

Preface

Layers and Transfers for Learning Theories and Applications

Mental Models continued to be a key subject in different fields of research for almost half a century. For good reason. Foundations from cognitive science, computer science, philosophy and cognitive psychology describe the workings of the human mind in tasks of deductive and inductive reasoning, especially for reasoning under uncertainty. They lead to theories of problem solving and to theories of learning and instruction which are both highly interdependent. Stepping into the design of both computer-based and face to face learning environments is obviously not very far since well founded theories on learning and instruction are ready for transfer into implementation and applications. By following these layers, we will always find two processes of transfer.

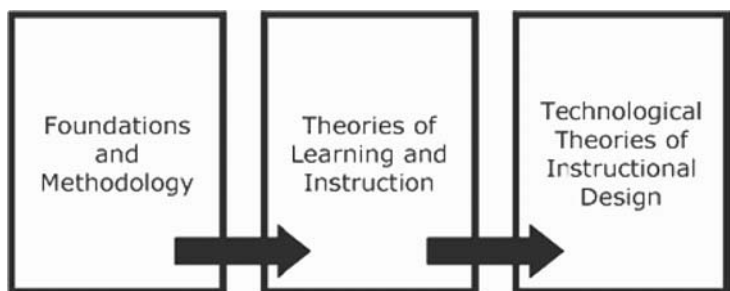


Fig. 1. Layers and transfers for learning theories and applications.

The first transfer is to be made from the theoretical foundations and methodology towards the theories of learning, instruction and problem solving, by taking into account the insights about reasoning and mental model building. This transfer is not unique for the field of mental models and should be applied for all theories of learning and instruction. In our case it leads to *Model-based Learning and Instruction* which is sometimes also referred to as *Model-centered* or *Model-oriented*.

Because learning environments are too complex to be described directly by the theories of foundation, the layer of learning theories is necessarily needed in between. In most cases insights on the foundation layer can not directly be translated and properly transferred into applications. Consequently the second transfer aims at the construction of well founded learning environments on the bases of the theories of learning and instruction. This transfer is the integral part of *Instructional Design*. However it is nearly impossible to conduct the second transfer

without understanding the foundations and the first transfer process. And of course insights on learning environments can lead to new hypothesis for the foundations. Hence only the consolidated investigation of all three layers leads to a deep understanding of the field.

Norbert M. Seel's Lifework

Norbert M. Seel dedicated his lifework to all of the three fields and consequently contributed to them with great reputation on the levels of theory, psychometrics, empirical studies and instructional design. We invite international researchers to participate in an integral work on all the three domains of expertise and the corresponding transfers within the field of mental models. This work will contain the actual state of research, methodology and technology. The three parts for the outline of the work are:

- Foundations and Methodologies of Mental Model Research
- Model-based Theories of Instruction
- Engineering the Model Environment

Foundations and Methodologies of Mental Model Research

The first part of the work will focus on the foundations of mental models and on methodologies which allow to measure constructs of mental models and how to track changes to them over time. Backgrounds and interdisciplinary interdependences between cognitive science, computer science, philosophy and psychology will be thoroughly presented and discussed.

Model-based Theories of Instruction

The second part will consequently be about the transfers into theories of model-centered learning and instruction on the basis of the foundations and methodologies. It will show how the foundations can be generalized into larger settings of learning and instructions from a perspective of educational science and instructional design. This part will also show how the corresponding findings can be specified again for the referring theories.

Engineering the Model Environment

The third part will lead us to technological theories on applications for instructional design and educational engineering. Selected examples and empirical findings on learning environments based on theories of model-centered learning and instruction will show how state-of-the-art technologies can be build and evaluated.

The Book Project

The editorial committee has selected a wide range of internationally know distinguished researchers who present innovative work in the areas of educational psychology, instructional design, and the learning sciences. The audience for this volume includes professors, students and professional practitioners in the general area of educational psychology and instructional technology. Without the assistance of several specialists the editors would have been unable to prepare this volume for publication. They wish to thank Joost Lowyk and Sanne Dijkstra for their tremendous help with both reviewing the chapters and linguistic editing. Their thanks also go to David Heyde for proofread of several chapters and Andreas Lachner for preparing the chapters to meet the editorial style prescriptions.

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Understanding Models for Learning and Instruction:

Essays in Honor of Norbert M. Seel

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2008, XVIII, 330 p., Hardcover

ISBN: 978-0-387-76897-7