Basic Concepts/theory Underlying the 4C/ID-Model: Transfer and Reflective Expertise

Objective: With the examples of a lesson plan, process worksheets, and the active dialogue from participants, the participants will experience the process of intentionally designing instruction for developing expertise and promoting transfer of knowledge and skill, as prescribed by van Merriënboer's 4C/ID-Model for technical training. The participants should be able to state what the four components to the 4C/ID-Model are and how they are used by the instructional designer to develop expertise and promote-transfer—for this is what the 4C/ID-Model does.

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Predictions of Transfer

> …it is predicted that application of the model will yield instruction that leads to higher transfer performance than conventional instruction, and that this superiority will increase as the transfer tasks differ more from the original training tasks. This prediction has been tested in a range of experiments conducted if the fields of computer programming, fault diagnosis in process industry, and statistical analysis, among others. (van Merriënboer, 1997, p. 276)

4C/ID -- This sign is the shortened form for Jeroen J.G. van Merrienboer's model for training complex cognitive skills: Four-Component Instructional Design Model for Technical Training. The four components are learning tasks, supportive information, just-in-time (JIT) information, and part-task practice (van Merriënboer et al, 2002). I note that in van Merriënboer's text (1997) he introduces the four components as Compilation, Restricted Encoding, Induction, and Elaboration. These four components are the basic blueprints in developing training for complex cognitive skills. The ID is the shortened form for Instructional Design, thus a Four-Component Instructional Design Model …, or 4C/ID.

Van Merriënboer includes a great pearl of wisdom in a footnote within his text, "…the 4C in the model's name not only indicates its four components but, pronounced as *foresee*, also its capability to predict and positively affect the transfer capacity of particular training strategies" (1997, p74, footnote 23).

[Notice the connection to Robert Gagne and Learner Strategies and Transfer (Gagne and Driscoll, 1988, *Essentials of learning for instruction*, pp. 125-130; 133-148]

Five Key Points to Jeroen J.G. van Merriënboer's 4C/ID-model for Technical Training.

Rather than present the four components in the 4C/ID-model now, I present five foundational key ideas:

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1. **Transfer and Reflective Expertise**

"The ability to perform an acquired skill in new, unfamiliar situations. A distinction can be made between near and far **transfer**, where the transfer tasks closely resemble the trained tasks, and far transfer, where the tasks are different from the trained tasks. The terms retention or self-transfer are used for situations in which the transfer tasks are identical to the trained tasks" (van Merriënboer, 1997, p. 322).

The goal of training is positive **transfer**. If the transfer goal is nearer or further from the original training goal, the instructional designer knows to emphasize procedural overlap, (rule automation) or schema--based transfer (schema acquisition) so that **reflective expertise** is enhanced and cognitive overload is avoided. The goal of instruction is to develop **Reflective Expertise**: the ability to solve new problems or perform a complex cognitive skill in a new situation because of the ability to (1) use a "domain-specific production to perform familiar aspects of a task," [perform a routine procedure), and (2) "the conscious use of cognitive schemata to solve unfamiliar aspects of the task" [the ability to think through an unfamiliar problem and find a solution]" (van Merriënboer, 1997, p.71).

The concept of **reflective expertise** leads to predictions regarding the transfer of particular training strategies. In particular, training strategies must pay more attention to schema acquisition and schema-based transfer if transfer tasks become more different from the original tasks" (van Merriënboer, 1997, pp. 74).

2. **Cognitive Load Theory**

Cognitive load is "The amount of effort-demanding, controlled processing [schema-based and knowledge-based] that is imposed on a learner's cognitive system. Well-designed training systems prevent cognitive overload, decrease cognitive load that is not relevant for learning, and optimize cognitive load that *is* relevant for learning" (van Merriënboer, 1997, p. 312).

"Control over **cognitive load** that is mainly provided by *redirecting the learners' attention* …to processes that *are* relevant for learning, and in particular schema acquisition by induction from concrete cases" (Mager, 1997, p.76). As well as providing problem-solving support, [modeling examples and case studies], or scaffolding, and the [benefits of whole-task practice].

3. **Component Fluency Hypothesis**

Automation of skill (recurrent) can decrease the amount of thinking that is required to perform that skill (decrease cognitive load); thus freeing up the capacity of the brain to use the reasoning processes (schema-based processes) for solving problems, or even thinking about how to perform a new recurrent skill.

As Frederiksen (1984) put it: "…problem solving capacity can be greatly increased by learning to use automatic processing for the more routine elements of an activity, making available controlled-processing resources [reasoning/thinking] for the novel aspects of problem solving (p. 365)" (van Merriënboer, 1997, pp. 72-73).

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Thus, the more **fluent** a person is in performing the **components** of a skill, the more schema-based processes can be available for solving "unfamiliar aspects of a problem situation" (van Merriënboer, 1997, p. 77).

4. **Understanding Hypothesis**
The better we **understand a specific topic** (subject area domain), or the more knowledge we have in that topic (available cognitive schemata to solve a problem) the more likely we are able to reflect about our behavior/performance in that topic, and identify our errors and make appropriate changes (correct our errors; van Merriënboer, 1997, p. 73).

5. **Developing a learning environment**
Based on the type of transfer required by the learners, the strategies and tactics are appropriately chosen for a **learning environment**, so that the learners can manage or keep in balance their cognitive load: "…a training strategy is developed that mainly facilitates rule automation and transfer on the basis of procedural overlap for recurrent constituent skills, and schema acquisition and transfer on the basis of those schemata (e.g., by analogy) for non-recurrent constituent skills. In short, a **learning environment** is designed that promotes the development of reflective expertise" (van Merriënboer. 1997, p. 76).