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Beliefs about justification for knowing when ethnic majority and ethnic minority students read multiple conflicting documents

Helge Ivar Strømsø*, Ivar Bråten, Øistein Anmarkrud and Leila E. Ferguson

Department of Education, University of Oslo, Oslo, Norway

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We examined the role of justification for knowing beliefs in learning and comprehension when ethnic majority and ethnic minority students from the same school classes read five conflicting documents on the scientific issue of sun exposure and health. Results showed that the more ethnic minority students trusted scientific authorities and the less they relied on personal opinion when validating knowledge claims in the domain of science, the more they learned from and the better they comprehended the documents. In contrast, justification for knowing beliefs did not seem to play a role in learning and comprehension among ethnic majority students. These results may reflect that the documents represented more of a challenge to the ethnic minority students, with justification beliefs affecting learning and comprehension processes to a greater extent when the task is perceived as an ill-structured problem. This study is probably the first to indicate different relationships between various justification beliefs and performance in different language and cultural groups, having theoretical as well as educational implications.

Keywords: epistemic beliefs; justification for knowing beliefs; multiple documents; minority students

In multimedia societies students are frequently exposed to conflicting information on controversial issues, which may represent a substantial challenge if the information concerns questions of personal relevance. In this study, high school students read multiple conflicting documents on sun exposure and health, with some documents focusing on the possible relationship between sun exposure and cancer, and others highlighting that vitamin D from sun radiation may protect against cancer. From lay persons' perspectives, such a conflict may seem unsolvable. Still they have to decide whether to protect themselves against sun exposure or not. Beliefs about knowledge claims may affect how people deal with this situation.

Beliefs about knowledge and knowing were labelled personal epistemology by Hofer and Pintrich (1997). Several researchers have proposed and demonstrated that personal epistemology may affect learning and problem-solving (e.g. Hofer, 2001; Muis, 2004), and recent work has shown that such beliefs also may be related to students' comprehension of multiple conflicting documents (Bråten, Britt, Strømsø, & Rouet, 2011). Personal epistemology and its relationship to learning and comprehension may, however, vary with cultural context (Hofer, 2008), with cultural

*Corresponding author. Email: h.i.stromso@ped.uio.no

differences demonstrated for a number of psychological constructs (Henrich, Heine, & Norenzayan, 2010). The relationship between personal epistemology and performance may even vary among different cultural groups within the same educational system (Schommer-Aikins & Easter, 2008). One common problem in cross-cultural studies is that many variables may be responsible for differences in findings, such as school environment and curriculum. Such variables may obscure or exaggerate differences in personal epistemology found between different cultural groups. To explore possible differences in personal epistemology due to cultural values, factors such as school environment and curriculum should, preferably, not vary between the groups. In addition, one should not only study possible differences in personal epistemology but also study whether personal epistemology is differently related to learning and performance. One way to reduce the number of variables is to study subcultural groups within the same school system and environment. Such studies may expand our knowledge of possible relationships between students' cultural values and the role of personal epistemology in learning and performance. Accordingly, we set out to explore the extent to which beliefs about the justification of knowledge claims might differentially predict learning from and comprehension of multiple conflicting documents among ethnic majority and ethnic minority students from the same school classes.

Personal epistemology

The multidimensional models of Schommer (1990) and Hofer and Pintrich (1997) have framed much research on personal epistemology and learning (Buehl, 2008). Both refer to personal epistemology as a kind of belief system. According to Calderhead (1996), beliefs generally refer to 'suppositions, commitments, and ideologies' (p. 715), and in the context of the above models, such beliefs concern the nature of knowledge and the process of knowing. Thus, personal epistemology refers to psychological concepts and not to theories about epistemology as conceptualised within philosophy. However, Greene, Azevedo, and Torney-Purta (2008) recently argued that psychologists should pay more attention to how philosophers have addressed questions regarding epistemology, positing that beliefs about how knowledge claims are justified should be of primary concern in personal epistemology. Although personal epistemology may be understood more broadly (Chinn, Buckland, & Samarapungavan, 2011), it seems pertinent to further explore how justification beliefs relate to student performance (Bråten & Strømsø, 2010).

Justification beliefs

Reviewing 37 studies of beliefs about knowledge and knowing, Buehl (2008) found only four studies where justification beliefs were identified as a separate dimension, and only one of those indicated a relationship between justification beliefs and performance (Conley, Pintrich, Vekiri, & Harrison, 2004). One possible reason for this lack of evidence for a justification dimension in personal epistemology may be an, until now, narrow conceptualisation of how knowledge claims may be justified (Greene et al., 2008). The Hofer and Pintrich (1997) model, for example, focuses on justification beliefs on a single dimension concerning 'how individuals evaluate knowledge claims, including the use of evidence, the use they make of authority and expertise, and their evaluation of experts' (p. 120). Greene et al. (2008) argue

that different means of justification may be regarded as distinct dimensions, with, for example, justification by authority and personal justification being separate dimensions. Empirical evidence for this view was later provided by Greene, Torney-Purta, and Azevedo (2010), and the same dimensions were identified in a think-aloud study by Ferguson, Bråten, and Strømsø (2012), where a third dimension involved that students considered which claims to believe on the basis of cross-checking, comparing and corroborating across several sources of information. The three dimensions of justification by authority, personal justification and justification by multiple sources were also established through factor analyses (Ferguson, Bråten, Strømsø, & Anmarkrud, 2013), and personal justification and justification by multiple sources have been found to predict 10th graders' comprehension of multiple conflicting documents (Bråten, Ferguson, Strømsø, & Anmarkrud, 2013).

Justification beliefs and multiple documents comprehension

Individuals' beliefs may become more pertinent in situations that require processing of ill-structured problems, where standard processing strategies do not work, as opposed to processing well-structured problems (Nespor, 1987). Tasks involving the reading of multiple conflicting documents may be classified as ill-structured problems. To construct a coherent representation of the content, the reader has to compare, contrast and integrate information across documents, and also attend to the sources of the various claims (Goldman, 2004; Rouet, 2006). When claims conflict, the reader needs to consider the evidence and judge the reliability of sources. Prior research has shown that such tasks represent a challenge to high school students (Britt & Aglinskias, 2002; Stahl, Hynd, Britton, McNish, & Bosquet, 1996), and that lay people may have problems detecting contradictions (Stadtler, Scharrer, & Bromme, 2011). Also, several studies have shown that personal epistemology may predict students' multiple-documents comprehension (see Bråten et al., 2011, for review), but only a few studies have indicated that justification beliefs are related to comprehension.

In a study of high school students reading partly conflicting documents on climate change, Strømsø and Bråten (2009) found that justification beliefs predicted both within- and cross-text comprehension independent of topic knowledge and topic interest. Likewise, using the same materials, Bråten and Strømsø (2010) found a unique positive relationship between law students' justification beliefs and multiple-documents comprehension. In both studies, high scores on the justification beliefs measure reflected the belief that knowledge claims should be based on rules of inquiry and the evaluation and integration of multiple information sources, while low scores represented the belief that knowledge claims can be justified through own opinion, first-hand experience or common sense. In a more recent study, Bråten et al. (2013) found that different dimensions of justification beliefs uniquely predicted 10th graders' comprehension of multiple conflicting documents on the topic of sun exposure and health. In that study, comprehension was assessed by short-essay questions requiring students to consider different positions and integrate information across texts, while justification beliefs were measured by a questionnaire capturing three dimensions: personal justification, justification by authority and justification by multiple sources. After controlling for prior knowledge, results showed that more students believed that justification of knowledge claims should be based on personal opinion, the poorer their comprehension, and the more they believed

that justification should draw upon multiple sources of information, the better their comprehension performance. Justification by authority did not appear as a unique predictor of comprehension in that study. However, beliefs in authorities as a basis for scientific truth may be emphasised differently in various cultures (Karabenick & Moosa, 2005), which motivated our decision to explore how dimensions of justification beliefs relate to learning and comprehension in student groups coming from different, or partly different, cultural contexts.

Cultural differences

Many studies indicate substantial variability in psychological constructs across cultures. Examples are visual perception, categorisation and inferential induction, reasoning styles and self-concepts (Henrich et al., 2010). In a number of studies, Nisbett and colleagues showed differences in cognitive processes between East Asians and Westerners, with one such process being judgements about contradictory propositions (for review, see Nisbett, Peng, Choi, & Norenzayan, 2001). These authors also assumed that ‘tacit epistemology ... dictates the cognitive procedures that people use for solving particular problems’ (p. 306). This notion seems to imply that cultural differences in personal epistemology may have consequences for how people from different cultures deal with multiple conflicting documents.

Cultural differences have been identified in a few studies of personal epistemology among students. Karabenick and Moosa (2005) compared Omani and US college students and found that Omani students had stronger beliefs in authority as a source of what is true than US students, whereas there was no difference between the two groups regarding beliefs about scientific methodology vs. personal opinion as means of justification. Hofer (2008) reported that Japanese college students believed more in authority as a source of knowledge than US college students, and they were also more likely to consider personal knowledge and first-hand experience a basis for the justification of knowing. Chan (2008) noted that the authority dimension seems to be more significant in East Asian than in Western cultures, possibly due to a stronger tradition for respecting authority figures in Asian cultures. At the same time, there were no noticeable differences in justification beliefs in a study of Spanish and Norwegian university students reading multiple conflicting documents about climate change (Bråten, Gil, Strømsø, & Vidal-Abarca, 2009), but in the Spanish sample, topic interest was positively related to beliefs in authority as a source of knowledge, while topic interest was negatively related to such beliefs in the Norwegian sample. This suggests that Spanish students high in topic interest may rely more on experts than do high-interest Norwegian students, which may be related to the fact that Spanish students also have less knowledge about the topic. Though few in numbers, the above studies suggest cross-cultural differences in students’ beliefs regarding the justification for knowing, and that such differences may be smaller within Western societies than between Western and Asian societies.

Cross-cultural differences in personal epistemology may be due to a number of conditions, such as differences in philosophical and moral systems of thought, school systems or the degree of industrial development. Research on other psychological phenomena has also demonstrated differences between groups within countries (Henrich et al., 2010), and Schommer-Aikins and Easter (2008) found differences in personal epistemology between Euro-American and Asian-American university students attending the same class, with Euro-American students having stronger beliefs in knowledge

organised as complex networks than Asian-American students. Likewise, in a study of three subcultural groups of American middle and high school students, Kuhn and Park (2005) found substantial variation in epistemic beliefs across groups. Caucasian students exhibited evaluativist beliefs, that is, justification and debate of claims, more strongly than the two American-Asian subgroups. This finding suggests that it might be worthwhile to further explore whether justification beliefs vary across different subcultures. Following suggestions by Greene et al. (2008) and the findings of Bråten et al. (2013), as well as the work by Kuhn and Park (2005) and Schommer-Aikins and Easter (2008) regarding other epistemic beliefs, we set out to explore whether justification beliefs also vary between different cultural groups in the same educational environment. By selecting participants with different cultural backgrounds attending the same school classes and following the same curriculum, we assumed that the potential relationship between cultural values and the role of justification beliefs in learning and performance would not be confounded by differences in school or classroom learning environments.

The present study

Given that research on justification beliefs and learning and comprehension is scant, and that such research in a multicultural context is even more meagre, this study will be exploratory, with no specific hypotheses guiding the study. Our main goal is to investigate differences in justification beliefs between ethnic majority and ethnic minority groups in the same educational environment, and to study potential differences in relationships between justification beliefs and learning and comprehension when students read multiple, partly conflicting documents on a science topic. The ethnic minority group will include only immigrants or second-generation immigrants from countries outside Scandinavia, while the ethnic majority group includes only ethnic Norwegian students. Ethnicity could be described as membership in any group defined with racial, linguistic, national or religious criteria (Staerklé, Sidanius, Green, & Molina, 2010). In this study, we defined ethnicity according to parents' origin and first language (Verkuyten & Brug, 2003) (see *Participants* below).

The Norwegian context

Large-scale immigration to Norway started only three to four decades ago and the majority of the immigrant population is first-generation (born outside Norway). The proportion of second-generation immigrants (born in Norway with two foreign born parents) in high school is increasing, however. In 2010 the proportion of immigrants in high school was 10.2%, with approximately half of those being second-generation (Statistics Norway, 2011). Given the relatively new context of immigration in Norway, only first- and second-generation immigrants were included in this study.

In general, both first- and second-generation immigrant students have lower grades during the first year of high school, and they have a lower completion rate than ethnic Norwegian students. However, the completion rate has been stable for ethnic Norwegian students during the last 10 years, whereas the rate has increased for immigrant students (Bratsberg, Raaum, & Roed, 2011). While socio-economic status (SES) appears to impact the completion rate for ethnic Norwegian students, SES seems to be less important to immigrant students' completion of high school (Bratsberg et al., 2011; Støren & Helland, 2010).

Although first-generation immigrant students have slightly lower grades and completion rate than second-generation immigrants, both groups differ substantially

from ethnic Norwegian students regarding those measures (Støren & Helland, 2010). The same trend was found in the Norwegian results from the Organization for Economic Cooperation and Development's Programme for International Student Assessment, where first-generation immigrants scored slightly (but not statistically significantly) lower than second-generation immigrants on reading literacy, with both groups scoring significantly lower than ethnic Norwegians (Kjærnsli & Roe, 2010). Thus, it seems defensible to not differentiate between the two immigrant groups concerning academic performance when comparing them with ethnic Norwegian students. Still, immigrants from various cultures may differ in values and it might be questionable to collapse all immigrant students into one group. In this study, we still found it reasonable to do that because Norwegians seem to differ from immigrants regarding both cultural value orientations and attitudes towards science. Analyses of data from 73 different countries map Norway, together with other Scandinavian and Western European countries, onto a cultural profile emphasising intellectual autonomy, egalitarianism and harmony more than other regions (Schwartz, 2006). Those values may, of course, also influence immigrant students, but there are indications that intellectual values from the new country only partly transmit to those students (Kuhn & Park, 2005). Also, differences between ethnic minorities and majorities in national attitudes seem especially strong in egalitarian, welfare-state-based national contexts (Staerklé et al., 2010). Hence, Norwegian students are likely to hold values that are somewhat different from the majority of immigrant students.

Students' attitudes towards science, in particular, have received a lot of attention and concern during the last decades, and it has been suggested that cultural and material conditions in a country may affect those attitudes (Osborne, Simon, & Tytler, 2009). More specifically, Sjøberg and Schreiner (2005) showed that among 14–16-year-old students from 25 different countries, there was a strong correlation between participants' interest in learning about science topics and the country's level of development. While students from all countries expressed positive views on science and technology, Norwegian students were among the most negative when asked if they would like to work in those fields. This ambivalence, that is, positive attitudes towards science but negative attitudes towards working in that field, also seems to be reflected in the Norwegian adult population. In a recent European Commission (2010) report on adults' attitudes towards science and technology in 32 countries, Norwegians were among the most positive and the most eager users of new technology, also scoring high regarding trust in scientists and support for scientific research. Still, they had the lowest scores when asked about the importance of knowledge about science in their daily lives. Thus, in Norway, the ambivalence towards science that is expressed in many developed countries seems to be more pronounced than in most other European countries. That is, Norwegians express positive attitudes towards science and technology, but they do not want to study it. This also speaks for distinguishing ethnic Norwegian students from students with another cultural background when investigating relationships between justification beliefs and multiple-documents comprehension on a science topic.

On this theoretical and empirical backdrop, we set out to explore potential differences in ethnic majority and ethnic minority high school students' justification beliefs, and whether those beliefs might relate differentially to students' learning from and understanding of multiple conflicting documents on a complex science topic.

Method

Participants

Participants were 55 ethnic majority (age: $M = 16.4$, $SD = .49$) and 55 ethnic minority (age: $M = 16.7$, $SD = .75$) first-year high school students from a school district in south-east Norway. The two groups were selected from a total sample of 279 students from four different schools, with all ethnic majority students (EMAS) being native Norwegian speakers and the ethnic minority students coming from families where neither parent spoke Norwegian as their first language. The ethnic minority group (EMIS) included students with a background from Europe (11), Asia (31), Slavic-speaking communities (11), the Middle East (1) and Africa (1). The two groups came from the same school classes, and were matched for gender (male: 49.1%), word decoding skills and self-reported grades in natural science. That is, the two groups were equal regarding basic reading skills and self-reported competence in the domain. All participants were completing college preparatory courses. The sample was relatively homogeneous (i.e. middle class) with regard to SES.

Materials

Documents

Participants read five documents presenting different views on sun exposure and health. The first was a 382-word excerpt from an upper-secondary science textbook written by a science teacher. It described ultraviolet radiation in neutral, academic terms, concluding that more research is needed to clarify the health implications of such radiation. The second document was a 398-word popular science article from a university research magazine that was authored by a journalist, citing scientists who advocated more sun exposure because it is an essential source of vitamin D and presenting evidence that exposure to ultraviolet radiation may protect against cancer, particularly in internal organs. The third document, also written by a journalist, was a 393-word popular science article from an online research magazine published by a group of educational institutions. This document presented an interview with a professor who explained and provided evidence for a causal relation between ultraviolet radiation and skin cancer, claiming that tanning is a dangerous way to obtain vitamin D and therefore suggesting cod liver oil or supplements for those who lack vitamin D. The fourth document was a 323-word journalist-authored article from a newspaper referring to a study indicating that sunrays may protect against all types of cancer through the production of vitamin D, and recommending at least 30 min of daily sun exposure. Finally, the fifth document was a 375-word public information text published by the National Cancer Association, describing different types of skin cancer that may be caused by ultraviolet radiation and suggesting ways of reducing the risk. Apart from the textbook excerpt, the four other documents contained partly conflicting information, with two arguing that ultraviolet radiation may cause skin cancer and two arguing that ultraviolet radiation may protect against cancer through the production of vitamin D.

We used Björnsson's (1968) formula to compute readability scores for each of the documents. This formula is based on word length and sentence length, and yields scores ranging from about 20 (very easy text) to about 60 (very difficult text). Vinje (1982) reported that textbooks used in Norwegian high schools had a readability score of 42 and that public information texts from the Norwegian government

had a readability score of 45. The readability scores of the five documents ranged from 37 to 46 ($M=41.6$, $SD=3.9$), suggesting that they represented a sufficient challenge for the participants. At the beginning of each document, source information was presented in the form of author's name and credentials, publisher, document type and date of publication.

We selected these documents because the participants were likely to have some, but not extensive, prior knowledge of the topic, and because they dealt with an issue regularly discussed in different types of media. Moreover, the discussion of this issue was likely to elicit engagement as sunbathing is quite popular among adolescents in Norway.

Topic knowledge measure

A 20-item multiple-choice test was used to assess knowledge about the topic of the documents before and after reading. The items referred to concepts and information central to the issue of sun exposure and health that were discussed in the five documents. In designing the measure, the first and the second author independently selected key concepts and information from the documents and together wrote items to cover the concepts and information agreed upon by both test constructors (e.g. ultraviolet radiation, vitamin D, skin cancer and sun protection). Taken together, the 20 items assessed both conceptual understanding and factual knowledge. A preliminary version of the measure was reviewed by a professor of medical biochemistry who was not part of the project, resulting in only minor modifications to the response alternatives of a few items. Participants' topic knowledge scores were the number of correct responses out of the 20 items. The reliabilities (Cronbach's α) for scores on the measure were .65 at pre-test and .73 at post-test.

Justification beliefs measure

To assess students' beliefs about justification for knowing, we used the 18-item Justification for Knowing Questionnaire (JFK-Q) (Ferguson et al., 2013), where all items pertain to the domain of natural science. The JFK-Q is based on Greene et al.'s (2008) multidimensional conceptualisation of justification for knowing and the think-aloud study of Ferguson et al. (2012). A three-factor solution was identified through both exploratory and confirmatory factor analyses with a sample of lower secondary school students by Ferguson et al. (2013), with this solution including beliefs concerning justification by authority, personal justification and justification by multiple sources. Because the participants in this study were older than in the Ferguson et al. (2013) study, we also examined the underlying structure of students' scores on the JFK-Q by conducting exploratory as well as confirmatory factor analysis in the total sample of 279 upper secondary students.

Using principal component analysis with oblique rotation to force a three-factor solution on the 18 items, we first identified three factors with eigenvalues from 1.7 to 3.4 that explained 45.4% of the total sample variation. After removing one overlapping item and one item that neither fitted theoretically into the solution nor loaded very high (.38), 16 items were included in this three-factor solution. To further examine how well the solution represented students' beliefs concerning justification for knowing, we conducted a confirmatory factor analysis with Mplus (Muthén & Muthén, 2010). This analysis confirmed our hypothesised three-factor

model, with fit indices indicating a reasonably good fit between the model and the data: $\chi^2(74) = 229.93$, $p < .001$, standardised root mean square residual = .074 and root mean square error of approximation = .068.

In accordance with Ferguson et al. (2013), the three factors were labelled Justification by Authority, Justification by Multiple Sources and Personal Justification. Justification by Authority consisted of six items dealing with beliefs concerning the reliability of statements or claims based on scientific research and conveyed by teachers, textbooks or scientists (sample items: Things that are written in natural science textbooks are correct; If a scientist says that something is a fact, then I believe it). The higher the scores on this factor, the more students can be assumed to believe that knowledge claims can be justified by appealing to an authoritative external source or evidence derived from scientific research. The five items assigned to Justification by Multiple Sources concerned the cross-checking and corroboration of claims across several sources of information (sample items: To be able to trust knowledge claims in natural science texts, I have to check various knowledge sources; Just one source is never enough to decide what is right in natural science). Higher scores on this factor can be assumed to represent stronger beliefs in the importance or necessity of justifying knowledge claims in natural science by checking multiple external sources for consistency. Finally, the five items assigned to Personal Justification dealt with personal views and opinions as a basis for judging what to trust in natural science (sample items: What is a fact in natural science depends on one's personal view; Everyone can have different opinions about natural science, because no completely correct answers exist). The higher the scores on this factor, the more students can be assumed to believe that knowledge claims can be justified by appealing to subjective, internal means of justification.

The participants rated each item on a 10-point anchored scale (1 = *disagree completely*, 10 = *agree completely*). The reliability estimates (Cronbach's α) in the sample of 110 students were .83 for the scores on the justification by authority measure, .80 for scores on justification by multiple sources and .65 for scores on personal justification.

Multiple-documents comprehension measure

Multiple-documents comprehension was assessed by three short-essay questions modelled on the integrative short-essay questions used by Rukavina and Daneman (1996) to assess understanding of a controversial scientific issue. The first question indirectly required participants to integrate perspectives across documents or, at least, to consider each perspective's claim and reasons. The second and third directly required participants to pit perspectives against each other, measuring how well they could reason about the issue in terms of the claims and reasons presented in the documents.

The first question was 'Explain the relationship between sun exposure, health, and illness'. Responses were coded according to how well participants explained the issue and integrated the different perspectives discussed in the documents, with scores ranging from 0 (no response or irrelevant information) to 6 (mentioning the two perspectives [sun exposure is harmful and sun exposure is healthy] and providing elaborate explanation or reason for one or both as well as relating the two perspectives to each other by comparing and/or contrasting them and trying to reconcile them by demonstrating that they might not be mutually exclusive). A random selection of 20% of

participant responses was independently scored by the second and third author, resulting in 84% agreement and with all disagreements solved through discussion. The remaining responses were scored by these two authors separately.

The second question was 'There are different views on the relationship between sun exposure, health, and illness. Describe important differences between these views'. The coding scheme yielded scores from 0 (mentioning no perspective, only one perspective or providing irrelevant information) to 4 (mentioning the two perspectives and providing explanation or reason for both). Independent scoring of a random selection of 20% of the responses by the first and second author resulted in 80% agreement. Disagreements were solved through discussion and remaining responses were scored by the authors separately.

The third question was 'Could more than one view on the relationship between sun exposure, health, and illness be correct? Yes or no? If no, why not? If yes, why?' First, we recorded whether participants recognised that the two perspectives were not mutually exclusive or might be reconciled (i.e. whether they answered 'yes' or 'no'). Second, we assessed to what extent they could explain and reconcile the perspectives (i.e. when they answered 'yes') and to what extent they could select one of the perspectives and provide explanation or reason for that (i.e. when they answered 'no'). Scores ranged from 0 (only answering 'no' to the first question) to 5 (answering 'yes' to the first question and mentioning the two perspectives and providing elaborate explanation or reason for one or both as well as relating the two perspectives to each other by explaining how they may be reconciled). The first and second author independently scored a random selection of 20% of participant responses, reaching an agreement of 90% and solving all disagreements through discussion. The remaining responses were scored by the authors separately.

The possible range of scores was thus 0–6 on the first question, 0–4 on the second question, 0–5 on the third question and 0–15 on the entire measure. Only participants' total scores on the entire measure were used in subsequent statistical analyses.

Procedure

Data were collected in two sessions in participants' ordinary classrooms. In the first session, participants received folders with questionnaires on demographics, topic knowledge and justification beliefs in that order. These measures were paper and pencil measures containing a short-written instruction that they were told to read carefully before responding. Two weeks later, participants read the documents about sun exposure and health on paper and answered the short-essay questions in writing during a 60 min session that also took place in their classrooms. Before starting on the documents, they read the following instruction: 'You shall now read five different texts on sun exposure and health. While reading, imagine that you are going to hold a presentation for the rest of the class about how sun exposure affects our health'. The general instruction for the short-essay questions was: 'Here are some questions concerning what you have just read. Answer the questions as fully as possible. Use the time you need for reflection when answering'. Participants were not given access to the documents while working on the short-essay questions because we wanted them to respond on the basis of the mental representations they constructed during reading rather than on the basis of searching for, locating and copying information at the time of task performance.

Results

Descriptive data for all measured variables are displayed in Table 1. Independent samples *t*-tests showed that ethnic majority students (EMAS) had statistically significantly higher topic knowledge than ethnic minority students (EMIS) both before ($M = 13.35$, $SD = 2.86$ vs. $M = 11.31$, $SD = 3.30$, $t(108) = 3.46$, $p < .001$, Cohen's $d = .66$) and after ($M = 16.41$, $SD = 2.09$ vs. $M = 14.62$, $SD = 3.15$, $t(105) = 3.46$, $p < .001$, Cohen's $d = .68$) reading the documents. There was, however, no statistically significant difference in knowledge gain between EMAS ($M = 3.07$, $SD = 2.07$) and EMIS ($M = 3.43$, $SD = 2.76$). Nor were there any statistically significant differences between EMAS and EMIS on the justification beliefs measures, although EMAS tended to score higher on justification by authority than EMIS ($M = 7.50$, $SD = 1.77$ vs. $M = 6.89$, $SD = 1.88$, $t(107) = 1.74$, $p = .08$, Cohen's $d = .33$). Finally, EMAS scored statistically significantly higher than EMIS on the comprehension measure ($M = 7.91$, $SD = 2.58$ vs. $M = 6.13$, $SD = 2.96$, $t(108) = 3.36$, $p < .001$, Cohen's $d = .64$).

Table 1 also presents correlations between the measured variables for both groups. Pre-reading topic knowledge correlated positively with only post-reading topic knowledge for EMAS ($r = .70$, $p = .000$), while pre-reading topic knowledge correlated positively with justification by authority ($r = .38$, $p = .005$) and post-reading topic knowledge ($r = .63$, $p = .000$) and negatively with personal justification ($r = -.40$, $p = .003$) for EMIS. Thus, prior knowledge was positively related to reliance on academic expertise and negatively related to confidence in personal views for EMIS only. Further, justification by authority correlated negatively with personal justification for EMAS ($r = -.29$, $p = .034$), while it correlated positively with post-reading topic knowledge ($r = .41$, $p = .003$) and multiple-documents comprehension ($r = .31$, $p = .023$) for EMIS. The more ethnic majority students relied on academic authority, the less they believed that knowledge claims can be justified by personal opinion. For the ethnic-minority students, beliefs in justifying knowledge claims by academic expertise were positively related to both post-reading knowledge and comprehension. There were no other statistically significant correlations for EMAS, while there was a positive correlation between justification by multiple sources and personal justification ($r = .30$, $p = .026$) for EMIS, as well as a negative correlation between personal justification and multiple-documents comprehension ($r = -.38$, $p = .004$). The more ethnic minority students relied on personal opinion in justifying knowledge claims, the more they also preferred to check multiple external sources for consistency regarding the claims in question. However, for those students, increasing reliance on personal views in underpinning claims was related to lower multiple-documents comprehension. Finally, the correlation between post-reading topic knowledge and multiple-documents comprehension was $.53$ ($p = .000$) for EMIS and non-significant for EMAS, indicating that separate constructs were captured by the two measures.

To further investigate relationships between EMAS and EMIS's justification beliefs and their learning from and understanding of multiple conflicting documents, we ran two simultaneous multiple regression analyses with post-reading topic knowledge and multiple-documents comprehension, respectively, as dependent measures. In both analyses, we included cross-product multiplicative terms between ethnic group and each of the justification variables to investigate the interaction of ethnic group and justification beliefs. Interaction terms were created and regression analyses

Table 1. Descriptive statistics and zero-order correlations for measured variables for ethnic majority students (below the diagonal) and ethnic minority students (above the diagonal).

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | M | SD | Skewness |
|--------------------------------------|--------|-------|------|--------|--------|--------|-------|------|----------|
| 1. Topic knowledge – pre | – | | | | | | 11.31 | 3.30 | –.07 |
| 2. Justification by authority | .03 | .38** | –.12 | –.40** | .63*** | .26 | 6.89 | 1.88 | –.40 |
| 3. Justification by multiple sources | –.13 | –.01 | .08 | .00 | .41** | .31* | 6.13 | 1.84 | .10 |
| 4. Personal justification | –.18 | –.29* | – | .30* | .01 | .07* | 3.87 | 1.66 | .62 |
| 5. Topic knowledge – post | .70*** | –.05 | –.14 | .22 | –.23 | –.38** | 14.62 | 3.15 | –.89 |
| 6. Multiple-documents comprehension | –.03 | –.07 | .24 | .04 | .09 | .53*** | 6.13 | 2.96 | –.01 |
| M | 13.35 | 7.50 | 6.63 | 3.50 | 16.41 | 7.91 | – | – | – |
| SD | 2.86 | 1.77 | 1.89 | 1.43 | 2.09 | 2.58 | – | – | – |
| Skewness | –.56 | –.61 | –.06 | .30 | –1.05 | .15 | – | – | – |

* $p < .05$; ** $p < .01$; *** $p < .001$.

performed after centring the three justification variables while the pre-reading topic knowledge measure, also included as a predictor, and the dependent measures were left in their original metrics (Aiken & West, 1991). Thus, we regressed scores on each of the outcome measures on ethnic group, pre-reading topic knowledge, justification by authority, justification by multiple sources, personal justification, and interaction terms between ethnic group and each of the justification variables. By controlling for pre-reading topic knowledge in the analysis with post-reading topic knowledge as the dependent measure, results indicated the contributions of other predictors to change in topic knowledge from before to after reading, that is, to learning from the texts.

Table 2 shows that when post-reading topic knowledge was entered as the dependent variable, the eight predictors together explained a statistically significant amount of the variance, $R^2 = .52$, $F(8, 97) = 12.92$, $p < .001$. Pre-reading topic knowledge was the single best predictor ($\beta = .59$, $p < .001$). In addition, the interaction between ethnic group and justification by authority was a statistically significant predictor ($\beta = .49$, $p < .05$). This interaction is graphed in Figure 1. It indicates that the more EMIS relied on authority as a source of justification in science, the higher their post-reading topic knowledge, that is, the more they learned from reading the documents, whereas justification by authority was not related to post-reading topic knowledge for EMAS.

With multiple-documents comprehension as the dependent variable, the eight predictors again explained a statistically significant amount of the variance, $R^2 = .26$, $F(8, 100) = 4.30$, $p < .001$. Table 2 shows that ethnic group was a statistically significant predictor ($\beta = -.23$, $p < .05$), indicating that EMAS outperformed EMIS. In addition, the interaction between ethnic group and justification by authority ($\beta = .59$, $p = .05$), and between ethnic group and personal justification ($\beta = -.61$, $p = .05$) were statistically significant predictors. As illustrated in Figure 2, the more EMIS relied on authority as a source of justification, the better their multiple-documents comprehension, and the more they relied on personal means of justification, the poorer their multiple-documents comprehension. In contrast, these justification beliefs were not related to multiple-documents comprehension for EMAS.

Table 2. Results of simultaneous multiple regression analyses for variables predicting post-reading topic knowledge and multiple-documents comprehension.

| Predictor | Post-reading topic knowledge | | | Multiple-documents comprehension | | |
|---|------------------------------|-----------------------|---------|----------------------------------|-----------------------|---------|
| | <i>B</i> | <i>SE</i> <i>B</i> | β | <i>B</i> | <i>SE</i> <i>B</i> | β |
| Ethnic group | -.62 | .43 | -.11 | -1.36 | .54 | -.23* |
| Topic knowledge – pre | .51 | .07 | .59*** | -.01 | .09 | -.01 |
| Justification by authority | -.60 | .37 | -.39 | -.69 | .47 | -.44 |
| Justification by multiple sources | -.12 | .35 | -.08 | .42 | .45 | .27 |
| Personal justification | -.25 | .46 | -.14 | .61 | .59 | .33 |
| Justification by authority \times ethnic group | .47 | .23 | .49* | .58 | .29 | .59* |
| Justification by multiple sources \times ethnic group | .11 | .22 | .12 | -.07 | .28 | -.07 |
| Personal justification \times ethnic group | .09 | .28 | .08 | -.69 | .36 | -.61* |

Notes: For post-reading topic knowledge, $R^2 = .52$, ($p < .001$); for multiple-documents comprehension, $R^2 = .26$, ($p = .001$).

* $p < .05$; *** $p < .001$.

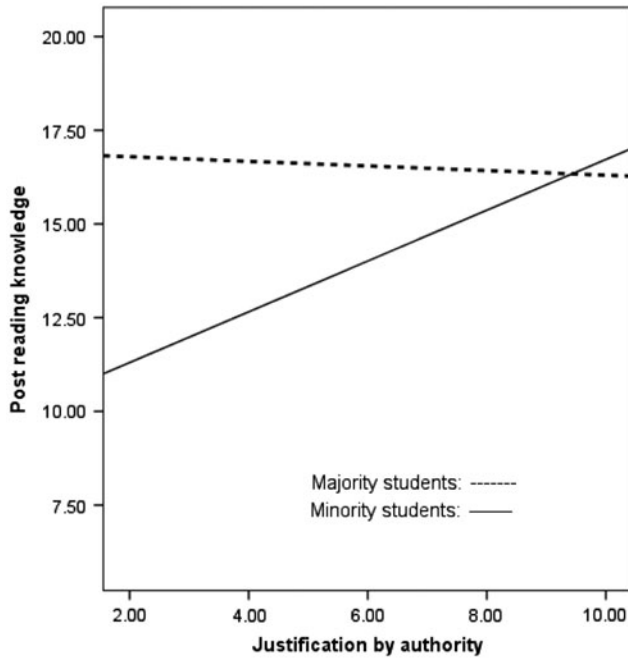


Figure 1. Interaction between ethnic group and justification by authority for post-reading topic knowledge.

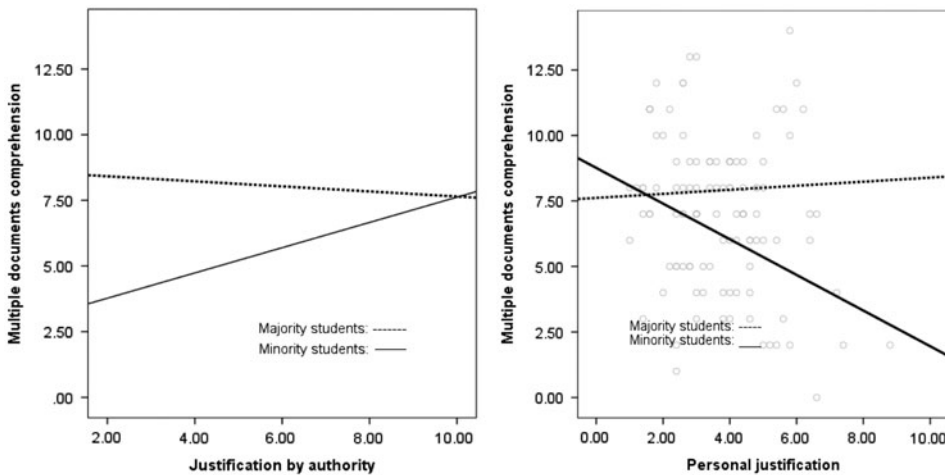


Figure 2. Interaction between ethnic group and justification by authority, and between ethnic group and personal justification, for multiple-documents comprehension.

Discussion

This study contributes uniquely to research on epistemic beliefs and multiple-documents reading by demonstrating that dimensions of justification beliefs may interact

with students' cultural background in predicting how well they learn from and understand a complex set of documents on a scientific topic.

There were no statistically significant differences between the ethnic majority and the ethnic minority students on the three types of justification beliefs. A small to medium difference on the justification by authority measure suggested, however, that to some extent, the ethnic majority students relied more on scientific authority in justifying knowledge claims than did the ethnic minority students. This may reflect the high-trust Norwegians seem to have in science and scientists, as reported by the European Commission (2010). Prior studies have suggested that non-Western students may respect authority more than Western students (Chan, 2008; Hofer, 2008; Karabenick & Moosa, 2005), which might be seen as opposing our finding. However, of note is that beliefs in authority, as measured in prior studies, tend to capture more general beliefs in whether knowledge is self- or other-generated, whereas justification by authority in this study measures the extent to which students rely on authorities in justifying knowledge claims in science. Norwegian students' positive views towards science and technology (Sjøberg & Schreiner, 2005) may explain their tendency to score higher on the justification by authority measure than ethnic minority students.

Moreover, none of the justification beliefs uniquely predicted learning or multiple-documents comprehension. Still, interactions between ethnic group and two of the justification beliefs predicted scores on the dependent measures. Thus, an interaction between ethnic group and justification by authority predicted both learning and multiple-documents comprehension. For ethnic minority students, there were positive relations between justification by authority and both dependent measures, while no such relations were found for the ethnic majority group. Although prior studies of differences between cultural groups regarding beliefs in authority (Chan, 2008; Hofer, 2008; Karabenick & Moosa, 2005) are not supported by our findings, authority beliefs seemed to contribute differently to learning and comprehension in the two groups. For ethnic minority students, believing that knowledge claims can be justified by appealing to an authoritative external source seemed to facilitate learning and comprehension, while such beliefs were not associated with ethnic majority students' learning and comprehension. This result might also be explained by prior studies indicating that Norwegians have very positive attitudes towards science and very high trust in scientists, yet are reluctant to work in that field and do not believe science is important in their daily life (European Commission, 2010; Sjøberg & Schreiner, 2005). Those attitudes might imply that strong beliefs in justification by authority do not necessarily mean that they work harder to understand messages communicated by science teachers or scientists. In contrast, ethnic minority students scoring higher on justification by authority may find it more worthwhile to work harder to learn from and comprehend the documents when authorities in the domain are referred to. The main common characteristic of the ethnic minority students was their non-Norwegian cultural background. Otherwise, they represented several cultures, in particular Asian cultures, with earlier studies showing that students in those countries express more interest in learning about science and technology than Norwegian students (Sjøberg & Schreiner, 2005). Our results regarding justification by authority thus suggest that such beliefs may be related to learning and comprehension to the extent that student values are in accordance with the specific academic domain.

Results also showed an interaction between ethnic group and personal justification on multiple-documents comprehension, with a negative relation between personal justification and comprehension observed for ethnic minority students and no relation observed for ethnic majority students. Two prior studies also found a negative relationship between beliefs in self as a source of knowledge (i.e. personal justification) and multiple-documents comprehension (Bråten, Strømsø, & Samuelstuen, 2008; Strømsø, Bråten, & Samuelstuen, 2008). However, the single justification dimension that was used in those studies implied that students had to choose between emphasising personal judgement or external authority. In this study, a lack of correlation between justification by authority and personal justification among ethnic minority students implies that those concepts are not necessarily related. This seems to support Greene et al.'s (2008) assumption about the multidimensional nature of justification beliefs, also suggesting that the present results are not entirely comparable with results from our prior studies. Still, those studies suggest that high scores on personal justification may, indeed, be negatively related to multiple-documents comprehension, as also demonstrated in the present study among ethnic minority students and in another recent study in lower secondary school (Bråten et al., 2013). Possibly, the lack of such a relationship among the ethnic majority students may be due to their attaching less value to the comprehension of documents on a scientific topic. Thus, justification beliefs may simply not come into play because the Norwegian students do not consider it sufficiently important to learn about the topic, as suggested by the study of Sjøberg and Schreiner (2005) on youths' interest in science topics. Whether differences in values and interests between cultural groups matter for the role of justification beliefs in multiple-documents comprehension may be a relevant question for future studies.

Justification by multiple sources was not a significant predictor for either of the groups, in contrast to Bråten et al.'s (2013) study in lower secondary school, where that dimension predicted multiple-documents comprehension positively. When exposed to a set of conflicting documents, readers will need to compare and contrast content across documents to construct an integrated understanding (Wineburg, 1991). This is a demanding task not necessarily emphasised in upper secondary school (Stahl et al., 1996). In line with Bråten et al. (2013), our results showed a positive, albeit weak, correlation between justification by multiple sources and multiple-documents comprehension among the ethnic majority students. This tendency did not occur among the ethnic minority students, however, indicating that justification by multiple sources did not contribute to those students' processing of the documents.

In conclusion, our findings indicate that the role of epistemic beliefs may vary with linguistic and cultural background. Prior studies in the Norwegian context have showed that language-minority groups score lower on reading comprehension than language-majority students despite equal decoding skills (Lervåg & Aukrust, 2010). Reading multiple conflicting documents may represent more of a challenge to the ethnic minority students, increasing the pertinence of justification beliefs in students' processing of the documents (Nespor, 1987). Another possibility might be that the two groups differ in the values they attach to dealing with documents on science topics (Sjøberg & Schreiner, 2005), or more generally to contradictory propositions (Nisbett et al., 2001). With this study aiming to explore possible differences among different ethnic groups in the same educational environment, we acknowledge that the explanations that we suggest are somewhat speculative, however.

Limitations

Our study comes with several limitations. The heterogeneity of the ethnic minority group warrants caution in interpreting the results, and future studies should collect data from groups representing more homogenous cultural values and experiences. Previous studies indicate that minority students differ from ethnic Norwegians regarding cultural value orientations (Schwartz, 2006; Staerklé et al., 2010) and attitudes towards science (European Commission, 2010; Sjøberg & Schreiner, 2005). However, measures that could confirm such differences were not included. Neither was the minority group sufficiently homogenous to assume that members shared values and attitudes. Thus, results inform more on how ethnic Norwegian students differ from other groups than on differences between specific ethnic groups. Given the lack of studies on the role of epistemic beliefs in different ethnic student groups' reading of complex and contradictory texts in science, we still believe our results are a fruitful point of departure for further work.

Preferably, future studies should also control for potential differences between ethnic groups in regard to reading comprehension in addition to word decoding, gender and grades, which we used as matching variables. Of note is that the topic knowledge measure did not require students to explicitly express their understanding of the topic, whereas the short-essay questions did. On those questions, students needed to compare and integrate information and stances across documents and respond in writing. While pre-reading topic knowledge was a predictor of post-reading topic knowledge, linguistic and cultural background was a predictor of multiple-documents comprehension. On the more demanding task of expressing understanding of multiple documents, ethnic minority students seemed to struggle more. Although groups were matched on word decoding, the ethnic minority students may still have experienced more problems expressing themselves in writing or struggled more to comprehend document content. Prior studies indicate that second-language learners may display equal decoding skills to first-language learners but still score lower on reading comprehension (e.g. Lervåg & Aukrust, 2010) and struggle more with writing (Fitzgerald, 2006). Therefore, minority students' lower scores on multiple-documents comprehension might, at least in part, be due to comprehension difficulties or lack of writing skills.

Finally, it is a limitation that our data do not directly inform on how justification beliefs may affect ethnic minority students' learning and comprehension. Verbal protocols from online processing may provide such data. Also, because our measures were mainly author developed, their generalisability to other studies is an issue. However, as we already have used the same measures successfully in another study with lower secondary students (Bråten et al., 2013), we optimistically believe that they will prove valid and reliable in future work.

Despite the limitations, our findings may have educational implications. Prior work has shown that epistemic beliefs may play a role in the comprehension of multiple documents (Bråten et al., 2011), and this study indicates that this role may vary across cultural groups. By discussing possible epistemic assumptions connected to academic topics and tasks, teachers may be able to mobilise and modify students' justification beliefs, and thus attune such beliefs to facilitate, rather than hinder, comprehension. This may be of specific importance in the case of contradictory propositions, such as those frequently encountered in the media, where students'

beliefs about how knowledge claims can be justified may be of importance in taking a stance, making decisions and understanding complex topics.

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