Building Information Literacy Skills Using Science News Media: Evidence for a Hands-On Approach

By Cassie Majetic and Catherine Pellegrino

News media reports of scientific discoveries are often oversimplified, lacking nuance and context. As a result, citizens need both science literacy and information literacy skills to both decode the science content in a media report and track down the original scientific literature that prompted the media report. This article evaluates the effectiveness of a scaffolded science and information literacy skill building assignment in an undergraduate environmental science course, modeled after real-world, information-seeking tasks. The authors assessed students' self-reported skills and confidence levels, both before and after they completed the assignment, and found clear increases both in students' skills in locating the original scientific article, as well as in their confidence in that skill; increases were especially notable for nonmajors. More modest gains were found for increased science literacy skills, suggesting future areas of instructional focus. The assignment is transferable to other introductory science courses and can be further adapted to emphasize skills in decoding science content in news media and in scientific literature.

For undergraduate students who do not go on to careers in science fields, news of scientific discoveries as reported in the popular media will be their most common interaction with science after they leave college (Funk, Gottfried, & Mitchell, 2017, pp. 22–24). Unfortunately, news media accounts of published scientific studies often suffer from a variety of shortcomings, including limited description of the study's methodology, overly specific language that eliminates nuance or uncertainty in the study's results, and implicit causation where only correlation was established (Hoskins, 2010; Korpan, Bisanz, Bisanz, & Henderson, 1997). All of these shortcomings contribute to a sensationalized treatment of science that draws in readers but can obscure the actual significance and relevance of the findings.

For undergraduate students to develop into educated, engaged citizens who can interact effectively with reports of scientific discoveries in the popular media, they need both science literacy and information literacy skills. Information literacy, defined as "the set of integrated abilities encompassing the reflective discovery of information, the understanding of how information is produced and valued, and the use of information in creating new knowledge and participating ethically in communities of learning," is necessary to locate and access the original primary literature that forms the basis of a popular media report (Association of College and Research Libraries, 2016, p. 3). And science literacy, defined as "the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity," is necessary to understand how scientific research works and to decode, at even a basic level, the science behind what is being reported in the media (National Research Council, 1996, p. 22). Together, these two skill sets allow students to evaluate reports of science in the news critically and are essential to enabling them to make sound decisions in a wide variety of areas, ranging from personal health choices to positions on public policy and engaged citizenship.

However, several studies demonstrate, as best summarized by Manuel (2002), that young adults "seemed poorly prepared to read critically the types of texts with which they will interact throughout their adult lives." Similar results have been found in English-speaking countries around the world, with both high school and undergraduate students (Korpan et al., 1997; Manuel, 2002; Murcia, 2009; Norris, Phillips, & Korpan, 2003;

Phillips & Norris, 1999). Compounding their inadequate skills, students also "may be more secure in their ability to analyze media reports of science than is warranted" (Norris et al., 2003, p. 139).

As a way of addressing these gaps, science educators have developed a variety of approaches to teaching students skills for engaging critically with science in the news media, most of which involved careful reading of science news articles, along with examining the evidence they provide and finding additional evidence to corroborate claims made in the news stories (Brickman et al., 2012; Clements & Guertin, 2016; Hoskins, 2010; Terry, 2012). In an earlier publication (Majetic & Pellegrino, 2014) we reviewed much of the relevant literature surrounding science literacy and the use of news and popular media reports of science in undergraduate classrooms. However, we found that in most of the studies we reviewed, students were interacting only with the news stories themselves and not with the primary research literature that often underlies the news reports.

A smaller number of educators have developed approaches that involve students with both news reports and the original research literature. Rangachari (2006) designed an innovative assignment in which students had to verify claims made in newspaper articles by corroborating those claims with "acceptable publications" (p. 7); possible sources for corroboration could have included the original research article but its use wasn't required. Most recently, Waddell (2016) designed an assignment in which students worked individually and in groups to find and read news articles, and then to locate, access, and read the corresponding articles in the science literature. Waddell's assignment was based on our previous work (Majetic & Pellegrino, 2014), in which we designed an assignment where students were required to track down the primary research article that formed the basis for one of a set of preselected news articles, then compare the account of the research and its conclusions as presented in the news article with the account from the research literature.

Although Rangachari's (2006) work asked students to verify claims in a news article, the students weren't necessarily required to locate original scholarly publications. Waddell (2016) specifically addressed the skill of locating and accessing the primary research literature, but her analysis of student progress was highly qualitative and anecdotal (pp. 216–218). Our previous work (Majetic & Pellegrino, 2014) detailed an approach to addressing both science and information literacy skills but offered no concrete data to demonstrate student learning. Here, we present a systematic, multiyear study (the first we have found up to November 2017) designed to measure students' progress on both locating original research literature described in popular news media and using it to understand and critically evaluate the science being reported in the popular media. The assignment from our previous work (Majetic & Pellegrino, 2014) entailed four broader objectives: (a) gain a basic exposure to the nature and content of a scientific research paper; (b) develop information literacy skills that allow tracking and accessing the scientific research presented in popular media reports; (c) explore the connectedness between scientific endeavors; and (d) evaluate the nature and accuracy of media representations of scientific research (pp. 108–109). The research presented here is our attempt to offer data that specifically addresses Objectives 1, 2, and 4 of our previous work.

Materials and methods

Study location and cohort description

Our study population consisted of students enrolled in a nonmajors course in environmental science at a small college in the Midwest during the spring semesters of 2014, 2015, and 2016. A few students were science majors but most were majoring in other fields, taking the course for general education. The course enrolled 25 students in 2014, 25 in 2015, and 36 in 2016, for a total of 86 possible participants. Because attendance in class varied on the days when the study was conducted, and because students could and did opt out of part or all of the study, the number of actual participants varied from year to year and between the pre- and postassignment instruments.

Study design and implementation

Because the research presented here builds on our previous work (Majetic & Pellegrino, 2014), we began with the same assignment, in which students read a preselected news article about science, locate and access the original scholarly paper on which the article is based, and critically evaluate the representation of the scientific findings in the news article. To then assess perceived and actual student achievement of assignment objectives, we designed a survey instrument to be administered both before and after students completed the assignment (Appendix 1, available at http://www.nsta.org/college/connections.aspx). Students

worked on the assignment during the 10th through 13th weeks of a 15-week semester. The preassignment instrument was given at the beginning of the 10th week of the semester and the postassignment instrument at the beginning of the 14th week.

The first part of the instrument gathered information about students' basic demographics and experience with college-level science, news and science news media access and consumption, and comfort with science content in the news. The second part assessed students' perceived and actual understanding of a sample science news story (both the story as a whole and science content in the story specifically), as well as students' perceived and actual ability to access the original scientific research described in the article. We used two different news stories for the instruments to minimize possible student recall.

The library instructor on the research team administered both instruments after explaining the project to students, assuring them that the classroom instructor would have no access to them until after grades were submitted, and distributing and collecting consent forms (Appendix 2, available at http://www.nsta.org/college/connections.aspx) from the students. Both the instruments and the consent form were approved by the college's Institutional Review Board for research with human subjects and were stored securely by the library instructor until after grades for the spring 2016 semester were submitted.

Data analysis

After the instruments were collected and the data were tallied into a spreadsheet, our initial examination suggested no striking differences in general media and science media consumption (Questions 3 and 4) by students before or after the assignment, by academic year, or by the year in which the survey was administered. We therefore pooled all the responses to these questions from students in the study population to generate a profile of students' media access and consumption.

We did notice some differences between pre- and postassignment responses to the questions about students' confidence in understanding science in the news (Questions 5, 6, and 7) and their confidence in their ability to locate the original scientific paper (Question 9). We also noted that students who were science majors or minors tended to answer these questions differently than students who were not majoring in science fields. We therefore compared preassignment and postassignment answers with these questions in three ways: overall (all preassignment survey answers [$n = 68$] vs. all postassignment survey answers [$n = 71$]), nonmajors only ($n = 52$ pre, 51 post), and science majors/minors only ($n = 16$ pre, 20 post). Because of our limited sample sizes, particularly for the science majors/minors category, and the unequal numbers of surveys in pre- vs. postcategories because of student attendance issues, we decided not to perform statistical analyses on these data and instead examined general patterns using frequency histograms.

Initial examination of answers to the free-response Questions 8 and 10 suggested no differences on the basis of the year in which the survey was administered, academic year, or previous college science experience, leading us to aggregate responses based on pre- vs. postassignment status only. The library instructor then used a 3-point rubric to score each free response; in this way, the evaluation was based on a "nonexpert" perspective rather than that of a "science expert," which we believe represents a more accurate interpretation of our objectives. Several randomly sampled survey answers were also read by the science instructor, who agreed with the coding and scoring. Unfortunately, time and resource constraints prevented us from using multiple raters on all surveys and methods to ensure interrater reliability in scoring these qualitative items. However, we believe that even the limited infor-

TABLE 1

Reported student exposure to news media and science news in the media ($N = 139$ responses). Data are pooled across survey types (pre vs. post), years, academic class, and classroom science experience to represent the media exposure profile of all respondents.

	How often do you read…	
	News media?	Science stories when reading news media?
Rarely	11.5%	67.6%
Once per week	36.7%	24.5%
Daily	36.7%	7.9%
Multiple times per day	15.1%	0%

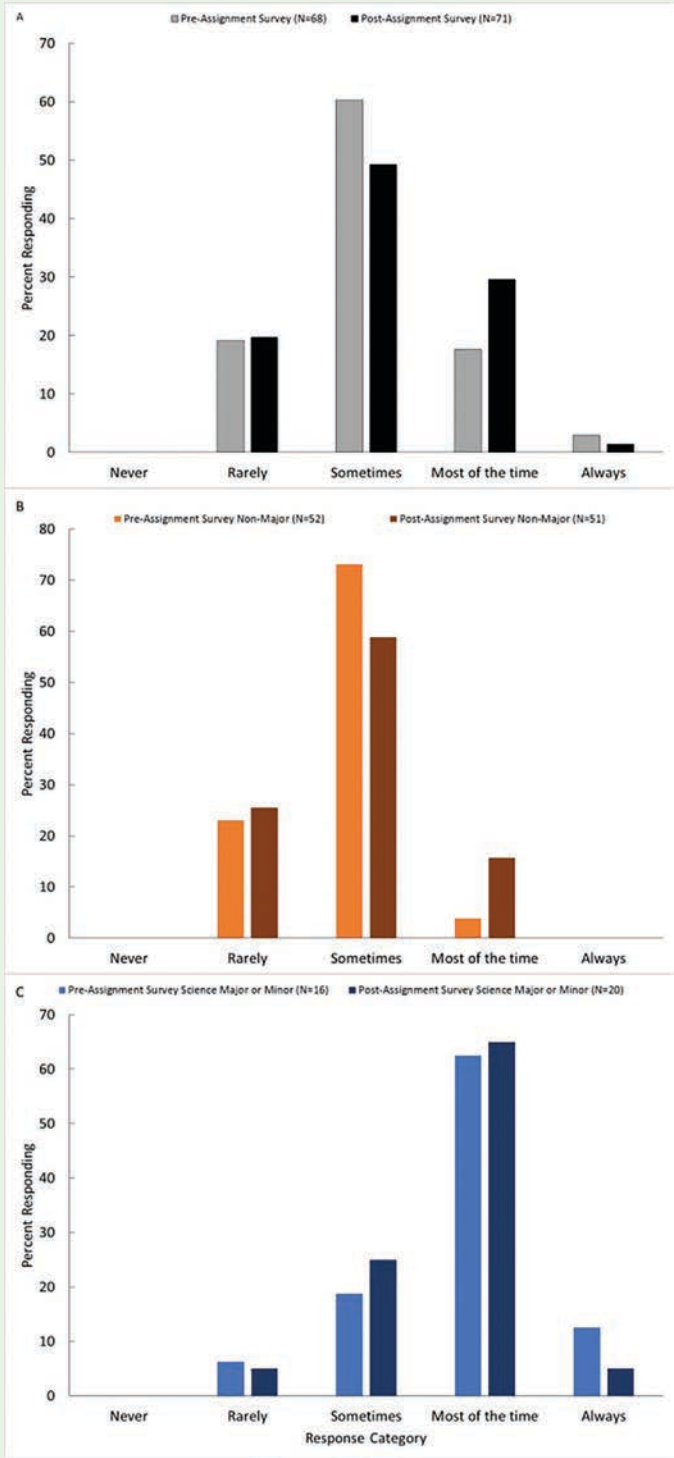
mation available from the informal evaluation of the students' responses was valuable, so long as its limitations were kept in mind.

Results

Students in our study population tended to read news media either once per week or daily (36.7% of respondents in each category; Table 1) and rarely read science stories when reading news media (67.6% of respondents; Table 1). Both before and after the assignment, the largest number (49%–60%) of students answered "sometimes" in response to the question "When confronted by science in the news, do you feel like you understand the scientific content" (Figure 1A). However, the proportion answering "most of the time" increased following our assignment (Figure 1A). The increase was larger for nonmajors (Figure 1B) than for science majors (Figure 1C), whose gains were more modest. The percentage of science majors responding "always" actually decreased following the assignment (Figure 1C).

Students' self-reports of how well they understood the sample news story itself seemed to decline following the assignment (Figure 2A); this was particularly true for nonmajors (Figure 2B). Science majors and minors retained higher overall levels of confidence in their abilities following the assignment, but there was nevertheless a decline within this group as well (Figure 2C). Despite this decline in confidence in their understanding of the news story, students' confidence in their understanding of the *science content* actually increased following the assignment (Figure 2D); this finding was most pronounced for students who were not science majors or minors (Figure 2E). Science majors

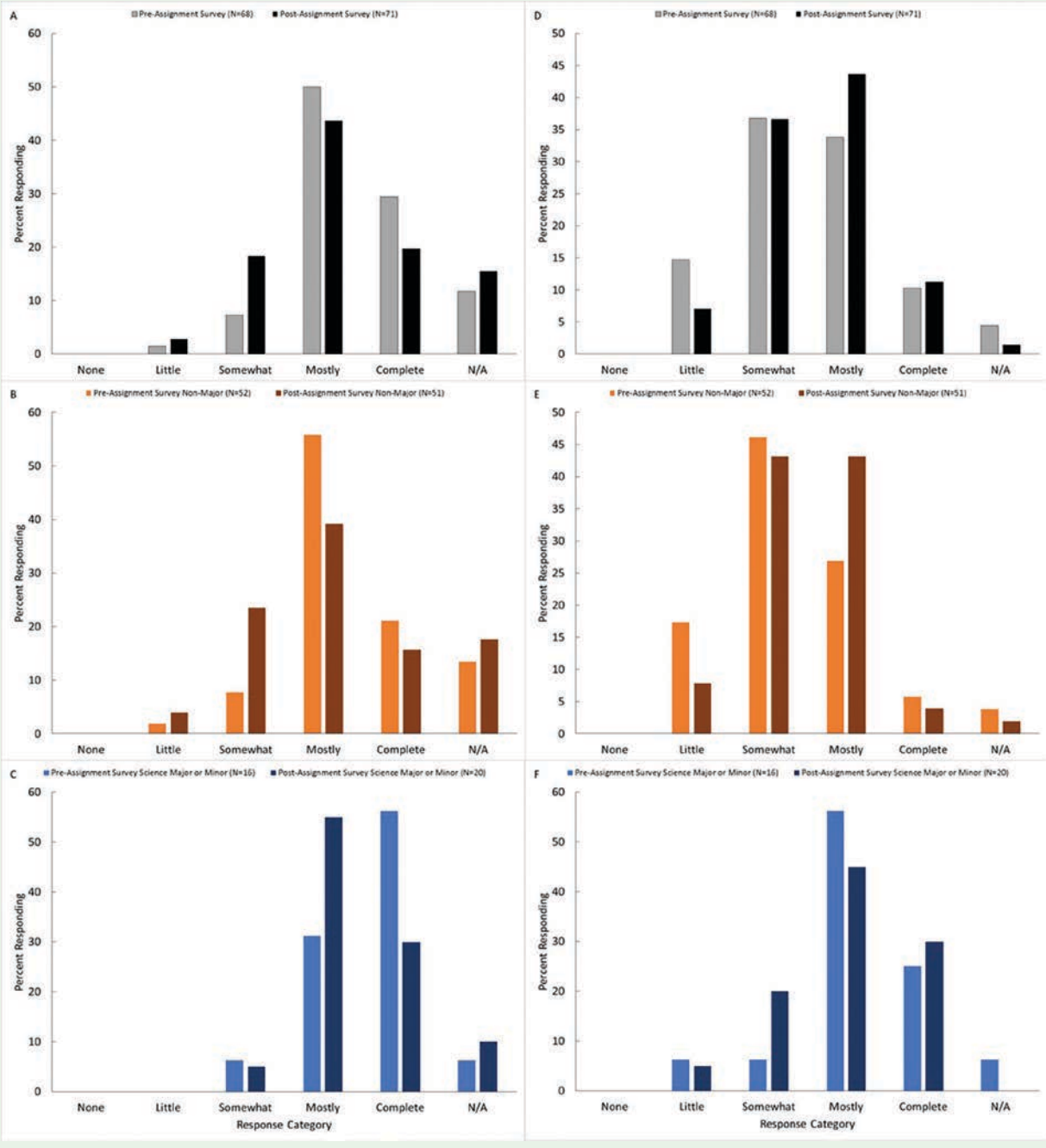
FIGURE 1



Changes in student responses (percentage responding, pre [light shades] vs. post [dark shades] assignment surveys) to the question "When confronted by science in the news, do you feel like you understand the scientific content?" by (A) all students, (B) nonmajors, and (C) science majors/minors. Although students were provided with a "Never" category, no responses were reported in this category.

FIGURE 2

Changes in student responses (percentage responding, pre [light shades] vs. post [dark shades] assignment surveys) to questions about a provided science news story by (A, D) all students, (B, E) nonmajors, and (C, F) science majors/minors. Panels A–C represent responses to the question "Which of the following best describes your understanding of the *news story itself*?" Panels (D–F) represent responses to the question "Which of the following best describes your understanding of the *science content* in the news story?" Although students were provided with a "Never" category, no responses were reported in this category.



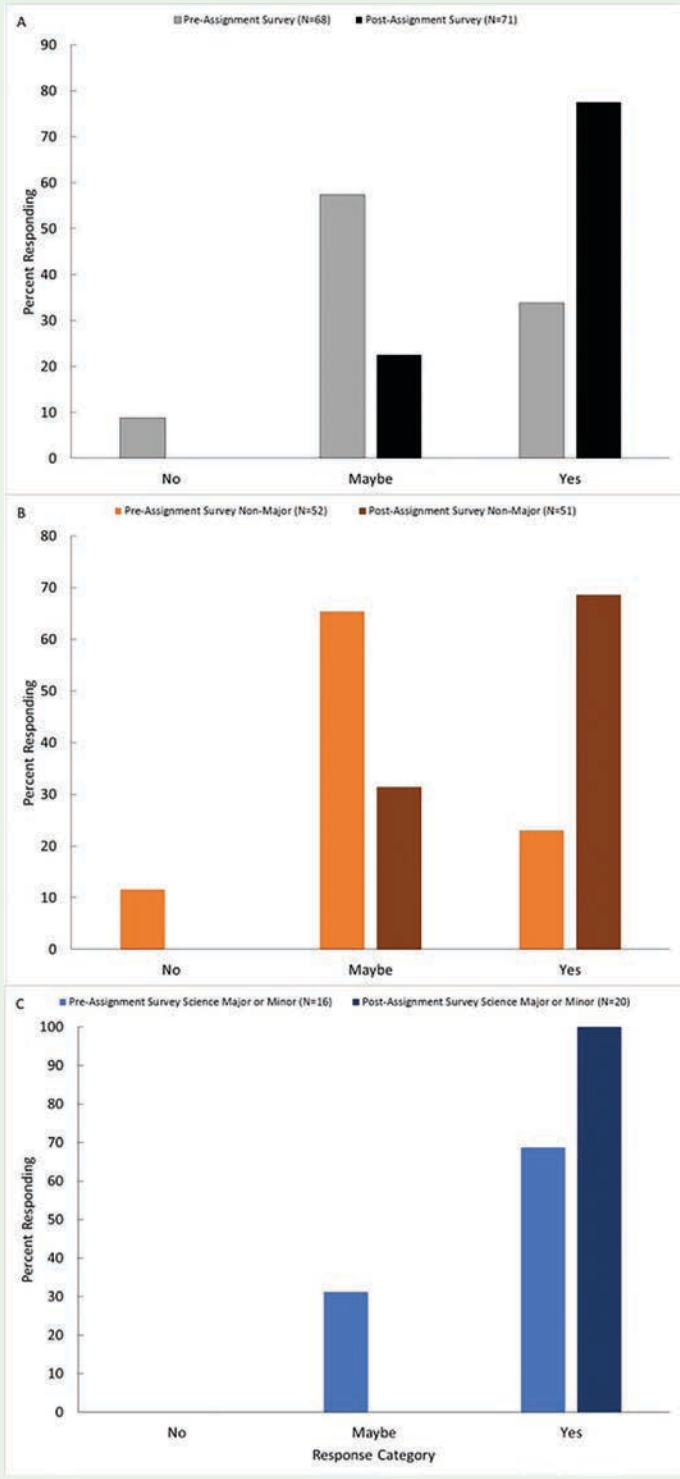
and minors showed a more complex pattern, with slight increases in both "somewhat" and "complete" responses but a decrease in "mostly" responses following the assignment (Figure 2F). Even though students *thought* their science knowledge had increased, our informal evaluation of their free-response questions showed no increase in the accuracy of their understanding of the science content in pre- vs. post-assignment surveys (average ± SD: pre = 1.32 ± 0.78, post = 1.32 ± 0.92).

Following the assignment, all students reported increased confidence in their ability to find the source of the original scientific research described in the short science news story provided (Figure 3A). The effect was found in both nonmajors (Figure 3B) and science majors/minors (Figure 3C), but yielded more notable positive shifts for nonmajors. Actual student skills, as informally measured by their answers to the free-response question, corresponded with the increased confidence in their search skills. Before the assignment, students scored an average of 0.94 (± 0.81 *SD*) points on the 3-point rubric, whereas after the assignment students averaged 1.77 (±0.92 *SD*) points.

Discussion

The purpose of this assignment was to provide students with (a) basic exposure to scientific papers and content, (b) skills for locating and accessing scientific papers referenced in media reports, and (c) an opportunity to understand and critically assess media representation of scientific findings. Results from the surveys administered before and after the assignment suggest that although students made greater gains in some areas than in others, students generally improved their skills and confidence for all

FIGURE 3



Changes in student responses (percent responding, pre [light shades] vs. post [dark shades] assignment surveys) to the question "Do you think you would be able to find the source of the original scientific research described in this article?" by (A) all students, (B) nonmajors, and (C) science majors/minors.

objectives.

Following the assignment, students' ability to locate and access the scholarly publication that was being reported on by the news media (Objective 2) showed the most substantial gains. Both nonmajors and majors reported increased confidence in their ability to find the original scientific research described in their news stories (Figure 3). This increased confidence was informally confirmed by the researcher-scored, free-response answers, which indicated that after the assignment, students' ability to describe the process of using information literacy skills to perform this task increased. This increase suggests that the assignment allows students to develop and practice information literacy skills associated with understanding the root source of science presented in the news.

Because the news media will be the primary mechanism that most nonscientist adults use to interact with science, the findings here point to an instructional approach that lays the groundwork for increased critical media assessment (Objective 3) in a population that does not often read science news (Table 1). Moreover, in our previous article (Majetic & Pellegrino, 2014), we noted that these information literacy skills are transferrable; students who completed the assignment on which this article is based anecdotally reported using the same techniques to identify and assess media stories on politics, social science, and the arts (p. 111). As this population does read general news media somewhat regularly (Table 1), those transferable skills may help them use science effectively to make decisions about health choices; environmental policy options; and other aspects of informed, engaged citizenship.

Gains were more modest and mixed when students were asked about their confidence in understanding science content (Objective 1). Nonmajors displayed an initial low-to-intermediate level of confidence in understanding science content in news stories in general (Figure 1B) and in relation to a sample story (Figure 2E); it seems possible that this is linked in some way to the low reported incidence of reading science news stories in this population (Table 1). However, the nature of this study does not allow us to determine whether low confidence in understanding science content leads to less reading of science stories or vice versa. We can state that for students who were not science majors, self-reported confidence in understanding science content increased after the assignment. It is noteworthy that the assignment itself was not designed to increase science content knowledge; our focus was instead on skills such as how to read a scientific paper, decode (but not necessarily develop expertise in) science content in news media, and critically assess the representation of science in news media. However, the postassignment survey results suggest that nonmajors finished the assignment and/or semester feeling more confident in their ability to understand science presented in the news media.

Science majors and minors showed more nuanced and complex attitudes toward their understanding of science content before and after the assignment. When asked about their general understanding of science content in news media, this group's attitude shifted toward intermediate categories of confidence following the assignment (Figure 1C). When students were asked about their understanding of the science content in specific stories, the pattern was more variable: more "somewhat" and "complete" understanding following the assignment (Figure 2F), as opposed to the overall shift to higher confidence seen in the nonmajors (Figure 2E). One possible explanation for this pattern may be that science students are more critical of their science decoding skills than nonmajors. Alternatively, science majors may assess their skills differently than science minors. The small sample sizes in these two categories limited our ability to test this latter explanation with a more detailed analysis. Overall, however, the results suggest that the positive effects of increased science decoding confidence are much stronger for nonmajors, the primary audience for the course.

As other authors have noted (e.g., Norris et al., 2003), our informal analysis of students' actual gains in science content knowledge did not match their own perceptions that their skills had improved. Instead, students' ability to summarize the science content of news stories, as reflected in the researcher-scored, free-response question, remained static across all student demographic groups. Because the primary focus of this assignment was to build science decoding and information literacy skills instead of content knowledge, we were to some degree unsurprised by this result. However, we had hoped that students' improved skills for decoding science would translate into more comprehensive and detailed responses to the free-response question in the postassignment survey. One interpretation of our results may be that nonmajors come to see themselves as proficient in decoding science while not actually improving their skills in such a short time frame, whereas science majors and minors are more likely to recognize the limits to their

understanding. We plan to reflect on these findings seriously as we move forward, adjusting the assignment to focus more explicitly on skills for decoding science.

Our surveys only partially assessed our third assignment objective; the questions examined students' self-reported understanding of "the news story itself" instead of students' ability to critically assess media representations of science content (we did assess the latter component via graded student work in our previous article; Majetic & Pellegrino, 2014). Across all groups, self-reported confidence in understanding the news story itself declined postassignment (Figure 2A–C), suggesting that the assignment did not achieve Objective 3 as intended. Students' self-assessment of their confidence and skills also may not be an effective measure of their understanding or critical abilities. In addition, we partially attribute the decline in confidence to the different news stories used in the pre- and postassignment surveys. We deliberately chose different stories for the two surveys to prevent students from becoming familiar with the content of the story and thus scoring higher on the postassignment survey. The preassignment survey story focused on primate behavior and the postassignment survey story focused on meteorological patterns. However, our experience with this student population suggests that they are more comfortable with animals and anthropocentric phenomena like behavior than they are with Earth sciences. The results may therefore reflect student comfort level with topics rather than the effects of the assignment itself on skill building. Alternatively, it is possible that following the assignment, students more readily recognized the complexity of the science presented in the meteorology news story and adjusted their answers accordingly. Future research will be designed to minimize effects of topic identity and complexity on student responses and more directly assess student-reported understanding of news stories.

Conclusion

In our view, the most notable finding in this research is clear improvement in students' skills for locating and accessing the original scientific research that underlies many news media reports on science, as well as students' improved confidence in their abilities, whether warranted or not. We note that this improvement is greater in students who are not majoring in science fields, which is our intended audience for the course and the assignment. We believe that this assignment, which is readily adaptable to other science disciplines, courses, and educational contexts, offers genuine opportunities for students to build both science literacy and information literacy skills in a context that mimics real-world information needs and challenges. As we move forward with our faculty/librarian collaboration, we intend to refine the assignment by incorporating more explicit instruction and emphasis on science decoding skills, as our results suggest further intervention is needed for students to achieve recognizable gains. Future research with larger study populations may also reveal more subtle differences between science majors, science minors, and nonmajors. Some of the more ambiguous results that we found, such as science majors self-reported confidence with science content, may also become clearer with larger sample sizes. In addition, a more robust study could incorporate multiple raters for the qualitative questions to assess students' understanding and critical abilities, ensuring interrater reliability and addressing the weaknesses of students' self-reported confidence and skills. ■

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Cassie Majetic (cmajetic@saintmarys.edu) *is an associate professor in the Department of Biology and* ***Catherine Pellegrino*** *is a reference librarian and instruction coordinator in the Cushwa-Leighton Library, both at Saint Mary's College in Notre Dame, Indiana.*