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Computers in Human Behavior 20 (2004) 551–567

Computers in Human Behavior

www.elsevier.com/locate/comphumbeh

Reflection prompts and tutor feedback in a web-based learning environment: effects on students' self-regulated learning competence

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Abstract

This study investigated the effects of reflection prompts and tutor feedback on the development of students' self-regulated learning competence (i.e. SRLC). In a web-based learning environment forty-two students completed a study task with embedded prompts eliciting reflection. The reflection prompts could either deal with aspects of self-regulated learning or not. In addition, the students could either receive electronic feedback from a tutor on their reflection expressions or not. The inventory of learning styles that was used to register development of the SRLC revealed a significant progress on the regulation subscales as a function of tutor feedback. An interaction between the students' evaluations of reflection prompts and tutor feedback indicated that the prompts that were related to aspects of self-regulated learning were perceived as less disturbing than the non-SRLC related prompts, especially when combined with tutor feedback. This study offers indications for the practical value of the combination of reflection prompts and tutor feedback as a promising means to develop students' SRLC in distance education applying a web-based learning environment.

Keywords: Self-regulated learning; Web-based learning environment; Reflection; Feedback; Tutoring

1. Introduction

It is well established that self-regulated learning is of considerable interest for students in higher education (Boekaerts, 1996; Pintrich, 1999, 2000; Zimmerman, 2000). Instructional measures that foster students' ability to self-regulate their

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0747-5632/$ - see front matter
doi:10.1016/j.chb.2003.10.001

learning are broadly investigated in many different educational settings (Belfiore & Hornyak, 1998; Corno & Randy, 1999; Graham & Harris, 2000; Hofer, Yu, & Pintrich, 1998; Ley & Young, 2001; Pressley, 1995; Weinstein, Husman, & Dierking, 2000; Winne & Stockley, 1998). Theory provides indications that reflection is an important factor concerning the development of self-regulated learning (Boekaerts, 1999; Boud, Keogh, & Walker, 1985; Ertmer & Newby, 1996; Lee & Hutchison, 1998; Sobrol, 2000; Von Wright, 1992). Until now hardly anything is known about utilization of reflection in distance education, that increasingly utilizes web-based learning environments as a means for delivery and communication nowadays. In this study we question whether reflection prompts embedded in study tasks that were presented to higher education students in a web-based learning environment are fruitful for the development of students' competence to self-regulated learning (SRL). In this introduction, first the self-regulated learning competence (SRLC) will be discussed, and second, a theoretical basis for the reflection prompts and feedback as a means to foster development of the competence to SRL will be presented.

1.1. Self-regulated learning competence

Students are considered to become competent as self-regulated learners. This is not only important for their progress in formal education, but also afterwards in their professional careers in which they have to be able to maintain their professional and academic competences (Vermunt, 2000). In accordance with Lemos (1999), higher educated professionals should be competent as self-regulated learners which means that they posses the ability to organize learning according to their own purposes and to modulate their learning to changing circumstances. Theory (e.g. Boekaerts, 1999; Paris & Paris, 2001) points at self-regulated learning as a construct that provides a holistic view of the skills, knowledge and motivation that students must acquire. Self-regulation comprises such processes as goal setting, using effective strategies to organize, code and rehearse information, monitoring performance, seeking assistance when needed, and holding positive beliefs about capabilities (Butler & Winne, 1995; Pintrich, 2000; Schunk & Ertmer, 2000). To indicate the whole complex of skills, knowledge, and attitudes as aspects that are related to skillful self-regulated learning (SRL), we use the concept of self-regulated learning competence (i.e. SRLC). In accordance with Van Merriënboer (1999), we define competence as the mix of complex cognitive skills, interpersonal skills and attitudes based on how someone can function effectively in a particular domain or profession. So, competence refers to someone's ability to adequately and effectively use and apply relevant knowledge, skills, and attitudes in particular task situations.

Based on a review of literature regarding self-regulated learning, self-managed learning, independent learning, self-directed learning, learning to learn, metacognition, and expert learning, a Self-Regulated Learning Competence Map was developed. The competence map offers a schematic overview of the processes that play a role in SRL. Additional to the SRL processes, the competence map depicts the constituent cognitive, affective, metacognitive, and contextual aspects (prerequisite

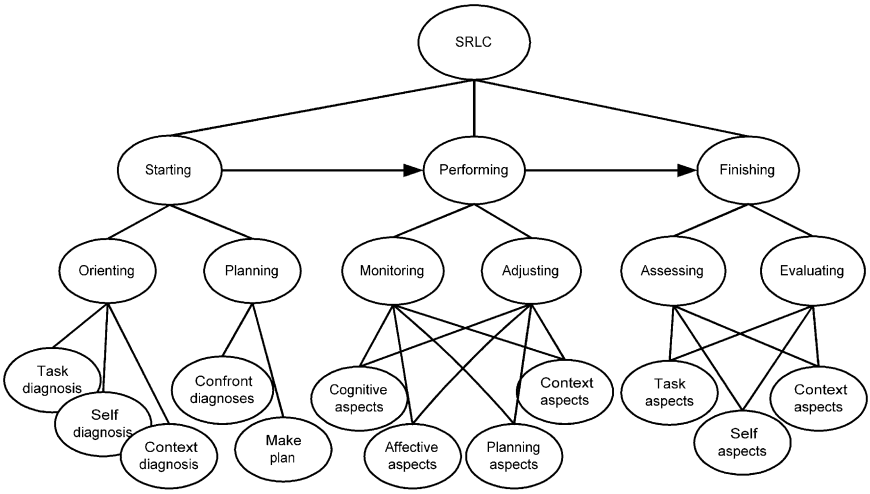

Fig. 1. Self-regulated learning competence map.

knowledge and constituent skills) that are important in the SRL processes. Moreover, the competence map also shows the relations between the depicted elements (cf., Pintrich, 2000, p. 454), and although presented in a different format, the basis of our model is basically a refinement of the process model of learning cycle phases, as presented by Zimmerman (1998, 2000).

Fig. 1 displays the SRLC map and shows a grouping of process elements into three hierarchic levels. The first level shows the study process in the restricted sense, which consists of 'starting', 'performing', and 'finishing'. The second level shows the matching regulation activities. In the 'starting' phase of layer 1, regulation concerns 'orienting' and 'planning' in layer 2. During 'performing', the regulation processes of 'monitoring' and 'adjusting' occur. In the last phase, 'finishing', assessing and evaluating take place. The third level shows the constituents elements on which the regulation activities of level 2 are directed. For instance, orienting is directed to a task (task diagnosis), to the self of the student (self diagnosis) and to the context (context diagnosis).

The elements of layer 3 can be decomposed more in depth. Doing so, an overview of the basic constituent elements can be obtained. As an example the constituent elements of 'orienting' and 'planning' of layer 3 are presented in Fig. 2.

1.2. Reflection and feedback

There are many indications that reflection (e.g. Boud et al., 1985; Lee & Hutchison, 1998) or self-explanations (e.g. Chi, de Leeuw, Chui, & La Vancher, 1994) play an important role in learning processes, and that reflection also constitutes an important factor in the acquisition of learning competences (e.g. Boekaerts, 1999; Ertmer & Newby, 1996; Von Wright, 1992). According to Borkowski, Carr, Rellinger, and Pressley (1990), reflection can be conceived of as a strategy or skill that

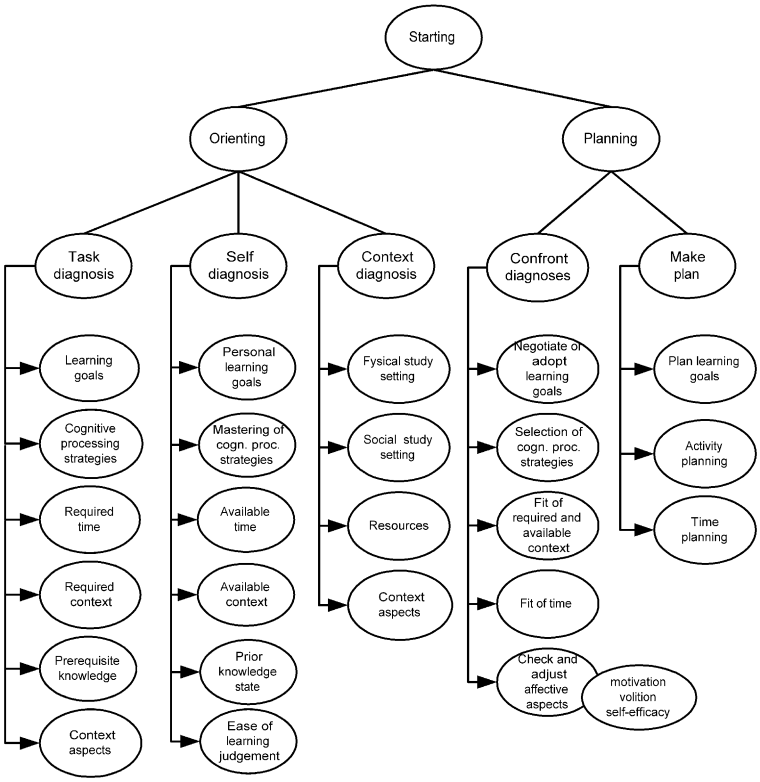

Fig. 2. Decomposition of the Starting phase.

operates on other strategies, or in other words, a form of personal mental experiment which is conducted to compare strategies to each other. The acquisition of SRLC can be stimulated by embedding aspects of SRLC in instruction and study tasks (e.g. Ley & Young, 2001; Schunk & Ertmer, 2000). By reflecting on ones own learning students become aware of their learning processes and possible alternative strategies. This is important because the perception of choice is a critical aspect of SRL (Boekaerts, 1999), and the awareness of alternatives is a prerequisite for changing less than optimal study habits (Boud et al., 1985). On the one hand reflection promotes the development of the necessary cognitive structure, on the other hand it makes this structure available for learning activities. Reflection can thus be conceived of as the bridge between metacognitive knowledge and metacognitive control (self-regulation), facilitating the transfer of metacognitive knowledge to new situations (Ertmer & Newby, 1996). In accordance with Butler (1998) we suppose that reflection prompts used to provoke students' reflections are well suited to embed the different aspects of the SRLC into instruction. We assume that this also counts for electronic learning environments in which reflection prompts can serve as the cues to elicit reflection that facilitates students' self-regulated learning strategy construction (Schunk & Ertmer, 2000; Seale & Cann, 2000; Winne & Stockley, 1998).

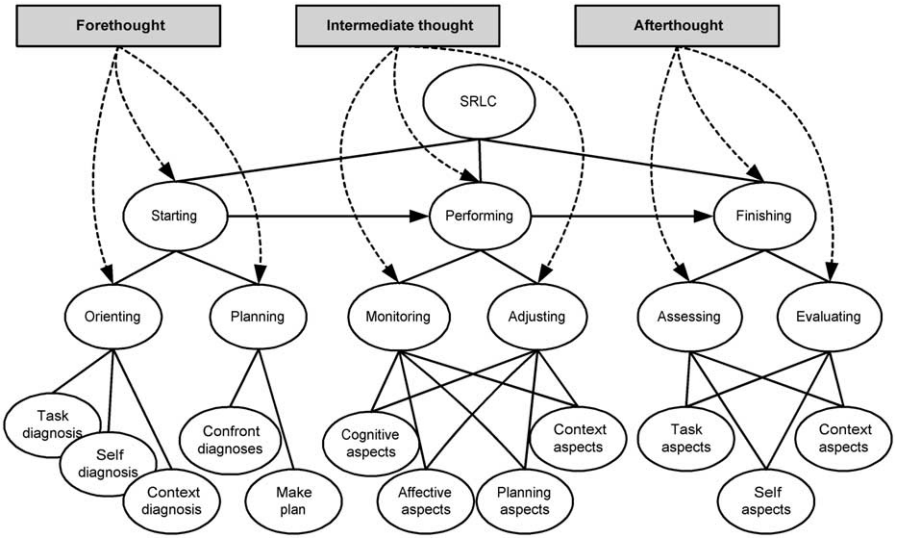

Fig. 3. Self-regulated learning competence map with reflection layer.

Fig. 3, in which a reflection layer as an additional dimension is projected in the SRLC map of Fig. 1 shows the opportunities for the reflection activities for each phase. The reflection can be directed to the aspects of all layers. Dependent on what layer the reflection is directed, the scope of the reflection will be more general or more specific. The activities that constitute reflection during the starting phase are labeled 'forethought' (Zimmerman, 1998). Others use the terms reflection-before-action, or pre-active or anticipatory reflection (Schön, 1983; Van Manen, 1991). Reflection during the performing and finishing phase is labeled 'intermediate thought' (cf., reflection-in-action or active or interactive reflection) and 'after-thought' (cf. reflection-on-action or recollective reflection), respectively. The three phases of the reflection process are separately included in our theoretical model because of their relationship with the three phases of the main process of learning as depicted in layer 1.

For the development of SRLC the quality of students' reflections is supposed to be a factor of influence. This quality primarily depends on internal factors like the available cognitive structure (cf. metacognitive knowledge warehouse, Ertmer & Newby, 1996) that contains knowledge, experience, and skills regarding learning and studying. But the quality of reflection can also be influenced by external factors like external feedback (Butler & Winne, 1995; Kluger & DeNisi, 1996; McKendree, 1990). Another important factor that has been shown to affect the quality of reflection is the interaction of students with a tutor (Chi et al., 1994; Perry, Vande Kamp, Mercer, & Nordby, 2002). To instantiate this interaction Chi (1996) implemented a five-step tutoring frame, in which external feedback provided by a tutor plays an important role (Graesser, Person, & Magliano, 1995). This external feedback provides the students with information with which they can confirm, add to, overwrite,

tune, or restructure information in memory. Chi (1996) differentiates between three kinds of tutor feedback: corrective feedback, didactic explanations, and suggestive feedback. Chi, Siler, Jeong, Yamauchi, and Hausmann (2001) suggest that providing students with suggestive feedback leads to student-tutor interactions that are beneficial for effective learning. Suggestive feedback alerts the student that there is a problem without telling exactly what the problem is. In accordance with the findings of Bangert-Drowns, Kulik, Kulik, and Morgan (1991), Butler and Winne (1995), Chi (1996), and Chi et al. (2001) it is assumed that suggestive external feedback on students' reflections will be beneficial to the acquisition of SRLC to the extent that it empowers the students with useful information in relation to their reflections.

The present study intended to investigate the impact of reflection prompts and feedback on the development of students' SRLC. In a study task an experimental intervention with reflection prompts in two modalities, combined with feedback also in two modalities was embedded. In a web-based learning environment participants received the study task containing one of the four intervention variants. We hypothesized that students working with the study task variant with embedded reflection prompts focusing on the aspects of self-regulated learning would gain more development on SRLC aspects than students studying the task without these prompts. Also, we hypothesized the effect of the reflection prompts to vary as a function of tutor feedback in such a way that the impact of the reflection prompts increases if in addition tutor feedback is provided on the resulting reflection expressions. So, the highest increase of development on SRLC aspects was expected in the condition in which students are confronted with embedded reflection prompts focusing on aspects of self-regulated learning and tutor feedback. No development was expected for students in the condition without these prompts and without feedback. Additional we explored the assumption (Pintrich, 2000) of a possible positive relation between the development on the SRLC and learning performance. Finally we evaluated students' appreciation of the presented intervention.

2. Method

2.1. Participants

The participants in this study were 42 first and second-year students from a Teacher Training College for primary education in Heerlen, the Netherlands. There were 32 women and 10 men (mean age = 20.1 years, S.D. = 1.5 years). They were familiar with the domain of psychology to some extent, but before the experiment they had not been taught anything on health psychology, the subject of the study task in the experiment. So the subject matter was supposed to be completely new for them. This was controlled for in a pretest dealing with basic knowledge as presented in the study task. None of the participants was able to answer the pretest questions correctly. So it was concluded that the students could be divided over the experimental groups at random. Participants were offered a reward of €30 in gift vouchers for their participation.

2.2. Materials

Students received a study task within the domain of Health Psychology dealing with the subject of psychological interventions. The study task was delivered in the electronic learning environment on the Open University's Study Net. There were two variants of the task. The first variant contained three reflection prompts, each of which focused on aspects of one of the three main phases of the learning process as presented in the SRL-competence map. We refer to these prompts as SRP1, SRP2 and SRP3. The other variant of the study task contained three reflection prompts that focused on aspects irrelevant to self-regulated learning. We refer to these prompts as placebo prompts (PRP1, PRP2 and PRP3). In both variants the first prompt was built in as an assignment. The second and third reflection prompts were delivered as electronic-messages and were signaled by a pop-up screen. The reflection prompts were related to the three phases of the learning process aiming respectively to elicit 'forethought' (SRP1), 'intermediate thought' (SRP2), and 'afterthought' (SRP3). For example, SRP1 asked students to reflect on their intentions how to handle the task and their expectations to encounter any problems while working on the task. So SRP1 gives concrete form to the SRLC aspects of 'Selection of necessary cognitive processing strategies' and 'Ease of learning judgments' (cf., Fig. 2). In reaction to this prompt, students were supposed to reflect on their perception of the study task and the confrontation of their diagnosis of the task and self-diagnosis, and their study plan. SRP2 focused on the elicitation of 'intermediate thought'. It asked students to reflect on whether they were proceeding according to their initial study plan, whether they liked the task, and whether they felt they were heading for the goals of the task. SRP3 was used to elicit 'afterthought' and asked students to reflect on their use of cognitive processing strategies in the learning process. The PRP were not based on the SRLC model. PRP1 asked students to indicate which subject at the Teacher Training College they liked best and what they considered the value of arithmetic education at the Teacher Training College. PRP2 asked them which subject at the Teacher Training College should be banned and what they would do if they were not studying at the Teacher Training College. PRP3 asked them whether they intend to work in the field of education after graduation and how they feel about the teaching practice they have to do. The rationale of the PRP is to control for a bare reflection effect without taking into account the content of the reflective process.

Both variants of the study task also differed with regard to the presence of a tutor for the students. Half of the students in each Reflection Prompt condition (SRP or PRP) received feedback from a tutor. The tutor provided feedback on the student's reflection expressions in an electronic format (e-message) to improve or elaborate the reflections in successive series of exchanges (electronic reflective dialogue).

The student–tutor communication took place in an electronic discussion group, which was linked to the electronic study task. After posting an e-message, the students in the without-tutor feedback condition received a receipt message (''Thank you for your message'') or the suggestive feedback from the tutor in the with-tutor feedback condition, respectively. For all students in the SRP and PRP

with-tutor feedback condition, the quality and quantity of the feedback was held as constant as possible within the constraints of the setting of a natural reflective dialogue.

The development of SRLC was measured by means of three subscales of the Dutch version of the Inventory of Learning Styles (ILS; Vermunt, 1992). The ILS is a self-report questionnaire, and is comparable to the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich, Smith, Garcia, & McKeachie, 1993). The ILS covers several learning related domains. Validation research on the ILS is reported by Vermunt (1992, 1996, 1998). Boekaerts, Otten, and Simons (1997) stated that the ILS is adequate for the complexity of student learning. Vermetten (1999) used the ILS in several successive experiments and concluded that the subscales represent constructs that have separate functions and stand on their own and should be analyzed accordingly, at the level of subscales. In this study we focused on the three subscales referring to metacognitive regulation strategies. Metacognitive regulation is defined by Vermunt as thinking activities aimed at regulating and controlling one's learning, e.g. orientation to and planning of one's learning processes, and the monitoring of the learning progress. The three subscales of metacognitive regulation strategies are: Self-Regulation (regulate one's own learning processes; 10 items), External Regulation (letting an external source regulate one's learning; 10 items) and Lack of Regulation (noticing one's difficulties with regulation of learning processes; five items). All items had to be scored on a five-point Likert scale, ranging from (1) 'I never or hardly ever do so' to (5) 'I (almost) always do this'. A description of the subscales, an item example, and Cronbach's alpha reliability coefficients for our data are presented in Table 1.

To assess the learning performance of the students a paper and pencil posttest with three open-ended questions (total seven points) and seven multiple-choice questions (total seven points) were used. The open-ended questions were scored (score range 0–7 points) by the psychologist who developed the content of the study task. For the analyses, performance scores of the students were converted to a score between 0 and 10.

To get an idea to what extent reflection prompts, tutoring, reflective activities and reflective dialogues between students and tutors are appreciated or might be experienced as distracting while working on the study task, the student opinions were collected by means of an Evaluation questionnaire. Each item was accompanied with a five-point Likert scale, ranging from (1) 'I totally disagree' to (5) 'I totally agree', on which students could indicate how much they agreed with the content of the item.

The apparatus consisted of IBM compatible computer systems with 17-inch color monitors. The computers in the laboratory were connected to a Windows NT server. The server automatically logged all data.

2.3. Design and procedure

The participants were randomly assigned to one of the four experimental conditions in such a way that each condition contained 10 or 11 participants. The participants were tested in groups on consecutive days. The experimental design was a 2

Table 1
ILS subscales: reliability, description, and examples

Subscale and number of items	ILS pre test Cronbach's alpha	ILS posttest Cronbach's alpha	Description	Item example
Self-Regulation $N = 10$	> 0.86	> 0.86	Controlling the learning process yourself, by orientation, planning, monitoring, evaluation, et cetera.	When I have difficulty grasping a particular piece of subject matter, I try to analyze why it is difficult for me.
External Regulation $N = 10$	> 0.67	> 0.80	Depending on an external source for the regulation of the learning process, e.g., taking learning goals or directions and questions of teachers to heart.	I use the instructions and the course objectives given by the teacher to know exactly what to do.
Lack of Regulation $N = 5$	> 0.83	> 0.87	Noticing one's difficulties with regulation of the learning process.	I notice that the study instructions that are given are not very clear to me.

(Reflection Prompt: SRP vs. PRP)×2 (Tutor Feedback: with vs. without) factorial pretest–posttest design. In the first experimental condition (C1, $N = 10$) participants worked with the study task with embedded reflection prompts that focus on other than SRLC aspects (PRP) and were not provided with feedback from a tutor. In the second experimental condition (C2, $N = 10$) the participants also received the study task with embedded PRP but in contrast with C1 they were provided with tutor feedback. In the third experimental condition (C3, $N = 11$) participants worked with the study task with embedded reflection prompts that focus on the SRLC aspects (SRP) and were not provided with feedback from a tutor. In the fourth experimental condition (C4, $N = 11$) participants also received the embedded SRP but in contrast with C3 they were provided with feedback from a tutor.

All participants completed the ILS twice; the first time 2 weeks before the start of the experiment and directly after the experiment.

When they arrived at the laboratory the participants filled in a demographic questionnaire and the knowledge pretest. At the start of the experiment, the procedures were verbally explained to the participants. Then, they were directed to their computers, received a written instruction, and could start with the study task and the use of the discussion group. The first computer screen of the task contained the introduction to the task. Immediately after the introduction, the first reflection prompt was given, either a SRP (in conditions 3 and 4) or a PRP (in conditions 1 and 2). It was not possible for the students to proceed with the task before responding to the prompt. After responding to the prompt the students in the 'No tutor feedback' conditions (C1 and C3) received the receipt message. The students in the 'Tutor feedback' conditions (C2 and C4) received a feedback reaction from the tutor and a reflective dialogue developed. In condition 4 the tutor elaborated on the relevant aspects of SRLC in that phase, while in condition 2 the tutor responded to the students' reactions to the PRP. After responding to the reflection prompt the participants proceeded with the study task. Halfway through the study task, after approximately one hour, the second prompt was given. Reflection prompt 2 was not embedded in the study task as an assignment, but arrived as an electronic message. The feedback procedure was similar to that of reflection prompt 1. After completing the study task, each participant had to send an electronic request to receive the performance posttest. Upon requesting the test, they received the last reflection prompt by e-message before they got the test. The feedback procedure was again similar to that of the first and second reflection prompt. Finally, after the performance test, the participants completed the evaluation questionnaire and the ILS (for the second time).

3. Results

The variables under analysis were the development of SRLC aspects, learning performance, and evaluative opinions of the students about the reflection prompts and the tutor feedback.

To measure developments of SRLC aspects within the four experimental groups the ILS subscales of the metacognitive regulation strategies domain were completed twice. For each subscale the difference between posttest score and pretest score was computed. The descriptive statistics of the scores, labeled as difference scores are presented in Table 2. In this table the descriptive statistics for learning performance and the evaluation of the reflection prompts and tutor feedback are also presented.

All data were analyzed with 2 (Reflection Prompt: SRP vs. PRP)×2 (Tutor Feedback: with vs. without) multivariate analyses of covariance (MANCOVAs), with Reflection Prompts and Tutor Feedback as between subject factors, and the pretest scores on the three subscales of metacognitive regulation strategies (self-regulation, external regulation, lack of regulation) serving as covariates. The difference scores on the three subscales of metacognitive regulation strategies, the learning performance, and three evaluation items were used as dependent variables. A MANCOVA on the difference scores on the metacognitive regulation strategies subscales yielded main effects of tutor feedback (with or without) on the subscales Self-Regulation, $F(1, 38) = 6.262$, MSE = 0.177, $P < 0.05$, and External Regulation, $F(1, 38) = 5.190$, MSE = 0.187, $P < 0.05$, but not on the subscale Lack of Regulation, $F(1, 38) = 2.289$, MSE = 0.236, ns. No significant main effects were found for the reflection prompt condition on any of the subscales: Self-Regulation, External Regulation, and Lack of Regulation, all Fs $(1, 38) < 1.0$. Also no significant Reflection Prompt×Tutor Feedback interaction was found for any of the metacognitive regulation strategies subscales, all Fs $(1, 38) < 1.0$, ns. The scores on the subscale Self-Regulation increased for the students in condition PRP with tutor feedback ($M = 0.30$, SD = 0.49), SRP with tutor feedback ($M = 0.18$, S.D. = 0.43), and PRP without tutor feedback ($M = 0.13$, S.D. = 0.32), but decreased for the students in condition SRP without tutor feedback ($M = -0.25$, S.D. = 0.49). For the scores on the subscale External Regulation an increase was found for the students in condition PRP with tutor feedback ($M = 0.35$, S.D. = 0.60) and SRP with tutor feedback ($M = 0.25$, S.D. = 0.27), whereas a decrease was found for the students in condition SRP without

Table 2
Means and standard deviations of dependent measures

	C1 PRP−Tutor		C2 PRP+Tutor		C3 SRP−Tutor		C4 SRP+Tutor	
	M	S.D.	*M*	S.D.	*M*	S.D.	*M*	S.D.
Self-Regulation difference score	0.13	0.32	0.30	0.49	−0.25	0.49	0.18	0.43
External Regulation difference score	−0.01	0.39	0.35	0.60	−0.08	0.41	0.25	0.27
Lack of Regulation difference score	0.24	0.68	0.34	0.51	0.22	0.38	0.29	0.44
Learning Performance	4.45	2.13	3.90	1.76	4.25	1.60	4.94	1.41
Opinion about reflection prompts	3.45	0.72	3.20	0.92	3.09	0.94	3.27	0.65
Opinion about tutor feedback	3.10	0.88	4.20	1.03	2.64	0.92	3.91	1.14
Evaluation of prompts as disturbing	2.30	0.95	3.80	1.14	3.45	0.93	2.90	1.22

tutor feedback ($M = -0.08$, S.D. = 0.41) and PRP without tutor feedback ($M = -0.01$, S.D. = 0.39). For the scores on the subscale Lack of Regulation an increase was found for the students in all conditions: PRP without feedback ($M = 0.24$, S.D. = 0.68), PRP with feedback ($M = 0.34$, S.D. = 0.51) SRP without feedback ($M = 0.22$, S.D. = 0.38), and SRP with feedback ($M = 0.29$, S.D. = 0.44).

With regard to learning performance, a paired-samples t-test yielded a meaningful increase in performance from pretest to posttest ($M = 4.39$, S.D. = 1.71; $t(38) = -14.359$, $P < 0.001$). However, a MANCOVA revealed neither main effects nor an interaction (Reflection Prompt condition, $F(1, 38) = 0.716$, $MSE = 3.117$, ns; Tutor Feedback condition, $F(1, 38) = 0.215$, ns; Reflection Prompt×Tutor Feedback interaction, $F(1, 38) = 1.280$, ns). This leads to the conclusion that the overall increase of learning performance was not differentially affected by the independent factors.

The opinions of the participants about reflection prompts and tutor feedback as measured by the evaluation questionnaire yielded positive opinions about reflection prompts ($M = 3.25$, S.D. = 0.80) and tutor feedback ($M = 3.45$, S.D. = 1.51). The MANCOVAs revealed a main effect of tutor feedback on the opinion about the tutor, $F(1, 38) = 7.875$, $MSE = 0.946$, $P < 0.01$. Whereas, the students who received feedback from a tutor were positive ($M = 4.05$, S.D. = 1.07), students in the no tutor feedback condition tend to prefer the option to have an active tutor ($M = 2.87$, S.D. = 0.91). No main effects of tutor feedback were found on the opinion about the reflection prompts, $F(1, 38) = 0.140$, MSE = 0.653, ns, and perception of the reflection prompts as disturbing, $F(1, 38) = 1.267$, MSE = 1.108, ns. No main effects of the reflection prompt condition were found on the opinion about the reflection prompts, $F(1, 38) = 1.296$, ns; opinion about the tutor, $F(1, 38) = 0.662$, ns; and evaluation of the reflection prompts as disturbing, $F(1, 38) = 0.475$, ns.

The evaluation of the reflection prompts as disturbing was about equal for the students who received the PRP ($M = 3.05$, S.D. = 1.27) and the students who received the SRP ($M = 3.18$, S.D. = 1.09). The MANCOVA performed on the perception of

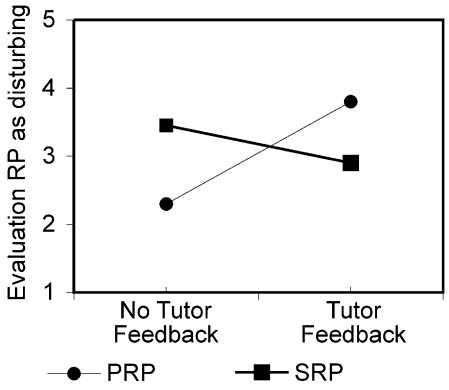

Fig. 4. Reflection Prompt×Tutor Feedback interaction for the Evaluation of reflection prompts as disturbing.

reflection prompts as disturbing revealed a significant Reflection Prompt×Tutor Feedback interaction, $F(1, 38) = 10.659$, $MSE = 1.108$, $P < 0.01$. Visual inspection of the interaction graph depicted in Fig. 4 reveals that students who received a SRP but no feedback from a tutor experienced the prompts as more disturbing ($M = 3.45$, S.D. = 0.93) than students who received the same SRP but with feedback from a tutor ($M = 2.90$, S.D. = 1.22). The combination of a PRP and tutor feedback was evaluated as the most disturbing condition ($M = 3.80$, S.D. = 1.14), a PRP without feedback from a tutor as the least disturbing ($M = 2.30$, S.D. = 0.95).

4. Discussion

The goal of the study discussed in this article was to determine effects of reflection prompts and tutor feedback on the development of the self-regulated learning competence within a web-based learning environment. The main findings indicate that the intervention with reflection prompts and tutor feedback differentially affected the development on SRLC aspects.

With regard to the development on SRLC aspects it was expected that students working with a study task with embedded reflection prompts focusing on the aspects of SRLC would gain more development on the regulation subscales than students who were confronted with reflection prompts that were not relevant to SRLC. In addition the effects of the reflection prompts were expected to vary as a function of the tutoring in such a way that the impact of the reflection prompts increases in combination with tutor feedback. The results showed a somewhat complicated, and differentiated picture. The two groups that received feedback from a tutor showed an increase on all three subscales related to metacognitive regulation strategies and achieved a higher score for Self-Regulation, External Regulation, and Lack of Regulation. The groups without the tutor feedback showed a decrease or a slight increase for Self-Regulation and External Regulation and an increase for Lack of Regulation. The difference between the four groups regarding their development (upward and downward) on the respective subscales of the ILS was statistically confirmed. No significant development on the three regulation subscales was found when students received a PRP without feedback from a tutor. Whereas PRPs alone seem to have no effect for the domain of metacognitive regulation strategies, in combination with feedback from a tutor a higher score for all three regulation subscales was found. Obviously there is an impact of the tutor feedback stimulating all regulation mechanisms, even when the prompts are irrelevant to SRLC. A comparable, but somewhat less clear picture is found for the SRP the self-regulation relevant prompts. Without feedback from a tutor a higher score on Lack of Regulation was found. With feedback from a tutor a higher score was found for all the three regulation subscales.

These findings reveals a significant progress on the regulation subscales as a function of tutor feedback. At first sight it seems surprising that the changes for the three subscales are in the same direction. However, in perspective of the short duration of the intervention and the structuredness of the web-based learning

environment, it is conceivable that the students might have experienced both the study task and the reflection prompts as a form of external regulation. At short notice this might have caused an increase of the perceived external regulation. The measurement shortly after the relatively short intervention might have reflected this. Future research that uses longer intervention periods and delayed post-test measurement is necessary to determine if these factors affect the direction of development on aspects of the SRLC.

Two other issues must be taken into account in further research. The first deals with the time constraints of the study task in the present experiment. Although there are no guidelines for the amount of reflection prompts in a study task, it was decided not to offer more than three reflection prompts embedded in the experimental study task. This caused that only a small sample of the SRL elements as presented in the competence map could be brought up. The three reflection prompts assured that the three process phases as depicted on the first layer of the competence map (forethought, intermediate thought, and afterthought) were represented in the study task. The second issue that should be taken into account deals with the nature of self-regulation. Boekaerts (2002) argued the nature of self-regulation to be linked to the students' goal structure. This and the related more general question about the domain specificity of SRLC compels to cautious interpretation of the presented findings and urges to the conclusion that further research is needed.

ILS data reveal some developments on the regulation subscales. The ILS is a self-report scale and therefore the results should be interpreted as students' opinions. To control the presented findings in future studies the ILS as an instrument for measuring SRLC should be combined with other measurements. Although we took notice of the advice of Vermetten (1999) to analyze the ILS data at the level of subscales, we conclude that it might be better to determine developments of competence using a triangulation of measurements (Weinstein & Meyer, 1996). In this respect also the MSLQ (Pintrich et al., 1993) can be considered as an alternative for the ILS, and 'think aloud measures' or direct observations of performance on regulation tasks and in-depth interviews (Winne & Perry, 2000) represents promising measures to realize this triangulation.

The exploration of the question whether or not students working with a study task with embedded self-regulated learning reflection prompts would show better learning performance than students studying the task without these prompts is not leading to clearness. The learning performances are not differentially affected by the intervention. In accordance with Pintrich (2000) who stated that self-regulatory activities are mediators between personal and contextual characteristics and actual learning and performance this finding is not very surprising in the context of the relatively short duration of the learning trajectory. Furthermore, so far there is no knowledge about the minimal time needed for learning effects to emerge. This makes the duration of the study tasks and courses an important factor for future research.

Evaluation of the reflection prompts and the tutoring showed that there were no differences in appreciation of the reflection prompts (relevant or irrelevant to self-regulated learning) by the students. Tutor feedback on reflections elicited by PRPs was experienced as more disturbing than on reflections elicited by SRPs. A possible

explanation for this can be found in the content of the prompts. Students seemed to be aware of the fact that their reflections provoked by the irrelevant prompts and the associated feedback was not relevant to the learning process. When a prompt was perceived as relevant for the task the students judged the resulting reflection and the associated tutor feedback as helpful.

In summary, this research offers indications that reflection prompts, especially if combined with tutor feedback, have positive effects on the development of students' self-regulated learning competence. It might be expected that in longer lasting settings in which prompts and feedback are embedded in broader courses, relevant prompts will be superior to non-relevant prompts with regard to their effects on the acquisition of the self-regulated learning competence (Pressley, 1995). These concluding remarks offer the perspective for further research on the impact of reflection prompts and supportive feedback and the development of students' competence to self-regulated learning.

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