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Guided reflection to support quality of reflection and inquiry in Web-based learning

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Abstract

The purpose of this study was to design prompts for guided reflection and to validate them in an empirical manner. Guided reflection was applied in a Web-based learning environment *Young Researcher*. This environment was used with lower-secondary school biology students whose quality of reflection and inquiry skills were evaluated. The results of the study demonstrate development in their reflection quality. Significant improvement in terms of students' inquiry skills was detected among skills related to formulating research questions, inferences and planning experiments. Significant associations were found between the development of the students' inquiry skills and reflection quality.

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1. Introduction

Reflection as a thinking process was used by Socrates more than 2,000 years ago, but the approach that is used today for applying reflection in learning settings derives from Dewey's work (1933) (Leijen, Valtna, Leijen, & Pedaste, 2012). Reflection is defined as a cognitive process that is performed to learn from experience (Dewey, 1933; Mezirow, 1991; Schön, 1983). Reflection leads to deeper learning (Moon, 2004) and the achievement of more complex, integrated, and usable knowledge (Billing, 2007). Research has shown that reflection is important for successful learning processes (Davis, 2003; Baird & White, 1996; Dewey, 1933). For example, Davis (2003)

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demonstrated that reflection helps to create new relationships between initial and acquired knowledge and the makes learning process more effective.

Leijen et al. (2012) synthesized the works of Tsangaridou and O'Sullivan (1994), McCollum (1997), and Moon (2004) to distinguish four hierarchical levels in reference to evaluating the quality of reflection: *description* (descriptive information), *justification* (logic or rationale), *critique* (explanation and evaluation), and *discussion* (discussing alternative solutions for changing one's practice). *Description* is the lowest level, followed by *justification (containing description)*, then *critique (containing description and justification)*, and the highest level is *discussion (containing all previous levels)* (Leijen et al., 2012). All of these levels were applied in the current study to evaluate students' answers about their reflective activities.

Reflection is relevant in education, but it is also a challenging activity because what students think and feel about an experience may differ from the actual event (Agryris & Schön, 1974). In addition, several researchers in the field have shown that instead of evaluating experiences themselves, students tend to wait for the teacher to present evaluations (Leijen, Lam, Wildschut, Simons, & Admiraal, 2009; Mountford & Rogers, 1996). That is why there is a need to guide students to reflect on their learning. Reflection is guided in many ways, for example, using guiding questions to point out specific elements in an activity (e.g., Hsieh, Jang, Whang & Chen, 2011; Winchester & Winchester, 2012), reflective blogs or portfolios to note important events during or at the conclusion of activities (Roberts, 2009; Paulus & Spence, 2010), videotaping an action in order to look at it later in order to memorise previous activities (Bannik & Dam, 2007; Calandra, Brantley-Dias, Lee, & Fox, 2008; Leijen et al., 2009), and soliciting feedback from peers who can provide alternative viewpoints on one's activities (Chen, Wei, Wu, & Uden, 2009; Leijen et al., 2009). Guided reflection is a reflection form that takes place in a structured manner between instructor and student (Swardt, Toit, & Botha, 2012; Sööt & Leijen, 2012). All of the described ways of guidance can be integrated with a guided reflection approach.

Reflection can be linked to a wide variety of learning methods, including inquiry learning. Inquiry learning is a process of discovering new relationships, during which a learner formulates hypotheses and tests them by performing experiments or observations (Mäeots, Pedaste, & Sarapuu, 2011). It is possible to distinguish two types of inquiry skills: transformative and regulative (De Jong & Njoo, 1992). This study focuses on transformative inquiry skills, which involve actions that students need to follow step-by-step to discover new relationships (Mäeots, Pedaste, & Sarapuu, 2009). In general, it is possible to differentiate two phases of inquiry learning: the hypothesis and the experimentation phase (Klahr & Dunbar, 1988). The hypothesis phase entails the formation and evaluation of theories and involves the use of transformative inquiry skills such as problem formulation and formulating research questions and hypotheses. The experimentation phase involves the design of experimental or observational procedures and transformative skills such as planning and conducting carrying experiments, analysis and interpretation of the results, and formulating inferences. In this study, three transformative inquiry skills are analysed: formulating research questions, planning experiments, and forming inferences. Baird and White (1996) and Davis (2003) found that inquiry learning can also be used to develop reflection skills. Reflection, along with planning and monitoring, has been identified in some studies as a metacognitive skill that is applied in the context of inquiry learning (White & Frederiksen, 2005). These metacognitive skills are similar to the skills applied in regulative inquiry processes introduced by De Jong and Njoo (1992), which were planning, monitoring, and evaluating. Moreover, it has been shown that inquiry learning improves regulative inquiry skills (De Jong & Njoo, 1992; Mäeots, Pedaste, & Sarapuu, 2009; Wilhelm, 2001). Therefore, we can hypothesize that reflection is one of the skills that can be developed through inquiry learning.

One way to link inquiry learning and reflection is to use technology-enhanced learning environments. Many learning environments have been designed to support students' inquiry, and regulative, and reflection skills (see De Jong et al., 2012; Pedaste & Sarapuu, 2006; Pedaste & Sarapuu, 2012). Technology-enhanced learning environments have often been used in science education to apply inquiry learning; in the technology-enhanced learning environments, students acquire skills or knowledge with the help of teachers or other facilitators,

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