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Let me critically question this! – Insights from a training study on the role of questioning on argumentative discourse

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ABSTRACT

Critical questioning is crucial for being able to successfully construct knowledge within collaborative argumentation on science-related issues. Regrettably, laypeople often lack the required skills and intrinsic motivation to do so. In a 1×2 between-subjects design (training vs. no training), the present study investigated if training the members of a dyad on critical questioning individually promotes their critical questioning behavior in discourse and their subsequent argumentation behavior. Results of content analyses show corresponding beneficial effects of the training. Furthermore, analyses revealed a marginal positive effect of the training on general critical thinking scores. The training also succeeded in ensuring students' intrinsic motivation. Implications for developing further trainings to promote critical argumentation and critical thinking are discussed.

1. Introduction

According to the OECD (2016), one main goal of education is to promote critical thinking skills in schools and at universities (also see Kraak, 2000). By acquiring these skills, students should be better prepared for the challenges that arise in their future work. Particularly for teachers, it is important to develop critical thinking skills because they will argue better in classrooms and their students will be able to learn scientific content better. Moreover, teachers are often asked for advice by parents on topics that are outside of their expertise, such as computer use in childhood or specific learning support. In order to provide helpful and differentiated responses on such issues, teachers need to critically question and elaborate background information from various sources such as, for instance, texts or other people (such as in online forums).

One key educational activity that promotes critical thinking (Guiller, Durndell, & Ross, 2008; Thiebach, Mayweg-Paus, & Jucks, 2016), problem-solving skills (Golanics & Nussbaum, 2008), and learning about a particular topic (e.g., Andriessen, 2006; Chinn & Clark, 2013; Mason, 2001) is computer-supported collaborative argumentation, in which "learners communicate with each other via text-based asynchronous discussion boards [and] are supposed to engage in argumentative discourse with the goal to acquire knowledge" (Weinberger & Fischer, 2006). Here, the "argumentative discourse" aspect is critical: Previous studies have shown that simply discussing a science-related topic with others does not automatically lead to learning (Jucks & Mayweg-Paus, 2016; Felton, Garcia-Mila, Villarroel, & Gilabert, 2015; Felton, Garcia-Mila, & Gilabert, 2009; Nussbaum, 2008). Instead, to developing well-founded and elaborated knowledge on an issue learners must engage in high-quality collaborative argumentation including critical questioning of information (Abrami et al., 2008; Browne & Keeley, 2007). However, learners in online communication settings rarely ask critical questions

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spontaneously (e.g., Thiebach et al., 2016). Thus, the present study aimed at testing whether encouraging a person to critically question science-related information and arguments in computer-supported collaborative argumentation would enhance the quality of their argumentation behavior, increase their awareness of the epistemic complexity of an issue, and improve their critical thinking in terms of argument evaluation. For this purpose, we gave training in critical questioning to a group of preservice teachers; no training was given to the control group (also preservice teachers). In the following, we will provide a theoretical overview of collaborative argumentation and discuss the role of critical questioning and thinking in this context before describing how our results offer some key requirements for training programs that promote critical questioning.

2. Theoretical background

2.1. The role of critical thinking and questioning in collaborative argumentation

From an educational perspective, collaborative argumentation aims at jointly constructing knowledge on a science-related topic (Leitão, 2000). However, in collaborative argumentation learners tend to superficially summarize information and to build positively but uncritically on what the other has said (*quick consensus building*; Weinberger & Fischer, 2006). This strategy does not require much cognitive effort and primarily helps learners memorize and accumulate the main arguments. Reasoning in communication is often one-sided, not sound, contains false information or lacks important elements, such as good reasons and evidence for conclusions (e.g., Jimenez-Aleixandre, Rodriguez, & Duschl, 2000; Kuhn & Udell, 2007).

For learners to be able to perform deep and elaborated knowledge construction in collaborative argumentation, they must actively interact with and evaluate the communication content. They need to deeply engage in the process of argumentative information processing (Weinberger & Fischer, 2006). In other words, communication partners need to engage in *critical collaborative argumentation* (Osborne, 2010), dealing constructively but critically with the arguments in order to expand their knowledge and enable them to adopt reasonable and rationally based beliefs/positions (Cederblom & Paulsen, 2006).

In general, critical thinking is a fundamental goal of science education (Bailin, 2002). Critical thinking – a complex and multidimensional concept – has many proposed definitions (for overviews see, e.g., Abrami et al., 2008; Niu, Behar-Horenstein, & Garvan, 2013,van Gelder, 2005), but most scholars agree that "a core part of critical thinking is handling arguments" (van Gelder, 2005, p. 44). Critical thinking is a higher-order thinking skill that helps people actively and skillfully identify, construct, analyze, synthesize, and/or evaluate information and arguments to draw valid conclusions and address opposing viewpoints (Hyytinen, Holma, Toom, Shavelson, & Lindblom-Ylänne, 2014; Scriven & Paul, 1987). It facilitates making an informed and self-regulatory decision about how to evaluate science-related issues that often contain conflicting claims and evidence (Ennis, 1991; Fisher, 2011). A promising setting for developing critical thinking is that of collaborative argumentation (e.g., Scheuer, McLaren, Weinberger, & Niebuhr, 2014; Frijters, ten Dam, & Rijlaarsdam, 2008), as this context expects learners to engage in key aspects of critical thinking (Browne & Keeley, 2007; Watson & Glaser, 2007): It asks them to explicitly and critically question arguments and their associated evidence, thereby encouraging learners to consider more and better arguments for different positions (Chan, Burtis, & Bereiter, 1997). Such critical questioning enhances critical consumption of scientific knowledge (Millar & Osborne, 1998; Newton, Driver, & Osborne, 1999) as well as critical reflection on the quality of arguments (Watts, Alsop, Gould, & Walsh, 1997; Nussbaum & Edwards, 2011) in order to co-construct elaborated knowledge (e.g., Chin & Osborne, 2008; Walton, Reed, & Macagno, 2008).

2.2. Training in critical questioning

As has been outlined above, learners within computer-supported collaborative argumentation settings rarely spontaneously engage in critical questioning (e.g., Weinberger & Fischer, 2006; Thiebach et al., 2016). Therefore, in order to support in-depth knowledge construction, there is a clear need to support critical questioning in discussions about science-related issues (Osborne, 2010).

Some research seems to suggest that generic critical thinking can be taught (see Abrami et al., 2008; Niu et al., 2013; van Gelder, 2005). However, success of the teaching seems to depend heavily on the type of intervention, and it is still unclear how the specific activity of critical questioning can best be promoted in collaborative argumentation. Meta-analyses identify several key elements that should be considered when trying to support this desired behavior (e.g., Abrami et al., 2008).

In the present study, the training program we designed to promote critical questioning meets many of these key elements: First, the training should intervene as little as possible in the natural communication situation; our study meets this requirement because the training takes place just before participants engage in collaborative argumentation, as opposed to in other types of training, such where participants are provided with collaboration scripts (e.g., Scheuer et al., 2014). Second, it should explicitly educate participants about the general principles of critical questioning and in how to apply these skills in the context of a specific subject matter.

In this regard, the exact design of the training is crucial for its success. For example, following the definitions of critical thinking (e.g., Browne & Keeley, 2007), training in critical questioning must consider two aspects that determine whether the participant will show a behavior (in this case, critical questioning): These aspects are the participant's skill and willingness level (Hefter et al., 2014).