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Improving critical thinking skills and metacognitive monitoring through direct infusion

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ABSTRACT

To test the effectiveness of the direct infusion, instructional approach on the acquisition of argument analysis, critical reading, and metacognitive monitoring skills, we compared three similar groups of college students receiving different instruction of the same course material. The group receiving direct infusion of critical thinking (CT) was explicitly taught application of rules for analyzing psychological arguments and critical reading infused into their course work and given practice with assessments and feedback to guide skill acquisition. Compared to a second group receiving direct infusion of principles of memory improvement and a third focusing on content knowledge acquisition, the CT group showed significantly greater gains on tests of argument analysis and critical reading skills. Students in the CT group also showed significantly greater gains on the ability to accurately postdict their CT test scores. The results suggest that direct infusion can improve both CT skills and metacognitive monitoring with implications for how they are related.

1. Introduction

The acquisition of critical thinking (CT) skills has for decades been a highly valued outcome of higher education; yet, instructors continue to question whether their pedagogical practices promote the acquisition of these important skills. Acquiring CT skills is important because they provide the means for students to question assumptions, analyze arguments, and evaluate the quality of information inside and outside of their chosen fields. The purpose of the present study was to test direct infusion, an approach for explicitly teaching CT skills that promotes their efficient acquisition.

Numerous studies have shown that explicit instruction is effective in promoting the acquisition of CT skills (e.g., Bensley, Crowe, Bernhardt, Buckner, & Allman, 2010; Marin & Halpern, 2011; Nieto & Saiz, 2008). See Abrami et al. (2008) for a review. Although the research on skills and explicit instruction has increased understanding of what makes CT instruction effective, a focus on skills alone is incomplete because CT is a multi-dimensional construct (Bensley, 2011). Research shows that CT performance involves, not only various reasoning skills but also CT dispositions (Clifford, Boufal, & Kurtz, 2004; Taube, 1997) and metacognition (Ku & Ho, 2010; Magno, 2010). Although many theorists have linked CT skills with metacognition (e.g., Halpern, 1998; McGuinness, 1990; Swartz, 1989; Tarricone, 2011), few studies have examined how explicit CT instruction may affect the acquisition of CT skills and metacognitive monitoring. Accordingly, this study tested the effectiveness of a

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form of explicit instruction called direct infusion on the acquisition of argument analysis and critical reading skills and on the ability to accurately estimate CT test performance on tests of those skills.

The complexity of CT as a multi-dimensional construct presents many challenges to those seeking to scientifically study its instruction and assessment (Bensley & Murtagh, 2012).

Despite the attention paid to the improvement of CT skills, identification of specific skills and their relationship to components of CT remain controversial. Taxonomies have identified a wide range of CT skills, sometimes listing the same and sometimes different terminological labels to what appear to be similar skills (e.g., Ennis, 1987, 1992; Facione, 1990; Halpern, 1998). For example, although these taxonomies commonly include argument analysis skills as core CT skills, they identify different subskills for argument analysis.

The lack of consensus about CT skills is found in discussions of reflection and metacognition across disciplines as well. Although philosophers have emphasized the importance of self-reflection in CT (e.g., Ennis, 1987; Paul, 1993), their lists of skills do not include the related psychological concept of metacognition developed by Flavell (1979). Metacognition refers to knowledge, awareness, and control of one's own cognition. Of particular relevance to our study is the component of metacognition called monitoring which involves a person's self-assessment of how well they are comprehending, acquiring certain knowledge, and thinking. Psychologists have identified metacognitive monitoring as central to CT (e.g., Bensley, 2011; Halpern, 1998; Tarricone, 2011). Being able to accurately monitor one's learning and performance is needed for effective self-regulation of cognitive activities such as knowing whether more study is needed or whether one is reasoning well (Stone, 2000). Unfortunately, with few exceptions (e.g., Ku & Ho, 2010; Magno, 2010) empirical studies have not directly examined the relationship between CT skills for argument analysis and metacognition.

From the perspective of psychological science, the problem of CT skill identification remains unsolved because the skills listed in taxonomies have been mostly identified through introspection, philosophical analysis, and informal, post hoc inspection of thinking instead of through systematic, scientific investigation. Empirical research is needed on how instruction impacts performance on tasks requiring specific CT skills and how skill use is related to metacognition. More specifically, the present study examined whether a form of explicit instruction called direct infusion could facilitate acquisition of both argument analysis and critical reading skills and metacognitive monitoring. Direct infusion involves the explicit instruction of CT rules and principles infused into course work, providing practice with exercises and formative assessments with feedback to guide skill acquisition. It might be expected that direct infusion of CT instruction could increase students' awareness of their levels of CT knowledge and skills, facilitating acquisition of both CT skills and the ability to accurately monitor performance on tests of CT. To understand why this might be, we first examine explicit CT instruction in general, and then direct infusion, in particular, followed by a discussion of how metacognition may be related to direct infusion.

1.1. Review of research on explicit instruction

Ennis (1989) has used the explicitness of instruction as a criterion for classifying different CT instructional approaches. His scheme separates CT instructional approaches into four different types (general, immersion, infusion, and mixed) with the types differing in how explicitly CT principles are taught and how principles are taught in relation to course content. The general approach focuses instruction on explicitly teaching principles for thinking, usually separate from regular course content instruction and sometimes in a more abstract form as in a formal logic course. A second approach called 'immersion' does not make rules or principles of thinking explicit but instead relies on intense, thoughtful exposure or immersion to CT in subject matter. A third approach called 'infusion' resembles the general approach in that it involves explicit instruction of CT, but this explicit instruction is delivered in conjunction with the study of relevant subject matter as students are encouraged to think deeply about it. Finally, the mixed approach combines explicit teaching of CT principles as a separate thread of instruction with either immersion or infusion.

In one of the few empirical studies directly comparing the different approaches, Angeli and Valanides (2009) compared students taught with the general, immersion, and infusion approaches on their ability to write a CT discussion of an ill-defined issue. The infusion group received guided instruction in the use of CT skills while the immersion group was engaged in Socratic questioning about the essay without any explicit mention of the skills and a control group received no explicit instruction but simply prepared an outline of the essay. Statistically controlling for students' initial CT test performance, Angeli and Valanides found that both the infusion and immersion groups performed significantly better than the control group on the outline task showing large effect sizes; however, the infusion group had the largest effect size.

Obtaining additional support for explicit infusion of CT, Abrami et al. (2008) assigned studies testing the different approaches identified by Ennis and performed a meta-analysis on their outcomes. Specifically, Abrami et al. (2008) found that the effect size for the infusion approach was larger than that of either the immersion or general approaches, but that the mixed approach had the largest effect size. This suggests that instructors should design courses in which CT skills are explicitly taught as a separate thread of instruction and then in concert with course content. Abrami et al. (2008) noted that more research was needed to clearly identify the instructional elements that promote CT.

Recently, Marin and Halpern (2011) conducted a study in which they more clearly specified the conditions of explicit CT instruction than in many previous studies. Explicit instruction involved modeling CT for their high school student participants, encouraging them to thoughtfully respond to questions, having them practice specific CT skills, as well as recognize the structure of problems, and discuss the process of thinking to promote metacognition. A second imbedded instruction