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Effects of visual feedback on medical students' procrastination within web-based planning and reflection protocols ☆

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ABSTRACT

Procrastination is a very common problem among students that results from ineffective selfregulation. In two field-experimental studies ($N = 18$ and $N = 49$), we investigated whether visual feedback on students' previous procrastination was effective in provoking a decrease in students' future procrastination as well as improvements in self-regulated learning. The visual feedback was implemented as a dynamic line chart in a web-based planning and reflection protocol used once a week by medical students to record their class preparation and homework once a week. In the protocols, the students planned and reflected on their personal learning processes and they estimated retrospectively their inclination to procrastinate. The results of both studies consistently showed that presenting students a line chart that adaptively visualizes the course and extent of their self-reported previous procrastination led to a statistically significant and practically relevant decrease in their future procrastination. Furthermore, the visualization had positive effects on other variables central to self-regulated learning. The studies provide converging evidence that the inclination to procrastinate can successfully be counteracted both by a parsimonious and easy-to-implement method. They are suggestive of ways how Internet technology can be used support students' self-regulated learning.

1. Introduction

Although there is an increasing demand for self-regulation strategies in studying, many students have problems in regulating themselves (Zimmerman, 2002). Consider the case of a university student who is in the last year of her medical studies. An important exam on orthopedics is three weeks away, and the student has not started studying yet. She keeps on postponing her tasks, although she already experiences anxiety due to the growing pressure. Shortly before the exam, the student starts repeating the facts, resulting in only superficial gains in understanding, because there is no time for deep learning strategies. In some cases, such learning behavior may lead to satisfying grades on the exam. However, in the majority of cases, students suffer from such procrastination, which is defined as the irrational postponing of important tasks (Steel, 2007).

In order to reduce their procrastination, students need to become aware of it. To this end, they need to observe and assess their own learning behavior accurately. Observed and reflected discrepancies between one's own behavior and one's personal standards of "good" studying can on their own – without further support – lead to significant improvements, such as, for example, to a reduction of one's procrastination (Zimmerman, 2002). Web-based planning and reflection protocols are a promising approach to guide students' self-reflection to those aspects of learning behavior that need to be improved (Schmitz & Perels, 2011; Wäschle, Allgaier, Lachner, Fink, & Nückles, 2014). In the present article, we present two empirical studies on the effectiveness of visual feedback within web-based planning and reflection protocols to combat students' procrastination in medical studies.

1.1. Procrastination – a failure of self-regulation

Procrastination is a very common problem among students (Häfner, Oberst, & Stock, 2014; Ferrari, Díaz-Morales, O'Callaghan, Díaz, & Argumedo, 2007) that often results from ineffective time management and low metacognitive strategy use when high

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standards of self-regulation are required (Häfner et al., 2014; Steel, 2007; Wolters, 2003). To procrastinate means to delay the beginning of unpleasant but important learning tasks (e.g. the preparation of an exam) to an unspecified later date. Several studies have shown that procrastination is negatively related to several aspects of self-regulated learning, such as goal-setting (Lay & Schouwenburg, 1993), self-efficacy (Ferrari, Parker, & Ware, 1992; Wolters, 2003), and use of learning strategies (Wolters, 2003). Procrastination is associated with lower learning outcomes (Klassen, Krawchuk, & Rajani, 2008; Lay & Schouwenburg, 1993; Wäschle et al., 2014) and increased levels of stress (Tice & Baumeister, 1997). Tice and Baumeister found that students who irrationally postponed their tasks perceived lower stress levels at the beginning but higher stress levels at the end of a semester. At the same time, the overall stress level was significantly higher for students who procrastinated than for non-procrastinators.

1.1.1. Strategies involved in successful self-regulated learning

The empirical findings reported so far suggest that procrastination can be understood as a failure of self-regulation (Häfner et al., 2014; Wäschle et al., 2014). Therefore, it is useful to describe the cognitive, metacognitive and motivational strategies that are needed to regulate one's learning processes successfully. Current models of self-regulated learning (e.g., Winne & Hadwin, 1998; Zimmerman, 2000) assume a number of specific strategies during the different phases of learning. Following Zimmerman's cyclical-interactive model of self-regulated learning, there are three main phases during the learning process: the forethought phase, the performance phase and the self-reflection phase. In the forethought phase, the learner is supposed to setup personal goals that should be achieved during the learning episode and to select appropriate strategies in order to reach these goals. There is considerable evidence for increased academic success related to specific learning goals (Locke & Latham, 2002; Schunk, 2001). The goals act as a reference that allows the learner to decide whether the process and product of learning are appropriate or should be changed (Boekaerts, 2011). Specific goals (e.g., I am going to get an overview of the functionality of the circulatory system by developing a visualization) that include detailed information about what should be achieved and how it should be achieved facilitate the selection of appropriate cognitive strategies as well as self-monitoring, reflection of performance, and strategy regulation. Thus, specific learning goals contribute to enhancing one's performance and help reduce students' vulnerability to procrastination (see Locke & Latham, 2002; Schunk, 2001).

During the performance phase, students employ cognitive and metacognitive strategies in order to reach their learning goals. Following Weinstein and Mayer (1986), cognitive strategies can be categorized into rehearsal, organization, and elaboration strategies. Rehearsal strategies refer to the repetition of information in order to support refreshment and retention in memory. Organization strategies include, for example, identifying the main concepts of newly learned contents as well as the structuring of the concepts (e.g., relating the main concepts to each other in a map). Elaboration strategies connect the new information with a learner's prior knowledge (e.g., constructing examples and analogies) to facilitate integration of the learning contents into the learner's existing cognitive representations (Mayer, 2002). Self-monitoring is an important metacognitive strategy in the performance phase. Self-monitoring refers to learners' deliberate observation of their learning process in order to recognize discrepancies between the observed and the ideal learning process. Self-monitoring is the basis for self-reflection (Winne & Hadwin, 1998). Several empirical studies showed that procrastination is indeed negatively related to the frequency in which students use cognitive and metacognitive learning strategies (Howell & Watson, 2007; Wäschle et al., 2014).

In the self-reflection phase, learners evaluate to what extent they have achieved their learning goals and whether adaptations are necessary to their learning behavior (Zimmerman, 2000). In this way, learners can infer consequences for later learning episodes in order to avoid making the same mistakes again. Thus, via self-reflection and self-monitoring, learners can improve their learning process in a self-guided fashion (Zimmerman, 2002). Several studies impressively showed that self-monitoring contributes to academic performance (Chang, 2007) and increases performance on key competences, such as reading (Joseph & Eveleigh, 2011) and writing (Cho, Cho, & Hacker, 2010). Self-reflection on the data retrieved via self-monitoring is essential because, via self-reflection, the learners evaluate their learning process (e.g., what strategy was helpful? Which goals are appropriate?), and themselves as a learner (e.g., what are my strengths and weaknesses? What motivates me?). Hence, self-reflection establishes the basis for an increase in metacognitive knowledge that may help to improve future studying (Zohar & Peled, 2008). Furthermore, via self-reflection, students can become aware of ineffective or inappropriate learning behavior, such as procrastination, and try to change this behavior to better meet their personal standards in the future.

1.1.2. Intervention studies to reduce procrastination

Empirical research on interventions to prevent or reduce procrastination behavior is rather scarce. Nevertheless, several studies have been conducted showing that students' inclination to irrationally postpone important tasks can successfully be influenced. For example, Schmitz and Wiese (2006) devised a comprehensive training in self-regulation learning skills for engineering students in which the reduction of self-reported procrastination was a major dependent measure. As part of the training, Schmitz and Wiese first introduced Zimmerman's (2000) model of self-regulation to the students. Then, they instructed the students on methods of planning and time-management (e.g., day- and week-planning, developing specific and proximal learning goals, prioritizing of tasks) as well as on methods of self-instruction, such as stopping negative thoughts and positive self-talk to enhance concentration and motivation. Schmitz and Wiese obtained a significant decrease of self-reported procrastination behavior and an increase in perceived self-efficacy as a result of their four weeks of self-regulation training. Häfner et al. (2014) developed and evaluated experimentally a similar training with a focus on time management and planning strategies. They found that the trained experimental students showed a more even distribution of their invested learning time in the weeks before an important deadline (e.g., examination; handing in of a thesis), whereas the control students' self-reported learning time strongly increased in a curvilinear fashion in the week right before the deadline. Together, the reported studies show that procrastination can indeed be reduced or prevented by self-regulation training. However, both training courses were rather time-consuming and expensive (2-h training sessions over several weeks in small group settings). Also, the studies available so far assessed procrastination and measures of self-regulated learning but did not investigate effects of the interventions on students' learning outcomes. Thus, given the high prevalence of procrastination among students, it would be good to have a more parsimonious, that is, less laborious intervention available that could reduce students' procrastination and support effective self-regulation behavior.

1.2. How procrastination can be reduced by web-based planning and reflection protocols

A simple and promising approach to support self-regulation is to have students self-record their learning behavior in a diary or