

DIFFERENT WAYS OF DESCRIBING EXPECTED STUDENT LEARNING OUTCOMES IN SCIENCE

Dear Readers!

The best way of describing what and how a teacher should teach science or what a student should learn in a national level curriculum is not self-evident. Descriptions of “learning outcomes” are increasingly used and have been considered as an important basis for the quality of science education. However, there are variations in the descriptions and also whether they are written as a form of teacher behaviour or as a form of student learning. For example, in the UK the descriptions in the beginning of 1990 in the National Curriculum were written in the form of what students should learn. But the policy has changed and the new curriculum will describe what topics a teacher should introduce to students.

Definitions, uses and descriptions of learning outcomes were discussed in mid-March 2011 in an international seminar in Kiel, organised by the IPN - Leibniz Institute for Science and Mathematics Education at the University of Kiel and the Science Education Group at the University of York. Some outcomes of the discussions among the science education researchers from Australia, Finland, France, Germany, Hungary, Ireland, Switzerland, Taiwan, the Netherlands, Turkey, United Kingdom and USA will be briefly described here.

The discussion on learning outcomes is not straight forward because the education context and the terminology used in the curriculum documents and, moreover, the meanings of these terms vary between countries and people. For example, the use and definitions of the terms knowledge, skills, objective, aim, goal, ability, proficiency, proficient, learning outcome, competence, competent and competency vary and have different meanings in the national level curriculum in different countries. However, there is a consensus, at least at some level, that goals are used typically to describe the overall purpose of a subject or a course in a national level curriculum. Goals indicate general intentions and are not easily validated. Aims break down goals into measurable behaviours. Objectives are stated in narrower, precise, concrete and measurable terms. They are nowadays stated in terms of what the learner should know or be able to do or have attained by the end of a course or compulsory school and are called learning outcomes. Several countries have started to use the concept “competence” in order to describe “learning outcomes”. However, there are several hundred definitions or interpretations of the concept “competence”. In the English language, the concept “competence” does not exist, instead there are the concepts “competent” and “competency”. In Germany several researchers interpret the concept “competence” in a similar way to the concept “skill”. The PISA framework defines three competencies which describe the use of science subject knowledge and knowledge about science and, moreover, willingness to use this knowledge in three situations: in identifying scientific issues, in explaining scientific phenomena and in drawing evidence-based conclusions.

In Europe, the Bologna Process has put the focus on learning outcomes in terms of this concept being a “common language” to describe the curricula in countries throughout the world. The general idea behind transforming the educational aims into the form of learning outcomes is to enhance transparency and accountability of learning outcomes, and to increase the quality of learning. Moreover, the description of learning outcomes of a learning sequence is assumed to enable learners to have an active



role in the learning process alongside their teachers. Learning outcomes are typically described in a way they could be used or modified for assessment criteria and for designing items for national level external examinations. Therefore, use of learning outcomes has a direct link to teacher and national level assessment.

The basic idea of use of learning outcomes is old. The roots are argued to be close to the behaviouristic tradition of teaching and learning of the 1970s in the US. Robert Mager proposed the idea of writing specific statements about observable outcomes, *instructional objectives*. The idea was to define the 'end behaviour' in precise terms in order to create a basis for optimal instructional treatment. This kind of simplistic idea of teaching and learning could lead to an approach that does not consider learning as a process. Furthermore, use of learning outcomes could create the phenomenon of 'teaching for the test'. This approach is especially claimed to decrease the amount of science inquiry in science education. However, the descriptions and use of learning outcomes have developed since the time of Mager. In the Kiel seminar, novel approaches to the definitions and use of learning outcomes were discussed.

In the UK, there is a long tradition of use of learning outcomes and national external examinations in science. Several other countries, like Germany and France, have followed or are following the UK. However, several interesting novel approaches could be recognised in this movement. For example, in Germany the German psychologist Weinert uses competencies for describing "learning outcomes" as "clusters of cognitive prerequisites that must be available for an individual to perform well in a particular content area". The operationalisation of this definition is challenging. In practice, in German standards, there are three dimensions: basic concepts, domain (e.g. communication) where the concepts are used, and demand in the use of the concepts (reproduction, application, transfer). In the USA some researchers have introduced a term "learning progress" to describe learning outcomes. These researchers are planning to introduce in the next curriculum as "learning progress" a small number of core ideas and practices.

There are also countries, like Finland, where the learning outcomes, similar to other countries, have not been used to express the aims of science education. Pre-defined learning outcomes are not the only way to assure the quality of science education: the quality assurance of education can be approached from different perspectives. There is a general international interest, for example, in using the information from classroom-based assessment not only for improving teaching and learning but also for the purposes of educational decision-making and maintaining the quality of education. Recent research has focused also on the shift towards teacher-conducted procedures such as alternative and formative forms of assessment.

Several countries, like the UK, Germany and Finland, are preparing or are planning to prepare in the near future national level curricula. It will be interesting to follow how different demands, like quality assurance, EU harmonising policy, research on teaching, learning and assessment, are realised in 2010 or 2020 curricula.

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