

Epistemic justification in multiple document literacy: A refutation text intervention

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ABSTRACT

This study investigated the effects of a refutation text intervention on Norwegian teacher education students' ($n = 150$) beliefs about justification for knowing and their subsequent performance on a multiple document literacy task. Participants were randomly assigned to one of three conditions in which they read a refutation text that promoted the conception that an appropriate way to judge the trustworthiness of information about educational topics is to rely on personal understanding and practical experience, the expertise of the author, or comparison of multiple sources. Results showed that participants' beliefs about epistemic justification were strongly influenced by the intervention. Beyond effects on self-reported justification beliefs, effects on participants' selection of documents varying in terms of the expertise of the author and the stance toward the issue discussed across the documents were observed, as well as effects on how participants justified their document selections, processed the selected documents, and finally used them in their written task products. As such, the effects of the intervention targeting beliefs about epistemic justification transferred to various stages of the multiple document task.

Epistemic justification concerns people's beliefs and thinking about the justification of knowledge claims (Greene et al., 2008). Such beliefs and thinking have been linked to students' academic achievement (Cartiff et al., 2021; Greene et al., 2018), including their performance on multiple document literacy tasks, which involve the selection, evaluation, processing, and use of multiple documents to construct and communicate a coherent understanding of a topic, issue, or phenomenon (Bråten et al., 2018; Bråten & Strømsø, 2010). Few researchers have tried to influence students' epistemic justifications experimentally, however, and no prior study has investigated the effects of an experimental intervention targeting epistemic justification on a broad array of multiple document literacy tasks (Cartiff et al., 2021). The main aim of the current study was to fill this gap in the literature by designing an intervention to influence teacher students' reliance on personal justification, justification by authority, and justification by multiple sources, respectively, and examining the effects of this intervention on their beliefs about the justification of knowledge claims, as well as on their selection of documents, justifications for document selections, processing of selected documents, and use of selected documents when performing an authentic multiple document task on a controversial educational issue. In this way, our study has the potential to provide new

insights into the theoretical and empirical intersection of the burgeoning areas of epistemic cognition and multiple document literacy (Braasch et al., 2018; Greene et al., 2016). Further, it may provide educators with new knowledge about how students' beliefs about justification of knowledge claims can be changed and the consequences of such changes for performing multiple document literacy tasks. In the following background analysis, we describe the theoretical grounding of our study and relevant empirical work. Because our intervention study utilized a refutation text approach (Hynd, 2001) to change students' epistemic justification, we also briefly discuss this approach before stating our research questions and hypotheses.

1. Epistemic justification in multiple document literacy: theoretical perspectives

In the last decades, scholars in learning and literacy have highlighted the need to justify knowledge claims, especially in the information wilderness of the Internet where inaccurate and untruthful information may be spread both intentionally and unintentionally (Chinn et al., 2020; Greene & Yu, 2016; Sinatra & Lombardi, 2020). Theoretically, justification of knowledge claims belongs to the realm of epistemic

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cognition, an area of research in which understanding and promoting people's beliefs and thinking about what knowledge is like and how one comes to know are essential scientific aims (Sandoval et al., 2016). Within epistemic cognition, several dimensions of epistemic beliefs, such as beliefs regarding the certainty and simplicity of knowledge, have been studied in relation to literacy tasks, including the comprehension of both single and multiple documents (Bråten et al., 2016). However, with respect to beliefs about justification for knowing, in particular, this aspect of epistemic cognition has mainly been linked to multiple document comprehension. Presumably, this is because the need to critically evaluate and justify knowledge claims becomes more salient in the context of encountering different, often conflicting perspectives on the same issue presented in different documents (Chinn et al., 2020).

Originally, beliefs concerning justification for knowing were assumed to fall on a single dimension. Thus, in the influential theoretical framework proposed by Hofer and Pintrich (1997), such beliefs were considered to fall on a continuum ranging from beliefs in justification through observation and authority, or on the basis of what just feels right, to the use of rules of inquiry and the evaluation and integration of multiple information sources. In their integrated model of epistemic beliefs and the comprehension of multiple documents, Bråten et al. (2011), who built on Hofer and Pintrich's (1997) conceptualization of justification beliefs, theorized that adaptive beliefs in the context of multiple document comprehension would involve beliefs in the need to justify knowledge claims through reason, rules of inquiry, and the integration of multiple sources. On the other hand, maladaptive beliefs about justification for knowing would involve beliefs in justification through own opinion, firsthand experience, and common sense. More specifically, Bråten and colleagues (2011) proposed that adaptive beliefs on the justification dimension would help readers of multiple documents bridge different perspectives and evaluate sources through the process of corroboration, that is, through comparing perspectives presented in different sources and considering consistencies and discrepancies among them (Wineburg, 1991). Maladaptive justification beliefs were, in contrast, assumed to hinder corroboration in the service of content integration and source evaluation (Bråten et al., 2011).

In an important contribution, Greene et al. (2008) challenged a unidimensional conceptualization of beliefs about justification for knowing and proposed that, in accordance with philosophical epistemology, people may hold many different types of beliefs about how knowledge claims can be justified (see also, Chinn et al., 2011). In particular, Greene et al. (2008) distinguished between reliance on self and reliance on external authority, and they argued that these two types of justification beliefs should be conceived of as falling on two separate dimensions rather than on one single dimension (as proposed by Hofer and Pintrich). In this study, we built on the trichotomous justification beliefs framework proposed by Ferguson and colleagues (2012, 2013), which, following Greene et al. (2008), included separate dimensions of beliefs about personal justification and justification by authority. However, based on both verbal protocol data (Ferguson et al., 2012) and questionnaire data (Ferguson et al., 2013), Ferguson et al. (2013) added a third dimension in their framework that they termed justification by multiple sources. In essence, this third dimension captures the degree to which learners believe in justification through cross-checking, comparing, and corroborating across several information sources, that is, through a form of "lateral reading" (Wineburg & McGrew, 2019).

More recently, the role of presumably more adaptive beliefs about justification for knowing, in particular, beliefs "about appropriate sources of knowledge and methods for justifying knowledge claims," were highlighted in the comprehensive framework of multiple document literacy proposed by List and Alexander (2019, p. 25). In this framework, such beliefs are assumed to influence the particular stance to task completion that readers adopt when assigned a complex multiple document literacy task, with adaptive justification beliefs, for example, beliefs in the need to take the competence and expertise of the source into consideration (i.e., justification by authority) and beliefs in the need

to cross-check multiple sources for consistency (i.e., justification by multiple sources), increasing the likelihood that readers will adopt a critical analytic stance. Importantly, the stance to task completion that readers adopt at the outset is assumed to guide their selection of documents, their processing of documents, and their use of documents in their task products in later stages of multiple document literacy tasks (List & Alexander, 2019). In this way, the beliefs that readers hold about justification for knowing may be assumed to have a widespread effect when working with multiple documents.

As noted above, the need to justify knowledge claims may be particularly salient in the context of reading and learning within Internet technologies. This is because the Internet can be considered a knowledge resource that has its own peculiar ways of presenting knowledge claims and its own peculiar ways of knowing (Cheng et al., 2021). Accordingly, the notion of Internet-specific epistemic beliefs was introduced by Bråten et al. (2005), who argued that epistemic beliefs, including beliefs about justification for knowing, need to be addressed with explicit reference to the Internet as a knowledge resource. Of note is that these authors continued to conceive of Internet-specific justification beliefs as falling on a single dimension, ranging from the belief that knowledge claims on the Internet can be accepted without critical evaluation to the belief that such claims need to be checked against prior knowledge, reason, and other sources. However, more recently, Bråten, Brandmo, and Kammerer (2019) adapted the notion of Internet-specific epistemic beliefs about justification for knowing to the trichotomous justification beliefs framework proposed by Ferguson and colleagues (2012, 2013), including beliefs about personal justification, beliefs about justification by authority, and beliefs about justification by multiple sources on three separate dimensions in their conceptualization of epistemic justification when reading and learning on the Internet. This three-dimensional structure of students' beliefs about Internet-specific epistemic justification has been confirmed in several studies across different student populations and cultures (Bråten, Brandmo, & Kammerer, 2019; Cheng et al., 2021; Hämäläinen et al., 2021). Because the participants in the current study worked with multiple document literacy tasks in a digital environment, we addressed their beliefs about justification for knowing at an Internet-specific level, also targeting their justification beliefs in relation to the particular content domain discussed in the documents.

2. Epistemic justification in multiple document literacy: empirical work

The first empirical support for a relationship between beliefs about epistemic justification and multiple document comprehension was presented by Strømso and Bråten (2009) and by Bråten and Strømso (2010), who reported that the more students believed that knowledge claims about the topic of climate change need to be justified through rules of inquiry and cross-checking of information sources, the better their within- and cross-document integration of content about this topic on post-reading tests of comprehension performance. While these early findings were based on a unidimensional conceptualization of justification beliefs, research within the trichotomous justification beliefs framework has indicated that beliefs in personal justification in the domain of science are a negative whereas beliefs in justification by multiple sources are a positive predictor of integrated understanding when students read multiple documents that discuss a scientific topic from different perspectives (e.g., Bråten et al., 2013; Ferguson & Bråten, 2013). With respect to justification by multiple sources, Bråten et al. (2014) found that higher scores on this belief dimension indirectly predicted multiple document comprehension via increased behavioral engagement and more use of deeper-level processing strategies when a host of other cognitive, motivational, and personality factors were controlled for. Although findings regarding the predictability of beliefs in justification by authority in multiple document contexts have been less consistent, there is some evidence to suggest that relying on expert authors is an adaptive form of epistemic justification when working with

multiple documents, especially when documents discuss complex, relatively unfamiliar issues from different perspectives (Bråten et al., 2008, 2018; Stadler & Bromme, 2014).

Prior empirical work on Internet-specific epistemic beliefs, in particular, has indicated that the more students believe that knowledge claims encountered on the Internet need to be checked against prior knowledge, reason, and other sources, the more they use self-regulated strategies (Chiu et al., 2013), critically evaluate websites (Knight et al., 2017), and construct a balanced representation from conflicting perspectives presented across different websites (Kammerer et al., 2013). Examining the predictability of different dimensions of Internet-specific justification beliefs, Kammerer and colleagues (2015) also found that beliefs in personal justification positively predicted time spent on less reliable, commercial websites when searching the Internet for health information, whereas beliefs in justification by multiple sources positively predicted time spent on reliable websites. Internet-specific beliefs about justification by authority were not targeted by Kammerer et al. (2015), however.

More recent research on Internet-specific beliefs about justification for knowing has used the Internet-Specific Epistemic Justification Inventory (ISEJ; Bråten, Brandmo, & Kammerer, 2019), measuring all three dimensions in the trichotomous framework in the context of reading and learning on the Internet. For example, Hämäläinen et al. (2021) found that when high-school students evaluated the credibility of multiple online texts on a health-related topic, their evaluation performance was positively predicted by their beliefs in justification by authority and beliefs in justification by multiple sources, but not by their beliefs in personal justification. Positive effects of both justification by authority and justification by multiple sources in the context of an online inquiry task were also reported by Kammerer et al. (2021). These authors, who had university students perform a Web search on an unfamiliar and controversial socio-scientific issue in order to communicate and justify their position on that issue, found that beliefs in justification by authority positively predicted students' source evaluation and consideration of more search results simultaneously. Further, beliefs in justification by multiple sources were found to positively predict the extent of students' written justifications and the quality of those justifications. In contrast, beliefs in personal justification negatively predicted students' corroboration of information across websites and the quality of their written justifications. In a cluster-analytic study of university students' online learning profiles, Binali et al. (2021) found that students who were highly engaged behaviorally, cognitively, and socially in online learning were not only higher in metacognitive self-regulation but also held higher beliefs in justification by authority and justification by multiple sources compared to less engaged students. In contrast, less engaged students held higher beliefs in personal justification than did more highly engaged students. Finally, Karimi and Richter (2021), who only included the justification by multiple sources dimension of the ISEJ, found that high beliefs in justification by multiple sources counteracted undergraduates' tendency to construct an unbalanced representation in accordance with their own opinion when reading about a controversial topic in multiple sources. Specifically, beliefs in justification by multiple sources seemed to facilitate deeper comprehension of text information that opposed students' own opinion about the issue and, as such, promoted a more balanced mental representation of the controversy (Karimi & Richter, 2021).

Although beliefs in justification for knowing, including Internet-specific beliefs in personal justification, justification by authority, and justification by multiple sources, have been linked to aspects of multiple document literacy in a number of studies, no prior study has investigated such beliefs in relation to the successive stages of a complex multiple document literacy task, ranging from the selection of documents to the use of documents in a task product (List & Alexander, 2019). Further, a general reliance on correlational rather than experimental data makes it difficult to draw any causal conclusions about the relationship between justification beliefs and multiple document literacy from prior research.

3. A refutation text intervention

Refutation texts can be described as an instructional tool to promote revision or change of individuals' beliefs or conceptions (e.g., Sinatra & Broughton, 2011). Typically, a refutation text presents a misconception about a scientific phenomenon (e.g., heavier objects fall faster), explicitly refutes it by stating that this conception is incorrect, and explains why an alternative, scientific conception is correct (Hynd, 2001). Kendeou and colleagues (2013, 2014) have shown that the explanation component of a refutation text is essential to its success in changing people's conceptions, as is the extent and interconnectedness of the explanation. According to Kendeou and O'Brien (2014), an elaborated explanation of the alternative conception while the originally endorsed conception is simultaneously active in working memory is needed to strengthen subsequent activation of the alternative conception at the expense of the original one.

In the domain of science, a range of studies have shown that refutation texts can be used to change students' incorrect beliefs or misconceptions (e.g., Braasch et al., 2013; Mason et al., 2008; Sinatra & Broughton, 2011). Beker et al. (2019) have presented evidence to suggest that belief revisions resulting from refutation text interventions also may transfer to new, albeit quite similar, contexts. In a recent meta-analysis of between-subjects experiments, Schroeder and Kucera (2022) found that refutation texts had a positive effect ($g = 0.41$) on conceptual change learning compared to non-refutation texts. Of note is, however, that only six of the 44 independent comparisons included in this meta-analysis fell outside the domains of mathematics and science. Accordingly, Zengilowski et al. (2021) pointed out that the scientific topics addressed in refutation text interventions have been relatively homogeneous (e.g., Newtonian mechanics, changing of seasons), leaving the question of whether refutation texts will be effective in changing beliefs in other domains and with respect to other topics somewhat open. Specifically, Zengilowski et al. (2021) asked whether refutation texts would be as effective in promoting alternative beliefs outside the realm of relatively neutral, narrow scientific misconceptions, such as in more value laden areas involving social scientific and social political issues (see also, Sinatra & Mason, 2013). However, this was recently demonstrated by Johnson et al. (2022), who found that a multimodal refutation intervention using an authentic video from an expert source was effective in reducing misconceptions about a public health issue (i.e., the COVID-19 pandemic) compared to a baseline no-treatment condition. Arguably, how teacher students and teachers believe the reliability of knowledge claims encountered on the Internet about educational topics should be justified is also connected to areas that fall outside the area of purely scientific, non-controversial (mis)conceptions.

While we were not able to identify any prior study targeting beliefs about justification for knowing by means of a refutation text intervention, some prior work has tried to change students' beliefs about whether their intelligence is static or malleable (i.e., their implicit theories of intelligence; Dweck, 1999) by using a refutation text. Thus, Tornsey et al. (2021), who had college and university students read a short text designed to refute the belief that intelligence is static and explain the alternative view that intelligence is malleable, found that their beliefs in static intelligence decreased and their beliefs in malleable intelligence increased relative to control students who read a non-refutation text. In the present study, we brought the refutation text to bear on yet another area within human cognition that potentially has educational and societal implications: the strengthening (and weakening) of epistemic beliefs about justification for knowing.

4. The present study

We designed and implemented a refutation text intervention targeting teacher students' beliefs about justification for knowing in the context of encountering claims about educational topics on the Internet. Specifically, we created three versions of a text that accorded with the

basic principles of refutation text design (Hynd, 2001), with each version designed to promote a particular belief about justification for knowing (e.g., personal justification) at the expense of the two other types of justification beliefs figuring in the trichotomous framework (e.g., justification by authority and justification by multiple sources; Ferguson et al., 2012, 2013). Regardless of the specific version that they read, participants were afterwards presented with a set of documents on an educational topic – deep learning – to write a report to other students on the topic. The notion of deep learning, which has played a crucial role in Norwegian curricular reform at the national level in recent years (The Norwegian Directorate for Education and Training, 2019), essentially refers to a pedagogical approach that prioritizes more concentration on less subject matter over time (i.e., depth over breadth) in order to promote well-organized, principled, and transferable knowledge, as well as metacognitive reflection, among students (Gilje et al., 2018; Sawyer, 2006). In Norway, the adoption of this approach has not been uncontroversial, however (e.g., Hernes, 2018; Melby-Lervåg, 2019). Accordingly, we varied the documents included in the set not only with respect to their source (researcher or teacher) but also with respect to the stance they took toward deep learning as a pedagogical approach (positive or negative stance). We asked participants to select the documents they wanted to use when writing their reports and to justify their document selections, process the selected documents, and use information from these documents in their reports on deep learning.

First, we investigated whether participants' beliefs about epistemic justification would change as a result of the refutation text intervention. Given prior research on refutation texts as an effective instructional tool in changing students' conceptions and beliefs (e.g., Braasch et al., 2013; Tornsey et al., 2021), we expected that participants' beliefs would change substantially in the direction of the type of justification beliefs that was targeted by the particular refutation text that they read.

Second, we investigated whether participants' document selections would be affected by the refutation text intervention. We expected that the changes in participants' justification beliefs would be accompanied by effects on their selection of particular types of documents in this initial stage of the multiple document task (List & Alexander, 2019). In particular, we expected that participants predominantly endorsing beliefs in justification by authority would mainly select documents from higher expertise sources (i.e., researchers), whereas participants predominantly endorsing beliefs in personal justification and justification by multiple sources, respectively, would differentiate much less between documents from higher and lower expertise sources, if at all.

Third, we investigated whether participants' written justifications for their document selections would be affected by the refutation text intervention. We expected that participants would enact their justification beliefs in justifying their document selections, such that the changes in participants' justification beliefs would be accompanied by corresponding justifications for their document selection. In particular, we expected that participants predominantly endorsing beliefs in personal justification would provide most personal justifications, participants predominantly endorsing beliefs in justification by authority would provide most justifications by authority, and participants predominantly endorsing beliefs in justification by multiple sources would provide most justifications by multiple sources.

Fourth, we investigated whether the refutation intervention would affect participants' processing of the documents when writing their reports on deep learning. We expected that the changes in participants' justification beliefs would be accompanied by effects on their processing of particular types of documents in this stage of the multiple document task (List & Alexander, 2019), with participants predominantly endorsing beliefs in justification by authority prioritizing the processing of documents from higher expertise authors, and with participants predominantly endorsing beliefs in personal justification and justification by multiple sources, respectively, differentiating much less between different types of documents, if at all.

Finally, we investigated whether participants' use of information

from the documents in their written reports would be affected by the refutation text intervention. In this final stage of the multiple document task (List & Alexander, 2019), we expected that participants predominantly endorsing beliefs in justification by authority would mainly use information from higher expertise documents in their reports, whereas participants predominantly endorsing personal justification and justification by multiple sources, respectively, would differentiate much less between information from higher and lower expertise documents, if at all.

Because individual differences in motivation and engagement in online reading contexts, prior beliefs about the topic of the documents, and prior knowledge about this topic also may influence students' selection, processing, and use of multiple documents (List & Alexander, 2019; Richter & Maier, 2017), we included these variables as potential covariates in the present study.

5. Method

5.1. Participants

Participants were 150 teacher education students (M age = 22.47, SD = 2.93; 67.3 % female) from three different institutions (one university and two university colleges) in southeast Norway. All participants were completing five-year master programs in teacher education, with 37.7 % completing a program qualifying for teaching in grades 1–7 and 62.3 % completing a program qualifying for teaching in grades 5–10. Further, 62.7 % attended the second year and 37.3 % attended the third year of their respective program. The majority (90 %) had Norwegian as their first language and the rest were bilingual. Participation was voluntary, and the collection and handling of all data met the requirements of the Personal Data Registers Act and were approved by the Norwegian Social Science Data Services.

5.2. Design and conditions

The present study used a $3 \times 2 \times 2$ mixed-model design with refutation text intervention (personal justification, justification by authority, or justification by multiple sources) as a between-subjects factor and source (researcher or teacher) and stance (for or against deep learning) as within-subjects factors. Participants were randomly assigned to one of the three levels of the refutation text intervention. Participants in the personal justification condition read a refutation text designed to promote the belief that knowledge claims encountered on the Internet about educational topics should be justified by applying one's own understanding and knowledge of the topic. Participants in the justification by authority condition read a refutation text designed to promote the belief that knowledge claims encountered on the Internet about educational topics should be justified by judging the expertise of the author. Finally, participants in the justification by multiple sources condition read a refutation text designed to promote the belief that knowledge claims encountered on the Internet about educational topics should be justified by checking several different sources for consistency. The refutation texts presented two types of justification (e.g., justification by authority and justification by multiple sources) as incorrect, whereas one type (e.g., personal justification) was presented as correct together with an explanation of why this way of justifying knowledge claims about educational topics was correct (for more information about the refutation texts, see the *Materials* section).

After reading the refutation text, participants in each condition were presented with a list referring to 12 Web texts and asked to select the texts they wanted to use when writing a report to other teacher students about deep learning. The list contained information about the source and the content of each of the 12 texts, indicating that the texts varied with regard to sources in terms researchers versus teachers and with regard to stances in terms of supporting versus rejecting a deep learning approach. This means that each participant was presented with four

categories of text: researcher-authored/for deep learning, researcher-authored/against deep learning, teacher-authored/for deep learning, and teacher-authored/against deep learning. When participants had made their selections, they justified their selections and could access and use the texts when writing their reports.

5.3. Materials

5.3.1. The internet-specific epistemic justification inventory

To assess beliefs about justification of knowledge claims, we administered the Internet-Specific Epistemic Justification Inventory (ISEJ) both before participants had received the refutation text intervention (pre-test) and after they had completed the multiple document literacy tasks (post-test). The ISEJ was developed and validated by Bråten, Brandmo, and Kammerer (2019), and it has also been validated in subsequent studies (Binali et al., 2021; Cheng et al., 2021; Hämäläinen et al., 2021; Kammerer et al., 2021). The 12-item inventory targets justification beliefs when using the Internet as a knowledge resource and captures the dimensions of personal justification, justification by authority, and justification by multiple sources. In this study, all items were formulated to address education as the content domain.

The four items assessing beliefs about personal justification concerned the evaluation of claims found on the Internet about educational topics in light of prior knowledge and reasoning, with higher scores representing confidence in one's own cognitive resources in evaluating knowledge claims (sample item: To check whether information about an educational topic I find on the Internet is reliable, I evaluate it in relation to my own knowledge about the topic). Of note is that compared to the measure of justification for knowing in science developed and used by Ferguson and colleagues (i.e., the JFK-Q; Ferguson & Bråten, 2013; Ferguson et al., 2013), the personal justification dimension of the ISEJ concerned reliance on one's own cognitive resources in the form of prior knowledge and reasoning, whereas the personal justification dimension of the JFK-Q mainly concerned reliance on personal views or opinions regardless of their knowledge base. The four items assessing beliefs about justification by authority concerned the evaluation of Internet-based knowledge claims about educational topics in light of the competency and expertise of the source, with higher scores indicating reliance on expert authors in the evaluation process (sample item: When I find information about an educational topic on the Internet, I check whether it comes from an expert source). The four items assessing beliefs about justification by multiple sources focused on the evaluation of Internet-based knowledge claims about educational topics by checking several information sources and comparing across websites, with higher scores indicating reliance on claims corroborated by multiple sources (sample item: To determine whether information I find about an educational topic on the Internet is trustworthy, I compare information from multiple sources). Each item was rated on a 10-point scale ranging from *strongly disagree* (1) to *strongly agree* (10). Internal consistency reliabilities (Cronbach's α) were 0.80 (pre-test) and 0.94 (post-test) for personal justification, 0.90 (pre-test) and 0.90 (post-test) for justification by authority, and 0.90 (pre-test) and 0.94 (post-test) for justification by multiple sources.

5.3.2. The internet-specific reading motivation and engagement scale

To assess reading motivation and engagement, we administered the Internet-Specific Reading Motivation and Engagement Scale (IRMES). This measure, which built on Guthrie and Klauda's (2014) Reading Motivation and Engagement Scale, consisted of 21 items that targeted positive (affirming) as well as negative (undermining) aspects of motivation and engagement in the context of reading about educational topics on the Internet. Specifically, the IRMES was designed to capture the positive reading motivation and engagement constructs of intrinsic reading motivation, perceived competence, value, and dedication, as well as the negative reading motivation and engagement constructs of perceived difficulty, devalue, and avoidance. This dimensionality has

been confirmed in prior research with Norwegian teacher students (Brandmo & Bråten, 2021). In the present study, only the positive constructs mentioned above were included.

The three items targeting intrinsic reading motivation focused on interest and enjoyment when reading about educational topics on the Internet (sample item: I enjoy reading about educational topics on the Internet). The three items assessing perceived competence concerned confidence in one's ability to learn from and comprehend what one reads about educational topics on the Internet (sample item: I figure out the meaning of central academic constructs by reading about educational topics on the Internet). The three items assessing value concerned perceptions of the relevance, utility, and importance of reading about educational topics on the Internet (sample item: What I read about educational topics on the Internet will help me in future studies or work). Finally, the three items targeting dedication focused on the time and effort spent on reading about educational topics on the Internet (sample item: I spend more time and effort on reading about educational topics on the Internet than other students). Each item was rated on a 10-point scale ranging from *strongly disagree* (1) to *strongly agree* (10). Internal consistency reliabilities (Cronbach's α) were 0.89 for intrinsic reading motivation, 0.82 for perceived competence, 0.74 for value, and 0.67 for dedication.

5.3.3. Topic belief measure

To assess participants' prior beliefs about deep learning, we used a six-item inventory asking them to rate their agreement with six statements concerning potential advantages and disadvantages of the deep learning approach on a 10-point scale (1 = *not at all true*, 10 = *very true*). Higher scores on this measure represented a positive stance towards deep learning (sample items: I believe deep learning is necessary for students' learning; I believe deep learning is an educational fashion term without much content [reverse coded]). Internal consistency reliability (Cronbach's α) for the scores was 0.87.

5.3.4. Topic knowledge measure

We assessed topic knowledge by asking participants to explain their understanding of the concept of deep learning in writing, using a text box with seven blank lines for that purpose. We developed a coding scheme for their written responses based on Sawyer's (2006) distinction between deep learning and traditional classroom practices, as well as on the description of deep learning within the newly implemented national curriculum (The Norwegian Directorate for Education and Training, 2019). Participants were awarded one point for each information unit in their written response that reflected conceptual understanding of an aspect of deep learning, as described by Sawyer (2006) and included in the national curriculum. For example, points were awarded for mentioning that deep learning put an emphasis on understanding (sample response: To understand a topic rather than just memorizing), application of knowledge (sample response: To use new knowledge in other contexts), connecting information (sample response: To construct a coherent representation), interdisciplinary work (sample response: To work on several subjects at the same time), concentration on a particular topic (sample response: Students achieve deeper understanding of a specific topic), multiple perspectives (sample response: One gets acquainted with several aspects of the topic), and metacognition (sample response: To reflect on how one works).

A random selection of 20 % of participants' written responses was independently scored by the first and fourth authors. The interrater reliability (Cohen's Kappa) was 0.85. The total scores of the two raters were also highly correlated, with Pearson's $r = 0.88$, $p < .001$. Disagreements were solved through discussion, and the scoring of the remaining responses was done by the fourth author alone.

5.3.5. Refutation texts

Three different texts following the refutation text format (Hynd, 2001) were created by the authors. Each text presented source

information at the top of the page, with the text said to be taken from a well-known Norwegian educational journal (*Bedre Skole*) and published in 2018. Each text continued with an introduction of 55 words, a refutation and explanation section of approximately 170 words ($M = 173.33$, range = 9), and a closing section of 41 words. The source information and the introduction and closing sections were identical in the three texts, but the refutation and explanation sections differed depending on the refutation text condition.

The introduction contextualized the refutation and explanation components of the text by describing a study in which Norwegian teacher students were asked to report on how they judged whether information encountered on the Internet about educational topics was reliable. In the personal justification condition, the refutation and explanation section started by stating that many teacher students were found to believe that the best ways to judge the reliability of Internet-based information about educational topics was to evaluate whether the information came from an expert (i.e., justification by authority) or whether different sources agreed with respect to the topic (i.e., justification by multiple sources). This was followed by a refutation of those beliefs and an explanation of why those beliefs were incorrect and the belief that relying on one's own understanding and knowledge about the topic (i.e., personal justification) was more appropriate. Similarly, participants in the justification by authority condition and the justification by multiple sources condition read that the two other beliefs about justification (i.e., personal justification and justification by multiple sources in the justification by authority condition, and personal justification and justification by authority in the justification by multiple sources condition) were incorrect followed by an explanation of why justification by authority and justification by multiple sources, respectively, were more appropriate. The closing section briefly concluded that being able to judge the reliability of Internet-based information is important because many teacher students search for and read about educational topics on the Internet. An English translation of the refutation text used in each condition is included in Appendix A.

5.3.6. Documents, computer application, and dependent measures

Documents. Participants in all refutation text conditions were presented with a list of 12 documents on deep learning. In each document, information about the source (author, author credentials, author affiliation, publication venue, and date) was presented on the first two lines, followed by three or four sentences of content information. The source information showed that half of the authors were researchers (i.e., professor, associate professor, senior researcher, researcher) affiliated with educational research centers or institutes at Norwegian university colleges and universities who had published their texts in professional journals and reports. Further, the source information showed that the other half were teachers in elementary and lower secondary schools who had published their texts in media outlets and publications for teachers. All 12 documents were recently published (i.e., within the last two years). The names of all authors were common Norwegian names that were made up, but the names of all institutions, schools, and publication venues were real.

The three to four sentences of content information that were shown below the source information in each document varied with respect to the stance taken towards deep learning. Half of the documents in the list supported central tenets of the deep learning approach (e.g., concentration on one topic at a time) whereas the other half took a stance that opposed this approach, for example by referring to research (when authored by researchers) or practical experience (when authored by teachers).

Thus, the list of 12 documents consisted of four categories with three documents included in each category: (1) higher author expertise/positive stance on deep learning, (2) higher author expertise/negative stance on deep learning, (3) lower author expertise/positive stance on deep learning, and (4) lower author expertise/negative stance on deep learning. The source and content information displayed for each

document is shown in Appendix B. Authors' gender was controlled for when constructing the four categories. Although the 12 documents were created by the authors of this article, the author team, through thorough discussion, tried to ensure that the stances and the arguments included in the documents represented authentic stances and arguments concerning the issue of deep learning.

Application. Participants accessed the list of 12 documents in an adapted version of a Web-based application program used in prior research (Bråten, Brante, & Strømso, 2019; Bråten et al., 2018). First, they selected the documents they wanted to use when writing their report on deep learning. Then, on a page displaying only the selected documents, they justified in writing why they had selected each of these documents. On a third page, participants could access expanded versions of the selected documents. By clicking on a selected document, participants gained access to a document consisting of approximately 200 words including the source information and three- to four-sentence content information shown at the outset, and by clicking on another document, that document was expanded and the previous one was reduced to the original source and content information again.¹ Participants could re-access and reread the expanded documents as many times as they wanted by clicking on the selected documents, and they could go back and forth between a page where they were writing their report in a dedicated textbox and the page on which their selected documents were located. While reading the expanded documents and writing their report, participants could also go back to the list of all 12 documents and select additional documents, justify their selection of those documents, and get access to expanded versions of the documents when writing their report. Participants could not copy or cut any information from the documents and paste it into their report. After completing their reports, participants submitted them to a server.

Dependent measures. We constructed four dependent measures to assess participants' performance on the multiple document literacy task, one focusing on the selection of documents, one focusing on the justification for document selection, one focusing on the processing of the selected documents, and one focusing on the use of the selected documents in the written reports. In addition, we assessed potential changes in participants' beliefs about justification for knowing by means of their post-test scores on the Internet-Specific Epistemic Justification Inventory.

With respect to *selection*, we measured the selection of documents in terms of the four categories varying with respect to source and stance. This measure of the selection process was based on the log produced by the application program.

With respect to *justification*, we coded participants' written justifications for their document selections into the categories of personal justifications, justifications by authority, and justifications by multiple sources. Personal justifications referred to participants' own knowledge, understanding, experiences, opinions, or interests in relation to the issue of deep learning, as well as to the authors' practical experiences and personal knowledge of teaching, as reasons for document selection. Justifications by authority referred to the competency or expertise of the authors, their academic positions and affiliations, their knowledge of research and research methods, and their research publications, as reasons for document selection. Finally, justifications by multiple sources referred to participants' wish to check and compare different sources or perspectives, as well as to gain a more complete understanding of the issue, as reasons for document selection. The coding system is further described and exemplified in Appendix C.

The first and fourth authors independently coded a random selection of 20 % of participants' written justifications into the categories of personal justifications, justifications by authority, and justifications by multiple sources, resulting in 81 % agreement. Disagreements were solved through discussion, and the scoring of the remaining justifications was done by the first author alone. Following, Bråten, Brante, and Strømso (2019), subsequent statistical analyses using this dependent variable were done with weighted justification scores, computed by

dividing the number of personal justifications, justifications by authority, and justifications by multiple sources, respectively, by the number of selected documents.

With respect to the *processing of the selected documents*, we measured the time participants spent reading the expanded documents within the different categories. This measure was also based on the log produced by the application program.

Finally, with respect to the *use of the selected documents*, we identified which documents the information units included in the reports came from. Following previous work (Bråten, Brante, & Strømso, 2019; Bråten et al., 2018), when a sentence or part of a sentence in the written report contained information that corresponded to information contained in a particular part of one of the selected documents, we coded that information unit as coming from that document. The first and fourth authors independently coded 20 % of the written reports, which resulted in 98 % agreement on which documents the information units came from. Disagreement was solved through discussion and the first author coded the remaining reports. We used the number of information units in the written reports that came from the different categories of documents as a dependent measure.

5.4. Procedure

The data were collected in one 60-minute class period at each institution. First, participants received a folder containing a demographic survey, the Internet-Specific Epistemic Justification Inventory, the Internet-Specific Reading Motivation and Engagement Scale, the topic belief measure, and the topic knowledge measure and completed these measures on paper in this order before the folders were handed in. Afterwards, they were asked to study a text from an educational journal very carefully and answer a question about this text before they log on with their laptops to access an application in order to work on further tasks. A sheet of paper with the refutation text was then handed out, with participants within each class randomly assigned to different versions of the refutation text depending on the experimental condition. Below the refutation text, we included an implementation check by asking which way, according to the text, is the best to decide whether information is reliable. In answering this question, participants selected one of three alternatives: judge whether the information comes from an expert, judge whether the information is consistent with one's own understanding and knowledge, or check what several different types of sources say.² Finally, at the bottom of the page on which the refutation text was printed, the URL that participants should enter into their browser to access the application was provided.

On the first page of the application, participants read:

Deep learning is an educational topic that is much discussed in connection with the development of new curricula. In this program, you will be writing a report to other teacher students in which you discuss whether deep learning is an adaptive educational approach. First, you will be presented with a list referring to 12 web texts. From this list, you are going to select the web texts you want to use when writing your report. Then, you are going to justify your selections. Finally, you are going to write the report. The web texts you have selected and the report you are writing will not be on the same page, but you can go back and forth between the web texts and the report you are writing.

On the next page of the application, where the list referring to the 12 texts containing source information and restricted content information was located, participants were told that they could select as many web texts as they wanted and that the selected texts would be available when writing their report. The texts on this list were presented in random order for each participant.

On a subsequent page where only the selected texts were displayed, participants were asked "Why did you select this text?" below each text and justified their selections in corresponding textboxes. After having justified their selections, participants accessed a new page with only the selected texts, on which they read:

You will now be writing the report in which you discuss deep learning. The

list below contains the web texts you selected. By clicking on them, you will get a longer excerpt of each text. We want you to read these excerpts and use information from them when writing the report. You can read the web texts in the order you want, and you can go back and forth between the web texts and the report you are writing. If you want to select more texts than the ones you already have selected, you can click the "more texts" button.³

Participants accessed the final page on which they wrote their report by clicking on a "show report" button, and they could go back to the page on which the texts were displayed by clicking on a "show texts" button. On the final page, they were reminded that they could go back and reread the selected texts whenever they wanted, and that they could submit their completed report by clicking on the "send the report" button. Participants were debriefed about the conditions of the experiment before they left the room.

6. Results

We first present analyses comparing the experimental conditions with respect to Internet-specific motivation and engagement (i.e., intrinsic reading motivation, perceived competence, value, and dedication), prior topic beliefs, and prior topic knowledge. Next, we provide analyses that document effects of the refutation text intervention on participants' beliefs about epistemic justification. Further, we provide analyses documenting that the intervention affected not only participants' justification beliefs but also their selection of documents, their justifications for their document selections, their processing of the selected documents, and their use of the selected documents in their task products (i.e., written reports). All tests of statistical significance were made at the $p < .05$ level, and follow-up analyses used Tukey's honest significant difference test to control for family-wise error. Effect sizes are reported to indicate practical in addition to statistical significance.

6.1. Covariates

Table 1 shows descriptive information about the motivation and engagement variables, prior topic beliefs, and prior topic knowledge by condition. One-way between-subjects analyses of variance (ANOVAs) with condition as the independent variable indicated that there were no differences between the conditions with respect to intrinsic motivation, $F(2, 145) = 0.70, p = .500, \eta^2 = 0.010$; value, $F(2, 145) = 0.48, p = .619, \eta^2 = 0.007$; topic beliefs, $F(2, 145) = 0.28, p = .756, \eta^2 = 0.004$; or topic knowledge, $F(2, 145) = 1.11, p = .416, \eta^2 = 0.012$. Despite randomization, the ANOVAs indicated that the conditions differed with respect to perceived competence, $F(2, 145) = 3.12, p = .047, \eta^2 = 0.041$, and dedication, $F(2, 145) = 3.14, p = .046, \eta^2 = 0.041$. Follow-up multiple comparisons indicated that the personal justification condition scored lower than the justification by multiple sources condition with respect to both perceived competence ($p = .046, d = 0.458$) and dedication ($p = .036, d = 0.474$). Perceived competence correlated positively with all three dimensions of justification beliefs at posttest ($r_s = 0.179 - 0.394, p_s < 0.034$), and dedication correlated positively with the justification by authority ($r = 0.345, p < .001$) and justification by multiple

Table 1

Means and standard deviations for each experimental condition on the covariates of motivation and engagement, prior topic beliefs, and prior topic knowledge.

| Covariate | Experimental condition | | |
|----------------------|------------------------|-------------|------------------|
| | Personal | Authority | Multiple sources |
| Intrinsic motivation | 6.19 (1.79) | 6.44 (2.13) | 6.65 (1.95) |
| Perceived competence | 6.41 (1.98) | 7.03 (1.51) | 7.23 (1.60) |
| Value | 7.46 (1.42) | 7.71 (1.20) | 7.71 (1.62) |
| Dedication | 3.83 (1.56) | 4.20 (1.37) | 4.63 (1.81) |
| Topic beliefs | 7.89 (1.29) | 7.92 (1.25) | 8.07 (1.38) |
| Topic knowledge | 1.80 (1.14) | 1.85 (0.97) | 1.59 (1.04) |

sources ($r = 0.358, p < .001$) dimensions at posttest. Perceived competence and dedication were therefore included as covariates when assessing the effects of the intervention on participants' justification beliefs.

6.2. Justification beliefs

Table 2 shows participants' justification beliefs measured at both pretest and posttest by experimental condition. To assess the effects of the refutation text intervention, we performed three analyses of covariance (ANCOVAs) with experimental condition as the independent variable. Results of evaluation of the assumptions for performing ANCOVA were satisfactory. In the first analysis, we used personal justification measured at posttest as the dependent variable, and personal justification measured at pretest, perceived competence, and dedication as covariates. This analysis showed a large effect of experimental condition, $F(2, 135) = 26.32, p < .001, \eta^2_p = .281$, with follow-up multiple comparisons showing that the experimental condition emphasizing personal understanding and practical experience (i.e., the personal justification condition) scored statistically significantly higher than the justification by authority condition ($p < .001, d = 1.498$) and the justification by multiple sources condition ($p < .001, d = 0.862$) on the personal justification dimension at posttest. Further, participants in the justification by multiple sources condition scored statistically significantly higher on the personal justification dimension at posttest than did participants in the justification by authority dimension ($p = .010, d = 0.622$). Only the covariate of personal justification beliefs at pretest adjusted the personal justification posttest scores, $F(1, 135) = 38.58, p < .001, \eta^2_p = .222$.

In the second ANCOVA, we used justification by authority measured at posttest as the dependent variable, and justification by authority measured at pretest, perceived competence, and dedication as covariates. There was a large effect of experimental condition, $F(2, 135) = 25.97, p < .001, \eta^2_p = .210$. Follow-up multiple comparisons showed that the experimental condition emphasizing the expertise of the author (i.e., the justification by authority condition) scored statistically significantly higher than the personal justification condition ($p < .001, d = 1.148$) and the justification by multiple sources condition ($p < .001, d = 0.986$), which did not differ. Again, only the covariate of justification beliefs at pretest adjusted the posttest scores, $F(1, 135) = 113.67, p < .001, \eta^2_p = .457$.

In the third ANCOVA, we used justification by multiple sources measured at posttest as the dependent variable, and justification by multiple sources measured at pretest, perceived competence, and dedication as covariates. This analysis showed a large effect of experimental condition, $F(2, 135) = 15.75, p < .001, \eta^2_p = .189$, with follow-up multiple comparisons showing that the experimental condition emphasizing checking multiple sources for consistency (i.e., the justification for multiple sources condition) scored statistically significantly higher than the personal justification ($p = .034, d = 0.529$) and the justification by authority ($p < .001, d = 1.169$) conditions on the justification by multiple sources dimension at posttest. Further, participants in the personal justification condition scored statistically significantly higher on the justification by multiple sources dimension at posttest than did

participants in the justification by authority condition ($p = .008, d = 0.628$). Both the covariate of pretest justification beliefs, $F(1, 135) = 37.39, p < .001, \eta^2_p = .217$, and the covariate of perceived competence, $F(1, 135) = 6.06, p = .015, \eta^2_p = .043$, uniquely adjusted scores on the justification by multiple sources dimension at posttest in this analysis.

Taken together, these results demonstrate large and consistent effects of the refutation text intervention on the targeted dimensions of epistemic justification beliefs. Further, participants in the justification by authority condition had lower scores than participants in both other conditions on the personal justification and justification by multiple sources dimensions at posttest.

6.3. Document selection

Table 3 shows descriptive information for document selections as a function of document source and stance towards the issue for each experimental condition. We submitted these data to a $3 \times 2 \times 2$ mixed-model univariate ANOVA with experimental condition as the between-subjects variable and document source and stance as the within-subjects variables on document selection. The main effect of source was statistically significant, $F(1, 140) = 89.63$, mean squared error (MSE) = 0.92, $p < .001, \eta^2_p = .390$. Participants selected more documents from higher expertise authors ($M = 1.56, SD = 0.71$) than from lower expertise authors ($M = 0.80, SD = 0.66$). The main effect of stance was also statistically significant, $F(1, 140) = 94.62, MSE = 0.53, p < .001, \eta^2_p = .403$. Participants selected more documents with a positive stance ($M = 1.47, SD = 0.55$) than with a negative stance ($M = 0.88, SD = 0.65$) towards deep learning. These main effects were qualified by a statistically significant interaction between document source and stance, $F(1, 140) = 11.92, MSE = 0.63, p = .001, \eta^2_p = 0.78$.

Follow-up analysis indicated that higher expertise/positive stance documents were selected most frequently ($M = 1.97, SD = 0.90$), and that lower expertise/negative stance documents were selected least frequently ($M = 0.62, SD = 0.79$), whereas the selection of higher expertise/negative stance ($M = 1.15, SD = 0.88$) and lower expertise/positive stance ($M = 0.98, SD = 0.90$) documents did not differ (see Fig. 1).

The interaction between document source and experimental condition was also statistically significant, $F(2, 140) = 34.04, MSE = 0.92, p < .001, \eta^2_p = .327$. Follow-up analysis indicated that participants in the justification by authority condition selected more higher expertise ($M = 2.01, SD = 1.26$) than lower expertise ($M = 0.31, SD = 1.17$) documents (see Fig. 2). Likewise, participants in the justification by multiple sources condition selected more higher expertise ($M = 1.42, SD = 1.18$) than lower expertise ($M = 1.02, SD = 1.11$) documents, whereas the selection of higher and lower expertise documents did not differ statistically significantly among participants in the personal justification condition ($M = 1.24, SD = 1.21$ vs $M = 1.06, SD = 1.14$).

In summary, these results show that participants in the justification by authority condition predominantly selected documents written by higher expertise authors (i.e., researchers), whereas participants in the personal justification condition selected as many documents authored by teachers as by researchers. Participants in the justification by

Table 2

Means and standard deviations for each experimental condition on the three dimensions of the internet-specific epistemic justification inventory at pre-test and post-test.

| ISEJ dimension | Pre-test | | | Post-test | | |
|-----------------------------------|------------------------|-------------|------------------|------------------------|-------------|------------------|
| | Experimental condition | | | Experimental condition | | |
| | Personal | Authority | Multiple sources | Personal | Authority | Multiple sources |
| Personal justification | 7.45 (1.29) | 7.34 (1.58) | 7.16 (1.54) | 8.25 (1.33) | 6.08 (1.96) | 6.79 (1.92) |
| Justification by authority | 7.46 (1.59) | 7.81 (1.66) | 7.55 (2.02) | 6.76 (1.73) | 8.45 (1.60) | 7.06 (1.94) |
| Justification by multiple sources | 6.78 (1.85) | 7.20 (2.18) | 7.34 (1.90) | 6.70 (1.84) | 6.15 (1.88) | 7.97 (1.93) |

Note. ISEJ = The Internet-Specific Epistemic Justification Inventory.

Table 3
Means and standard deviations for each experimental condition on number of documents selected from each category.

| | Experimental condition | | | | | |
|-----------------|------------------------|-----------------|------------------|-----------------|------------------|-----------------|
| | Personal | | Authority | | Multiple sources | |
| | Higher expertise | Lower expertise | Higher expertise | Lower expertise | Higher expertise | Lower expertise |
| Positive stance | 1.81 (0.94) | 1.25 (0.98) | 2.29 (0.82) | 0.44 (0.69) | 1.80 (0.93) | 1.24 (0.96) |
| Negative stance | 0.67 (0.75) | 0.88 (0.89) | 1.73 (0.94) | 0.18 (0.53) | 1.04 (0.95) | 0.80 (0.88) |

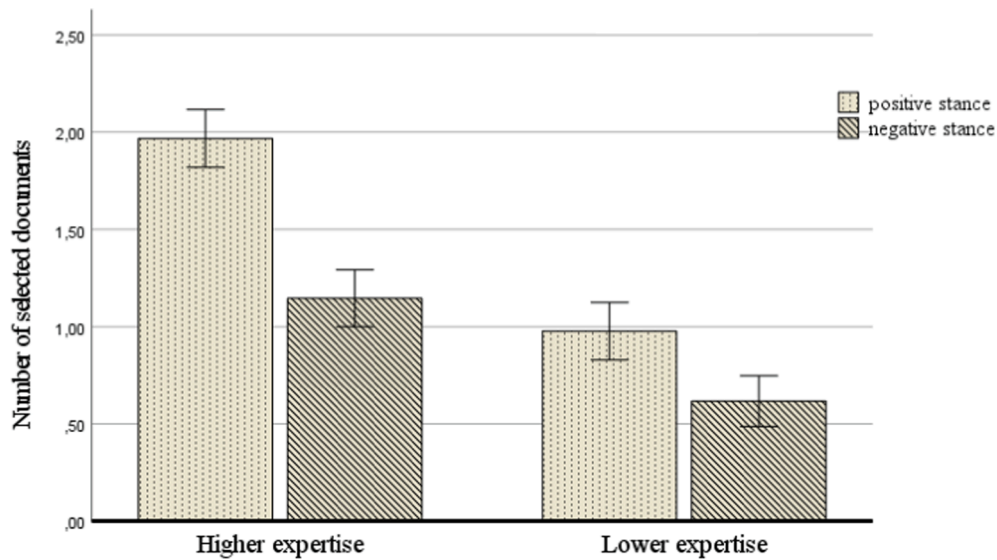


Fig. 1. Documents selected from higher and lower expertise authors with a positive or negative stance toward deep learning. Error bars represent 95 % confidence intervals.

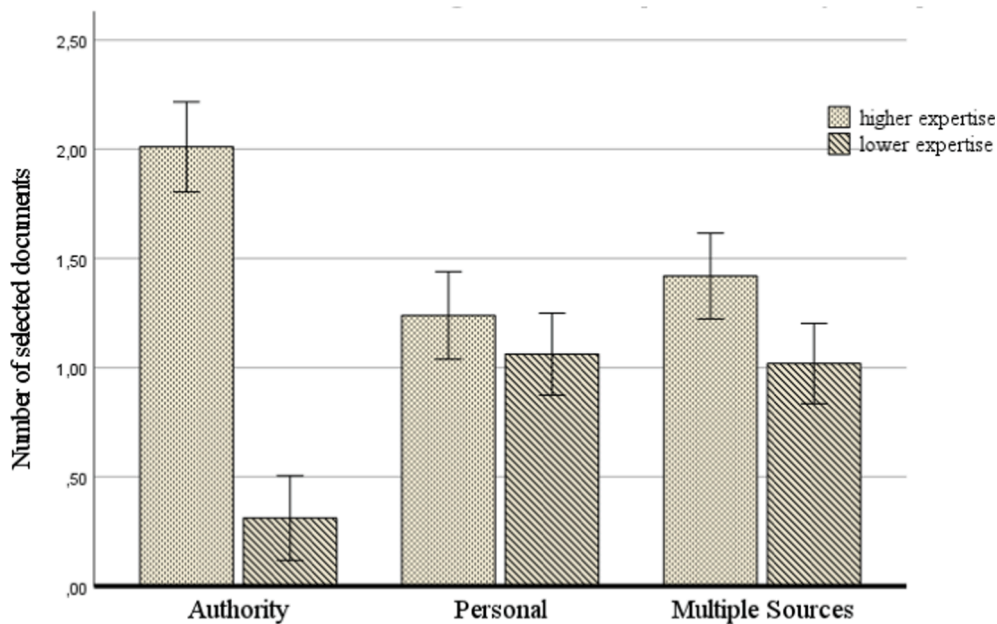


Fig. 2. Documents selected from higher and lower expertise authors by each experimental condition. Error bars represent 95 % confidence intervals.

multiple sources condition also selected more higher expertise than lower expertise documents, but the selections of these participants were much more balanced than those of the participants in the justification by authority condition.

6.4. Justifications for document selections

Table 4 shows participants' justifications for their document selections by experimental condition. A one-way between-subjects ANOVA with experimental condition as the independent variable and the three categories of justifications as the dependent variables indicated that

Table 4

Means and standard deviations for each experimental condition on the three categories of justifications for document selections.

| Justifications for document selections | Experimental condition | | |
|--|------------------------|-------------|------------------|
| | Personal | Authority | Multiple sources |
| Personal justifications | 0.75 (0.41) | 0.26 (0.35) | 0.53 (0.37) |
| Justifications by authority | 0.35 (0.49) | 0.94 (0.58) | 0.33 (0.45) |
| Justifications by multiple sources | 0.16 (0.26) | 0.13 (0.19) | 0.27 (0.33) |

Note. Justifications in each category are divided by the number of selected documents.

there were statistically significant differences between the experimental conditions with respect to personal justifications, $F(2, 140) = 19.87, p < .001, \eta^2 = 0.221$, justifications by authority, $F(2, 140) = 21.51, p < .001, \eta^2 = 0.235$, and justifications by multiple sources $F(2, 140) = 3.42, p = .036, \eta^2 = 0.047$. Follow-up multiple comparisons showed that with respect to the personal justifications provided for document selections, participants in the personal justification condition scored statistically significantly higher than did participants in the justification by authority condition ($p < .001, d = 1.309$) and the justification by multiple sources condition ($p = .010, d = 0.578$), with the justification by multiple sources condition also scoring higher than the justification by authority condition ($p = .002, d = 0.741$). With respect to justifications by authority, the justification by authority condition scored statistically significantly higher than the personal justification condition ($p < .001, d = 1.037$) and the multiple sources condition ($p < .001, d = 1.188$), which did not differ. Finally, with respect to justifications by multiple sources, the justification by multiple sources condition scored statistically significantly higher than the justification by authority condition ($p = .045, d = 0.480$) but not statistically significantly higher than the personal justification condition, and the personal justification and justification by authority conditions also did not differ.

Taken together, these results show that the effects of the intervention on participants' justifications for their document selections were consistent with its effects on their beliefs about epistemic justification. That is, the experimental conditions targeting different types of justification beliefs promoted corresponding justifications for document selections in a multiple document task. Also consistent with the findings regarding justification beliefs, participants in the justification by authority condition provided the fewest personal justifications and justifications by multiple sources for their document selections.

6.5. Processing of documents

Table 5 shows descriptive information for document reading time as a function of document source and stance towards the issue for each experimental condition. The main effects of source, $F(1, 139) = 46.66, MSE = 10,332.68, p < .001, \eta^2_p = .251$, and stance, $F(1, 139) = 28.65, MSE = 5,620.40, p < .001, \eta^2_p = .171$, were statistically significant, as were the interactions between source and stance, $F(1, 139) = 17.84, MSE = 5,906.96, p < .001, \eta^2_p = .114$, and between source and experimental condition, $F(2, 139) = 7.98, MSE = 10,332.68, p = .001,$

Table 5

Means and standard deviations for each experimental condition on reading time for each document category.

| | Experimental condition | | | | | |
|-----------------|------------------------|-----------------|------------------|-----------------|------------------|-----------------|
| | Personal | | Authority | | Multiple sources | |
| | Higher expertise | Lower expertise | Higher expertise | Lower expertise | Higher expertise | Lower expertise |
| Positive stance | 125.13 (189.76) | 42.00 (56.50) | 145.95 (147.35) | 15.16 (30.91) | 71.06 (99.85) | 28.10 (35.53) |
| Negative stance | 26.85 (52.61) | 41.31 (58.19) | 89.98 (90.01) | 5.82 (17.39) | 42.32 (81.53) | 18.80 (31.23) |

$\eta^2_p = .103$.

These effects were qualified by a statistically significant three-way interaction between source, stance, and experimental condition, $F(2, 139) = 3.24, MSE = 5,906.96, p = .042, \eta^2_p = .045$. To explore this interaction, we performed a separate 2 (source) \times 2 (stance) repeated measures ANOVA for each experimental condition.

For the personal justification condition, the main effects of source, $F(1, 47) = 4.38, MSE = 12,908.30, p = .042, \eta^2_p = .085$, and stance, $F(1, 47) = 12.01, MSE = 9,788.24, p = .001, \eta^2_p = .203$, were statistically significant, with these effects qualified by a statistically significant interaction between source and stance, $F(1, 47) = 10.20, MSE = 11,202.84, p = .003, \eta^2_p = .178$. Follow-up analysis indicated that participants used more time reading higher expertise/positive stance documents than the three other types of documents, which did not differ (see Fig. 3a).

For the justification by authority condition, the main effects of source, $F(1, 43) = 36.82, MSE = 13,805.10, p < .001, \eta^2_p = .461$, and stance, $F(1, 43) = 16.92, MSE = 2,773.94, p < .001, \eta^2_p = .282$, were statistically significant. The interaction between source and stance was also statistically significant, $F(1, 43) = 8.17, MSE = 2,929.63, p = .007, \eta^2_p = .160$. Follow-up analysis indicated that participants in this condition used more time reading higher expertise/positive stance and higher expertise/negative stance documents (which did not differ) than lower expertise/positive stance and lower expertise/negative stance documents (which also did not differ; see Fig. 3b).

For the justification by multiple sources condition, the main effects of source, $F(1, 49) = 11.47, MSE = 4,814.95, p = .001, \eta^2_p = .190$, and stance, $F(1, 49) = 4.39, MSE = 3,440.01, p = .041, \eta^2_p = .082$, were statistically significant. Participants used more time reading documents from higher expertise authors ($M = 56.69, SD = 71.03$) than from lower expertise authors ($M = 23.45, SD = 24.54$), and more time reading documents with a positive stance towards deep learning ($M = 49.58, SD = 56.30$) than documents with a negative stance towards deep learning ($M = 30.56, SD = 46.16$). However, participants in this condition devoted as much time to reading higher expertise/positive stance documents ($M = 71.06, SD = 99.85$) as to reading higher expertise/negative stance documents ($M = 42.32, SD = 81.53$), and also did not discriminate between higher expertise/negative stance documents and the two categories of lower expertise documents (see Fig. 3c).

In summary, participants in the personal justification condition prioritized the processing of higher expertise documents only if those documents represented a positive stance towards deep learning, which was consistent with their own prior topic beliefs (see Table 1), whereas participants in the justification by authority condition prioritized the processing of higher expertise documents regardless of whether those documents represented a positive or a negative stance towards the topic. Participants in the justification by multiple sources condition distributed their time more evenly to processing the different categories of documents than did participants in the two other conditions.

6.6. Information units in written reports

Table 6 shows descriptive information for information units in written reports as a function of document source and stance for each experimental condition. There were statistically significant main effects of source, $F(1, 126) = 56.65, MSE = 2.25, p < .001, \eta^2_p = .310$, and

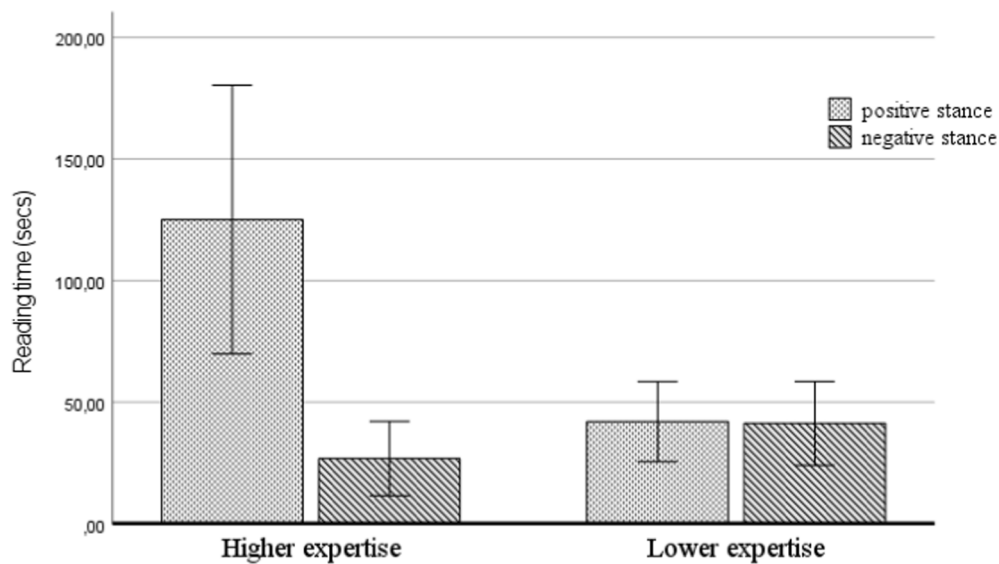


Fig. 3a. Reading time for higher and lower expertise authors with a positive or negative stance toward deep learning in the personal justification condition. Error bars represent 95 % confidence intervals.

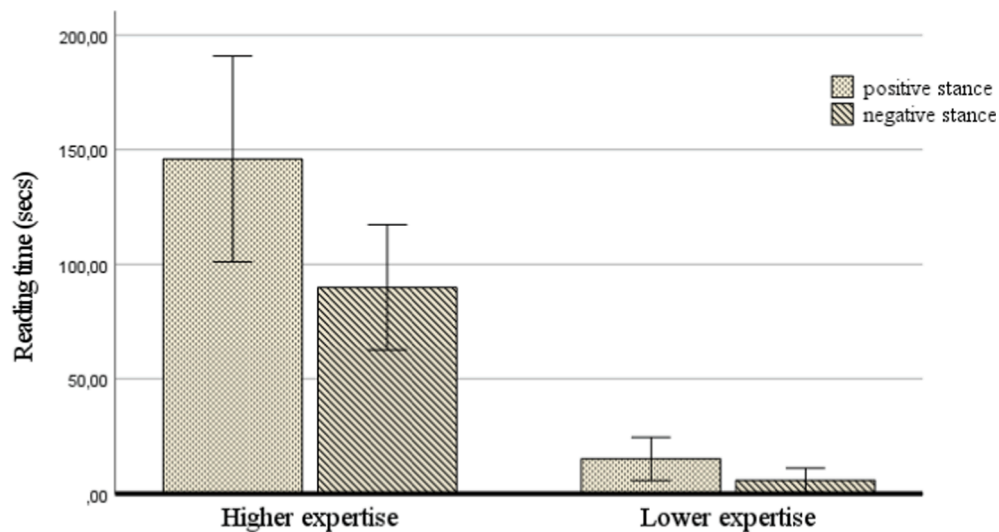


Fig. 3b. Reading time for higher and lower expertise authors with a positive or negative stance toward deep learning in the justification by authority condition. Error bars represent 95 % confidence intervals.

stance, $F(1, 126) = 53.79$, $MSE = 1.66$, $p < .001$, $\eta^2_p = .299$. There were also statistically significant interactions between source and stance, $F(1, 126) = 7.94$, $MSE = 1.86$, $p = .006$, $\eta^2_p = .059$, between source and experimental condition, $F(2, 126) = 6.35$, $MSE = 2.25$, $p = .002$, $\eta^2_p = .092$, and between stance and condition, $F(2, 126) = 4.28$, $MSE = 1.66$, $p = .016$, $\eta^2_p = .064$.

However, these effects were qualified by a statistically significant three-way interaction between source, stance, and experimental condition, $F(2, 126) = 3.51$, $MSE = 1.86$, $p = .033$, $\eta^2_p = .053$. To explore this interaction, we performed a separate 2 (source) \times 2 (stance) repeated measures ANOVA for each experimental condition.

For the personal justification condition, the main effects of source, $F(1, 46) = 7.97$, $MSE = 2.57$, $p = .007$, $\eta^2_p = .148$, and stance, $F(1, 46) = 45.77$, $MSE = 1.62$, $p < .001$, $\eta^2_p = .499$, were statistically significant, with these effects qualified by a statistically significant interaction between source and stance, $F(1, 46) = 11.37$, $MSE = 2.29$, $p = .002$, $\eta^2_p = .198$. Follow-up analysis indicated that participants included more information units from higher expertise/positive stance documents than

from the three other types of documents, which did not differ (see Fig. 4a).

For the justification by authority condition, the main effects of source, $F(1, 39) = 44.31$, $MSE = 2.53$, $p < .001$, $\eta^2_p = .532$, and stance, $F(1, 39) = 5.63$, $MSE = 1.51$, $p = .026$, $\eta^2_p = .121$, were statistically significant. Participants included more information units from higher expertise authors ($M = 1.96$, $SD = 1.39$) than from lower expertise authors ($M = 0.29$, $SD = 0.51$), and more information units from documents with a positive stance ($M = 1.35$, $SD = 1.04$) than from documents with a negative stance ($M = 0.90$, $SD = 0.75$; see Fig. 4b).

For the justification by multiple sources condition, the main effects of source, $F(1, 41) = 11.06$, $MSE = 1.63$, $p = .002$, $\eta^2_p = .212$, and stance, $F(1, 41) = 14.41$, $MSE = 1.85$, $p < .001$, $\eta^2_p = .260$, were statistically significant. Participants included more information units from higher expertise authors ($M = 1.45$, $SD = 1.12$) than from lower expertise authors ($M = 0.80$, $SD = 0.64$), and more information units from documents with a positive stance ($M = 1.52$, $SD = 1.13$) than from documents with a negative stance ($M = 0.73$, $SD = 0.70$; see Fig. 4c).

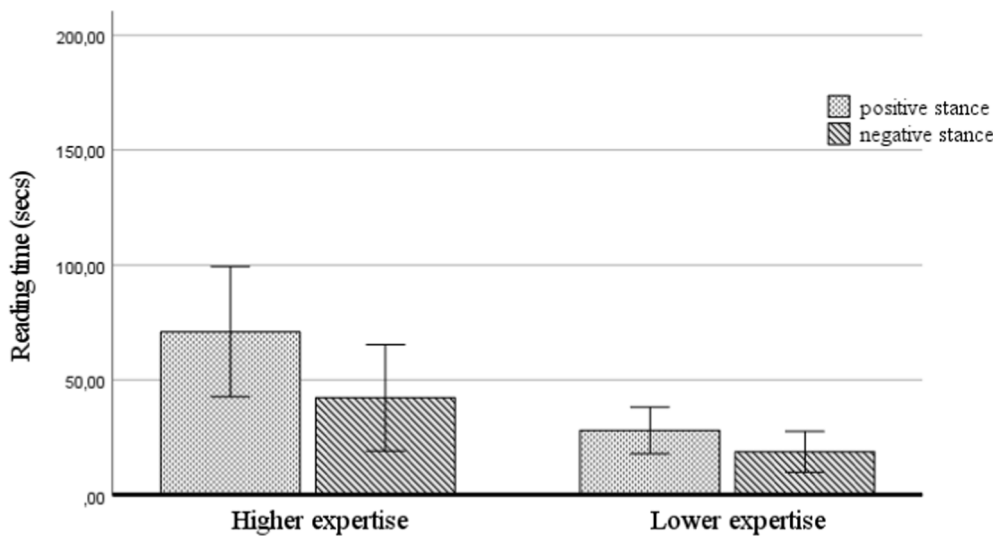


Fig. 3c. Reading time for higher and lower expertise authors with a positive or negative stance toward deep learning in the justification by multiple sources condition. Error bars represent 95 % confidence intervals.

Table 6

Means and standard deviations for each experimental condition on number of information units from each document category in written reports.

| | Experimental condition | | | | | |
|-----------------|------------------------|-----------------|------------------|-----------------|------------------|-----------------|
| | Personal | | Authority | | Multiple sources | |
| | Higher expertise | Lower expertise | Higher expertise | Lower expertise | Higher expertise | Lower expertise |
| Positive stance | 2.45 (2.26) | 1.04 (1.40) | 2.18 (2.00) | 0.53 (0.93) | 2.00 (1.93) | 1.05 (1.21) |
| Negative stance | 0.45 (0.83) | 0.53 (0.88) | 1.75 (1.50) | 0.05 (0.22) | 0.90 (1.19) | 0.55 (0.74) |

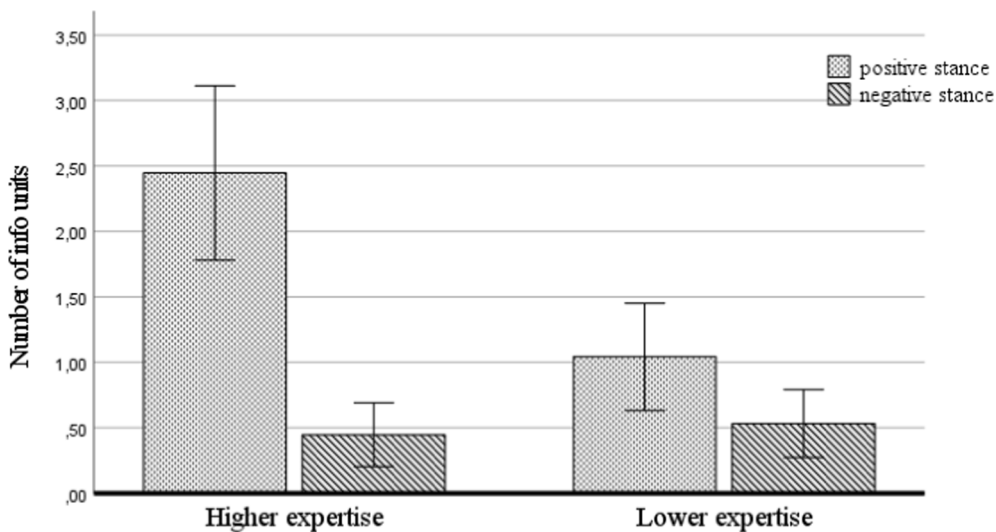


Fig. 4a. Information units from higher and lower expertise authors with a positive or negative stance toward deep learning in the personal justification condition. Error bars represent 95 % confidence intervals.

In summary, participants in the personal justification condition used more information units from higher expertise documents than from lower expertise documents only if those documents represented a positive stance towards deep learning, which was consistent with their own prior topic beliefs (see Table 1), whereas participants in the justification by authority condition used more information units from higher expertise documents regardless of whether those documents represented a positive or a negative stance towards the topic. Although participants in the justification by multiple sources condition, like those in the

personal justification condition, tended to prioritize information units from high expertise/positive stance documents, these participants seemed to show less preference for information units from particular categories of documents than did participants in the two other conditions.

7. Discussion

This study addressed the intersection of epistemic cognition,

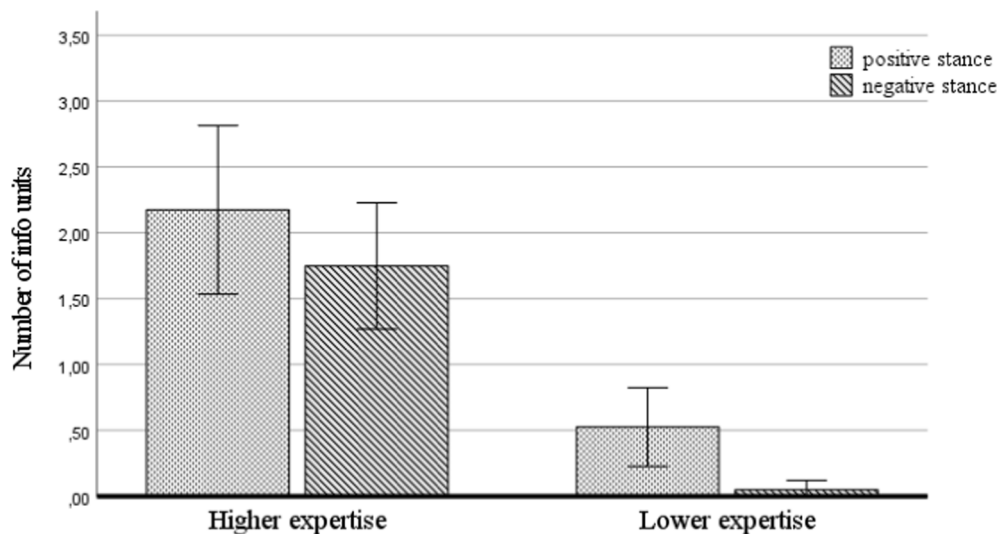


Fig. 4b. Information units from higher and lower expertise authors with a positive or negative stance toward deep learning in the justification by authority condition. Error bars represent 95 % confidence intervals.

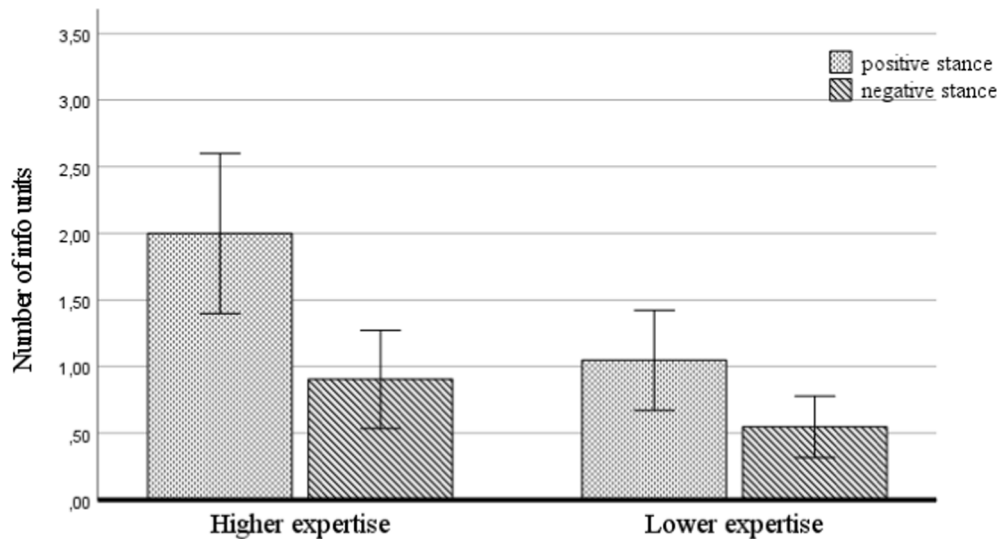


Fig. 4c. Information units from higher and lower expertise authors with a positive or negative stance toward deep learning in the justification by multiple sources condition. Error bars represent 95 % confidence intervals.

multiple document literacy, and refutation texts in a unique way. Using a refutation text approach typically applied to correct more neutral and narrow scientific misconceptions (Zengilowski et al., 2021), we demonstrated that such an approach led to changes in teacher students' beliefs about how knowledge claims about educational topics encountered on the Internet should be justified, and that such changes in beliefs were accompanied by changes in how participants performed across the stages of a complex multiple document literacy task. As such, this study complements and extends prior work on refutation texts by showing its effectiveness in a new domain (Zengilowski et al., 2021), as well as prior correlational work linking dimensions of epistemic justification to multiple document literacy (Bråten et al., 2016; Cartiff et al., 2018).

With respect to the substantial changes in participants' beliefs about epistemic justification that resulted from the refutation text intervention, we would argue that this is an important finding in and of itself. Although comparably brief interventions have been shown to influence students' beliefs about intelligence (Dweck, 1999), also in the form of a refutation text approach (Torsney et al., 2021), prior intervention research targeting different dimensions of epistemic justification

through a brief text-based approach is lacking. The finding that Internet-specific beliefs about epistemic justification in a particular content domain can be strongly influenced by a brief intervention utilizing a refutation text approach suggests that such an approach may be used to promote adaptive epistemic justification in the context of reading and learning on the Internet, such as consideration of expertise and comparison across sources (Binali et al., 2021; Hämäläinen et al., 2021; Kammerer et al., 2021; Karimi & Richter, 2021).

Still, it can be argued that an even more important finding of this study is that beyond its effects on participants' beliefs about epistemic justification, the refutation text intervention, as expected, also impacted participants' performance on a whole sequence of subsequent multiple document literacy tasks concerning a specific educational topic. This is consistent with theoretical frameworks highlighting the potential roles of epistemic justification in multiple document literacy (Bråten et al., 2011; List & Alexander, 2019), in particular with List and Alexander's (2019) proposal that such epistemic beliefs may influence readers' stance to task completion and, as such, have consequences for their performance in various stages of a multiple document literacy task,

including the selection, processing, and use of multiple documents.

Thus, with respect to the selection process, we found that participants reading a text promoting reliance on external expertise in justifying knowledge claims, and changing their beliefs accordingly, predominantly selected documents written by researchers, whereas participants reading a text promoting reliance on personal judgment and experience selected as many documents written by teachers as by researchers. Further, participants reading a text promoting reliance on multiple sources of information, although selecting more documents written by researchers than by teachers, did still not ignore documents written by teachers in the selection process. As expected, these findings indicate that in the essential stage of document selection, a refutation text intervention and changes in participants' beliefs about epistemic justification that such an intervention brings about can both constrict and expand the types of sources that participants have available in later stages of a multiple document literacy task.

With respect to how participants justified their selections of documents, the findings were also consistent with our expectations in that changes in participants' beliefs about epistemic justification were mirrored by the written justifications that they provided for their document selections. Justifications for document selections can be considered a form of enacted justification beliefs (i.e., beliefs in action), with our findings suggesting that the justification beliefs participants adopted were not inert but rather operational in the sense that they transformed into corresponding justifications in a multiple document literacy task.

With respect to how participants processed the selected documents, the reading time data indicated that the effects of the refutation text intervention in terms of changes in beliefs also extended to the processing stage of multiple document use (termed the "execution stage" by List & Alexander, 2019). Thus, as expected, participants relying most on external expertise focused on what the researchers said about deep learning irrespective of their stance toward the issue, whereas participants relying most on internal, personal means of justification focused most on what the researchers said only to the extent that they conveyed a positive view on deep learning. As such, the latter group of participants largely ignored that experts may hold opposing views about the issue in question. Also as expected, participants relying most on comparing information across multiple sources seemed to focus more evenly on the four categories of documents.

The widespread effects of the refutation text intervention and participants' adoption of particular beliefs about epistemic justification were further evidenced by the information that participants included in their reports in the final stage of the multiple document literacy task (termed the "production stage" by List & Alexander, 2019). In essence, the patterns we observed with respect to participants' inclusion of information units from different types of documents were consistent with the patterns we observed with respect to the processing time. These patterns also suggest that the adoption of stronger beliefs in justification by authority and justification by multiple sources, respectively, may counteract readers' tendency to process and use documents that agree with their own prior beliefs about a topic (see also, Karimi & Richter, 2021). Importantly, the effects of the intervention targeting justification beliefs that initially transferred to the selection of documents were also apparent in the final stage of the multiple document literacy task when participants composed their reports based on the available documents.

An interesting question concerns the interpretation of the change in the epistemic justification dimensions that we observed as a result of the intervention. Because participants' overall scores on these dimensions may not seem particularly low, their changes from pre- to post-intervention may also be considered rather unimpressive. However, as our main analyses concerning the effects of the intervention on participants' beliefs about epistemic justification showed, there were large effects of experimental condition on each dimension of epistemic justification. This means that participants reading a refutation text targeting a particular dimension increased their scores on that dimension much

more than did participants reading refutation texts targeting the two other dimensions. Further, such increases on particular dimensions of epistemic justification proved their importance by impacting a whole range of essential multiple document literacy tasks.

Another interesting question concerns why participants in the personal justification condition, given the large effect on their beliefs, did not select even more documents written by teachers, focused even more on such documents during processing, and included even more information from such documents in their task products. One possibility is that participants in this condition leaned relatively much on documents written by researchers, albeit with a stance toward deep learning consistent with their own, because they participated in a research project with data collected by researchers in the context of the college classroom. Another, related possibility, is that these participants felt that researchers with a positive stance toward deep learning would provide stronger support for their own prior beliefs about the issue. Further, we cannot exclude the possibility that reliance on researchers was privileged because the refutation text itself was said to be published in an educational journal and referred to research on the issue. On the other hand, the authority of the refutation text in this regard could also be assumed to promote reliance on personal means and multiple sources more than another type of refutation text (e.g., taken from a personal blog and referring to anecdotal evidence). These questions illustrate that to gain more insight into why participants performed as they did in the different stages of the multiple document literacy task, the type of data we collected may have to be supplemented with more qualitative data, such as verbal protocol or interview data, within mixed methods designs.

The issue of expertise also merits further consideration. That is, it could be questioned whether our participants really regarded the researchers as more expert than the teachers on the educational issue in question (i.e., deep learning). This question is relevant because both teacher students and teachers have been found to rely more on sources derived from teaching practice than on theoretical and research-based sources, also in a Norwegian context (e.g., Bråten & Ferguson, 2015; Ferguson et al., 2022). However, in this study, we observed that participants who had read a refutation text designed to promote reliance on expert knowledge/an expert/an author with high expertise and competence, notably without ever mentioning that expert knowledge was possessed by researchers (rather than by teachers), almost exclusively selected, processed, and used documents written by researchers (and also referred much more to researchers and research when justifying their document selections). We would argue that the only reasonable interpretation of this finding is that our participants actually considered the researchers to possess higher expertise than the teachers about this issue. Still, future research in this area could measure teacher students' and teachers' perceptions of the expertise of researchers and teachers with respect to an educational issue more directly. Also, contrasting educational researchers with authors who are more obviously less expert with respect to educational issues, such as parents or other laypersons, seems relevant in future research.

Although our demonstration that the effects of the refutation text intervention targeting beliefs about epistemic justification transferred to an authentic multiple document literacy task is noteworthy, we do not know, of course, whether the effects also would transfer to more spontaneous, self-initiated work with multiple documents in a scholarly setting, not to speak of what would happen when students engage with multiple documents out of school. Therefore, further work is needed to probe potentially far transfer (Barnett & Ceci, 2002) resulting from our intervention, including to contexts in which students search for, select, process, and use multiple documents on the open Internet.

Another issue related to transfer or generalizability is that our participants did not really have any clear preferences for a particular way of justifying knowledge claims at the outset (see Table 2), which may have made their beliefs about epistemic justification easier to change. This also raises the question of whether the belief changes we observed in this

study were merely expressions of compliance or agreement with the content of the refutation texts rather than real epistemic changes. Of note is, however, that the effects of our intervention on participants' beliefs were not only large but also transferred to a whole sequence of subsequent multiple document literacy tasks, which seems hard to explain without assuming that real, effective changes took place. Still, although the topic-specific beliefs that we targeted can be considered highly relevant in the context of teacher education, future researchers should also try to change justification beliefs concerning other topics for which participants have clear preferences through a refutation text approach, including beliefs concerning more value-laden issues for which "deep epistemic disagreements" exist (Chinn et al., 2020; p. 167). Of course, future research in this area also needs to probe the long term effects of a refutation text intervention on students' beliefs and subsequent task performance in addition to its generalizability.

It should also be noted that we did not use a refutation text of exactly the same nature and for the same purpose that is typical in the domain of science (Zengilowski et al., 2021). Specifically, in this study, we deviated from the classic procedure by not refuting and replacing incorrect beliefs that participants held themselves but by using a similar text format to refute particular beliefs about epistemic justification purportedly held by others and promoting alternative beliefs. Further, none of the types of justification beliefs that we targeted, including beliefs in personal justification, could actually be termed a misconception in the sense of being incorrect. Thus, we would argue that evaluating knowledge claims found on the Internet about an educational topic in light of their understanding and knowledge about the topic (i.e., personal justification) can also be considered an adaptive or availing form of epistemic justification for teacher education students, corresponding to the emphasis on prior knowledge activation within text comprehension more generally (McCarthy & McNamara, 2021). Of note is also that the effect of the intervention in terms of personal justification was shown on a dimension of the Internet-Specific Epistemic Justification Inventory that targeted use of one's own prior knowledge and reasoning in evaluating claims about educational topics, rather than personal opinion (which has been shown to be less adaptive in prior research; Bråten et al., 2016). However, although our innovative application of the refutation text format was successful in promoting each of the three types of epistemic justification, future research in this area could attempt to promote all these types of epistemic justification simultaneously, that is, by targeting a combination of reliance on one's own

prior knowledge and reasoning, reliance on external expertise, and corroboration across multiple sources, with particular emphasis put on some of these dimensions dependent on the context.

Finally, in acknowledging several limitations of the current study and the need for much further work to overcome them, we remain enthusiastic about the educational potential of a refutation text approach for the combined areas of justification beliefs and multiple document literacy. This approach may be used separately, as we did in the current study, or integrated into a more comprehensive approach, such as the digital document mapping scaffold created and evaluated by Barzilai and colleagues (2021). According to these authors, the scaffold they created to facilitate comprehension and integration of multiple documents can also be considered an epistemic scaffold that supports epistemic processes, including epistemic justification, and, given our findings, it could be explored whether this scaffold might be further strengthened by embedding a refutation text component in the approach.

Notes

1. The average length of the expanded versions of the 12 documents was 201.33 words ($SD = 6.58$). Readability scores ranged from 43 to 53 ($M = 46.00$, $SD = 2.98$), indicating a difficulty level comparable to that of information texts from the Norwegian government.

2. All but three participants (from different experimental conditions) answered this question correctly.

3. This button brought participants back to the page on which the list referring to all 12 web texts was located. Using this button, nine participants selected one additional text each, three participants selected two additional texts each, and one participants selected three additional texts. These participants were distributed across the experimental conditions.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A

Refutation Text in Each Condition (Translated to English from Norwegian)

Bedre Skole, no 4, 2018

[Introduction – all conditions]

In a recently conducted investigation of what Norwegian teacher students think and believe about different educational topics, it was used a questionnaire that asked them to report how they judged whether the information they found on the Internet was reliable. This investigation received much attention and was fiercely discussed in many classrooms across the country.

[Refutation and explanation – personal justification]

Many teacher students believed that the best ways to decide what is reliable knowledge about educational topics when they read on the Internet, are to judge whether the information comes from an expert or judge whether different sources agree with respect to this topic. This is not correct, however. An expert may lack practical pedagogical knowledge about the topic, and that several sources say the same thing about this topic does not mean that those who say something have practical knowledge about the topic. The most appropriate way to judge whether information about educational topics on the Internet is trustworthy, is therefore to take one's own understanding and knowledge about the topic as a starting point. If the information comes from one or more authors who are out of touch with practical pedagogical reality, there may be good reason to be skeptical about this information. On the other hand, information in accordance with the practical knowledge and experiences of a teacher student or a teacher will be more reliable because it is based on personal knowledge about the topic.

[Refutation and explanation – justification by authority]

Many teacher students believed that the best ways to decide what is reliable knowledge about educational topics when they read on the Internet, are to judge whether the information agrees with their own understanding and knowledge about the topic or judge whether different sources agree with respect to this topic. This is not correct, however. The reader may be wrong, and that several sources say the same thing about this topic does not

mean that those who say something have expert knowledge about the topic. The most appropriate way to judge whether information about educational topics on the Internet is trustworthy, is therefore to judge whether the information comes from an expert. If the information comes from an author who is not an expert in the area, there may be good reason to be skeptical about information from this author. On the other hand, information that comes from an author with high expertise and competence will strengthen the reliability of the information one reads about an educational topic on the Internet because the expert has a more solid basis for expressing himself or herself accurately.

[Refutation and explanation – justification by multiple sources]

Many teacher students believed that the best ways to decide what is reliable knowledge about educational topics when they read on the Internet, are to judge whether the information comes from an expert or judge whether it agrees with their own understanding and knowledge about the topic. This is not correct, however. Both an expert and the reader himself or herself may be wrong; in both cases it is only about individual persons. The most appropriate way to judge whether information about educational topics on the Internet is trustworthy, is therefore to check what several different types of sources say about the same topic. In this way, one can check whether there is agreement between the different sources with respect to this topic. If one particular source stands out with a peculiar view, there may be good reasons to be skeptical about information from this source. On the other hand, correspondence among several different sources will strengthen the reliability of the information one reads about an educational topic on the Internet.

[Closing – all conditions]

This is an important topic because many teacher students express that they search for and read information about educational topics on the Internet. To be able to judge the reliability of this information in an appropriate way is therefore a necessary competence for a teacher student.

Appendix B. Source and content information displayed for each document in the list

Professor Andreas Lie, Center of Excellence in Mathematics Teaching, University of Agder
Nordic Studies in Mathematics Education, no 2, 2018

An important principle within deep learning is that students should connect new information to what they already know.
The issue is, however, that a one-sided emphasis on this principle can hinder as well as help students' learning.
Educational research has solidly documented that students' previous knowledge just as well can lead them astray.

Teacher Ole Martinsen, Eidsvåg School, Bergen
Educationalnews.no, March 29, 2019

When students are going to learn something new, it is absolutely essential that they build on what they already know about the topic. This is something experienced teachers have been aware of for a long time. In the field of practice, it is generally acknowledged that new subject matter must be anchored in students' previous knowledge and experiences.

Educational researcher Inger Rasmussen, Department of Education, University of Bergen
Norwegian Journal of Education, no 6, 2018

A central element in deep learning is that students organize their knowledge in conceptual systems. The teaching must therefore be adapted such that students themselves discover how various concepts hang together, that is, how they are similar and how they are different. This new emphasis on systematic concept teaching is solidly anchored in research on what works.

Teacher Liv Moe, Setermoen School, Bardu
Educational News, no 1, 2019

Today some researchers emphasize that students learn best through organizing their knowledge in conceptual systems. But it is totally unrealistic to expect that all students will learn in such a way. Those of us who work in schools daily and see how different the students are, know that a very different approach is needed in Norwegian schools.

Senior researcher Øyvind Mathisen,
Norwegian University of Science and Technology, Trondheim
Research.no, May 3, 2019

Nobody can disagree that today's youth will face great societal challenges. The new curricula make it look like deep learning can provide students with the creativity needed to overcome these challenges. From a research perspective, this seems totally unfounded.

Teacher Frode Knutsen, Østersund Lower Secondary School
Aftenposten.no, April 26, 2019

Yesterday's solutions are not suitable for dealing with the great challenges that today's youth will face in the future. Therefore, we need to educate students who can come up with new ideas and solutions. An important reason to welcome deep learning is that such a pedagogical approach can promote creativity.

(continued on next page)

(continued)

Professor Elin Berge, Department of Education, University of Southeast Norway
Bedre Skole, no 4, 2018

We live in a society in which we are continuously bombarded by incoherent and partly conflicting information. Such a situation may lead to confusion, frustration, and passivity both in and out of school. Deep learning is a pedagogical strategy that can counteract this by giving students a better understanding of how things hang together.

Teacher Elisabeth Fredriksen, Mølladammen School, Bærum
Bærums Budstikke, June 21, 2019

In today's society, all the world's information is just a keystroke away. Such a situation provides unimaginable possibilities for gaining new knowledge. One has to be informed about a host of topics to exploit these possibilities, but if one follows the principles of deep learning, the risk is that the students will never learn about many of these topics.

Teacher Bente Svendsen, Engebråten Lower Secondary School, Oslo
nrk.no, November 1, 2018

Deep learning emphasizes that students should understand what knowledge is and how knowledge is generated. Knowledge is something being created by people who try to understand how nature and society work. As teachers, our main task is to help students gain an understanding of what is required for something to be called knowledge.

Associate Professor Linda Bakke, Center for Lifelong Learning, Inland Norway University of Applied Sciences
Journal of University and College Education, no 2, 2018

The authority of the teacher has long been threatened in Norwegian schools. Today's slogan is that the students should construct knowledge themselves, preferably with as little interference from the teacher as possible. When deep learning becomes even more important in the new curriculum, I fear that it will make bad matters worse. Respect for valid knowledge must be grounded in reliance on academic authorities.

Researcher Tom Solberg, Nordic Institute for Studies in Innovation, Research, and Education
NIFU-report no 6, 2019

To learn how to learn is as important as learning subject matter. Some may believe that students learn how to learn by working with as much different subject matter as possible. But, in fact, jumping from one thing to another provides little insight into one's own learning process. To the contrary, to understand one's own learning and develop good learning strategies, it is necessary to study only one topic in depth at a time.

Teacher Stian Eide, Borgheim Lower Secondary School, Nøtterøy
Theteacherportal.no, September 20, 2019

Many students are passive and helpless in learning situations. These students need systematic teaching of study techniques to improve their learning. This is not something they will discover on their own; in this area, instruction by experienced and skilled teachers is required. To believe that deep learning almost automatically will lead to better learning strategies is unrealistic wishful thinking.

Appendix C

Coding system for scoring the written justifications for document selections

| Justification | Definition | Examples |
|---|---|--|
| <i>Personal justifications</i> | References to participants' own knowledge, understanding, experiences, opinions, or interest in relation to deep learning, as well as to the authors' practical experiences and personal knowledge of teaching. | I chose this text because I personally believe in the organization of knowledge into conceptual systems. I chose this text because I want a teacher's view on deep learning since it is the teachers who work with the students and see what works in school. |
| <i>Justifications by authority</i> | References to the competency or expertise of the authors, their academic positions and affiliations, their knowledge of research and research methods, and their research publications. | The author is highly educated (professor) and works at an acknowledged institution in the area. I chose this text because the author is a school researcher and because it was published in Norwegian Journal of Education. Additionally, it says that this is grounded in solid research in the area. Research based knowledge. |
| <i>Justifications by multiple sources</i> | References to participants' wish to check and compare different sources or perspectives, as well as to gain a more complete understanding of the issue. | I chose this web text to show the contrast between a researcher's perspective on deep learning and what a teacher with practice based knowledge thinks about deep learning. That is, to get a different view on the issue. It is important to read different opinions about the topic, such that one can see several aspects of it. If one just chooses those that speak positively about what you like, you will only find things that support what you already think. It is therefore important to consider both sides of an issue. |

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