# When science and information literacy meet – an approach to exploring the sources of science news with non-science majors

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**ABSTRACT**

The skill set associated with life-long scientific literacy often includes the ability to decode the content and accuracy of scientific research as presented in the media. However students often find decoding science in the media difficult, due to limited content knowledge and shifting definitions of accuracy. Faculty have developed a variety of approaches to increasing scientific literacy, but these approaches often miss out on valuable opportunities to teach core information literacy skills including accessing original scientific research. We describe a scaffolded assignment using news reports that allows students enrolled in a science course for non-majors to learn about the nature of the scientific research literature, the connection between the popular press and the scientific literature, and the accuracy of popular media reporting of science while developing important information literacy skills. Our experience suggests that students develop information literacy skills associated with finding scientific articles using media reports, actively engage in trying to decode scientific articles, and are willing to thoughtfully assess the accuracy of science reporting in the news despite minimal content training. Moreover students anecdotally report that the skills developed here are portable to decoding media reports from other academic fields of research, especially the social sciences.

**INTRODUCTION**

Scientific literacy is a topic that has been explored at length in the science education literature. While the definition varies from author to author (Holbrook and Rannikmae 2009, 275-277;

Jarman and McClune 2002, 997-998; Korpan, Bisanz, and Bisanz 1997, 516; Liu 2009, 302-303; Murcia 2005, 40), most descriptions of scientific literacy include an understanding of basic conceptual knowledge, principles of scientific inquiry, and the role of science in everyday life. Moreover many researchers stress the idea that developing scientific literacy is a life-long process shaped predominantly outside of the classroom by exposure to media such as the Internet, television, and print sources (Brickman et al. 2012, 374; Elliot 2006, 1249; Gardner, Jones, and Ferzli 2009, 332; Klosterman, Sadler, and Brown 2012, 52; Liu 2009, 307; MacKenzie 2007, 390). Much of this exposure will be to "cutting-edge" or newsworthy research and technology which often contrasts with "factual" concepts that have been well integrated into textbooks (Jarman and McClune 2002, 998; Kolstø 2001, 294-295). Scientific literacy becomes particularly important when one considers some of the potential shortcomings associated with the short news-brief format of most media science reports (as described in Korpan, Bisanz, and Bisanz 1997, 516-517). These shortcomings include limited description of methodology and results, use of more commanding and specific language (as opposed to cautious and conservative) in regards to findings, intentional or unintentional bias or opinion on the outcome of the research, lack of data for assessment by the reader, and the highly variable quality of reporting within and among media formats. These problems can be hard to avoid given the necessary brevity associated with media reports. As a result many curricula and science education standards specifically include the ability to decode science content in the media as a learning outcome (Jarman and McClune 2010; NRC 2012; Ratcliffe 1999; Tsai et al. 2013), leading educators and researchers to explore a number of different approaches to teaching this aspect of scientific literacy.

Researchers working on techniques for decoding science in the media have explored this concept at a number of different levels. Some have focused on developing an understanding of skills needed for such a task by interviewing teachers, journalists, scientists, and education scholars (Dani, Wan, and Henning 2010; Jarman and McClune 2010; Klemm, Idling, and Speitel 2001; McClune and Jarman 2010). Others have looked at how teachers use mass media in science teaching (Dani 2009; Jarman and McClune 2002; Klosterman, Sadler, and Brown 2012) or explored techniques for helping teachers incorporate such approaches into their classrooms (Elliott 2006; Planey and Hug 2012; Sperry 2012). Another subset has assessed students' ability to decode media reports of science at elementary, secondary, and college levels. These decoding studies, some conducted on a "control" population and some conducted to assess the effects of teaching interventions, find a great deal of variation in students' ability to critically assess media reports of science (Korpan, Bisanz, and Bisanz 1997; Manuel 2002; Murcia 2009; Norris and Phillips 1994; Norris, Phillips, and Korpan 2003; Preczewski, Mittler, and Tillotson 2009; Ratcliffe 1999; Tsai et al. 2013).

A final group of researchers has focused on describing experimental approaches for use in the classroom, providing detailed examples. The approaches generally begin by exposing students to current science media reports that have been provided by instructors or found by students themselves. Students then engage in a series of activities (including classroom discussion, portfolio development, and/or reflective writing) that ask them to think critically about the news stories on a number of levels, including identifying the main scientific ideas, examining the accuracy of the science, and assessing the potential for biased reporting. The variations on this basic blueprint are quite extensive. Hoskins and collaborators expanded on a comprehensive framework originally used to assess primary literature and the nature of science during the course of a semester in cellular/molecular biology (Hoskins, Stevens, and Nehm 2007; Hoskins 2008) and applied it to critical consideration of newspaper articles over a shortened time-frame (Hoskins and Stevens 2009; Hoskins 2010). Similarly Glaser and Carson (2005) developed a news report critique project using portfolios that has been implemented in various ways by chemistry instructors. Gregory (1992) and Ragnachari (2006) developed courses for non-majors and first year science majors that used critical assessment of news reports as a backbone, while Brickman et al. (2012) devised a smaller-scale project requiring students to research scientific claims made in media reports. Finally Alexander, Jarman, and McClune designed an extensive cross-curricular project linking English and science instruction through science journalism in a number of secondary education classrooms (Alexander et al. 2008; McClune, Alexander, and Jarman 2012).

All of these projects focus a great deal of effort on critical reading of science reports in the media and often ask students to think about the accuracy of the science presented in each report. However in many research papers the concept of accuracy and how to assess it is not well-defined. Are students expected to verify that the author of the media has accurately depicted the science described from an original source (like a press release or a journal article), or are students being asked to verify the accuracy of the scientific finding itself? Students at many levels may be hindered in adequately evaluating the latter due to limited scientific experience. Yet given the correct tools, the former can be assessed by science and non-science students alike. We also argue that the skill of finding and understanding the origin of science content in the media has generally been overlooked in the past by instructors hoping to improve science literacy. How can students read science information critically if they are unaware of the source of the science content in the first place? We suggest that this gap would best be addressed by a combination of information and science literacy instruction, providing opportunities for students to develop skills that allow them to identify and access the scientific research publications underlying news reports. Furthermore reading these original publications, even with limited content comprehension, would provide students with insight into the nature of scientific inquiry (another element often stressed in science literacy learning outcomes).

In this article we outline one potential approach for combining scientific literacy and information literacy in the college classroom. While broadly applicable to undergraduates in nearly all natural or social science disciplines, our approach focuses on an application in a non-majors' general education environmental science course. Our focus on a course for non-majors strikes us as particularly significant, because for these students general education courses are one of the few opportunities to gain authentic, real-world information literacy and science literacy skills that translate to a multitude of settings. The goal of the project was not specifically to increase environmental science content knowledge, although it is quite likely that students gained some additional knowledge during the course of the project. Instead, the underlying goal was to provide students with some understanding of the following broader ideas tied to scientific inquiry and information literacy:

1) What is the nature of a scientific paper? What does it contain? How do you begin to read it?
2) What is the connection between science in the popular press and science in the world of research? How do you identify the "references" in a media report and how do you find the original source material? How do you access those source materials (i.e., what limitations are presented with direct access by hyperlinks in a media report and how might library resources assist with access)?

3) How are scientific endeavors connected? How do science research projects connect topically to each other and how can you find more information once you have identified a topic of interest?
4) Do media reports accurately depict the scientific findings? Would the media report benefit from additional source information?

The work presented here represents an initial description and preliminary patterns associated with a larger data-based study assessing the effectiveness of the teaching approach described below.

## METHODS

### *Classroom and Study Location Description*

This project was implemented at a Catholic women's liberal arts college with an annual enrollment of ~1500-1600 students. The college recently implemented a new general education curriculum that has incorporated a more explicit emphasis on scientific literacy. In particular the "Science for the Citizen" natural science learning outcomes encourage instructors to focus on science content, methodology, and the role of science in everyday life:

> *"A student uses scientific methods to investigate questions appropriate to the natural sciences; demonstrates specific knowledge of processes and principles underlying natural phenomena; identifies, analyzes, and evaluates critical scientific issues and approaches pertaining to the issues that face her as a citizen."*

In addition the new program has also incorporated learning outcomes that address information literacy, emphasizing the importance of this skill set across disciplines and in everyday life:

*"A student determines the extent of her information need and obtains, evaluates, and uses information effectively with an understanding of economic, legal, ethical, and social issues surrounding information."*

The project described below was conceived as a series of linked assignments to help address both of these learning outcomes in an environmental science course for non-majors. This course serves as both a general education course open to any undergraduate student and the core science course for the Environmental Studies minor. The class is predominantly upperclasswomen who are non-science majors, combined with intended Environmental Studies minors. Enrollment is capped at 25 students, and there is no lab component to the course.

***Environmental Issues in the News Project***

This project takes place over a one-month period during the second half of the semester, when a large proportion of the scientific course content has already been delivered to the students. The timing enables students to be more confident in their scientific knowledge on environmental issues. The project is framed for the students as an opportunity to learn how an informed citizen could critically evaluate whether the science presented in a media report was accurately represented. To facilitate completion, the project is scaffolded into sequential pieces, each with a corresponding assignment (Table 1) to check student progress and work effort.

*Part One: Reading a Scientific Paper*

Even experienced science students often struggle with reading scientific journal articles; for undergraduates who are non-science majors the task generally seems impossible. However exposure to this form of writing and the role that it plays in disseminating scientific findings offers students insight into how scientists report the research that ends up in a news story. To that end students are assigned a short scientific paper to read that touches on a topic that has been discussed in class. To aid in their reading, the students are given a list of questions (Table 2) sequenced in a way that encourages them to look at each section of the paper in isolation. Instead of focusing on mastering the content of the article, the questions focus on what kinds of details might be worth examining to understand the research goals and findings. The questions form the basis of an in-class discussion held over two class periods.

On the first day of discussion students are given 15 minutes to discuss the questions in small groups. Starting in small groups allows students to test out their answers safely among their peers before presenting them to a larger audience or the professor. The instructor circulates throughout the classroom, answering any content-level questions that might arise. The instructor then leads a full-class discussion (completed over two class periods) in which the questions are addressed one by one. During the discussion the instructor often builds lists of details from the paper on the board, encourages questions on the scientific content, and spends significant time helping the students interpret graphical images from the paper in comparison to the written words on the page. The discussion often leads to questions about statistics, experimental methods, styles of writing, graphical displays, and the underlying biology of the study organisms, all of which help to build student understanding of the nature of science and formal scientific writing.

At the end of the discussion students are asked to write a 2-3 page synopsis of the article, addressing 5 major questions: what was the major objective of this research and why was it undertaken? What was the research methodology? What were the major results of this research (with a focus on figures and tables)? How do the authors interpret this research, particularly in regards to environmental issues? And finally, in your opinion, does this paper do a good job of achieving its objectives and presenting them to an audience, and why or why not? The first four questions in many ways mimic the content which might appear in a news media article about the research. The fifth question focuses on the student's critique of the paper itself, an important reflective piece to examine student understanding of how scientific writing and expression might function to disseminate information. The synopsis also provides a blueprint for two of the other associated assignments to be completed by the end of the project, ensuring that while the science content changes the instructor's expectations for student work do not, which in turn takes some of the fear and uncertainty out of the project overall.

*Part Two: News Story Assignment and Information Literacy Skills*

As discussion wraps up during part one, pairs of students select news stories on environmental topics from a collection assembled by the instructor in advance using the newspaper database ProQuest Newsstand. Each pair is asked to read their news story before the next class and the formal introduction of the remainder of the project.

To introduce the second part of the assignment all students participate in a library instruction session. The presentation focuses on the research skills needed to complete two tasks: 1) find the original scientific paper referenced in the news article provided and 2) find a related scientific paper that complements the original. This two-pronged search provides an opportunity for students to not only develop information literacy skills, but also to explore the ways in which science inquiry links separate research endeavors. During the library session, the librarian instructor demonstrates first how to identify the relevant scientific paper if it is not specifically cited in the news article. Tools like Google Scholar are useful here for searching on incomplete citation information. Then the students learn how to access that paper using their library's online journal subscriptions or in some cases interlibrary loan or nearby research libraries. Finally, the librarian demonstrates how to use a multidisciplinary article database (EBSCO's Academic Search Premier) to find scholarly articles on related topics.

After the lecture/demonstration, the students are given sufficient "hands on" time to search for their articles while the librarian and course instructor circulate to help students and reinforce the session content. This approach, made possible by assigning the news articles in advance, provides a purpose for the session. The students are then given approximately one week to find and obtain their articles as well as to turn in a bibliography listing both scientific papers in an appropriate citation format.

Following the library session two additional class days are set aside for work on the final products of the project: two short (2-3 pages) synopses of the scientific papers associated with the news story. These two synopses are similar in format to the first assignment, and the students are asked to answer the same five questions about each scientific paper. However, students are now asked to address an additional question in each synopsis. For the scientific paper detailing the research originally presented in the news story, students are asked to assess whether the news story accurately depicts the findings of the research and explain why or why not. The additional prompt directly challenges students to answer questions of accuracy in the media. For the related scientific paper, students are asked to consider whether the news story would have benefitted from the additional information found in this new research paper and to provide a rationale for their answer. Again, the additional question encourages students to think more broadly about the nature of scientific inquiry, the flow of scientific progress, and how this might better inform presentations of science in the media. The student pairs are encouraged to use their in-class time for reading, drafting, and asking the course instructor or librarian questions, while most writing takes place outside of the classroom. Rubrics are provided to ensure that students know exactly what content is expected in each synopsis.

**RESULTS AND DISCUSSION**

After two years of implementing this project in the non-majors' classroom we have noticed several positive gains. First, our focus on basic skill development, rather than high-level competence and significant content knowledge development, seems to be the right fit for our non-major students. Our approach appears to create a "low-pressure" environment in the classroom, which seems to render the science presented in news articles less intimidating and results in students who are more willing to engage in examining scientific papers. Second, the detailed synopsis format clearly requires the student to reflect on whether the newspaper article accurately reports scientific findings, remedying some of the problems with nonspecific language we have seen in similar assignments. Students' synopses suggest that they seem to be actively reflecting on the accuracy of media reporting. Third, the project gives students an opportunity to learn approaches to fact-checking and verifying source material through information literacy skills. In fact some students anecdotally report that they use these techniques for other science topics and even when encountering news reports in non-science disciplines, demonstrating that they recognize the real-world value of information literacy skills. We propose that simple edits to the questions used for the in-class discussion and synopsis assignments that reflect the specifics of academic writing in the social sciences or humanities could allow instructors to employ this approach in a variety of courses. Finally, our approach provides an opportunity for students to see what professionally published science looks like and to critique it from a "non-specialist" perspective. Many of the synopses contain instances of students describing "flaws" in papers from a non-scientist perspective. In some cases these "flaws" are true problems, while in other cases they point to significant differences in how scientists and non-scientists communicate. Given the vital importance of science communication, gathering these student critiques may provide significant insight to the scientific community on how to address the general public on important issues. At the same time students learn that what they view as “flaws” are actually legitimate statements in scientific communication, which helps students understand those communication differences from their own perspective.

Our experience suggests that a project like this one can help non-science students start to develop science and information literacy skills that can be useful in the “real world” when confronted with any scientific content (although some disciplines in science may be more accessible with this approach than others). The next logical step is to begin to formally assess whether a project of this nature leads to: 1) actual or perceived gains in students’ abilities to think about science as presented by the media or in their everyday lives; 2) actual or perceived gains in students’ information literacy skills; and 3) useful information that might give insights on approaches that scientists may use to communicate with non-specialists. We have recently begun a three-year survey to collect data to formally assess elements 1 and 2.

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