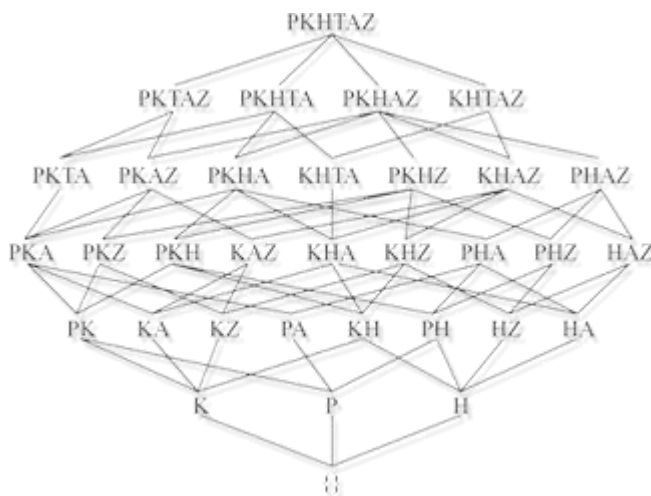


## Competence-based Knowledge Space Theory (CbKST)

The Competence-based Knowledge Space Theory provides a theoretical framework for knowledge and competence modeling. It is a powerful approach for structuring and representing domain and learner knowledge. In its original formalisation, a knowledge domain is characterized by a set of problems or test items. The knowledge state of an individual is identified with the subset of problems this person is able to solve. Due to mutual dependencies between the problems, not all potential knowledge states will occur. These dependencies are captured by the so-called prerequisite relation or its generalisation, the prerequisite function. The collection of all possible states is called a knowledge structure.



Competence-based extensions of the original framework consider the latent cognitive constructs underlying observable behaviour and assume a competence structure on a set of abstract skills underlying the problems and learning objects of the domain. By associating skills to the problems and learning objects of a domain, knowledge and learning structures on the problems and, respectively, learning objects are induced. The skills, which are not directly observable, can be uncovered on the basis of a person's observable performance. Skills are thereby commonly defined adopting learning and teaching goals as they can be identified from the curriculum and by combining action/procedural and conceptual/declarative components. These skills can be related to existing educational taxonomies; the skill modelling approach of CbKST is therefore in line with approaches aiming at the standardised and comparable representation of competence as an outcome of educational programs or school types and at providing a supporting frame for competence-oriented and learner-centred instruction.

The structures CbKST formulates on skills (or problems) in terms of prerequisite relations or functions can be graphically depicted by Hasse diagrams and, respectively, And/Or graphs, which are directed graphs with the nodes representing the problems of a domain and the arcs representing prerequisite relationships among those problems. These structures are traditionally been used at the backend of learning technologies, as a basis for adaptation mechanisms. CbKST provides the basis for

adaptive assessment procedures of a learner's current competence and knowledge state as well as for the realisation of intelligent educational adaptation and has been successfully applied as a cognitive basis for realising in terms of personalising learning experiences in different learning systems.