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Mônica Macedo-Rouet, Ladislao Salmerón, Christine Ros, Ana Pérez, Marc Stadtler, et al.. Are frequent users of social network sites good information evaluators? An investigation of adolescents' sourcing abilities. *Infancia y Aprendizaje*, 2020, Special issue: How adolescents read and learn on the Web: Internal and external factors / Número especial: Cómo leen y aprenden los adolescentes en la red: factores internos y externos, 43 (1), pp.101-138. 10.1080/02103702.2019.1690849 . hal-03100419

HAL Id: hal-03100419

<https://hal.science/hal-03100419>

Submitted on 8 Jan 2021

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Are frequent users of social network sites good information evaluators?

An investigation of adolescents' sourcing abilities

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Citation :

Macedo-Rouet, M., Salmerón, L., Ros, C., Stadtler, M., Perez A., Rouet, J.-F. (2020). Are frequent users of social network sites good information evaluators? An investigation of adolescents' sourcing abilities (¿Son los usuarios frecuentes de las redes sociales evaluadores competentes? Un estudio de las habilidades de los adolescentes para identificar, evaluar y hacer uso de las fuentes). *Infancia y Aprendizaje / Journal for the Study of Education and Development*, 43(1), 101-138.
10.1080/02103702.2019.1690849

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Abstract

This study investigates the relationship between teenagers' use of social networking sites (SNS) and their sourcing abilities. Sourcing is defined as students' ability (1) to discriminate reliable and unreliable links based on source characteristics, (2) to value source criteria as means to select information resources, and (3) to select reliable texts based on source characteristics. One hundred forty-six students (*M* age = 14.7 years old) completed three sourcing tasks, a questionnaire on SNS use, as well as language and memory skills tests. We found that SNS frequency of use negatively predicted both participants' ability to select the most reliable source among two conflicting sources on the same topic, and their ability to cite source features when justifying their choice. SNS frequency of use was unrelated to students' assessment of source criteria, but vocabulary level was positively related to performance in this task. We discuss various explanations for the observed relationship between teenagers' SNS communication and their critical appraisal of information sources, and we propose avenues for instructional interventions aimed at fostering information skills.

Keywords: sourcing, evaluation criteria, social network sites use, adolescence

Are frequent users of social network sites good information evaluators?

An investigation of adolescents' sourcing abilities

Social network sites (SNS) have become part of teenagers' daily life. According to recent surveys, 40 to 50% of European and US teens are almost constantly online on SNS, thanks to increased access to smartphones and other mobile devices (Anderson & Jiang, 2018; Livingstone, Mascheroni, Ólafsson, & Haddon, 2014; Tsitsika et al., 2014). Similar figures are reported in other parts of the world (Barbosa, 2013). SNS such as Facebook, Twitter, Instagram, and Snapchat, are web-based services that allow individuals to construct a public or semi-public profile, connect it to a list of other users, and view the connections made by others (Boyd & Ellison, 2008). Applications can vary in their technical features and user base, but all of them display visible profiles that contain lists of “friends” (people with whom an individual has a relationship) who are also users of the system. This allows users to communicate with friends and family and monitor what other people are saying or doing.

Intensive SNS use raises a number of questions regarding their potential impact on various aspects of teenagers' life. For instance, are teens making more social contacts than before? Are they developing new knowledge and skills? Can frequent SNS use affect their academic performance? One issue of particular interest is whether SNS use relates to teenagers' literacy skills. Although the phrase social networking may draw connections with visual as opposed to written communication (e.g., posting pictures of family events), a fair amount of SNS communication is actually done in writing. A growing number of studies have begun to examine the relationships between SNS use and schooling, (e.g., Junco, 2012; Kirschner & Karpinski, 2010; Tess, 2013), but only a few have examined the relationship between SNS use and reading literacy (Lee & Wu, 2013; Naumann, 2015; Salmerón, García, & Vidal-Abarca, 2018). In this study, we focus on a specific component of reading literacy, namely one's ability to identify and critically assess information sources.

Sourcing can be defined as the ability to attend to, evaluate, and use available or accessible information about the sources of documents (Bråten, Stadtler, & Salmerón, 2018; Wineburg, 1991). Because the Web is a vast space where anyone can publish virtually anything, sourcing is considered a critical aspect of literacy (Britt, Rouet, & Durik, 2018; Metzger & Flanagin, 2008). Evaluating the information source is one of the strategies that can help readers decide whom to trust, when and why (Paul, Macedo-Rouet, Rouet, & Stadtler, 2017). Previous research shows that most adolescents struggle to perform accurate source evaluation, especially when the content is unfamiliar or controversial (Coiro, Coscarelli, Maykel, & Forzani, 2015; Salmerón, Macedo-Rouet, & Rouet, 2016; Stadtler, Scharrer, Macedo-Rouet, Rouet, & Bromme, 2016). The conditions that may foster, or to the contrary hinder, adolescents' sourcing skills are still largely unspecified.

In this study, we focused on the potential relationship between teenagers' SNS use and their ability to evaluate sources while reading and searching for Web-based information. Because SNS provide students with opportunities to read what different people say about different things, their use may be positively associated with increased sourcing abilities. However, SNS use is based on the premise that members of one's network are "friends". In addition, teenagers report using SNS mostly for entertainment purposes (Ifinedo, 2016). Therefore, intensive use of SNS may in fact divert teenagers from other, more cognitively challenging uses of the Internet and reduce their opportunities to think critically about information sources (cf. displacement hypothesis, Mutz, Roberts, & Van Vuuren, 1993). Finally, it may be that no direct causal link exists between teenagers' use of SNS and their acquisition of sourcing links, but that both dimensions of their behavior are influenced by common factors. In the next sections, we introduce the construct of sourcing and we specify source dimensions that are most critical for source evaluation. We then review the literature on the relationship between SNS use and sourcing, and we present the rationale for our study.

Sourcing and critical source dimensions

A source may be defined as information about the origin of a document and the circumstances of its production, such as who the author is, when and where the document was published, and so forth (Bromme, Stadtler & Scharrer, 2018; Rouet & Britt, 2014). The literature on Web search (e.g., Rieh, 2002) has elicited a large number of features that may participate in users' decisions to engage with information. A few of these features arguably play a critical part in assessing the quality and credibility of a piece of information.

The role of information sources in readers' comprehension and use of information, both in print and online, has raised increasing attention on the part of researchers over the past three decades (e.g., Barry, 1994; Rouet, Britt, Mason & Perfetti, 1996; Strømsø & Bråten, 2002; Wineburg, 1991; see Bråten et al., 2018, for a recent review). Sourcing has been defined as a set of processes that allow readers of multiple documents to build a “documents model”, i.e. a representation of a document set that connects content information from the documents to their respective source (Britt, Rouet, & Durik, 2018; Perfetti, Rouet, & Britt, 1999). Sourcing processes include the location and evaluation of source features in a document, the use of source information to interpret content, and connection building between a particular source and a particular content (Bråten et al., 2018; Rouet & Britt, 2014). For instance, a reader may check the publication date of a document in order to evaluate whether information is up to date; or they may check the authors' credentials to determine their respective level of expertise when comparing two texts on the same topic.

Sourcing can occur at different stages of the information-seeking process (Rieh, 2002). Readers may look up source information in order to evaluate the relevance of a document prior to reading it (Rouet & Britt, 2011), or when browsing through a list of links in a search-results page in order to determine which sites are most adequate (Rieh, 2002). Once they engage with a document, readers may examine source information to determine whether the

information is current, reliable, neutral, complete and so forth. Finally, they may engage in sourcing when comparing a set of documents containing conflicting views on the same topic (Rouet, Mason, Britt & Perfetti, 1996; Wineburg, 1991). Source information may help readers place conflicting statements into perspective, understand the cause of the conflict, and decide on an interpretation of the situation (Merkt, Werner, & Wagner, 2017; Stadtler & Bromme, 2014).

Based on a review of studies on experts' information evaluation criteria, Pérez et al. (2018) identified three critical dimensions of source evaluation: author position (*"who says what"*), author motivation (*"why the author says it"*) and media quality (*"where it is published"*). Author position refers to an author's credentials, occupation and professional experience with the topic at hand. Expert readers are attentive to these characteristics and recognize information provided by qualified authors as more accurate and reliable (Rieh, 2002; Rouet et al., 1996). Author motivation refers to the intentions or benevolence of an author when he/she issues a message. Bad intentions or meanness, as well as commercial and ideological biases affect expert readers' perceptions of authors' credibility (Porsch & Bromme, 2011; Wineburg & McGrew, 2017). Finally, media quality refers to the level of information validation prior to publication. Web services that allow users to publish information without prior reviewing (e.g., forums) display a low level of validation, whereas those that impose internal and external filters (e.g., scientific journals) display a high level of validation. Taken together, author position, author motivation, and media quality represent key criteria for evaluating information from the Web.

SNS frequency of use and sourcing

Research has examined the possible role of SNS use as a means to foster teenagers and young adults' argumentation and sourcing skills (Ellison, Steinfield, & Lampe, 2007; Greenhow, Gibbins & Menzer, 2015; Puhl, Tsovaltzi, & Weinberger, 2015). For example, Greenhow et

al. (2015) used a tool embedded in Facebook to examine adolescents' and young adults' awareness and use of multiple sources while arguing about socio-scientific topics. Participants for this study ($N = 346$, age range 16-25) were recruited through the listserv of an environmental magazine, and were not enrolled in any formal science course. The authors analyzed 971 comments posted by 31 of the participants in response to a posted story. Of these, 345 referred to specific sources or perspectives (e.g., "*Wow, Shell Oil, we think your commitment to 'tackl[ing] climate change' just fell off the back of the truck*"), and 225 reflected conflict-oriented consensus building (e.g., "*Regardless of what Congress knows, our representatives need to realize that We the People want them*"). The authors concluded that active SNS use could foster the use of advanced argumentation skills. Similarly, Puhl et al. (2015) analyzed the effects of a "group awareness" tool embedded in Facebook on students' ($N = 63$, mean age 24) attitude change during a university course. Students who used the tool significantly increased their level of multi-perspective/flexible attitude, which the authors defined as "preferring analyses of conflicts that consider and potentially synthesize different perspectives of the involved parties and are flexible with respect to possible solutions" (p. 609). Here again, participation in a SNS was associated with a greater awareness of perspectives and sources.

These studies suggest that when organized as part of formal or informal learning scenarios, SNS use may provide users with opportunities to appreciate and reflect on multiple perspectives. This finding is consistent with the Documents model framework (Perfetti et al., 1999) and more specifically with the Discrepancy-Induced Source Comprehension hypothesis (D-ISC; Braasch, Rouet, Vibert, & Britt, 2012; Braasch & Bråten, 2017). The D-ISC hypothesis proposes that exposure to discrepant statements triggers students' attention to sources as a means for them to relate the discrepancy to conflicting perspectives or interests. Author (2012) found that students reading short stories in which two characters issued

discrepant (vs. consistent) statements spent more time reading the descriptions of the characters, and later remembered more accurately who said what. In line with this finding, Salmerón et al. (2016) reported that adolescents' attention and use of sources (measured as the probability to recommend a particular suggestion from an Internet forum based on the credibility of the author) was increased when the authors provided discrepant suggestions in the forum, compared to when the suggestions were consistent. In sum, research has found some evidence that when adequately prompted, SNS use is positively associated with source awareness and use of multiple sources. Whether the behaviors evidenced in these studies transfer to regular use of SNS under spontaneous, unprompted conditions remains to be demonstrated.

Other studies have investigated the relationship between reported SNS use and adolescents' performance in digital reading in the context of PISA assessments, which include a few items assessing source evaluation (Schleicher, Zimmer, Evans, & Clements, 2009). Based on data from the PISA study, Lee and Wu (2013) investigated the relationships between 15 year-old students' use of online social entertainment and their level of reading literacy ($N = 87,735$). They found a negative relationship between social entertainment and reading literacy, mediated by the use of metacognitive strategies. The more students engaged with social entertainment the less they knew metacognitive strategies, and the weaker they performed in reading tasks. Interestingly, information-seeking activities (i.e., reading online news, using an online dictionary, and searching for practical information on the Web) had a positive indirect effect on reading literacy. The authors speculate that information-seeking activities lead students to set goals in relation to information needs, whereas social entertainment merely led students to "wander around" without a specific goal, thus failing to support the development of metacognitive strategies that are useful in reading literacy.

Naumann (2015) studied the relationship between online social interaction and navigation patterns of participants ($N = 29,395$) in the PISA 2009 digital reading assessment. He found that the more students engaged in online social interaction (e.g., chatting or blogging), the lesser they adapted their Web site navigation to task demands. In low demanding tasks, frequent SNS users visited relevant pages many times although the answer could be found in just one visit. This negative effect of SNS use on navigation was significant in nine countries, but failed to reach significance for the whole sample. Naumann concluded that social engagement is “probably not detrimental”, but also “not hugely beneficial” to digital reading performance. Using a task similar to the digital reading assessment from PISA, Salmerón et al. (2018) also found a nonsignificant negative correlation between SNS use and performance in a sample of 7-10th grade students ($N = 558$, age range 12-16). Conversely, the frequency of use of the Internet for information-seeking tasks was positively with participants' test scores.

The latter set of studies suggest a negative correlation between the frequency of SNS use for social entertainment and reading literacy. Time spent socializing on SNS may not contribute *per se* to the development of strategies that are necessary for efficient navigation and evaluation of multiple sources. On the contrary, adolescents who report intensive use of SNS for social entertainment are less likely to display such strategies. These findings do not support any direct causal attribution, though. Rather, they suggest that intensive SNS use may be related to other variables that affect individuals' propensity to engage in cognitively demanding tasks, such as sourcing. At least two more studies further support this hypothesis: Zhong, Hardin, and Sun (2011) found evidence that students with a high "need for cognition" (as evidenced in their responses to the questionnaire designed by Cacioppo & Petty, 1982) use SNS less often than students with low need for cognition. Carpenter and colleagues (2018) demonstrated that students with high actively open-minded thinking draw more correct

inferences about authors' traits and use more references to others' speech in social media messages, than students with low actively open-minded thinking. SNS may be more appealing to students who are not so inclined to put effort in source evaluation. Additionally, more time spent on SNS for social entertainment means less time spent on other activities. As Bell, Bishop and Przybylski (2015) put it, "rather than technology affecting young people's capacities, the displacement of other activities seems to be an important source of negative effects" (p. 1).

Research based on self-reported frequency of use shows that SNS use tends to be negatively correlated to reading literacy, although the trend is not always significant. Importantly, this practice could also be detrimental for sourcing skills, as the time students devote to socializing on SNS would detract them from other activities requiring a more active stance toward sources, thus indirectly affecting the development of their sourcing skills.

Rationale of the present study

The purpose of the present study was to investigate the specific relationship between SNS frequency of use and a set of precisely defined sourcing skills. Our review of the literature shows support for two opposite trends. On the one hand, a few studies have found that SNS users can be good source evaluators when they are provided with appropriate tools to actively engage in public debate and assess multiple sources (Greenhow et al., 2015; Hargittai & Hsieh, 2010). But other studies have shown that the most intensive SNS entertainment users tend to be poor source evaluators, perhaps because they display low need for cognition (Cacioppo & Petty, 1982) and spend a lot of time navigating and not much time reading texts that may foster sourcing skills (Naumann, 2015; Zhong, Hardin, & Sun, 2011). Moreover, SNS use may interact with other variables associated with sourcing, such as reading fluency and vocabulary skills, working-memory capacity, and internet search experience (Lee & Wu, 2013).

However, thus far research has defined sourcing rather holistically, as one of many components of digital reading skills. Our purpose is to provide a more detailed assessment of sourcing skills among frequent and less frequent SNS users. Consistent with Bråten et al.'s (2018) definition, we operationalized sourcing as a) the ability to discriminate reliable and unreliable links on the basis of source criteria, b) the ability to assess source criteria when deciding whether to use a particular document for a particular task, and c) the selection of reliable documents on the basis of source characteristics. Furthermore, to better isolate the influence of SNS use, we controlled for the effect of adolescents' vocabulary, reading fluency skills, working memory capacity, internet use for information seeking, and parental education level.

Based on the literature review, our specific hypotheses regarding SNS use and sourcing were:

- H1: Frequent SNS use will negatively predict students' ability to discriminate reliable and unreliable links on the basis of source features.
- H2: Frequent SNS use will negatively predict students' appraisal of source criteria when deciding whether to use a particular document.
- H3: Frequent SNS use will negatively predict students' selection of the most reliable source when comparing reliable and unreliable sources on the same issue.
- H4: Students' citation of source features to justify their selection will negatively correlate with the frequency of SNS use

Method

Participants

The present study was part of a larger investigation of the impacts of a pedagogical intervention on adolescents' sourcing skills (Pérez et al., 2018). Participants were drawn from an initial sample of 189 students who attended ninth grade classes in four public French secondary schools. The schools were located in different neighborhoods of a middle-sized city and students came from various social and cultural backgrounds (e.g., 19% spoke a second language at home). In each school, two intact classrooms participated in the larger study. Parental consent was obtained prior to the investigation. There was some attrition in the sample due to students missing one of the sessions of data collection. For the present study, the inclusion criteria were: (1) being a French native speaker (all but two students); (2) participating in the assessment of sourcing skills before the intervention (pre-test); and (3) completing the technology use questionnaire and the standardized tests for language and memory skills. The final sample included 146 students (M age = 14.7 years old, range 13-17; 78 girls), about one fourth from each school.

Materials and measures

The materials consisted of three sourcing skills assessment tasks, one questionnaire (technology use and parental education level), two standardized tests of language skills (reading fluency and vocabulary) and a working memory task. More details about the materials may be found in Pérez et al. (2018).

Sourcing skills assessment tasks. Three tasks assessed students' sourcing skills in line with our operational definition of sourcing: the link evaluation task, the criteria evaluation task, and the multiple-document evaluation task.

Link evaluation task. The goal of this task was to measure adolescents' ability to discriminate between reliable and unreliable links based on available source cues. Students were presented with a list of nine short descriptions of Web pages that represented links

returned by a search-engine in response to a query about a specific topic (e.g. “*The period of world history called Cold War*”). Students rated whether they would consult each link in order to get “quality information” about the topic on a scale of 0 (certainly not) to 4 (certainly). We manipulated author position, author motivation, and media quality to create four types of links: (a) good links, which contained reliable features on all three dimensions (e.g., “*The website of the Ministry of Education which provides a record of the Cold War written by a professor of history*”), (b) fair links, which contained reliable features on two dimensions (e.g., “*The article of a student film-maker about the causes of the Cold War, published on the website of an academic journal*”), c) poor links, which contained reliable features on one dimension (e.g., “*The blog of a student's parent offering his personal reflections about the Cold War*”), d) bad links, which contained unreliable features in all dimensions (e.g. “*The Facebook page of a History books’ seller who comments on a book about the Cold War*”). Reliable and unreliable features were derived from our definition of the three critical source dimensions (e.g. regarding author position, a reliable feature was the author’s professional status: “professor of history”). The ninth link was a topically-mismatched control item (e.g., for the “Cold War” topic, the link referred to cold weather in countries under war). The links were classified as “good, fair, poor, and bad”, according to a two-step procedure. First, the authors discussed the classification and submitted it to seven experts who were either researchers ($N = 4$) or librarians ($N = 3$) who served in a national educational authority. These experts suggested minor changes and validated the classification. Then, a pilot-test with 12 adolescents ($M = 14.59$ years old; range: 13-16) who were appointed as “above average” at their grade level by their teachers and did not take part in the main study was conducted. This test (a) did not show significant differences among the three topics and (b) manifested a main effect of type of link, indicating that students were able to discriminate more reliable (good and fair) from less reliable (poor and bad) links.

A *discrimination index* was calculated to measure sourcing abilities. Raw scores assigned by each participant to the nine links were transformed into standardized (z) scores, thus controlling for interindividual differences in scale use. We then subtracted the average standardized score attributed to poor and bad links, from the average standardized score attributed to good and fair links. A score close to zero would mean “weak or no discrimination”. A positive score would mean that students correctly discriminated good/fair from bad/poor links, whereas a negative score would mean that discrimination occurred in the opposite sense. We generally expected that high SNS frequency of use would be associated with lower scores on the discrimination index.

Criteria evaluation task. Students were instructed to rate their perceived influence of ten criteria when selecting information on a scale from -3 (negative influence) to 3 (positive influence). The specific prompt was: *“Imagine you’ve found a document that deals with [the search topic]. Before you decide whether to use it in your presentation, please rate the influence that each of the criteria below would play on your decision”*. The list of criteria is presented in Appendix A. Criteria #2, 4, 6, 7, 8, 9, and 10 were related to source information (e.g., “author has professional experience”), whereas criteria #1, 3, and 5 were related to students’ opinion or content (e.g., “a nice writing style”). The latter aimed at controlling for the possibility that some students could be biased towards extraneous criteria (i.e. not related to the source dimensions). Mean scores for each item were calculated. The control criteria had little impact and were excluded from further analyses (see Results section).

Multiple-document evaluation task. This task aimed at evaluating adolescents’ ability to interpret conflicting views about the same topic by attending to source information. Students were instructed to read two short texts about a specific scientific or historical topic, which was different from the two other tasks. Subsequently, students had to answer two questions: (a) *“Is one of the documents better than the other to prepare for your school*

presentation?” (multiple-choice: “*Text A*”, “*Text B*”, “*Both are at the same level*”); (b) “*Why? Justify your answer*” (open-ended). Documents were presented side-by-side, and they both contained: a title (7-9 words), one paragraph with source information (i.e., URL, date, author’s name, profession and institution, and publication media), and one paragraph of text (53-60 words). An example of these materials is presented in Figure 1. The two texts expressed conflicting views about the topic (e.g., one sustained that solar energy is economically efficient and the other argued that solar energy is not efficient because of its cost). Two measures were obtained from this task: (1) selection of the trustworthy source, (yes/no), and (2) the citation of at least one source feature to justify their selection (yes/no). Accordingly, students were credited with one point if they chose the text containing the more reliable source (zero point if they chose the other text or both texts), and one point if they cited at least one source feature in their answers (zero point otherwise).

<INSERT FIGURE 1 ABOUT HERE>

Questionnaire of SNS and internet use. The questionnaire asked students to report: (a) the devices available at home and/or personally (smartphone, tablet, laptop computer, PC, with/without internet); (b) how frequently in the past 6 months they had used: “SNS for communicating with friends and family”, “the internet to search for school-related information”, “the internet to search for information for personal purposes”. Therefore, the first question focused on SNS use for social entertainment, and the last two questions focused on internet use for information seeking purposes (either personally or for school). The scale for frequency of use ranged from 1 (“*Never*” or “*I don’t know what it is*”) to 7 (“*several times a day*”). Raw scores were used for SNS frequency of use, and the average of school and personal internet search scores was used as an index of information seeking, based on the fact that scores for the latter two questions were significantly correlated, $r(145) = .41, p < .001$.

Questionnaire of parental education level (SES). The questionnaire asked students to report on their parents' level of education, by checking for each parent one of four levels adapted from the ISCED index (OECD, European Union, & UNESCO Institute for Statistics, 2015): primary education (up to 5th grade), lower secondary education (up to 9th grade), upper secondary education (up to 12th grade), higher education. These levels were coded with values from 1 to 4. Following previous work (Ehmke & Siegle, 2015; Säälík, 2015), only the highest level from both parents was used in the analyses.

Language skills tests. A reading fluency test and a vocabulary test were administered to adolescents. The reading fluency test called "Pipe and rat" (Lefavrais, 1986) requires students to read through a list of common words arranged in lines of 6 items over three full pages. Students have to mark every animal name in the list, for a limited time of 3 minutes. The word reading ability score is the number of words correctly marked minus the number of words mistakenly marked. The vocabulary test was the French version (Deltour, 1998) of the Mill Hill Vocabulary Scale (Raven, 1965). Only the second part of the test was administered, as suggested by Vigneau (2007). In this test, 33 items of increasing difficulty are presented in a page, with six potential synonyms per item. The student has to underline the correct synonym and the final score is the number of correct synonyms identified.

Working memory. To test working memory capacity, we used the standardized letter-number sequencing task (WISC-IV; Wechsler, 2005). The test was administered to the whole class simultaneously. The test administrator uttered a series of alternating numbers and letters, and students had to first report the numbers in ascending numerical order, and then the letters in alphabetical order. Difficulty increased progressively from a block of 2 to a block of 7 items, including three trials per block. A practice with a block of 2 and a block of 3 items was provided to ensure that students understood the instructions. The total score was the sum of all items included in the trials correctly recalled, with a maximum score of 81.

Procedure

Data collection took place on different days over a six-week period. The protocols were administered in print format, whole-class settings, in the presence of the teacher. The first day was dedicated to the assessment of adolescents' sourcing skills and reading fluency. The experimenters were introduced by the teacher in charge of the class. They explained the goals of the study, and distributed the first assessment (sourcing) to the participants. Students completed the sourcing tasks silently, at their own pace. Once a student had completed the tasks, he/she received a filler task (Sudoku). After all students were done (approximately 25 minutes), they took the reading fluency test (3 minutes). The vocabulary and working memory tests were administered four weeks after, during the first post-session of the intervention study (Pérez et al., 2018). The SNS and internet use questionnaire was administered two weeks after the previous tests. During the six-week period, students were taught to assess sourcing criteria. However, no instruction regarding technology use or any of the control variables of the study was provided. At the end of the last session, the participants were invited to ask questions about the goals and the details of the study. They were then thanked and dismissed.

Results

All variables were normally distributed (see Table 1). SNS frequency of use ($M = 5.21$, $SD = 1.83$) and information seeking index ($M = 4.33$, $SD = 1.67$) were high on average, indicating that most students used SNS for communication and the internet for information seeking everyday or almost everyday. Further, on average, adolescents were at standard levels of vocabulary, reading fluency and working memory for their age and school level.

Approximately half of the students selected the most trustworthy webpage (52%), and a third cited a source feature to justify their selection (36%). The average discrimination score was M

= 0.88 ($SD = .76$), indicating that most students somehow discriminated reliable from unreliable links.

<INSERT TABLE 1 ABOUT HERE>

Correlations between these measures indicated that SNS frequency of use had a significant negative correlation with the three main dependent variables of sourcing skills (see Table 2). Vocabulary, reading fluency and working memory capacity positively correlated with at least one of the dependent variables. Finally, the frequency of information seeking and parental education did not correlate with any of the dependent variables, and therefore were not retained in the subsequent analyses.

<INSERT TABLE 2 ABOUT HERE>

To test hypothesis 1 (H1), we performed a linear regression analysis controlling for the effect of vocabulary, reading fluency and working memory in step 1, and adding SNS frequency of use at step 2, on the link discrimination index (see Table 3). In the step 1, the model was significant, $R^2 = .14$, $F(3, 137) = 7.49$, $p < .001$. Adding SNS frequency of use added variance to the model, $F_{change}(1, 136) = 4.54$, $p < .05$. The final model was significant, $R^2 = .17$, $F(4, 136) = 6.90$, $p < .001$. Both, vocabulary and SNS frequency of use were significant predictors ($p < .01$ and $p < .05$, respectively). Students' scores on the link discrimination index improved along with vocabulary levels, and decreased with frequency of use of social networks.

<INSERT TABLE 3 ABOUT HERE>

To test H2, we considered students' responses to the criteria evaluation task. Specifically, we focused on the criteria that referred to sourcing factors (i.e., #2, #4, #6, #7,

#8, #9 and #10). As a first step to identify the underlying structure of the questionnaire, we computed an exploratory factor analysis using Oblimin rotation. Three factors had initial eigenvalues above 1: factor 1 with items #4, #8 and #10; factor 2 with items #6, #7 and #9 (see Table 4); and factor 3 with only item #2 (“*The author has a personal experience about the topic*”). The first two factors were in line with our theoretical assumptions, as factor 1 corresponded to items referring to different forms of author position or “*authority*”, and factor 2 to items referring to different aspects of author motivation/media quality or “*bias*”. As factor 3 only included item 2 and did not match any theoretical dimension, this item was dropped from further analyses. Subsequently, we ran a Partial Confirmatory Factor Analysis (PCFA) using the same rotation to test a two-factor structure (Gignac, 2009). The two-factor solution replicated factors 1 and 2 from the exploratory analyses, and explained 54.35% of the variance. Overall, the model had a good fit, $NFI = 0.95$, $CFI = 0.99$, $RMSEA = 0.04$.

<INSERT TABLE 4 ABOUT HERE>

Considering the two-factor solution model, we tested the influence of SNS frequency of use on the utilization of evaluation criteria (H2) by performing linear regression analyses controlling for the effect of vocabulary, reading fluency and working memory in step 1, and adding SNS frequency of use at step 2, on the average scores of the items corresponding to each of two factors identified in the PCFA. For factor 1 responses, the initial model was significant, $R^2 = .06$, $F(3, 137) = 2.80$, $p = .042$, but adding SNS frequency only changed the model marginally, $F_{change}(1, 136) = 2.93$, $p = .089$ (see Table 5, left columns). Vocabulary was the only significant and positive predictor ($p = .032$), indicating that higher levels of vocabulary were linked to using authors’ authority to positively evaluate documents. For factor 2 responses, the initial model was significant, $R^2 = .07$, $F(3, 137) = 3.02$, $p = .032$, but SNS frequency of use did not change the model (see Table 5, right columns), $F_{change}(1, 136) =$

1.11, $p = .294$. Vocabulary was the only significant and negative factor indicating that higher vocabulary was related to using source biases to negatively evaluate documents.

In order to test H3, we ran a binomial logistic regression with the same factors and steps as in the first model, on the selection of the text containing the reliable source (yes/no). While the model in step 1 resulted in no significant effects, $\chi^2(3) = 5.67, p = .133$, the inclusion of SNS frequency of use in step 2 significantly increased the variance explained in the model, $\chi^2(1) = 5.99, p = .014$. The final model (see Table 6) was also significant, $\chi^2(4) = 11.66, p = .020$, Nagelkerke's $R^2 = .11$. Moreover, two individual factors were significant: working memory ($p = .028$) and SNS frequency of use ($p = .017$) (all other factors $p > .792$). The probability to select the most reliable text increased as a function of working memory capacity and decreased as a function of SNS frequency of use.

<INSERT TABLE 5 and 6 ABOUT HERE>

Finally, to test H4, we reran the previous binomial logistic regression on the dependent variable of source citations in the explanations (yes/no). In step 1, the model was significant, $\chi^2(3) = 10.03, p = .018$, Nagelkerke's $R^2 = .09$ (see Table 7, left column), although none of the individual factors were significant (all $ps > .080$). In step 2, the inclusion of the variable SNS frequency of use increased explained variance significantly, $\chi^2(1) = 6.14, p = .013$. In addition, the final model was significant, $\chi^2(4) = 16.17, p = .003$, Nagelkerke's $R^2 = .15$ (see Table 7, right columns). The only significant factor was SNS frequency of use, $p = .015$. The probability that adolescents cited a source feature in their justifications decreased as a function of SNS use.

<INSERT TABLE 7 ABOUT HERE>

In sum, when confronted with conflicting texts on a scientific or historical issue, students who were frequent SNS users were less likely to select the most reliable document and to mention

source information in their justifications. These results are consistent with our hypotheses 3 and 4.

Discussion

The goal of the present study was to investigate possible relations between adolescents' SNS frequency of use and a set of tasks assessing specific dimensions of sourcing (i.e., the ability to attend to, evaluate and use source information from written documents). One hundred forty-six students (M age = 14.7 years) completed three tasks requiring the discrimination of reliable and unreliable links, the assessment of source criteria, and the evaluation of multiple documents offering conflicting views about scientific and historical topics. Several measures of technology use (including SNS frequency of use) as well as language and memory skills were gathered.

We found that SNS frequency of use negatively predicted adolescents' selection of the most reliable document among two conflicting documents on the same topic, and negatively predicted citation of source features when justifying their choice. The more students used SNS for entertainment purposes the less they chose the most reliable document (a Web page written by a competent author and published in a validated site) and the less they cited source features in their written justifications. Moreover, SNS frequency of use predicted the ability to discriminate reliable vs. less reliable links. The more students used SNS for entertainment, the less they discriminated between these types of links. Although there was a trend towards a negative relation between SNS frequency of use and students' appraisal of source "authority", this relation was not significant when other variables were taken into account. The only significant predictor of appraisal of the authority criterion was vocabulary.

These results support a negative (albeit not necessarily direct) relationship between SNS use and the selection of reliable information based on source criteria. In addition, they confirm the prevalent role of vocabulary in reading comprehension (Perfetti, 2007). The

association between SNS use and vocabulary needs to be further explored. For instance, we might speculate that teenagers with better language skills tend to engage in online activities that promote their awareness and use of more diverse information sources. Alternatively, because it relies on familiar language and communication acts, intensive SNS use for social entertainment might fail to promote vocabulary development, which would hinder teenagers' appraisal of source characteristics (e.g. understanding what a "scientific publication" or a "competent author" is). More research is needed to understand the links between the amount and type of online activities teenagers engage in, the development of their language skills and their ability to assess information sources critically.

Previous studies on adolescents' sourcing behavior have focused on the influence of document and task characteristics on students' reasoning (e.g., Braasch, Bråten, Strømsø, Anmarkrud, & Ferguson, 2013; Keck, Kammerer, & Starauschek, 2015), casting aside the life experiences that can shape teenagers' broader understanding of sources. The present study tried to fill in this gap by focusing on teenagers' use of SNS. In the wealthiest countries, virtually all teens use SNS to some extent, but with more or less intensity. Our study shows that the more time teenagers spend using SNS for social entertainment, the less they make use of source dimensions that are typical of expert readers when dealing with multiple documents. SNS may promote some kind of social participation, but potentially at the expense of reading literacy acquisition and academic outcomes (Jacobsen & Forste, 2011). It is thus important to understand whether and how SNS use relates to teenagers' appraisal of information sources.

The present study entails several limitations that reduce the scope of the findings and need to be addressed in future research. One of them is that our measure of SNS use is limited to frequency of use for communication purposes. Other researchers have criticized the simplification of correlational studies which use visiting frequency as the only measure to infer associations with other variables (Pasek, More, & Hargittai, 2009). Indeed, adolescents

use SNS for a variety of purposes, from communicating with friends and family, to reading news (Aillerie & McNicol, 2016). Two recent meta-analyses concluded that the correlation between SNS use and academic performance was small but negative, when considering as measure general SNS frequency of use (Huang, 2018; Marker, Gnambs, & Appel, 2018). By contrast, when analyzing frequency of use of SNS for academic purpose, the relation was small but positive (Marker et al., 2018). For the same reasons, internet use for information seeking should not be limited to two items as in the present study. Future studies should specify different types of SNS use and information seeking, and their expected impact on sourcing.

As a further limitation, the correlational nature of our data does not permit any causal inference. Thus, our study does not enable any conclusion regarding the causal link between SNS use and low literacy, or the reverse, or the intervention of a common underlying factor. To overcome this problem, future research should use controlled and/or longitudinal designs (e.g., Dienlin, Masur, & Trepte, 2017). A fruitful line of research would entail a manipulation of the conditions of SNS use to investigate whether some induced uses (e.g., using SNS for several months to actively participate in online discussions on political and/or controversial scientific topics) can lead to enhanced sourcing skills as compared to SNS use for entertainment and communication purposes. More participatory uses of SNS could encourage sourcing beyond socialization.

Acknowledgements

This study was supported by a joint grant from the Agence Nationale de la Recherche (grant ANR-12-FRAL-0015-01) and the Deutsche Forschungsgemeinschaft (grant STA 1291/1-41). We thank the teachers, staff, and students of the schools for their collaboration.

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Appendix A. List of source and other criteria used in the criteria evaluation task.

1. The text is easy to understand
2. The author has a personal experience about the topic
3. The text is written in a nice style
4. The author relies upon professional research
5. The conclusion corresponds to my own opinion
6. The author offers a personal reflection about the topic
7. The author has commercial interests in relation to the topic
8. The author writes in a scientific publication
9. The text is linked to a commercial offer (services or products)
10. The author has professional experience about the topic

<p>Text A</p> <p><u>Significant savings with solar energy</u></p> <p>Text found on www.solenergy_blog_NM.fr, October 14, 2015.</p> <p>Author: Nicolas Martin, professor of Sociology at the University of Strasbourg. In a personal blog he runs regularly, he shares an analysis of energy saving through solar drawn from his many meetings and lectures.</p> <p><i>“Although solar energy is still little developed, the results are nevertheless visible. I know many people who have installed solar panels at home, in cloudy regions, saving hundreds of euros per year. This saving can be even more important in the south of France.”</i></p>	<p>Text B</p> <p><u>The cost of solar electricity subsidies</u></p> <p>Text found on www.energy_science_journal.fr, December 20, 2014.</p> <p>Author: Jacques Dubois, researcher of alternative energy at the Higher School of Engineering in Lille. In an article published in the academic journal of Energy Science, he analyses the impact of solar energy in economy.</p> <p><i>“The cost of solar electricity subsidies exceeded 100 billion in France but their meager results jeopardize the country's transition to renewable energy. Our study shows that all solar plants combined produce less electricity than 2 nuclear reactors, which is insufficient to cover grants.”</i></p>
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Figure 1. Example of a pair of texts presented in the multiple-document evaluation task, where Text A is the less reliable source and Text B the more reliable source (translated into English from the original texts in French).

Table 1. Descriptive statistics for measured variables

Variable	<i>M (SD)</i>	Skewness (<i>SE</i>)	Kurtosis (<i>SE</i>)	Minimum	Maximum
Vocabulary	15.45 (4.57)	-.22 (.20)	-.13 (.40)	3	26
Reading fluency	86.37 (19.24)	.02 (.20)	.77 (.40)	29	144
Working Memory	4.80 (1.10)	-.37 (.20)	-.42 (.41)	2.5	7
Information seeking frequency	5.21 (1.83)	.01 (.20)	-.35 (.40)	1	7
Social network frequency use	4.33 (1.67)	.01 (.20)	-.96 (.40)	2	7
Link discrimination scores	0.88 (.76)	-.96 (.20)	.13 (.40)	-1.12	1.84
<hr/>					
Parental education	Low sec. = 13.4% Upper sec. = 46.3% Higher = 40.3%				
Selection of the most reliable document	52.05% selected trustworthy page				
Inclusion of source features in the explanations	35.62% included a citation				

Table 2. Correlations between the factors analyzed in the study and the three main dependent variables (selection of the trustworthy page, citations and link discrimination).

	Selection of the trustworthy text	Inclusion of citations in the explanations	Link discrimination
Vocabulary	.07 ^a	** .22 ^a	** .37 ^b
Reading fluency	.09 ^a	.11 ^a	* .19 ^b
Working Memory	** .23 ^a	** .22 ^a	.07 ^b
Parental education ¹	.06 ^a	.13 ^a	.11 ^a
Information seeking frequency of use	-.08 ^a	-.13 ^a	-.01 ^b
Social network frequency of use	* -.17 ^a	* -.21 ^a	* -.20 ^b

Note: * $p < .05$, ** $p < .01$; ^a Spearman Rho, ^b Pearson r ; ¹ Based on $N = 134$ due to incomplete data.

Table 3. Summary of multiple regression analysis for the effects of frequency of use of social networks and of vocabulary, reading fluency and WM on the scores of the link discrimination task.

Variable	Model 1			Model 2		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
Vocabulary	0.06	0.01	0.36**	0.06	0.01	0.35**
Reading fluency	0.00	0.00	0.05	0.00	0.00	0.06
WM	-0.02	0.06	-0.04	-0.03	0.06	-0.04
SNS frequency of use				-0.07	0.03	-0.17*
R^2		.14			.17	
F for change in R^2		7.49**			4.54*	

Note: * $p < .05$. ** $p < .01$.

Table 4

Factor loadings based on a PCFA for the document characteristics' evaluation task.

Item	Factor Loading	
	1	2
Factor 1: Authority		
4. The author relies upon professional research	.98	-.04
8. The author writes in a scientific publication	.45	.07
10. The author has professional experience about the topic	.25	-.07
Factor 2: Bias		
6. The author offers a personal reflection about the topic	-.03	.27
7. The author has commercial interests in relation to the topic	.04	.76
9. The text is linked to a commercial offer (services or products)	.01	.66

Table 5. Summary of multiple regression analysis for the effects of frequency of use of social networks and of, vocabulary, reading fluency and WM on the scores of the criteria evaluation task (Factor 1: Authority, Factor 2: Bias).

Variable	Factor 1 : Authority						Factor 2 : Bias					
	Model 1			Model 2			Model 1			Model 2		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
Vocabulary	0.04	0.02	0.19*	0.04	0.02	0.18	-.05	.02	-.21*	-.05	.02	-.20*
Reading fluency	0.00	0.01	0.00	0.00	0.01	0.01	-.01	.01	-.12	-.01	.01	-.13
WM	0.09	0.08	0.10	0.09	0.08	0.10	.04	.09	.04	.04	.09	.04
SNS frequency of use				-0.07	0.04	-0.13				.06	.05	-10
R^2		.06			.07			.07			.08	
F for change in R^2		2.80*			2.93			3.02*			1.11	

Note: * $p < .05$. ** $p < .01$.

Table 6. Summary of binomial multiple regression analysis for the effects of vocabulary, reading fluency, WM and frequency of use of SNS, on the selection of the trustworthy page.

Variable	Model 1			Model 2		
	<i>B</i>	<i>SE B</i>	<i>Exp(B)</i>	<i>B</i>	<i>SE B</i>	<i>Exp(B)</i>
Vocabulary	0.00	0.04	1.00	-0.01	0.04	0.99
Reading fluency	0.00	0.01	1.00	0.00	0.01	1.00
WM	0.37	0.17	1.45*	0.38	0.17	1.46*
SNS frequency of use				-0.24	0.10	0.79*
<i>Nagelkerke's R²</i>		.05			.11	
χ^2 for change in <i>R²</i>		5.67			5.99*	

Note: * $p < .05$. ** $p < .01$.

Table 7. Summary of binomial multiple regression analysis for the effects of vocabulary, reading fluency, WM and frequency of use of SNS, on the inclusion of a citation in the students' justifications.

Variable	Model 1			Model 2		
	<i>B</i>	<i>SE B</i>	<i>Exp(B)</i>	<i>B</i>	<i>SE B</i>	<i>Exp(B)</i>
Vocabulary	0.08	0.04	1.09	0.08	0.05	1.08
Reading fluency	0.00	0.01	1.00	0.00	0.01	1.00
WM	0.32	0.18	1.38	0.33	0.19	1.39
SNS frequency of use				-0.25	0.10	0.78*
<i>Nagelkerke's R²</i>		.09			.15	
χ^2 for change in <i>R²</i>		10.03*			6.14*	

Note: * $p < .05$. ** $p < .01$.