Learning from Worked-Out Examples via Self-Explanations: How it Can(not) be Fostered

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Learning from worked-out examples is of major importance for initial skill acquisition in well-structured domains such as mathematics and physics. However, only those learners who actively explain the rationale of the solution steps presented in the examples to themselves profit from this learning method ("self-explanation effect", Chi, Bassok, Lewis, Reimann, & Glaser, 1989). Unfortunately, most learners are to be characterized as passive or superficial self-explainers (Renkl, 1997a). From an educational perspective, two main questions arise: (1) How can productive self-explanations be fostered? (2) When should instruction move from the self-explanation of worked-out steps to actually solving problems for heightened speed and skill accuracy? Both of these questions were addressed in a series of experiments.

With regard to fostering self-explanations, four issues were investigated: (a) Setting situational incentives: The main idea was that if most learners do not spontaneously generate elaborated self-explanations, it might be helpful to put them into the role of a tutor for another learner. This should motivate them to increase their explanation activities (e.g., Renkl, 1997b). (b) Training and prompting: Self-explanation activities can be induced by a training or by prompting self-explanations at worked-out steps (Renkl & Atkinson, in press; Renkl, A., Stark, R., Gruber, H., & Mandl, H., 1998). (c) Support by instructional explanations: A number of studies have shown that it is difficult to provide effective instructional explanations during example study. However, on the other hand, relying only on self-explanations also has some restrictions (e.g., proneness to errors). Therefore, a set of principles highlighting how to effectively support example study by instructional explanations was developed and empirically investigated (Renkl, in press). (d) Structuring learning materials: Learning materials (i.e., examples and problems) can be designed in order to induce active and well-focused self-explanations, for example, by giving the learner the opportunity of problem-solving experiences before example study (Stark, Gruber, Renkl & Mandl, 2000). The main findings of a series of experiments on these issues can be summarized as follows. The setting of situational incentives has shown not to be very promising. The training and prompting as well as designing learning materials can substantially foster self-explanations and, thereby, learning outcomes. In addition, well-designed instructional explanations can further enhance learning.

For structuring the transition from example study in early phases of skill acquisition to problem solving in a later stage, we developed a fading rationale by which problem-solving elements are successively integrated into example study until the learners are able to solve problems on their own. The effectiveness of fading has been shown in several experiments (Renkl, Atkinson, Staley, & Maier, in press). Presently, we adapt the fading procedure to the learners' prior knowledge level.

Based on the results of our experimental research program, an instructional model of acquiring skills from examples and problems is proposed. It is argued that different learning goals are to be achieved in subsequent stages of skill acquisition (e.g., understanding vs. automation). Therefore, instruction should induce different learning activities during the course of skill acquisition. How these activities can be instructionally fostered can be derived from our experimental findings.

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