

## **Learning and Instruction**

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### *The overall framework of the training programme*

The training programme acquaints PhD students with the wider framework and major themes of the research problems of school-based learning and instruction. The theoretical background provided primarily includes issues of cognitive development, research on abilities, the relationship of declarative and procedural knowledge, the application of knowledge, problem solving, transfer, and the processes of learning and instruction in the school.

Research topics are offered primarily in two areas, in the examination of the quality and organisation of knowledge acquired in school and in the development of the methods and efficiency of instruction. There emerged two main methodological frameworks for the examination of knowledge acquired in the school. On the one hand, it is possible to describe and explore the developmental processes of different skills and abilities by cross-sectional and longitudinal assessments on larger samples. On the other hand, it is possible to explore the connections among different variables by means of assessments including several variables and investigating the effectiveness of interventions on smaller samples. Regarding the improvement of the methods of learning and instruction processes in the school and of their efficiency, experiments of developmental intervention can be carried out, the methodological frameworks and techniques of which have also been established in the Doctoral School.

The PhD students of the doctoral programme can join the work of the MTA-SZTE Research Group on the Development of Competencies, the projects implemented in the Scientific Foundations of Education Research Program of the Hungarian Academy of Sciences as well as the Center for Research on Learning and Instruction. The members of the research groups contribute to the training and research activities of the doctoral programme.

### *Main areas of research*

#### 1. The development of abilities

In the late 1990s, the assessment of several skills and abilities was carried out, mostly on nationally representative samples, using cross-sectional data collection. In all cases, the surveys of the abilities were preceded by the theoretical study of the given ability, by the description of its structure, and by the analysis of its role in learning from instruction and in the application of knowledge, then by pilot studies on smaller samples. The important skills and abilities assessed include, for example, combinative, systematising and logical abilities, the skill of solving word problems, converting units of measurement, and various foreign language skills. In the training programme similar skills and abilities can be defined, explored, and their developmental processes assessed.

a) The extension of previous studies: the examination of new domains, school subjects and age groups, in new contexts, with the analysis of a wider range of background variables.

b) The examination of the ability of complex problem solving in further realistic contexts, the relationship of knowledge acquired in the school and problem solving, the detailed analysis of transfer, the examination on of the role of contexts and structural factors.

c) The examination of reasoning related to chance, probability and uncertainty, the development of correlational and probabilistic reasoning, errors in reasoning, naïve

generalisations and misconceptions in correlational reasoning, the comprehension of probabilistic processes, and the possibilities of their representation in school subjects of the Social and Natural Sciences.

d) Studies on the strategic (metacognitive) components of reasoning.

e) The role of inductive, deductive and analogical reasoning in the learning of given school subjects. Analogies and isomorphic problems, the role of analogies in comprehension.

f) The improvement or adaptation of previously developed instruments, the repetition of assessments with different age groups, and in different contexts (in a different language, in a different culture, in a different country), with different background variables, using new procedures of data analysis.

## 2. The organisation of knowledge acquired in the school, and the characterisation of its quality

In recent years, there have been several consecutive concentrated studies targeting the development of instruments for the assessment of knowledge acquired in school (the application of Science knowledge, Science misconceptions, mathematical comprehension, written composition, historical reasoning, critical thinking, probabilistic reasoning, complex problem solving, proving ability, and reasoning schemas), and then empirical analyses.

Topics to be elaborated in the PhD programme primarily include:

a) The characteristics of the organisation of content knowledge, the examination of conceptual development, conceptual understanding and conceptual change in a few select central areas of the Natural and the Social Sciences. The possibilities of semantic representation and multiple representations, and their role in improving comprehension.

b) The relationships of academic achievement and affective factors influencing it (for example, achievement motivation, mastery motivation, self-regulated learning, attributions, and self-concept).

## 3. Facilitating the development of abilities in the school

In previous research projects, the facilitation of the development of several components of operational reasoning and analogical reasoning has been completed. A theoretical framework and instructional methods for fostering thinking embedded in content have been presented. Experiments have been conducted in helping the development of abilities in a criterion-referenced approach. For PhD students in the doctoral programme, an ideal research topic would be the development of content-specific intervention programmes and investigating their effectiveness.

a) The use and investigation of the effectiveness of the criterion-referenced and content based developmental intervention model can be carried out in several domains, primarily in the first language (reading or writing), logical-mathematical operations, inductive reasoning, and analogical reasoning, or in school subjects (Mathematics, Chemistry, Physics, Biology, History, or foreign languages).

b) The development of the abilities of students with a developmental lag. The development, experimental validation, and effect size calculation of targeted, mostly individualised, complex intervention programs to improve the performance of learners from disadvantaged families or low-stimulus environments. The study of resilience, the identification and creation of school environments conducive to high performance against the learners disadvantaged situation.

c) The exploration of the development, and of the possibilities to help this development, of learners with special educational needs.

#### 4. Methods improving the quality of acquired knowledge and the attitude towards learning

Previous research has, on the one hand, identified problems in the quality of knowledge, on the other hand, integrated instruction in school subjects and helping the development of reasoning skills. Further research is needed to develop methods of school based learning and instruction that, on the one hand, improve comprehension and the applicability of knowledge, and, on the other hand, improve motivation and affective factors in learning.

a) The school-based experiments targeting integrated instructional objectives can be enriched with new methods. Such endeavours include *Problem-Based Learning*, *Content-Based ... Learning*, and *Inquiry-Based ... Education*, where various subjects or domains can replace the dots. To assess changes in the quality of knowledge, instruments developed previously can be used.

b) Changing instructional methods to improve the quality of knowledge and the attitude towards learning. The use of mind maps, metacognitive support, individual and group projects, groupwork, cooperative learning, mastery learning, differentiation and personalisation as means to the abovementioned goal. Development of intervention programs, experimental validation.

c) The development and experimental validation of learning materials (textbooks or multimedia tools) informed by new concepts of knowledge, constructivist in nature, conducive to the improvement of general attitudes toward learning. The development and application of theoretical frameworks and techniques for such development and the analysis of learning materials.

#### 5. Helping development in the kindergarten, kindergarten to school transition, and the instructional issues of the first grades of primary school.

Because learning difficulties are usually formed in the first grades of schooling, research on early childhood education, kindergarten to school transition, and the conditions of successful school entry receive growing attention.

a) The identification of the preconditions of successful school entry, the exploration of the preliminary skills for learning to read and learning Mathematics.

b) Helping children's development in the kindergarten, the identification of atypical development, and developmental methods appropriate to compensate in domains lagging behind.

c) The exploration of kindergarten to school transition, the possibilities of longitudinal studies beginning before school entry.