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The effect of regulation feedback in a computer-based formative assessment on information problem solving

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ABSTRACT

This study examines the effect of regulation feedback in a computer-based formative assessment in the context of searching for information online. Fifty 13-year-old students completed two randomly selected assessment tasks, receiving automated regulation feedback between them. Student performance was (self-)graded by students and by experts. Expert, as well as student (self)grades showed a significant increase between Task 1 and Task 2. However, further analysis of the expert grades showed significant improvement in performance for girls only. Furthermore, the formative assessment system traced the number of searches and the number of websites consulted per student to complete the two assignments. On average, the results showed that students consulted significantly more websites for Task 2, compared to Task 1. The average number of searches did not differ significantly between Tasks 1 and 2. On the other hand, significant differences were found for those students who, during the evaluation of their performance on Task 1, explicitly stated that they would increase their searches.

1. Introduction

Rapid technological developments during the past decades have led to changing requirements for today's and future workers, increasingly requiring them to apply what are now called 21st century skills (Murnane & Levy, 2004). These skills include critical thinking, problem solving and creativity, and they 'are not new, just newly important' (Silva, 2009, p.631). Information problem solving is such a 21st century skill (Voogt & Roblin, 2010). Information problem solving refers to the ability to identify information needs, locate corresponding information sources, extract and organise relevant information from each source, and synthesise information from a variety of sources (Walraven, Brand-Gruwel, & Boshuizen, 2008). Research shows that students are not nearly as information savvy as their substantial use of the Internet requires them to be (Connaway & Dickey, 2010; Kolowich, 2011; Thompson, 2011). In addition, students tend to overestimate their own information problem solving skills (Gross & Latham, 2012; Ivanitskaya, O'Boyle, & Casey, 2006). Previous research implies that students generally show deficiencies with regard to defining the information problem, searching and evaluating information (Head & Eisenberg, 2010; Monroe-Gulick & Petr, 2012; Pinto, 2012; Walraven et al., 2008; Walraven, Brand-Gruwel, & Boshuizen, 2009). Courses in and standards for information problem solving are focused on aspects such as search strategy and the evaluation of the relevance and accuracy of information. However, most of these courses are aimed at graduate students (e.g., Dirkx et al., 2011), although these skills are also relevant in primary and secondary education.

Walraven and Voogt (2014) developed a computer-based instrument that traces student behaviour while searching, selecting and using information to solve an information problem. This instrument is called the Digital Information Skills Measurement (DIM). The DIM combines the fast and large scale data collection of a survey with the accurate view of skills provided by an observation and can be used in educational settings by teachers. The instrument includes assignments which require students to search the Internet for relevant information. It is a computer-based test-like event which also generates feedback. As such, the DIM can be categorised as a computer-based formative assessment (CBFA). The main aim of formative assessment is to support and stimulate student learning. Previous research shows that

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feedback in CBFA can positively influence student learning, but does not necessarily do so (Van der Kleij, Timmers, & Eggen, 2011). The effect of feedback is influenced by its characteristics. Feedback included in the DIM can be characterised as feedback aimed at stimulating the self-regulation of learning or the so-called regulation level of feedback (Hattie & Timperley, 2007). This kind of feedback encourages learners to monitor or self-assess their performance in order to modify affective, cognitive and behavioural processes with the intention of improving performance (Sitzmann & Ely, 2011). Although regulation level feedback is suggested to be effective, there is hardly any research available on the effect of regulation level feedback in computer-based formative assessments (Van der Kleij et al., 2011). The aim of this study is to examine the effect of regulation feedback on student performance and information-seeking behaviour in a CBFA. We will focus on the effects of regulation feedback in the DIM and determine whether it can be recommended as a learning tool for educational practice.

2. Theoretical framework

2.1. Computer-based formative assessment

In this study, CBFA is defined as a purposefully designed instrument embedded within a learning process (Bennett, 2011). Although formative assessment is not univocally defined in previous research, researchers generally agree that the aim of formative assessment is to stimulate and direct student learning, for example, by providing students with feedback on performance. Feedback informs learners or teachers about the actual state of performance. Effective feedback includes information on current performance, the intended level of performance, and how to bridge a performance gap (cf. Hattie & Timperley, 2007).

In this article, CBFA is conceptualised using the five-stage model for the process of receiving feedback in the context of a test-like event (Bangert-Drowns, Kulik, Kulik, & Morgan, 1991). A schematic overview is presented in Fig. 1. The learners' initial state (stage 1) is characterised by cognitive aspects and motivational beliefs. Students' initial motivational beliefs (e.g., success expectancy and task-value beliefs) influence the effort that students invest in the subsequent stages of the model (Timmers, Braber-Van den Broek, & Van den Berg, 2013). When a test-like event is administered, students are encouraged to address relevant prior knowledge and skills (stage 2) and construct a response (stage 3). After generating one or more responses, students are provided with automated feedback. Next, students are expected to evaluate their performance by processing the feedback (stage 4). The evaluation of performance can result in adjustments in the students' cognitive state and motivational beliefs (stage 5), and, subsequently, lead to an adjusted initial state (stage 1). When, for example, the intended learning outcome of a CBFA is increased knowledge and understanding in a specific domain, the process is considered successful if learners add to, tune or restructure domain knowledge and understanding (stage 5). Additionally, students' experiences with the CBFA can result in adjustment or confirmation of the initial motivational beliefs (e.g., task-value beliefs). The effect of the CBFA (instrument, as well as process) can be defined as the differences between stages 1 and 5.

The effectiveness of CBFA is influenced by the characteristics of the CBFA instrument, including the feedback intervention. For example, CBFA instruments which include feedback providing students with correct answers and additional information about the task have been shown to be more effective than CBFA instruments that merely inform students whether their answer is correct or incorrect (Van der Kleij et al., 2011). Elaborated feedback refers to information in addition to information about the correctness of a response and the correct response and has proven to be the most effective (Narciss et al., 2014). Regulation feedback is considered a type of elaborated feedback. Furthermore, the effect of CBFA strongly depends on the effort students invest in the task, including processing corresponding feedback (Bangert-Drowns et al., 1991; Timmers et al., 2013). In addition, research by Narciss et al. (2014) showed gender differences in the effects of feedback. Boys tend to benefit less than girls from tutoring feedback, while practicing fractions.

2.2. Self-regulated learning and feedback

Hattie and Timperley (2007) distinguished between four levels of feedback: feedback about the self, the task, the process and self-regulation. Self-level feedback provides information about the person (e.g., well done). Task-level feedback provides learners with information about their performance on a certain task. Process-level feedback provides learners with information about (their performance in) processing the task. Feedback aimed at self-regulation, or regulation-level feedback, focuses on (greater skills in) self-evaluation or

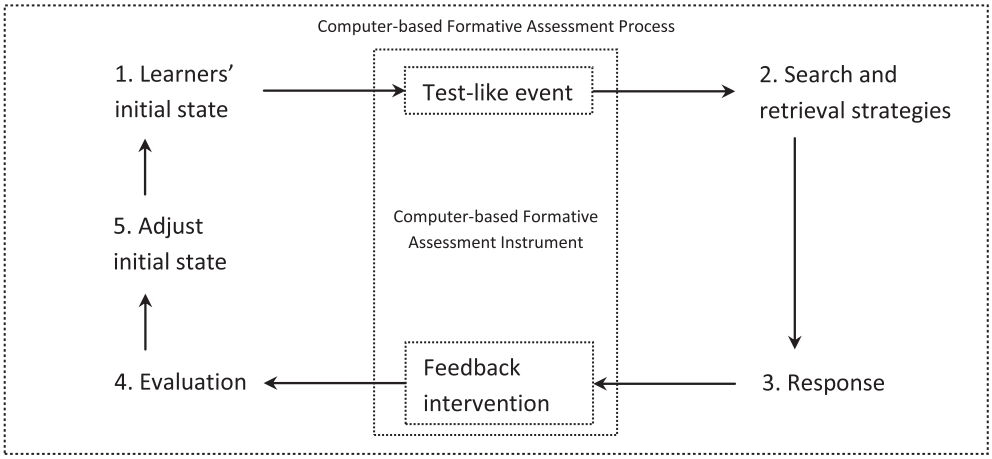

Fig. 1. Conceptualisation of CBFA based on the five-stage model proposed by Bangert-Drowns et al. (1991); adapted from Mory (2004, p. 752).