoretical interpretation, and some indication that they are likely to be used in different ways according to national preferences or traditions.
Comparison with other “competence” terms

1. The notion of competence does not appear universally in curricular discussions about science education.

   For example, the framework for primary and secondary science education proposed by the National Research Council (2012) in the United States does not use the idea of competence to characterise an instructional objective. Neither has it appeared as a frame of reference in recent discussions among expert science education researchers in Europe (e.g., European Commission, 2007; Harlen, 2010).

2. Many discussions of competence (or competencies) in science education are often in connection with or in response to OECD initiated projects (e.g., PISA).

3. A multiplicity of general definitions of competence have developed in relation to these projects, in contrast to OECD’s intention to provide ”a sound conceptual framework” (OECD, 2005, p. 5). Weinert (2001) noted that there are many different approaches to competence, with no common conceptual framework (p. 46).

There has been a particular interest, especially in Switzerland (e.g., Labudde, 2010) and Germany (e.g., Kulgemeyer & Schecker, 2014), to develop large-scale measurement systems that can assess pupil competencies in science. The technical demands of these assessments have lead to diverse operationalisations of the competence concept, even if they start from common considerations. In other words, the situation described by Weinert has not improved.

A basic premise of our investigations is that this multiplicity of definitions is a permanent condition for educational practice and research about that practice, reflecting real and substantive differences in the interests and conceptions being pursued here. Therefore, the main challenges are to learn how to make clear what one is pursuing under the heading of ”competence”, and how this conception is related to particular curricular interests. There is no expectation that it will be possible, necessary, or even desirable to establish a standard meaning of the term competence, provided there is a transparency in the particular meaning that is being used in a particular context.
At the same time, models devised by researchers for assessing pupil competencies “are not designed for competence-oriented teaching and it is not easy for teachers to cope with their depths of differentiation” (Kulgemeyer & Schecker, 2014, p. 266). Therefore, we are interested in developing a way of understanding competence (and its development) that can serve at the same time as a guide for planning relevant instructional activities.

Positive Proposal

Davydov’s ideas about using germcells (models of central conceptual relations in the subject matter), and ‘rising to the concrete’ (i.e., recognising these relations in concrete examples) provides a concrete way to operationalise competence development. An example from chemistry is provided.

References


