HOW DO COMPUTERS HELP A LEARNER TO MASTER SELF-REGULATION SKILL?

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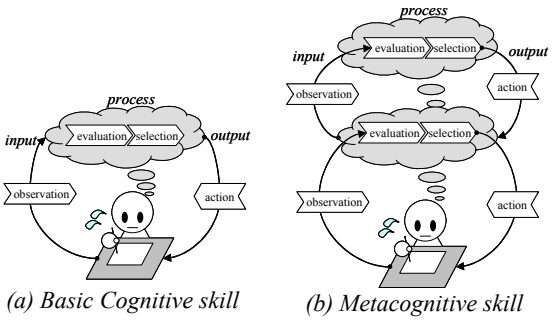
Abstract: In this paper, we propose a learning environment which facilitates the development of a learners' self-regulation skills. This learning environment provides opportunities for learners to collabolatively facilitate their self-regulation skills gradually: first, learning a skill by observational learning, and then, learning the skill by employing it as a cognitive skill. Finally, the skill is utilized as a metacognitive skill by means of computer system support. This method is based on Vygtsky's socio-cultural theory.

1. INTRODUCTION

The purpose of our study is to investigate how a computer-based learning support environment helps a learner to master self-regulation (SR) skill. SR skill is one of the metacognitive skills, and allows a learner to think about his/her own thinking process, and to control his/her own thinking process for achieving his/her goal by him/herself (Brown, 1987). There are many skills such as Motor skill, Cognitive skill, Metacognitive skill and so on. These terms cause confusion; it is often difficult to distinguish between what is metacognitive skill and what is cognitive skill. So, we attempted to explicate this confusion by defining metacognition as a double loop in mind and cognition as a single loop in mind (Figure 1). Based on this definition, we prepared a hierarchy structure of skills and surveyed existing learning support systems and methods, which facilitate learners' mastering of metacognitive skills (Kayashima & Inaba, 2003). In this paper, we describe what difficulties still remain in supporting learners' mastering of metacognitive skill, and then propose a learning environment to help learners' master the skill.

2. DIFFICULTIES IN MASTERING SELF-REGULATION SKILL

Every skill encounters its own difficulty in being mastered. We consider a hierarchy of the skills: Skill, Cognitive skill, Metacognitive skill and SR skill, and classify the difficulties according to the hierarchy. Mastering SR skill has difficulties in (a) understanding how to use the skill verbally or in writing, (b) observing the process to use the skill, (c-i) observing input and output of the skill, (c-ii) observing one's cognitive activity objectively, (c-iii) allocating one's mental resources, (c-iv) being aware when a learner should use the skill, (c-v) understanding the skill's importance and (d) acquiring knowledge and rules to regulate oneself. The difficulty (a) is applicable to not only SR skill but also all skills, and (b) is common for Cognitive skills. The Cognitive skill means the skill doing in mind. We identify two types of the Cognitive Skill: Basic Cognitive skill and Metacognitive skill. Both skills are similar and sometimes they are confused. The simple distinction between these skills is that of its controlling-target. The target of Basic Cognitive skill is at the outside world of



(a) Basic Cognitive skill *(b) Metacognitive skill*

Figure 1. Basic Cognitiveskill and Metacognitive skill

the person, the target of Metacognitive skill is at the inner world of the person who uses the skill. Thus, there are some proper difficulties for mastering Metacognitive skills (c-*). Due to the fact that input of metacognitive skill includes a track of cognitive activities, it involves the problem (c-iii). Use of metacognitive skill requires additional mental effort; nevertheless, sometimes a learner can solve problems even if the learner does not use metacognitive skill. That causes difficulties (c-iv) and (c-v). SR skill also has apt difficulty (d). The regulation task requires some specific knowledge and rules to evaluate and adjust one's own cognitive activity, but we rarely have the opportunity to acquire the knowledge and rules in our usual experiences in schooling.

3. A METHOD OF SUPPORTING LERNERS' DEVELOPMENT OF THEIR SR SKILLS

We propose a method and a learning environment to support learners' development of their SR skill. There are several methods to facilitate development of metacognitive skills. Although the existing methods reduce the difficulties (a), (c-iv), (c-v) and (d) (Palincescer & Brown 1984, King 1999, Shoenfeld 1987), there is no method designed to reduce difficulties (b), (c-ii) and (c-iii). So, adapting the existing methods, we propose our supporting method to facilitate to reduce difficulties (b), (c-ii) and (c-iii). To reduce these difficulties, we design the learning environment to provide learners with opportunities to develop their SR skill gradually.

The learning environment is composed of three phases. At the first phase, a learner plays the role of observer and learns SR skill as other-regulation skill, which is regulation skill at a cognitive level, by observational learning. At the second phase, the learner plays the role of monitor. The learner monitors the problem-solver's behaviour and tries to regulate his/her cognitive activities. Finally the learner plays the role of problem-solver and tries to monitor his/her cognitive activities and regulate them by him/herself. In order to learn SR skill by observational learning, it is ideal that input to the skill, process using the skill, and output of the skill is visible for the observer. In the first phase in this learning environment, the observer learns it by observing the process in which the monitor uses other-regulation skill. Its input information is the problem-solver's cognitive activity, and its outputs are questions that the monitor asks the problem-solver. The process using the skill is observed as discussion process among the monitors. It reduces the difficulty (b). Both the process and output are visible for the observer. In order to make the input visible, we provide an externalization tool for the problem-solver, which allows the problem-solver, the monitors and the observers to externalize his/her plan for problem solving. Therefore in this phase, the observers can examine all elements: input, process which the monitors use the other-regulation skill, and output: observational learning is realized. In the second phase, the

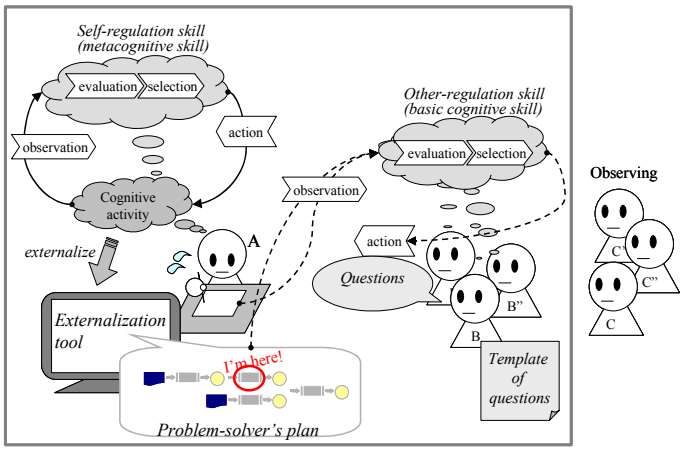


Figure 2. The learning environment

monitors observe, evaluate, and try to regulate the cognitive activities of the problem-solver through discussion among the monitors. The monitors have a checklist which has a template of some questions. These questions are intended to trigger the SR skill of the problem-solver and it includes the questions that Schoenfeld proposed. The problem-solver designs a problem-solving plan and then executes the plan while he/she points where he/she is in his/her plan using our externalization tool. The monitors can observe the plan, where the problem-solver points in the plan, and what he/she actually does, because the screen of the externalization tool is shared among the problem-solver and the monitors via a network. This means that the monitors can observe the problem-solver's cognitive activity. If the monitors evaluate the problem solver's behavior as wrong, the monitors select one of the questions in the checklist and ask the problem-solver. If this question triggers the SR of the problem-solver, the problem-solver's plan or/and behavior would be altered. In this phase, the monitors can practice monitoring another learner's cognitive activity and to control it with the checklist. Repeating this allows the monitors to internalize the questions which provide viewpoints regarding how a learner checks and regulates his/her cognitive activity. The monitors learn how to use the other-regulative skill during using the checklist as a practitioner. To reduce the difficulty of resource allocation, we propose to use the computer as part of a learner's working memory. It means that we provide an externalization tool for the learner's problem-solving planning. This externalization also allows him/her to concentrate on observing his/her own thinking process objectively. So, in the final phase, we aim to reduce the difficulties (c-ii) and (c-iii). This method is based on the socio-cultural theory that comes from Vygotsky (1978). He argued:

> The development appears on two planes: first on the inter-psychological, then on the intra-psychological. This theory means inter-psychological processes are themselves internalized by the individuals.

At first, the monitor's questions act as a trigger to the problem-solver's SR skill. Then the problem-solver internalizes the monitor's questions that are based on the checklist. The monitor's questions are internalized by the problem-solver, and can act as a trigger to cause his/her own SR skill.

4. CONCLUSION

We describe what difficulties still remain in supporting learners' mastering of SR skill and propose a computer-based learning support environment to help a learner master SR skill. This environment provides opportunities for learners to collabolatively master their SR skills gradually based on Vygtsky's socio-cultural theory: first, they learn the skill by observational learning, and then, they learn the skill by using it as a cognitive skill. Finally, they try to use the skill as a metacognitive skill with a computer system's support.

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