

## Learning from worked examples

It is widely accepted by both teachers and learners that worked examples are a Good Thing. But commonly held assumptions are not always supported by the empirical evidence, and there are many unanswered questions.

Lieberman, 1986, voices one common assumption when he says:

"The best teachers.....motivate their presentations by supplying illustrative examples for each concept to be learned" (our emphasis).

However, I shall present evidence to demonstrate that when students of programming languages were given instruction as a mixture of text (descriptions of concepts, rules etc.) and worked examples, they did not, in fact, regard the worked examples as mere illustrations of the text, but rather as the major source of instruction. I shall describe two studies in which students concentrated on worked examples at the expense of the accompanying theoretical instruction. In the first study, there were aspects of the worked examples which the students could not possibly have understood, and yet these aspects were copied slavishly by a substantial number of the students. In the second study, the textual instruction was demonstrably clear and unambiguous, but the learners still concentrated on the worked example.

As to the many unanswered questions, I intend to discuss (in particular) the following:

How effective would a teaching strategy, in which examples are the sole (or main) mode of instruction, be for the teaching of programming languages?

This question is of interest

- (a) because of the results quoted above which demonstrated that students direct the main focus of their attention to worked examples;
- (b) because of the well-accepted claim that, rather than developing programs from scratch, experts often use existing code as a starting-off point;
- (c) because there is a precedent in the field of natural language learning i.e. the audiolingual methods which were prevalent about 20 years ago, in which students were expected to induce the syntax and semantics of the language from multiple examples.

I shall describe two experiments, one in Holland with High School children, and one in England with undergraduates, in which worked examples were the main teaching medium, and shall discuss, in particular, the problems of evaluating such strategies.

I also intend to ask the following questions (in the hope of prompting discussion, rather than of supplying or receiving any easy answers):

- Is there any evidence that learners use worked examples for anything other than checking on syntax and basic structural templates?
- What makes an effective worked example effective?