Watch out! - An instruction raising students' epistemic vigilance augments their sourcing activities

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Abstract

Most students profit from the easy accessibility of online information, but specific competencies for successful reading on the internet are seldom taught during class. Therefore, students might not be able to choose credible information autonomously. Empirical evidence suggests that high school students hardly evaluate the credibility of sources ("sourcing") when reading multiple documents. Consequently, effective interventions which foster sourcing skills are needed. This study evaluates the effects of a written instruction designed to augment sourcing activities in a multiple document reading task by inducing epistemic vigilance. The written instruction introduces the concept of the division of cognitive labor and informs about low editorial control on the internet. In comparison to a control group, students receiving the instruction prior to completing an internet research task showed more attention to, evaluation of, and memory for sources.

Keywords: learning from multiple documents; instructional design; source evaluation, division of cognitive labor

Introduction

The internet offers a unique opportunity for accessing a virtually infinite amount of information in a short period of time. Learning from online information offers various conveniences. All over Europe 85% of 9 to 16 year old students draw on the internet for school related tasks (Haddon, Livingston & the EU kids Online network, 2012). Learning from online sources increases with age (Medienpädagogischer Forschungsverband Südwest, 2014) so that students in middle-school often face the task of choosing their information independently, without teachers providing preselected materials. Besides many advantages, reading online may also pose certain difficulties for readers. The freedom in online publication leaves the internet as a melting pot of information. Until now, online content does not mostly have to overcome the hurdles of editorial control. Therefore, the information spectrum on the web provides undisputed knowledge as well as controversial debates and information that is outright false. Similarly, information on the internet largely differs in term of its credibility, since not every author online is an expert on the topic or has the intention to give unbiased information. Therefore, strategies for evaluating source credibility should be a topic specifically addressed in class. Providing teachers with feasible teaching techniques dealing with students' source evaluation skills is an important step to address the gap between students' intense use of online information and the low amount of instruction for critical online reading.

Theoretical background

Sourcing as a Strategy for Validity Judgments

The variable quality of online information suggests that internet users frequently encounter conflicting propositions. According to the content-source-integration (CSI) model (Stadtler & Bromme, 2014) readers undergo three processing steps when confronted with conflicting information: detecting the conflict, regulating their understanding of the conflict, and finally resolving the conflict by evaluating the validity of competing claims. Regarding the final step, Bromme, Kienhues and Porsch (2010) distinguish between two strategies for successful validity evaluation: first-hand ("what to believe") and second-hand evaluations ("whom to believe?"). For first-hand evaluations, readers evaluate arguments based on their prior knowledge, and for second-hand evaluations, they process source features rather than the content itself. However, when researching information on complex scientific issues (e.g., medical information), the complexity of the content may soon exceed the readers' capabilities, suggesting that first-hand evaluations may be of limited value in the case of low prior knowledge. Readers might

then be well advised to defer to experts and engage in second-hand evaluations instead.

Two factors that have been found to influence whether individuals trust a source are its perceived expertise and its perceived benevolence (Mayer, Davis & Schoorman, 1995). The crucial role of expertise is rooted in the division of cognitive labor, meaning that knowledge is distributed unevenly among the members of our society (Keil, Stein, Webb, Billings, & Rozenblit, 2008). Since the whole extent of world knowledge exceeds the capacities of a single person, individuals stay laypersons in many domains, but may gain expertise (e.g., by academic training) in selected fields. Consequently, each individual can only arrive at a bounded understanding in most domains and needs to identify competent sources when it comes to knowledge beyond his or her areas of expertise (Bromme & Goldman, 2014). This may be done by reflecting on source parameters while reading online, such as the author's affiliation or professional background.

The importance of benevolence is rooted in the manifold functions of the internet, which serves as a platform for information, entertainment, communication and commerce. Therefore, authors pursue various goals, such as informing, entertaining, convincing and selling. Consequently, not every author is benevolent (i.e. has the reader's interest in mind), but he or she may present information in a way that supports his or her own vested interests. Again, readers may scrutinize source parameters, such as the author's affiliation to make inferences about the level of benevolence.

Do Students Use Sourcing Strategies while Searching the Internet?

Despite the importance of sourcing, empirical studies find that readers at varying age levels hardly pay attention to source features and often do not construct source-content-links (e.g., Britt & Aglinskas, 2002; Stadtler & Bromme, 2007; 2008). Even when the topic's complexity exceeds students' prior knowledge and when the information across sources is conflicting, they hardly cite or highlight source parameters (Kobayashi, 2014). For example, Stadtler, Babiel, Rouet, and Bromme (2014) found that students hardly visit imprint pages (i.e. pages containing source information) while reading a series of web documents. This lack of sourcing behavior seems especially striking when compared with small children's early sourcing competencies. In face-to-face situations, children do not blindly trust an informant, but evaluate an informant's expertise and benevolence when deciding whom to trust (Harris, 2012). In a similar vein, Stadtler et al. (2014) demonstrated that when reading short texts and receiving explicit instructions, ninth graders show good sourcing skills, such as identifying sources, rating authors' expertise and intentions and choosing appropriate links. These findings suggest that students do not lack crucial competencies for sourcing, but might have problems to put their competencies into action spontaneously. A similar conclusion could be drawn from intervention studies, which improve sourcing activities short term, but do not lead to significant transfer (Walraven, Brand-Gruwel, & Boshuizen, 2013). Furthermore, past attempts to improve students' sourcing skills often focused on prompts to evaluate sources (Stadtler & Bromme, 2007; 2008), instead of explaining the general scope of the importance of sourcing.

The present research examines whether the missing link between adolescents' fundamental sourcing skills and their spontaneous application might lie in the motivation to be epistemically vigilant (Sperber, Clément, Heintz, Mascaro, Mercier, & Origgi, 2010). Readers might not put their sourcing competencies into action unless they do not have good reasons to believe that they run the risk of receiving invalid information. That said, introducing secondary-school students to the division of cognitive labor and the publication principles on the internet might raise epistemic vigilance.

The Present Study

This study sets out to evaluate the effect of a written instruction, providing students with reasons for why they should be epistemically vigilant whilst answering a question based on online information. More precisely, we investigated if the students' choice of evaluation strategies ("what to believe" vs. "whom to believe") in the final stage of processing conflicting information (i.e. conflict resolution) can be influenced by a written instruction elaborating on the division of cognitive labor and the low editorial control on the internet (hereafter referred to as "vigilance instruction"). We hypothesized that the vigilance instruction would lead the students to question the validity of the content, as well as their own capability of evaluating the arguments based solely on their prior knowledge. Therefore, the intervention group, receiving the vigilance instruction, should show more sourcing activities when evaluating the validity of the information compared to a control group. This use of sources should be reflected in three outcomes.

First (H1), we assumed that a vigilance instruction increases students' **attention to sources**. Consequently, students in the intervention group should show more attention to sources during a multiple document reading task. This should be reflected in more visits of and longer dwell times on imprint pages containing source information. Additionally, students in the intervention group should spend less time on content pages.

Secondly (H2), we hypothesized that the vigilance instruction augments students' **consideration of sources** in an argumentative essay that requires students to take a stance on the topic. Therefore, we expected students who receive a vigilance instruction to cite more sources and to make more evaluative comments on sources when justifying their decisions. In addition, we expected students in the intervention group to be more likely to adapt the stance of a source high in expertise and benevolence.

Finally (H3), we assumed that students in the intervention group would construct more source-content-links (Perfetti,

Rouet & Britt, 1999), indicated by better **memory for sources**.

Method

Participants and Design

The study was conducted using a between-participant design. Participants were randomly assigned to a control or an intervention group. A total of 120 middle school students from a German "Gymnasium" (i.e., a school track in the German educational system leading to graduation which qualifies for university access) participated in this study. Due to technical error, the data from eight students had to be excluded. This left us with 112 participants (70% female; mean age = 14.73 years, *SD* = .54). 48,2% of the students reported using the internet at least several times a week or more for searching information for school, which is comparable to a representative German sample (48% of 12-19 year-olds) (Medienpädagogischer Forschungsverband Südwest, 2013).

Materials

Reading Instruction Both groups received an instruction to conduct an internet search on a controversial medical topic. This instruction asked students to imagine that their school's cafeteria sold drinks containing aspartame and that lately many discussions about the potential negative side effects of aspartame had arisen. Students were tasked to find out whether the consumption of the artificial sweetener aspartame has adverse health effects.

The intervention group received an additional text (221 words) on the same page, explaining the uneven distribution of knowledge in the society and the phenomenon of low editorial control on the internet ("Besides experts who are knowledgeable about aspartame, also authors who hardly know anything about aspartame comment on the topic.").

It was explained how these two factors make readers dependent on the sources' competence and good intentions ("…it is possible that information about aspartame is presented one-sided or in a biased way"). It was argued that evaluating source information can protect readers from being misinformed ("… it is not sufficient to understand what the text says. You additionally have to find out who provides the information."). Finally, students were advised to check for source information on every website they visit ("Ask yourself on every website: Does the author have enough expertise about the topic?").

Reading Materials Readers were presented with six websites providing information about the topic aspartame (*M* = 144.7 words, *SD* = 25.4). These were accessible via a link list that resembled a standard search engine result page. Three articles provided arguments supporting the claim that aspartame is not health damaging, whereas three sources claimed the opposite. Each argument was only provided once, so that arguments found in the students' argumentative essays could be traced back to its respective source. Text difficulty and argument credibility were held constant so that processing the content alone did not offer a clear-cut conclusion about the harmfulness of aspartame. Source information was presented on imprint pages that could be accessed via hyperlinks starting from the respective content page. Authors differed in expertise and intention, which could be inferred from their occupations and affiliations. For instance, a benevolent expert source was the spokesman of an independent governmental organization, the European Food Safety Authority (EFSA) providing information on an official website. An example of a malevolent lay-source was the website of a farmer, who has a vested interest in pronouncing the hazardous effects of aspartame as his business sells aspartame-free sodas.

Source information was designed to lead students to the conclusion that aspartame is not harmful (e.g., claimed by the benevolent expert-source and contradicted by the malevolent lay-source). Students who process source information therefore should arrive at the conclusion that aspartame is not health damaging.

Covariates

Several covariates[1] were included in order to control for their respective influence on the dependent variables.

Self-reported Prior Knowledge and Topic Interest Self-reported prior knowledge was measured with three items (e.g., "I know a lot about aspartame"). Topic interest was measured with two items (e.g., "I am interested in the topic of food ingredients"). Students rated all items on 1 to 5 point Likert-scales and mean value for prior knowledge and interest were calculated.

General Reading Capabilities Students' general reading capability was measured using a standardized test inventory in German language (LGVT 6-12; Schneider, Schlagmüller, & Ennemoser, 2007). Students have four minutes to read a text of 1,727 words. The text follows a cloze procedure which repeatedly requires students to choose the correct word from a list of three options. The individual coefficients of reading speed and reading comprehension are calculated from the number of words read within the given time limit and the number of words correctly selected.

Dependent Measures

Attention to Sources For measuring students' attention to sources, their navigation patterns were recorded and two main measures were extracted: number of visits to imprint and content pages and dwell times on imprint and content pages (in seconds).

[1] Please note that we collected further data on individual differences in source identification and source evaluation skills in the present sample. Because this data falls out of the scope of the present contribution, it is not reported in this paper.

Consideration of Sources when Justifying an Own Stance After reading, students were tasked to express their own stance on the controversy and provide reasons for their decision in a written essay. The students' essays were content-analyzed in terms of their consideration of sources. More precisely, we analyzed (1) the number of source references, (2) the number of evaluative statements about sources and (3) the sources of the arguments provided by the students. As (1) source references, we counted all references that made clear which source was being referred to (e.g. names, affiliations, occupations). (2) Evaluative statements were coded if students' answers referred in any way to the benevolence, expertise or general credibility of a specific source (e.g., knowledge about the topic, financial interest, trustworthiness). As an indirect measure of sourcing, argument use (3) was coded: arguments were traced back to their sources in order to analyze which sources the students relied on when justifying their decision. Additionally, students were asked to indicate their decision by marking their choice ("aspartame is health damaging" vs. "aspartame is not health damaging"). Two independent raters coded 40 essays. Inter-rater reliability was medium to high, Cohen's Kappa ranging from .79 to 1.

Memory for Sources To measure the memory for sources, students were presented six paraphrases of arguments that were used in the texts. Using a multiple-choice format, students had to indicate the correct source for each statement from a list of six options. To prevent students from guessing, they could also select a "don't know"-option. A score of correct answers (0 to 6) was calculated from students' answers (Cronbach's $\alpha = .64$).

Procedure

First, all students completed the items measuring self-reported prior knowledge and topic interest. Next, students were divided randomly into group A and group B due to a limited number of available computers. Group A completed the LGVT and questionnaires measuring the covariates, whereas group B started to work on the reading task. Students completed the task individually and were not allowed to take notes. Reading time was limited to ten minutes.

In the following, group A and group B switched rooms and tasks. Finally, students were thanked, debriefed and rewarded with sweets. The whole session lasted approximately 90 minutes (= 2 lessons).

Results

Means and standard deviations of the dependent variables are listed in Table 1.

Covariates

Self-reported Prior Knowledge and Topic Interest Students' self-reported knowledge on aspartame was rather low ($M = 1.09$, $SD = .34$) and their self-reported personal relevance moderate ($M = 2.85$, $SD = 1.00$). Both groups did not differ in their prior knowledge, $F(1,110) = .21$, *ns*) or topic interest, $F(1,110) = .14$, *ns*) concerning aspartame. Furthermore, the two variables did not show significant bivariate correlations with the dependent measures and therefore were not included as covariates in the following analyses.

General Reading Capabilities Students demonstrated average reading comprehension *(*T- Values*: $M = 49.63$, $SD = 9.10$) and reading speed scores (T- Values: $M = 50.12$, $SD = 8.52$). Intervention and control group did not differ in reading comprehension, $F(1, 110) = 2.13$, *ns*, or reading speed, $F(1, 110) = 2.20$, *ns*. Reading speed scores showed a significant negative bivariate correlation with dwell times on content pages ($r = -.315$, $p < .001$) and reading comprehension was correlated negatively ($r = -.251$, $p = .008$) with the number of different sources students drew arguments from. Therefore, reading speed and comprehension were included as covariates in the corresponding analyses. For the other dependent variables, no significant bivariate correlations were found.

Dependent Measures

Attention to Sources In line with H1, students in intervention group visited more imprint pages than students in the control group, $F(1,110) = 31.23$, $p < .001$, $\eta^2 = .221$. Regarding dwell times on imprint pages, students in the intervention group spent more time on imprint pages than students in the control group, $F(1,110) = 36.81$, $p < .001$, $\eta^2 = .251$. An ANCOVA including reading speed as a covariate showed that students in the control group spent more time on content pages than students in the control group, $F(2,109) = 6.04$, $p = .016$, $\eta^2 = .052$. In sum, log file data suggest that the vigilance instruction increased students' attention to sources and averted their attention from the content itself.

Table 1: Means and standard deviations (in parentheses) of the collected dependent measures for control group (CG) and intervention group (IG).

	condition	
	CG	**IG**
Attention to sources		
Visits IP	.71 (1.82)	3.30 (2.95)
Time on CP (sec.)	441.48 (80.93)	411.80 (91.25)
Time on IP (sec.)	7.14 (19.90)	51.31 (50.71)
Consideration of sources		
References	.09 (.48)	.79 (1.22)
Evaluations	.09 (.48)	.59 (1.11)
Arguments	2.5 (1.40)	2.04 (1.53)
Source memory	1.89 (1.56)	2.66 (1.72)

IP = imprint pages; CP = content pages

Consideration of Sources Students in the intervention group cited significantly more sources, $F(1,110) = 16.00$, $p < .001$, $\eta^2 = .126$, and included more evaluative comments on sources, $F(1,110) = 9.61$, $p = .002$, $\eta^2 = .080$ than students in the control group. An ANCOVA controlling for reading comprehension revealed that the essays of students in the control group contained arguments from a higher number of different sources than students in the intervention group $F(2,109) = 4.58$, $p = .035$, $\eta^2 = .040$. The overall stronger consideration of sources was also reflected in the students' decisions on the controversy. Students in the intervention group were more likely to adopt the stance proposed by the benevolent expert-source, that aspartame is not health damaging ($\chi^2 = 10.54$, $p = .001$).

Memory for Sources Regarding memory for source-content links, students in the intervention group showed a better memory performance than students in the control group, $F(1,109) = 6.14$, $p = .015$, $\eta^2 = .053$. In line with H3, results suggest that the vigilance instruction supported the construction of source-content-links.

Discussion

This study evaluated the effects of a written instruction aiming to increase readers' epistemic vigilance on attention to, consideration of and memory for sources in a multiple document reading task. In line with our expectations, students receiving written input on the division of cognitive labor and on the lack of editorial control on the internet engaged more frequently in sourcing strategies in order to determine the validity of the provided information, than students not receiving any input. Students in the intervention group visited imprint pages more frequently and spent more time on these pages (H1). They also cited more sources in an argumentative essay, commented more often on source credibility and were more likely to adopt the stance of the benevolent expert-source. Analysis of student statements also revealed that students in the control group borrowed arguments from a larger variety of available sources, whereas students in the intervention group seemed to select their arguments more thoroughly. The latter do not mention arguments from many different sources, but justify their decisions with fewer arguments chose to underpin their decisions with source information (H2). In doing so, students from the intervention group drew on their memory for source information, which proved to be better than among students from the control group (H3).

Interestingly, general reading abilities were not associated with students' sourcing behavior. From this we derive that sourcing might not be a facet of general reading ability and is not automatically applied by good readers. On the contrary, sourcing needs to be motivated with the help of explicit instructions. Our study suggests that a written instruction inducing epistemic vigilance is a potential tool for improving students' sourcing activities in a multiple document task containing conflicting information.

Since our intervention did not teach any technical sourcing skills (e.g., how to rate expertise and intentions) our results support the findings by Stadtler et al. (2014), who claim that students do not lack general sourcing skills per se, but may not be aware of *when* the application of their skills is needed. Therefore, an instruction raising their epistemic vigilance during online research enables them to put their sourcing competencies into action. Our results also offer an explanation why intervention studies promoting sourcing often fail to promote transfer (Walraven et al., 2013). If students are not aware of the fact that every search on the internet holds a high risk of being misinformed they do not apply their newly acquired skills autonomously to every online activity, but may exclusively apply them when requested to do so.

As an educational implication we suggest that informing students about the division of cognitive labor in society combined with explications about publication mechanisms on the web will raise students' considerations of sources during their internet research. We suggest that sourcing should be taught as an *additional* approach to judging validity of information and the need to evaluate *both*, arguments and sources, should be promoted during class.

A limitation of this study lies in the instruction's combination of *informing* students about online publication principles and *prompting* them to source at the same time. Currently, we cannot rule out the possibility that students' enhanced sourcing can be attributed to their obedience to the sourcing request instead of their deeper understanding of the reasons for sourcing. However, previous research showed that simple instructions to attend to sources did not raise the level of source attention to a notable extent (e.g., Britt & Aglinskas, 2002; Gerjets, Kammerer & Werner, 2011). Nevertheless, future studies need to disentangle the effects of prompting and providing reasons for sourcing. To this end, we shall conduct a slightly modified replication of our study, which adds a "prompting-only" condition to the experimental design. In addition, data on transfer of the acquired skills is needed to determine whether students are able to apply their sourcing skills spontaneously and in a variety of tasks and reading contexts. Additionally, in order to examine actual learning, transfer should be measured in long-term studies, revealing if the intervention's effects on sourcing are maintained over time. Only if transfer over task and time is achieved, students will be able to apply their skills when they are searching for information without guidance, as for example at home for schoolwork.

Future intervention studies could build on the present findings and teach knowledge about the division of cognitive labor and editorial control on the web. If a short written instruction leads to enhanced sourcing, a more elaborate lesson and practice might yield even greater success and prove as an effective tool to close the gap between students' autonomous search for information and their autonomous sourcing behavior.

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