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It is not only about the depth of processing: What if *eye* am not interested in the text?☆

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ABSTRACT

This study aims at extending current research on how the interaction between cognitive processing and topic interest shapes the online learning process of students when learning from expository texts. We used eye tracking to monitor the reading and learning behaviour of 31 students in higher education. In addition, we used self-report questionnaires to map students' general disposition towards deep and surface processing and their topic interest. Cued retrospective think-alouds were conducted to capture students' levels of processing during learning from text. We examined the interaction between levels of processing and topic interest on eye movement measures. Results indicate that high-interested students who use more deep processing reread key sentences longer than detailed sentences and thus process these sentences more deeply. This study advances present knowledge in the field by focusing on the online learning process and stresses the importance of giving students learning contents that spark their interest.

1. Introduction

Expository texts are an important medium through which higher education students acquire knowledge and understanding (Ariasi, Hyönä, Kaakinen, & Mason, 2017; Fox, 2009; Gillam, Fargo, & Roberston, 2009). Expository texts are used to explain or describe the learning content to the readers. The goal of an expository text is to present the reader with information so that the reader may learn something. This is in sharp contrast to story-telling or narrative texts that are meant to entertain the reader (Fox, 2009). Learning from an expository text is one of the most essential skills in higher education (Ariasi et al., 2017; Kirby, Cain, & White, 2012; McNamara, 2012; O'Brien, Cook, & Lorch, 2015). Therefore, considerable efforts have been made in educational research to better understand the learning process associated with learning from an expository text (Fox, 2009; Pressley & Afflerbach, 1995). During reading, students interact with the text, actually constructing their own mental representation of the text (Kendeou & O'Brien, 2018; Kintsch, 1998). How this mental representation is constructed depends on important cognitive and motivational characteristics that affect the quality of reading and learning (Alexander & Jetton, 1996; Fox, 2009; Kendeou & Trevors, 2012). However, empirical research that examines both cognitive and motivational characteristics during the learning process of text learning remains scarce (Alexander, 2017, 2018). The interplay between important motivational and cognitive characteristics during learning refers to the multidimensional nature of learning. Alexander (2017, 2018) argues that in order to fully understand the learning process, research should tap more explicitely into this multidimensional nature of learning.

An important cognitive characteristic that affects the quality of text learning is students' levels of processing (Alexander & Jetton, 1996; Fox, 2009; Kendeou & Trevors, 2012). Levels of processing refer to cognitive activities that students engage in when studying, and these processing activities are important for the development of knowledge and understanding (Vermunt & Donche, 2017; Vermunt & Vermetten, 2004). Although the relation between students' levels of processing and text learning has been examined during the online learning process with think-aloud protocols (Dinsmore & Alexander, 2016; Merchie & Van Keer, 2014a; Pressley & Afflerbach, 1995) and eye tracking (Catrysse et al., 2016, 2018), there is an even vaster amount of research that examined students' general disposition towards deep and surface levels of processing within one course context or throughout multiple course contexts or time (Fryer, 2017; Vermunt & Donche, 2017). Students' general disposition towards deep and surface processing can also have an important influence on how they learn from texts (Kirby et al., 2012), especially on what they perceive to be relevant or important in

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the text (Kendeou & Trevors, 2012). Previous research showed that a student's general disposition towards levels of processing influences how they process learning contents to some extent (Baeten, Kyndt, Struyven, & Dochy, 2010; Catrysse et al., 2018; Kirby et al., 2012), especially if the learning task is related to what they usually need to study (Richardson, 2015).

An important motivational characteristic for text learning is topic interest (Alexander & Jetton, 1996; Krapp, 1999; Renninger & Hidi, 2011, 2016). It is assumed that topic interest is an important precondition for deeper cognitive processing (Alexander, 1997, 2017; Pintrich, 2004; Vermunt & Donche, 2017). Alexander (2017) even claims that whether students process the learning content deeply is reflective of the interest they bring to the text. Empirical research already showed that topic interest is related to deep-level learning outcomes, such as deep comprehension, recall of main ideas, elaborations and coherence of recall of main ideas (Krapp, 1999; Schiefele & Krapp, 1996; Schiefele, 1999). However, previous research has often neglected the multidimensional nature and the interplay between cognitive processing and interest when investigating the learning process when learning from expository text. Although the offline product of reading is influenced by the online learning process (Kendeou & Trevors, 2012; Kintsch, 1998), much of the learning takes place during reading and thus it is important to gain in-depth insight into the learners' online process of learning (Kendeou & Trevors, 2012).

This study aims at extending current research on how the interaction between cognitive processing and interest shapes the online learning process of students when learning from expository texts. Before focusing on the present study, the relation between student characteristics and text learning, as well as measures that tap into the online learning process, are discussed below.

1.1. Student characteristics and text learning

Cognitive and motivational characteristics shape how students build a mental representation during text learning (Fox, 2009; Jarodzka & Brand-Gruwel, 2017; Kendeou & Trevors, 2012). With regard to cognitive processing, a main distinction has been made between deep and surface levels of processing (Vermunt & Donche, 2017). These different levels of processing are distinguished in important models of reading and learning, such as the Model of Domain Learning (Alexander, 1997), the Construction-Integration Model of comprehension (Kintsch, 1998), and models related to Students' Approaches to Learning (Richardson, 2015), such as the Learning Pattern Model (Vermunt & Donche, 2017). In the Learning Pattern Model, students with a general disposition towards deep levels of processing are described as having the intention to understand and to engage in meaningful learning. Students' with a general disposition towards surface levels of processing selectively memorize the learning content (Vermunt & Donche, 2017). Previous research on levels of processing during learning from text showed that deep processing activities include critiquing the reading, linking the text to prior knowledge, paraphrasing parts of the text, interpreting information in the text, linking the text to personal experiences, focusing on main themes and elaborating. Surface processing activities refer to rereading parts of the text, literally retelling, focusing on details and rehearsing (Dinsmore & Alexander, 2016; Fox, 2009; Pressley & Afflerbach, 1995; Schellings, van Hout-Wolters, Veenman, & Meijer, 2012). This research takes into account insights from the Model of Domain Learning (Alexander, 1997) and the Learning Pattern Model (Vermunt & Donche, 2017) and is thus situated at the crossroads of these models. As described by Alexander (2018) combining insights from several theories results in a greater strength than relying on one single model.

The different models of reading and learning stress the importance of motivational conditions which affect the quality of students' cognitive processing (Alexander, 1997, 2017; Vermunt & Donche, 2017). An important motivational condition for text learning is interest (Alexander & Jetton, 1996; Krapp, 1999; Renninger & Hidi, 2011, 2016). Different models of reading and learning from text highlighted the importance of interest for deeper cognitive processing (Alexander, 1997, 2017; Vermunt & Donche, 2017). In the literature on interest, there is a main distinction between individual interest and situational interest (Hidi, 2001; Renninger & Hidi, 2011, 2016). Individual interest refers to a persons' habitual interest in a specific domain, while situational interest is a more short-lived state that is induced by characteristics of the environment (Hidi, 2001; Renninger & Hidi, 2011, 2016; Schiefele, 1999, 2012). There is a debate on whether topic interest is a form of individual interest or situational interest, and some researchers believe it can be an indicator of both types of interest (Hidi, 2001; Renninger & Hidi, 2016; Schiefele, 2012), but both types of interest have a positive influence on the quality of learning (Hidi, 2001). Renninger and Hidi (2011) referred to the work of Schiefele (1996,1999) as a good conceptualization to examine interest in relation to text learning.

Research on topic interest in the field of text learning, has looked into specific sentences of the text that students did, or did not, define as main ideas (McWhaw & Abrami, 2001). The study of McWhaw and Abrami (2001) showed that high-interested students identified the main ideas in the text better than low-interest students. Alexander and Jetton (1996) showed that main ideas in the text are structurally important for text comprehension and that these main ideas are often rated as highly interesting. In addition, other empirical research demonstrated that a higher interest results in a stronger focus on the central ideas in a text (Krapp, 1999; Ryan, Connell, & Plant, 1990). Interest also increases attention and persistence with the learning content (Hidi, 1990, 2000; Krapp, Hidi, & Renninger, 1992).

Previous studies have investigated the relation between topic interest, as a form of individual interest, and deep and surface level learning outcomes, when learning from text (Schiefele & Krapp, 1996; Schiefele, 1996, 1999). Research of Schiefele (1999) and Schiefele and Krapp (1996) indicated that topic interest was related to deep-level learning outcomes, such as deep comprehension, recall of main ideas, elaborations and coherence of recall of main ideas. Krapp (1999) also showed that topic interest was associated with deep processing, both with students' general disposition towards deep processing and with deep processing measured after studying for exams. The strong associations between interest and deep processing may be explained by the fact that deep processing requires more cognitive effort from students and that interested readers are more willing to invest effort in learning than less interested readers (Schiefele, 2012).

1.2. Think-aloud and eye tracking to measure the online learning process

Learning is an ongoing process, and the multidimensional nature of processing can be assessed during the course of this process with online measures (Schellings, 2011; Veenman, 2005). Often used online measures that tap into the text learning process are think-aloud protocols (Fox, 2009; Pressley & Afflerbach, 1995) and eye tracking (Hyönä, Lorch, & Rinck, 2003; Jarodzka & Brand-Gruwel, 2017). Different measures capture different aspects of learning behaviour and all these measures have their advantages and disadvantages. The think-aloud method offers a rich source of data, but it can alter processing itself as students need to perform a learning task and concurrently report on their processing (Ericsson & Simon, 1993; Veenman, 2005). According to Hyönä and Lorch (2004) eye tracking is an attractive method for investigating global text processing in comparison with other online measures because eye tracking collects several indices of processing simultaneously and does not disrupt students' processing. However, eye tracking data still needs to be interpreted by the researcher and to reduce the amount of inferences required by the researcher, eye tracking data can be combined with other types of measures, such as verbal reports (Hyönä, 2010; van Gog & Jarodzka, 2013). Because concurrent reporting can affect eye movement patterns, cued retrospective