Investigating relations between beliefs about justification for knowing, interest, and knowledge across two socio-scientific topics

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ABSTRACT

In a sample of 281 Norwegian upper-secondary school students, structural equation modeling was used to test hypothesized relationships between beliefs about justification for knowing, interest, and knowledge across two controversial socio-scientific topics: climate change and nuclear power. Results indicated that beliefs in justification by multiple sources had a positive direct effect on knowledge about climate change and positive indirect effects on knowledge about both topics mediated by topic interest. Beliefs in personal justification had only a negative direct effect on knowledge about climate change, and beliefs in justification by authority were not related to knowledge about any of the topics, neither directly nor indirectly. Findings are considered in light of the existing literature on epistemic beliefs concerning justification for knowing and suggestions for future research are offered.

1. Introduction

In the 21st century, gaining accurate knowledge about controversial socio-scientific topics is more important than ever. In democratic societies, such topics are often publicly debated (Bromme & Goldman, 2014; Sinatra, Kienhues, & Hofer, 2014), and participation in a constructive democratic discourse on how to approach and solve them requires that people have some common ground in terms of basic topic knowledge despite other disagreements they might have (Sinatra et al., 2014). In an educational context, it is therefore pertinent to investigate other psychological constructs that may underlie students’ knowledge about socio-scientific topics. In the current study, we focused on two such constructs, epistemic beliefs concerning the domain of science and topic interest, as predictors of students’ knowledge about two publicly debated and essential socio-scientific topics: climate change and nuclear power plants. Additionally, we investigated the extent to which interest in these topic might mediate the effects of epistemic beliefs on students’ knowledge about them.

1.1. Theoretical assumptions and prior research

Within educational psychology, epistemic beliefs are considered forms of personal epistemology that concern lay persons’ views about the nature of knowledge and the nature of knowing (Hofer & Bendixen, 2012). Several dimensions of epistemic beliefs have been focused in the literature, including beliefs about the certainty, simplicity, and source of knowledge, as well as the justification for knowing (Hofer & Pintrich, 1997; Schommer, 1990). However, in the last decade, particular attention has been given to beliefs about justification for knowing, which concern the ways in which individuals evaluate knowledge claims (Hofer & Bendixen, 2012). A main impetus for this direction within epistemic belief research has been the philosophically inspired conceptualization proposed by Greene, Azevedo, and Torney-Purta (2008). The core argument of these authors was that thinking about justification for knowing is the centerpiece of personal epistemology, especially distinguishing between justification by an internal personal source and justification by an external authoritative source. Later, Greene, Torney-Purta, and Azevedo (2010) provided empirical evidence for the validity of these two dimensions concerning justification for knowing at a domain-specific level (i.e., in math and history).

In a think-aloud study framed by Greene et al.’s (2008) theoretical work, Ferguson, Bråten, and Stremme (2012) also found that students justified knowledge claims by both personal opinion and an external authoritative source when reading about a controversial socio-scientific topic. In addition, however, participants were found to justify knowledge claims by multiple sources, meaning that they judged knowledge claims by checking several sources of information for consistency. In a later study using a questionnaire designed to capture all three dimensions (i.e., personal justification, justification by authority, and justification by multiple sources), Ferguson, Bråten, Stremme, and Anmarkrud (2013) further validated this trichotomous framework concerning justification for knowing, which also forms the basis for the current
empirical investigation. Within this framework, personal justification refers to the evaluation of knowledge claims in relation to one’s own views or opinions about the claims in question, justification by authority refers to the evaluation of knowledge claims by appealing to a reputable external source (e.g., a teacher or a scientist), and justification by multiple sources refers to the evaluation of knowledge claims by cross-checking and corroborating across different information sources. Of note is that beliefs falling on these three epistemic belief dimensions are considered domain-specific in the sense that they vary across academic domains or disciplines (Muis, Bendixsen, & Haeerle, 2006).1 A number of recent empirical studies have established links between beliefs about justification for knowing and learning and performance (Bråten & Strømsø, 2010; Conley, Pintrich, Vekiri, & Harrison, 2004; Greene et al., 2010; Mason, Ariasi, & Boldrin, 2011; Mason, Boldrin, & Ariasi, 2010; Muis, 2008; Muis & Franco, 2010; Strømsø & Bråten, 2009). With respect to research conducted within the trichotomous framework described above, the general trend is that beliefs in personal justification are negatively related to performance whereas beliefs in justification by multiple sources are positively related to performance (Bråten, Anmarkrud, Brandmo, & Strømsø, 2014; Bråten & Ferguson, 2014; Bråten, Ferguson, Anmarkrud, Strømsø, & Brandmo, 2014; Bråten, Ferguson, Strømsø, & Anmarkrud, 2013; Bråten, Ferguson, Strømsø, & Anmarkrud, 2014; Ferguson & Bråten, 2013; Kendeou, Braasch, & Bråten, 2016; Trevors, Kendeou, Bråten, & Braasch, 2017). Of note is that different measures of performance have been used in this body of research, ranging from multiple text comprehension to conceptual change learning and science achievement. Additional evidence for a positive relationship between beliefs in justification by multiple sources and learning and performance comes from research on Internet-specific epistemic beliefs (i.e., beliefs about what knowledge and knowing are like on the Internet; Bråten, Strømsø, & Samuelstuen, 2005). In brief, this body of work indicates that higher beliefs in the need to check knowledge claims against other information sources positively predict adaptive strategy use and Internet-based learning (Chiu, Liang, & Tsai, 2013; Lee, Chiu, Liang, & Tsai, 2014; Kammerer, Amann, & Gerjets, 2015; Kammerer, Bråten, Gerjets, & Strømsø, 2013; Strømsø & Bråten, 2010; see also, Greene, Yu, & Copeland, 2014). Findings concerning justification by authority have been less consistent, however. While justification by authority have been found to be unrelated to performance in some studies (Bråten et al., 2013; Bråten, Ferguson, Stroemso et al., 2014; Kendeou et al., 2016), other research has found a positive relationship between this variable and performance in specific task contexts and cultural groups (Braasch, Bråten, Britt, Steffens, & Stroemso, 2014; Stroemso, Bråten, Anmarkrud, & Ferguson, 2016). Moreover, a recent study by Bråten and Ferguson (2014) suggested that a positive relationship between justification by authority and performance may be limited to justification by scientific authority.

In addition to research on epistemic beliefs in relation to learning and performance, a number of studies have examined relationships between epistemic beliefs and motivation constructs (for a recent review, see Chen & Barger, 2016). This line of research is grounded in Howie and Pintrich’s (1997) landmark review of personal epistemology, in which they proposed that beliefs about knowledge and knowing may be activated by specific topics and domains and impact learners’ motivation with respect to those topics and domains. Accordingly, epistemic beliefs can be considered to indirectly affect learning and performance through motivation (Hofer & Pintrich, 1997; Pintrich, 2002). Further specification of this idea of mediation through motivation is found in theoretical work by Buehl (2003) and Muis (2007), who suggested that epistemic beliefs influence motivation constructs such as self-beliefs, values, and achievement goals. Such motivation constructs may in turn influence learners’ knowledge generation and achievement (see also, Barger & Linnenbrink-Garcia, 2017). On the basis of this view, we set out to test a model where a particular value-related motivation construct, individual topic interest, was assumed to mediate the effects of the different types of justification beliefs included in Ferguson et al.’s (2012, 2013) trichotomous framework on students’ knowledge. Of note is that individual interest in a particular topic or activity is considered a part of the value component of motivation within expectancy-value theory of achievement motivation (Wigfield & Eccles, 2000). In the present study, we targeted students’ interest and knowledge with respect to two scientific topics (i.e., climate change and nuclear power). And, because our measures of interest and knowledge concerned scientific topics, justification for knowing beliefs were measured with respect to the domain of science.

Of note is that individual or personal interest, which refers to a relatively stable motivational disposition to be attracted by and engaged in specific topics or domains, figures prominently within motivation theory (Hidi & Renninger, 2006; Schiefele, 1999, 2009; Schunk, Meece, & Pintrich, 2014; Wigfield & Eccles, 2000), as well as in theories of domain learning (Alexander, 1997, 2012). For example, Schiefele (1999) has regarded individual interest as a dispositional motivational characteristic defined by the positive feelings and personal significance attributed to particular topics or domains, and in Alexander’s (1997) model of domain learning, individual interest involves an investment and involvement in a particular field that interacts with knowledge and strategic processing. Also, the will to engage in a topic is regarded as an aspect of individual topic interest by several theorists (e.g., Alexander, 1997; Hidi & Renninger, 2006; Schunk et al., 2014). Much motivation research has documented that interest in particular topics and domains positively predicts performance with respect to those topics and domains, presumably because it is associated with deeper-level strategic processing of information and more adaptive self-regulation (for review, see Schunk et al., 2014). Prior research has also found that justification for knowing beliefs may be related to individual interest. For example, Strømsø and Bråten (2009) found that the more students believed that knowledge claims about a scientific topic need to be justified through rules of inquiry and the evaluation and integration of multiple sources, the more likely they were to be interested in that topic. Likewise, Bråten, Anmarkrud, Brandmo et al. (2014) found that the more students believed in the importance or necessity of justifying knowledge claims in natural science by checking multiple external sources for consistency, the more interested they were in understanding science texts. However, to the best of our knowledge, previous research has not tested direct and indirect relationships between different justification beliefs in science, individual interest in a scientific topic, and knowledge about the topic.

1.2. The present study

Based on theoretical assumptions and prior research, we developed the model shown in Fig. 1. The fit of this hypothesized model to data was tested in a sample of Norwegian upper secondary school students. This is the first study that investigates different types of justification for knowing constructs as predictors of topic interest and topic knowledge, including how topic interest may mediate the effects of different justification constructs on topic knowledge. Of note is also that our dependent measures of knowledge about climate change and nuclear power were previously validated knowledge tests developed in collaboration with independent experts in those areas (see Materials below). Finally, we tested our model across two topics (i.e., climate change and nuclear power), which also adds to the novelty of this empirical work.

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1 In addition to dimensional models of personal epistemology (e.g., Hofer & Pintrich, 1997; Schommer, 1996), which figure prominently within educational psychology, models within developmental psychology (e.g., Kuhn, Cheney, & Weinstock, 2000; Perry, 1970) describe the development of people’s views about the nature of knowledge and the nature of knowing in terms of sequential stages or phases. Developmental models fall outside the scope of the current study, however, which is grounded in an educational psychology dimensional view of personal epistemology, focusing on multiple dimensions of justification for knowing, in particular.
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