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AN EXPLORATION OF SCHEMA DEVELOPMENT IN PROCEDURE-ORIENTED PROGRAMMERS LEARNING OBJECT-ORIENTED TECHNOLOGY

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ABSTRACT

As businesses move to object-oriented (OO) development, they often face the task of retraining experienced procedure-oriented programmers. These programmers, however, often have difficulty learning the new technology. One possible reason for this is the tendency of experienced programmers to incorrectly map their existing knowledge onto new and unfamiliar OO concepts. This research identifies some specific mappings procedure-oriented programmers make as they learn OO concepts.

This work has its foundations in theories of skill acquisition (Anderson 1982), skill transfer (Singley and Anderson 1989), and schema development (Bartlett 1932). As skills are acquired, a learner progresses from rote memorization of facts to a more automatic and "tuned" domain-specific encoding. During this process, a learner will attempt to transfer knowledge from a familiar domain to the unfamiliar one. This transfer of knowledge can be characterized as an adaptation of existing semantically-organized schemas.

When a schema maps from one domain to another (procedural programming to OO programming, for example), there is a positive transfer of knowledge. When a schema maps incorrectly, a negative transfer of knowledge occurs. The incorrect mapping interferes with the assimilation of the new knowledge. For example, when OO concepts are introduced to a procedure-oriented programmer, he/she may try to map concepts from the procedural domain to the OO domain. If this mapping is incorrect, the rate of assimilation will be slower than if he/she did not have procedural schemas.

When learning object-oriented technology, what knowledge schemas do procedure-oriented programmers activate and attempt to map into the unfamiliar object-oriented concepts? We have begun to explore this research question through verbal protocol analysis of twenty procedure-oriented programmers learning OO concepts. Table 1 reports that these subjects did activate their procedure-oriented schemas when introduced to three OO concepts.

Table 1. Mappings of Object-oriented Concepts and Procedure-oriented Schemas

| Object-oriented Concept | Procedure-oriented Schema |
|--------------------------------------|------------------------------------|
| object abstraction and encapsulation | abstraction of procedures |
| class hierarchy structure | database diagrams flowcharts |
| message passing | function calling spaghetti code |

These preliminary results suggest that trainers need to carefully guide experienced procedure-oriented programmers when the OO concepts of object encapsulation, class hierarchy, and message passing are introduced. As OO training becomes more effective, the time and cost of retraining programmers should decrease. We believe that this is a promising area of

research and are continuing the study of schema transfer in other subjects participating in both professional and academic OO training environments.

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