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Does prior domain-specific content knowledge influence students' recall of arguments surrounding interdisciplinary topics?

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ABSTRACT

Awareness of various arguments can help interactants present opinions, stress points, and build counterarguments during discussions. At school, some topics are taught in a way that students learn to accumulate knowledge and gather arguments, and later employ them during debates. Prior knowledge may facilitate recalling information on well structured, fact-based topics, but does it facilitate recalling arguments during discussions on complex, interdisciplinary topics? We assessed the prior knowledge in domains related to a bioethical topic of 277 students from Germany (approximately 15 years old), their interest in the topic, and their general knowledge. The students read a text with arguments for and against prenatal diagnostics and tried to recall the arguments one week later and again six weeks later. Prior knowledge in various domains related to the topic individually and separately helped students recall the arguments. These relationships were independent of students' interest in the topic and their general knowledge.

In many countries a specific aim of formal education is to cultivate upstanding citizens (Amnå, 2012). This also is the case in Germany (cf. Einheitliche Prüfungsanforderungen [Standard Examination Regulations], 2006), where controversial topics are addressed in some school subjects to provide students with the opportunity to explore various social issues and to practice expressing their points of view during in-class discussions. Such topics often are complex and interdisciplinary and include bioethical topics such as protecting the environment, abortion, and drug consumption. It commonly is believed that to be able to participate in discussions on a complex topic students need knowledge in diverse domains. In this research article we explore the extent to which students' prior domain-specific content knowledge in more than one domain is needed to recall arguments related to a bioethical topic.

Knowledge gained prior to exploring various topics at school can contribute considerably to learning outcomes (cf. Duncan, 2007; McNamara & Kintsch, 1996; Rittle-Johnson, Star, & Durkin, 2009; Thompson & Zamboanga, 2004). Research has been conducted on the kinds of prior knowledge that influence learning about complex topics and participation in discussions about them. For example, factual knowledge, also known as content knowledge, of mathematics- and science-related topics and its impact on learning outcomes (e.g., Alexander & Murphy, 1998; DeMarie, Aloise-Young, Prideaux, Muransky-Doran, & Hart Gerda, 2004) and on reading processes (e.g., McNamara & Kintsch, 1996) has been widely researched. Procedural knowledge has been found to be important in formulating arguments during discussions (e.g., Kuhn & Udell, 2007; Kuhn, Zillmer, Crowell, & Zavala, 2013; Zohar & Nemet, 2002). Epistemic

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knowledge, that is, beliefs about one's own knowledge of a topic, has been found to influence how persuasive messages are perceived and processed (e.g., Murphy & Alexander, 2004).

A domain usually is associated with an academic field (Buehl & Alexander, 2001). Topics within a domain can be ill-structured (Kitchener, 1983) in that they are seen as problems with multiple solutions of unclear feasibility. Many everyday life and social problems are ill-structured (Kitchener, 1983). Spiro, Feltovich, Jacobson, and Coulson (1992) claimed that ill-structured topics required the application of knowledge involving interaction among multiple, sometimes widely different, complex and changing conceptual structures. However, some ill-structured topics cannot be assigned easily to one domain. To understand ill-structured topics and their implications knowledge in more than one domain might be necessary. For example, in the case of bioethical topics knowledge in at least two domains – biology and ethics – is important. However, research on content knowledge of complex ill-structured topics such as bioethical topics is scarce.

The focus of research on the formation of arguments during discussions predominantly has been procedural knowledge. Kuhn et al. (2013) investigated meta-knowledge of what constitutes a good argument and what constitutes a bad argument. Kuhn and Udell (2007) focussed on strategic knowledge of how to respond to counterparties' arguments. Zohar and Nemet (2002) claimed knowledge of argumentation structure was important for developing argumentation skills. However, research on content knowledge relevant for discussions is scarce. Except for one study conducted by Means and Voss (1996) in which the impact of prior content knowledge on the ability to participate appropriately and effectively during discussions was investigated, the relationship between prior knowledge and argumentation ostensibly has not been researched. Their findings indicate that students with prior content knowledge are able to form more arguments than students with less prior content knowledge.

The focus of research on prior knowledge and its influence on interpreting a potentially persuasive message mainly has been epistemic knowledge: the most important kind of knowledge for processing a persuasive message (cf. Alexander, Buehl, & Sperl, 2001; Buehl & Alexander, 2001; Buehl, Alexander, Murphy, & Sperl, 2001; Murphy & Alexander, 2004). Alexander et al. (2001) reported that students' epistemic knowledge of a topic had greater influence on whether a persuasive message changed their opinion about that topic than their demonstrated conceptual knowledge of the topic. However, if students had too little content knowledge of a topic, persuasion seemed to be impossible. Additionally, they found that the structure of a persuasive text influenced its impact on the reader. Although a two-sided non-refutational text is less persuasive for readers than a one-sided text (Murphy & Alexander, 2004), it has greater impact on how much content knowledge the readers acquire from reading the text (Buehl et al., 2001). In all of these studies content knowledge was examined by asking participants what they knew about the topic presented in the persuasive text, but the impact of content knowledge in the related domain(s) was not explored.

In this study the role of prior domain-specific content knowledge in recalling arguments from a two-sided non-refutational text on an ill-structured topic is explored. Dochy (1992) and Alexander, Kulikowich, and Schulze (1994) distinguish conceptual knowledge in topic knowledge and domain-specific knowledge. While topic knowledge refers to a particular issue, domain-specific knowledge refers to several concepts and topics. In the aforementioned studies focus was on topic knowledge; however, students almost always have very little prior knowledge of a topic when it is first introduced at school and so investigating their prior domain-specific knowledge and how it affects their ability to develop and recall convincing arguments surrounding ill-structured interdisciplinary topics seems worthwhile.

Initiating and encouraging discussions on complex, real-life topics, such as bioethical topics, is considered an effective way to enhance students' ability to partake in such discussions (cf. Einheitliche Prüfungsanforderungen [Standard Examination Regulations], 2006; Reitschert, Langlet, Hössle, Mittelsten Scheid, & Schlüter, 2007). From a curricular perspective examining such topics in class presents students with the opportunity to connect their experiences with school subjects and to use their knowledge of formerly addressed topics during these encounters (cf. Rahmenrichtlinien [Guidelines], 1985). Genuine environments are believed to help students improve their argumentation skills and motivate them to learn; discussions on bioethical dilemmas are considered genuine environments (Zohar & Nemet, 2002). When delving into social or bioethical topics, students need to employ moral reasoning, critical thinking, and judging skills (Hurtado, Mayhew, & Engberg, 2012; King & Mayhew, 2002). Simultaneously, they develop their ability to reflect, feel empathy, and tolerate ambiguity (Kuhn & Udell, 2003, 2007; Raters, 2011).

When discussing a bioethical dilemma students are in a real-world environment requiring them to apply various kinds of knowledge. They tap into their previously acquired knowledge to try to understand the dilemma and see it from various perspectives (Zohar & Nemet, 2002). Reitschert (2007) emphasizes that learning about bioethical topics helps students understand why knowledge of biology is important. During discussions on such topics students need content knowledge to construct arguments (Means & Voss, 1996) and procedural knowledge to form arguments and participate in discussion. Scherb (2005) points out that when teachers present and discuss bioethical dilemmas in class, students learn how to assess them. During this assessment process students bring personal biographical preconditions including prior content knowledge of the bioethical topic, prior experience with dilemmas and argumentation, and personal experience. Fuchs (2010) points out that in addition to needing knowledge of ethics and religion, students need information on politics, biology, and medicine to understand some dilemmas. For example, in her study Fuchs describes a unit of instruction in religion class on the bioethical topic *prenatal diagnostics*. To teach this unit comprehensively students obtained relevant information on medicine and biology, the constitution of Germany, religious and ethical theories on the human condition, and prenatal diagnostics and its consequences.

It can be challenging to identify all the domains in which students need prior knowledge in order to learn about and discuss various ill-structured topics such as bioethical dilemmas. As Fuchs (2010) pointed out, understanding bioethical topics requires knowledge in various domains such as biology, medicine, religion, and politics. However, if the potentially important knowledge comes from such a broad range of domains, the question arises as to whether domain-specific knowledge and general knowledge are not one and the same.