Teaching Critical Media Analysis of Controversial Science, Agricultural, and Environmental News: An Exploratory Case Study

M. Hovey[1] and L.J. Pfeiffer[2]
Purdue University
West Lafayette, IN

Abstract

As access to science information in the digital age continues to accelerate, the ability to critically evaluate accurate science information is emerging as one of the core skills necessary for communication students in the 21st century. Therefore, agricultural communicators developed and pilot-tested a six-week, active-learning curriculum to teach critical media analysis skills for this study. The curriculum's primary objectives included: 1) student understanding of foundational media practices and 2) student development of an internal framework to critically analyze controversial science coverage in the news. Researchers utilized four assessment tools to measure and triangulate students' ability to evaluate news coverage of science in the media critically. Quantitative measures included: quiz scores 87% (mean 4.35/5), final paper scores 94.8% (23.7/ 25), final presentation scores 97.3% (14.6/15). Qualitative measures included a final reflection paper. Overall, the quantitative findings both supported and expanded the quantitative findings suggesting that students can be taught to effectively 1) understand media practices that influence credibility of science coverage and 2) internalize and apply a framework to critically evaluate the integrity of science, agriculture, and environmental issues in the media. Implications for the development of a critical media literacy curriculum are discussed.

Introduction

In the 21st century, the American public predominantly relies on the media to understand science (Brossard, 2013; Hargittai et al., 2018; Nisbet et al., 2002), forming perceptions of whether to accept or reject emerging innovations in science, agriculture, and the environment (hereafter science). As tomorrow's leaders, undergraduate students need to understand how to acquire and disseminate science information accurately in a format that will engage science audiences. To do so, they need to be able to distinguish credible from non-credible sources of science information, sources of misinformation, and how to leverage media outlets to disseminate science in the digital era effectively. This challenge calls for empowering students through information literacy training (Breivik, 2005; Jones-Jang, 2019; Young and Anderson, 2017), specifically, media literacy training (Kovach and Rosenstiel, 2014) addressing controversial science topics in science, agriculture, and the environment.

Historically, information literacy has primarily been found in the domain of education and is defined as 1) an understanding of when information is needed, 2) being able to locate necessary and credible information, 3) organizing this information, and ultimately 4) utilizing the information to address and understand the issues at hand (American Library Association, 2006). The abundance of news in the digital age can make sorting through information challenging (Metzger et al., 2003); yet, information illiteracy costs can also be relatively high (Breivik, 2005). This may be especially true with complex scientific issues such as the safety of genetic modification of foods, the practicality of meatless meats, or the urgency of climate change adaptation for protecting our food sources. As such, empowering students to be information literate in the 21st century requires the development of sound critical thinking

[1]Monique Hovey MS Agricultural Sciences Education and Communication (ASEC), Purdue University, 915 W. State Street, West Lafayette, IN 47906, Email: hovey@purdue.edu
[2]Linda J Pfeiffer, PhD Agricultural Sciences Education and Communication (ASEC), Purdue University, 915 W. State Street, West Lafayette, IN 47906 Office: 765-496-1890, Email: lpfeiff@purdue.edu

skills and the analytical framework needed to navigate information literacy (Macpherson, 2004; Miller, 1998).

Research has demonstrated that undergraduate students do not typically have the critical and sophisticated approaches required to search for credible information (Sjoberg and Ahlfeldt, 2010), nor do they effectively evaluate information sources for their credibility. As such, some researchers have developed a science literacy curriculum to address gaps in undergraduate science literacy (Murcia, 2009).

Empowering students to effectively engage with the public on science issues in the media requires an edification of media practices and media literacy (Kovach and Rosenstiel, 2014). To meet this need, research scholars have described "an urgent need" for academic courses in critical media literacy (Hammer, 2011). Critical media literacy is an emerging field of study which emphasizes a focus on skills in critical thinking, allowing students to effectively seek out and critique information in the media (Hobbs, 2011), develop an understanding of media production (Hammer, 2011) and, critically examine the influence of media on their own beliefs and inform student's communication practices (Kellner and Share, 2007). Concerns for the credibility and accuracy of science information emerge when media coverage becomes imbalanced, selective, or fails to include research findings (Flipse and Osseweijer, 2013; Listerman, 2010; Marks et al., 2007; Nisbet and Huge, 2006; Twardowski and Malyska, 2015). As such, a fundamental understanding of media practices and how to identify and navigate credible news outlets for science information are critical skills for students in the current media environment (Metzger et al., 2003).

A Skeptical Way of Knowing

With the advent of the digital revolution, students have access to a range of science information but with little training on how to verify what they are reading. "Active skepticism" is one technique described by Kovach and Rosenstiel (2010) to address the problem of media literacy. A skeptical approach involves internalizing a framework (schema) to critically evaluate the accuracy of information news consumers are exposed to day-to-day. To accomplish this, journalism scholars outline a conceptual framework that includes two elements: 1) identifying the veracity of the news outlet encountered and 2) determining how elements within the news story provide cues to the accuracy of the story's content (Kovach and Rosenstiel, 2010). News outlets are defined as organizations or publishers who produce and publish original content for public consumption (ex. New York Times, CNN, Fox). Comparatively, news stories refer to each individual story published by a news outlet.

To simplify media analysis, Kovach and Rosenstiel (2010) identified four categories of journalism practices that characterize news outlets currently seen in the media. Outlets using these practices can simply be characterized by those who practice: 1) verification and accuracy, 2) assertion, 3) affirmation, and 4) interest group promotion. It is important to examine each of these categories in depth.

News outlets that employ practices consistent with the journalism of verification follow a traditional editorial (or fact-checking) process in which the highest value is placed on the accuracy and veracity of the news story content. Reporting practices for the journalism of verification include adherence to ethical guidelines, journalistic norms of fairness and objectivity, and a strict fact-checking process prior to reporting. An example of this media outlet includes National Public Radio (NPR), the New York Times newspaper, or on television, the Public Broadcast Station (PBS). Comparatively, the second category of news outlets utilizes the "journalism of assertion," consisting of news that is often unfolding in real-time. It values immediacy and volume but can lead to communicators serving as a passive conduit of information with no cues for accuracy provided to the audience. An example of this type of news story may include a breaking story where the facts have not yet been verified. To be regarded as credible, it would be expected that the news outlet would identify that the story has not yet been confirmed and report on the limitations of their coverage. However, some broadcast outlets may utilize this model to assert a particular viewpoint-without identifying the limitations of their reporting.

The third type of news outlet utilizes an "affirmation" model. This type of information outlet builds loyalty in encouraging audiences to believe predetermined content, which may have a clear ideological or commercial slant. Often readers/ viewers notice "cherry-picked" information or sources that support a single predetermined viewpoint. Finally, the fourth type of news outlet is characterized by Kovach and Rosenstiel (2010) are "interest groups" - where the promotion of a product or service is often a primary goal. This reporting includes targeted websites or media stories funded by special interests practicing persuasion rather than more rigorous interrogation of the facts. Interest group sites may be designed to look like objective purveyors of information; however, a bit of background research can reveal their goal is less to inform than persuade. Examples of interest group outlets may include industry newsletters or environmental interest group websites.

The challenge for students and news consumers is that media outlets may offer news in multiple of these four categories of journalism practices. While readers can generally categorize media outlets as centered, right, or left-leaning (Ad Fontes Media, 2020), individual stories produced from all outlets can fall outside these general bounds (Kovach and Rosenstiel, 2010). Therefore, determining a science news story's credibility using only the news outlet category from which the story originates is not wholly reliable. Students must also learn to use criteria within a news story itself - not just the category of journalistic practices used by the story's media outlet- to establish the science coverage's credibility.

Researchers Kovach and Rosenstiel (2010) outline five within-story criteria to provide additional clues for determining a news story's trustworthiness. These criteria are defined as 1) sources- the credibility and range of sources employed by the writer; 2) the completeness of the story in providing wholistic context; 3) the evidence within the story and how it utilizes factual and verifiable data to support claims made in the story; 4) the objectivity of the journalist; and 5) the use of denotative, connotative or annotative language.

Critical Analysis Rubric

Pfeiffer, Forbes, Hovey - adapted from Kovach & Rosenstiel 2010

	Type of Journalism>|	Verification	Assertion	Affirmation	Interest Group
		Verified news/ credible	Incomplete news	Commentary/opinion/ideological	May be persuasive/informative
Media Source	Accuracy	Uses journalistic standards/ process, has editorial board/ fact checkers, or is peer reviewed	Breaking story (unverified) Single or limited views-no alternatives presented, facts not yet verified – AND to be verified- reporter informs that the story is not yet confirmed	May promotes a specific ideology/ world-view/ political perspective. Statements not verified within segment (*views not news*). No effort to alert audience to limitations of reporting	May only presents facts supporting industry or interest group.
Evidence within the Stories	Sources	Multiple perspectives from expertise in the area – or those affected by the issue, confirms facts with more than one source	Single or limited views. Lacks a range of sources-sometimes due to emerging nature of story	Source(s) predominantly support ideology/ worldview; often discount counter evidence with no support. "Experts" may be outside of field/have a questionable title/ background not pertinent	Limited perspective/ often shares positive elements of innovation/ product (not negatives). Often only use industry/ interest group spokesperson/confirming source
	Completeness Who • What • When • Where • Why • How	Provides *holistic* context on the narrow issue being discussed or background. Most of W's, H. Broadly presents what is known	Some W's, H but may not be complete / or updated over time. May only present limited information/not qualify limits	Often omits dissenting information. Limited inclusion of context (W's, H) / or details. Incomplete expression of opposing views	Often may omit dissenting information. Limited inclusion of context (W's, H) / or details. May discount opposing views
	Evidence / Facts	Includes citations/ links or sources to verify info. Includes limitations to facts reported	Limited evidence presented-either because breaking story or omitted intentionally. Can become verified over time	"Cherry picks" facts (to support a specific perspective) Or facts asserted for audience without evidence from reliable sources	May cherry picks" facts (to support a specific perspective) Or facts asserted for audience without evidence from reliable sources
	Objectivity	Objective, fair, and accurate coverage of multiple perspectives (at least 2 sides)	Goal is to be Objective, fair, and accurate in real time as story unfolds	Role Commentary – goal to inform or persuade on a topic. Opinion – to share a point of view Ideological – to share/ persuade on a point of view	Role – to persuade on a topic/ issue
	Reporter's Language	Denotative: Objective, neutral, jargon free. (Sources may use a range of language).	Not all language is objective-may be due to breaking story or intention to influence	Less neutral, may be emotionally charged (annotative), suggestive (connotative) Used to influence audience or persuade	Less neutral, may be emotionally charged (annotative)/ suggestive (connotative) may include jargon. May persuade

Figure 1. Critical Media Analysis Rubric. This rubric was adapted from the six steps to media evaluation by Kovach and Rosenstiel (2010). The objective is for students to determine to which category the articles they read belong. Media sources are evaluated separately from evidence within the stories for accuracy. Students should evaluate sources, completeness, evidence, or facts, objectivity, and reporters' language within the stories they read.

The framework put forward by Kovach and Rosenstiel (2010; 2014) was adapted to form a rubric (Figure 1) for the classroom, in consultation with both academics trained in journalism and practitioners experienced in public relations.

Overview of Course Design

The Controversial Science and Media in the Public Sphere course (Controversial Science hereafter) was developed to meet the Science, Technology, and Society and Humanities core university requirements and reflected lessons learned from four years of teaching. In general, the course is limited to 30 students, and a waitlist often reflects this course's popularity. Five-course objectives reflect the course design's focus, with objective three reflecting the focus of this paper.

1. Evaluate forces shaping public understanding of/ and engagement with/science in a democracy.
2. Understand and describe current media practices that contribute to controversy in the communication of science, agricultural, and environmental issues.
3. Be able to critically analyze media coverage of science issues, including journalism types, sources, levels of completeness, language, and evidence within the story.
4. Understand the cultural, social, and historical dynamics that influence how people's belief systems contribute to/ or detract from the understanding of science.
5. Critically evaluate the evolving role of media platforms in shaping an understanding of science across democratic societies.

The Controversial Science course was designed using active learning techniques, digital media technologies, communication theory, and controversial science content covered in the media. In general, the class structure consisted of a brief lecture (15-20 minutes) to provide a foundational understanding of the material, followed by interactive group activities-such as a deconstruction of media through case studies and peer teaching (Jensen, 2005). Other class activities included: diagraming relationships, presenting and leading a discussion, debate, and brainstorming (Frost

Table 1. Proportion and frequency of students correctly applying the six critical media criteria

Media Criteria (N)	Accuracy	Sources	Objectivity	Completeness	Evidence	Language
Nuclear Energy (3)	0.14 (3)	0.14 (3)	0.14 (2)	0.10 (3)	0.14 (3)	0.19 (4)
Self-driving Vehicles (4)	0.19 (4)	0.19 (4)	0.19 (3)	0.14 (3)	0.14 (3)	0.14 (3)
Designer Babies (3)	0.14 (3)	0.14 (3)	0.14 (3)	0.14 (3)	0.14 (3)	0.14 (3)
Vaping (3)	0.14 (3)	0.14 (3)	0.14 (2)	0.10 (3)	0.14 (3)	0.14 (3)
Meatless Meats (4)	0.19 (4)	0.19 (4)	0.19 (4)	0.19 (4)	0.19 (4)	0.19 (4)
Fires and Climate Change (4)	0.19 (4)	0.19 (4)	0.19 (4)	0.19 (4)	0.19 (4)	0.19 (4)
Total Criteria	1.00	1.00	1.00	0.86	0.95	1.00

Note: This table represents the students (N=21) who successfully applied each of the six criteria from the rubric to evaluate the news stories' credibility in their chosen media outlet. Ex. All three students in the nuclear energy group effectively applied the accuracy criteria, comprising 14% of the students who correctly applied the accuracy criteria to their news analysis. Because all 21 students effectively applied this criterion, 100% of the students were reported as 1.00

et al., 2018). Instructors monitored group discussions and activities to inject engagement prompts for apprehensive students (Frost et al., 2018). The monitored conversations of course material allowed students to construct meaning and associations for each other regarding assigned readings, activities, and material presented during lectures (Frost et al., 2018; Kosslyn, 2018). Weekly reading materials were chosen from various current science, technology, and agriculture topics originating from online sources across all four categories of media outlets described by Kovach and Rosenstiel (2010). Examples of popular press outlets used as examples in class included: Reuters, NPR, The New York Times, The Washington Post, CNN, Fox News, and MSNBC. Consistent with current research, these active-learning methods have been shown to improve memory retention and reduce failure rates (Bonwell and Eison 1991; Freeman et al., 2014; Huber and Werner, 2016; Markant et al., 2016). This active-learning approach was made possible through the enhanced classroom design.

The course was designed to utilize upside-down pedagogies in which the students complete readings before class. This "flipped classroom" approach is similar to the student-centered active learning environment with upside-down pedagogies (SCALE-UP) model for undergraduate students. SCALE-UP classrooms are specifically designed to support active learning in grouped settings and have been shown to improve learning in science, technology, environmental, agricultural, and mathematics, also known as STEAM, courses (Beichner, 2011; Brigati et al., 2019; Hacisalihoglu, 2018). Students worked in pairs, teams, or small groups in the Controversial Science classroom recommended by recent research (Fung et al., 2018). The classroom contained six whiteboards and four monitors to allow student groups to share their findings with the class.

During breakout sessions, students were allowed to use personal technologies to search for the information they used to enhance discussions of news coverage of science and technology and explore a range of familiar media outlets. Early in the semester, students were encouraged to form bonds with their table groups through structured introduction activities designed to foster collaborations and increase student-to-student interactions. Stronger bonds were intended to help students feel more comfortable sharing and learning together (Daud et al., 2018; Frost et al., 2018; Hasanuddin et al., 2019). As students' comprehension increased through group discussions and activity, they could advance to deeper-level learning at their own pace. Overall, the combination of active-learning approaches, classroom design, technology, and subject material appeared to enhance the opportunities to internalize the content being taught for the Critical Media Analysis unit, which was the focus of this study.

Purpose of the study

In the digital media environment of the 21st century, it more critical than ever that students learn to distinguish between reliable scientific information and misinformation, particularly if they wish to disseminate science information through digital media. The purpose of this study was to assess whether and to what extent a unit on critical media analysis resulted in students: 1) gained a foundational understanding of media practices, and 2) internalized a framework to critically analyze the veracity of controversial science, agricultural and environmental issues in the media. To accomplish this purpose, the following question guided researchers: 1) How effective was the six-week Critical Media Analysis Unit in meeting its objective of training students in critical media literacy?

Materials and Methods

Structure of the Critical Media Analysis Unit

Six weeks were dedicated to teaching the students journalistic practices and the skills and theoretical knowledge to critically analyze media coverage. Readings and activities were structured to iteratively introduce the students to journalism practices and norms and critically analyze media coverage of science issues in the news. Specifically, readings included relevant chapters from Kovach and Rosenstiel (2010; 2014), which explained the theoretical foundations for media analysis criteria and examples from past case studies to illustrate how to apply journalism practices. The focal criteria for media analysis were adapted from Kovach and Rosenstiel to design a rubric (Figure 1). They included two parts: 1) the quality of journalism used by the four categories of media outlets (verification, assertion, affirmation, and interest group practices) and 2) the five within-story criteria (of source use, completeness, evidence, objectivity, and language use). During class, instructors utilized case studies using popular press stories of science issues such as climate change, herbicide use (Dicamba), and forest management to illustrate how to apply criteria in the rubric to evaluate the quality of media coverage and evaluate bias. Instructors chose popular press stories from a range of credible and non-credible media outlets to illustrate how to critique media coverage of science. Instructors trained students in the class to use the Media Bias Chart (Ad Fontes Media, 2020) and the adapted Critical Media Analysis rubric (Figure 1) to establish the news outlet's veracity in covering science issues.

Participants

Students are recruited from across the university to practice communication across social barriers and increase the opportunity to understand students who differ from themselves (Craven and Fredrick, 2018). This design has been particularly useful in bringing together students in the "hard sciences" (ex. biochemistry, engineering, materials science) with students who specialize in "social science" (ex. communications, psychology, sociology).

Twenty-seven students completed the Critical Media Analysis unit. Gender was almost evenly divided with13 male and 14 female undergraduates. Racial diversity was limited, and the course consisted of primarily Caucasian students who were relatively evenly distributed across class (freshman to seniors), with two international students (Hong Kong, China). Gender distribution was similar to national statistics of students enrolled in an agricultural college, with 50.3% of undergraduates being male, with 76% of agricultural students reporting being Caucasian (IES-NCES, 2020). Random selection of participants was not possible due to the students' self-registration (Campbell and Stanley, 2015).

Data Collection and Analysis

The instructors evaluated students using four assessment measures: 1) a formative quiz, 2) a final group paper, 3) a final group presentation, and 4) a reflection paper. Data was collected and triangulated across all four measures. The quiz measured a definitional understanding of the terms used in the rubric and the foundational media practices that influence controversy. The quiz was worth 5 points of 100 possible class points (5% of their course grade).

The final paper and presentation were the primary assessments utilized to measure students' ability to understand and apply critical media analysis skills to media coverage of a real-world science controversy. For the final papers and presentations, students worked in groups of four or five students to critically analyze media coverage of one of six controversial science topics. The students were allowed to choose the controversial science topic for their group and the news outlets covering that topic to increase internal motivation. One student researched and critically evaluated the science topic within each group based on credible, peer-reviewed sources to provide a baseline for comparing the media outlets' veracity in their reporting. The other three to four students in that group completed an individual analysis of a media outlet (Table 1). The individual media analysis consisted of each student choosing one media outlet (ex. New York Times, Bloomberg, Huffington Post) to critically evaluate how well that outlet reported on the science topic selected. Once a news outlet was chosen, the student then found 3-5 separate news articles covering the group's science topic selected and analyzed each story by applying the rubric criteria. As a result, each group ended up with a report consisting of an analysis of three to four different media outlets covered by each student within that group, an introduction to the science, and a conclusion. Student group scoring consisted of the following: First, a cohesive introduction section reflected the accurate science behind each group's chosen science topic based on peer-reviewed science (5 points). Second, each student was scored on how effectively they could utilize the Critical Media Analysis rubric (Figure 1) to evaluate their news outlet's credibility in covering their chosen topic's science. Specifically, students were awarded two points for correctly applying each of the six criteria from the rubric (accuracy of reporting, source use, completeness, evidence use, objectivity, and language use) across their analysis of the 3-5 news stories reporting on the science. Additionally, students could earn 3 points for an overall cohesive structure of their analysis section (for a total of 15 possible points). Table 1 reflects the proportion of student responses in which the student accurately identified, defined, and supported their claim about each of the six critical media analysis criteria from the rubric in their analysis. Finally, the students worked together to demonstrate in the conclusion how the analysis of media outlets reflected accurate science and what they had concluded about media coverage of controversial science in the news based on their analysis (5 points). The total points available to each student reflected a combination of a group score for their ability to work together to craft the introduction and conclusion (10 points maximum), plus their individual critical media analysis score (15 points) for an individual maximum score of 25 points.

In the critical media analysis itself, instructors required each student to accurately apply the criteria as defined on the rubric to the news stories they analyzed. For the first criteria (media outlet's reporting accuracy), instructors taught students to utilize the Media Bias Chart (Ad Fontes Media, 2020) if possible. The media outlet's accuracy criteria defined which type of journalism practices the media outlet was employing (verification, assertion, affirmation, or interest group). If the media outlet analyzed was not included on the Media Bias Chart (Ad Fontes Media, 2020), students were required to explore the online news site for alternative clues regarding the outlet's credibility. These clues most often could be found in the "about us" section of most news outlets. For example, students evaluated the authors' reputations by investigating whether they had journalistic training or were experts in the reported science. Was the outlet utilizing any type of editorial processes such as fact-checking or peer-review? Who was funding the outlet, was there any conflict of interest involved?

Similarly, for the critical media analysis, students were required to evaluate within-story measures to point to the story's credibility and how well each media outlet did in meeting (or not meeting) each criterion. Students needed to summarize the news coverage and give examples of each of these five criteria from their popular press readings to support their claim. Instructors graded students on their ability to accurately define the five within-story media criteria from the rubric (source, completeness, objectivity, evidence, and language use), use of persuasive examples to support their claims, and whether they applied the criteria effectively. The within-story standard was often consistent with the type of practiced journalism (verification, assertion, affirmation, interest group). Therefore, users can find it in the same column in Figure 1.

The presentation was the third assessment tool utilized to determine how well the students had internalized the critical media analysis process. For this assignment, the students developed a 12 to 15-minute-long power-point presentation to explain their critical media analysis of the chosen science controversy. Instructors graded students on 1) cohesiveness of the presentation overall, 2) presentation of (reliable) background information to describe their science topic, 3) methods used for their final analysis, 4) presentation of their findings, 5) presentation of broader implications, 6) overall graphic quality. The presentation was worth 15 of 100 possible class points (15% of their course grade).

The fourth and final assessment for the Critical Media Analysis unit consisted of student reflection papers. Instructors collected reflection papers at the end of the course to triangulate the findings from the quiz, the final project, and the final presentation with the reflection paper. The qualitative reflection papers consisted of two questions: (1) Think back to your evaluation of news stories in the media before this course. How did your evaluation methods/approaches change (what have you learned)? and (2) What is the most important thing you have learned in this class? To analyze student reflections, researchers utilized qualitative analysis. An inductive, open-coding process identified three distinct themes from the data, including student reflections on 1) the utilization and understanding of the accuracy criterion in their evaluation of the news outlet itself, 2) the value and functionality of the critical media criteria utilized within the news story, 3) an understanding of the process of persuasion versus verification. Researchers used axial coding to evaluate relationships between the three themes and refine the theme definitions for categorizing the data (Williams and Moser, 2019). The final reflection was worth 5 points (5% of course grade) and graded on a substantive response to the two reflection questions.

The Purdue University Institutional Review Board approved the study protocol (IRB-2020-235).

Results and Discussion

This study examined the efficacy of a Critical Media Analysis unit in training students to 1) develop a foundational understanding of media practices and 2) develop an internal framework or schema to critically analyze the media coverage of controversial science in the news. Student assessments consisted of a formative quiz, a final group paper, a final group presentation, and an end-of-the-semester qualitative reflection. Overall, this pilot study's results suggest that the Critical Media Analysis curriculum outlined in this research is an effective tool for helping students become more informed and critical consumers of science issues in the media.

Formative Assessment: Quiz

Instructors administered a formative quiz was early in the Critical Media Analysis unit to measure conceptual understanding of media practices and definitions for the six criteria utilized to analyze media coverage of science in the news. Individual student scores on quizzes ranged from a low of 3.75 to a high score of 5. Students scored an average of 4.35 out of 5 points (approximately an 87%) on the formative quiz, demonstrating that students largely understood the basic, foundational concepts of media practices and the definitions of the criteria that are the foundation for critical media analysis.

Assessment of Students Ability to Apply Concepts: Final Paper

Instructors utilized a final small-group paper as a comprehensive assessment of students' basic understanding of core concepts and their ability to utilize them to analyze media coverage and apply the criteria to media coverage of a current real-world science controversy from various media outlets. As seen in Table 1, students were able to apply critical media analysis principles to a range of popular press stories and compare the popular press coverage to that of reliable (peer-reviewed) sources. Students averaged 23.7 out of 25 possible points on the final paper, indicating that they could apply the concepts learned to help them sort through how effectively (or ineffectively) science was covered by varied media outlets.

When examining how well students scored on the six media criteria outlined in the rubric, it is clear that students effectively internalized some criteria more than others. For example, in assessing the media outlet's accuracy, all 21 students correctly applied the accuracy criterion to their news outlets, meaning the score reflected a strong understanding (100%) of applying this criterion in a news analysis (Table 1). The high score comes as no surprise as they used the Media Bias Chart, which outlines the accuracy standard. In evaluating the contents of each story, students also effectively defined and gave examples from their news stories supporting their claims of how well their news stories demonstrated credible (or not credible) use of

Table 2. Qualitative Analysis of Student Reflections

Categories	Criteria	Exemplars		
Evaluation of the news outlet	Accuracy	…checking into the authors' backgrounds	…now evaluating news outlets as a whole. How important it is for news outlets to follow journalistic practices.	…establishing the articles' intentions
Evaluation of criteria within the news story itself	Sources, Evidence within the story, Language	taking time to understand the diversity and credibility of sources	…the role of connotative and annotative language in persuasion.	links to supporting evidence, and references to unbiased, science-based information
Separating persuasion versus verifiable news	Objectivity, Completeness	look for "cherry-picked" information	… including varying viewpoints.	the importance of denotative language for objectivity

Note: This table provides examples of how the Critical Media Analysis Rubric sections were evaluated in student submissions.

the source criteria, the objectivity criteria, and the language criteria 100% of the time- consistent with the definitions outlined on the Media Analysis Rubric. These constructs were the most concrete and easy to conceptualize. The students' most significant challenges appear to be in evaluating the completeness (86%) of each news story and whether the evidence within the story (95%) is sufficient to support the author's claims. The less than perfect scores reflect the students who did not correctly apply these criteria from the Critical Media Analysis Rubric in the completeness and evidence categories, respectively. In journalistic terms, completeness a presentation of all sides of a story. Completeness in a story includes journalism's 5Ws (who, what, when, where, why) and 1H (how). Authors focused on completeness should not omit key dissenting perspectives in their stories. The evidence criteria require the students to establish the central claims made in the news articles they analyzed and determine if there is sufficient credible evidence to support the author's central claims. Here students search for expert sources use, links to original data, and other cues that the author includes in the story that would allow the reader to find support for the claims made. Future classes would benefit from further exploring where students are confused on these two criteria. For the most part, students understood that the journalists needed to include evidence or facts to support the news story's claims.

Assessment of Students Ability to Communicate Analysis: Final Presentation

The third measure of students' ability to critically evaluate news coverage of science consisted of a small-group presentation. The students shared the findings of their critical media analysis with their peers and instructors. Students scored an average of 14.6 out of 15 total points for the final presentation suggesting that the learning approach helped students learn, build upon, retain, apply, and present a media literacy framework. Ultimately the purpose of the final paper and final presentation was to evaluate whether students could critically analyze media reports of science issues using six criteria: accuracy, sources, completeness, objectivity, evidence or facts, and reporter's language using the Critical Media Analysis Rubric (Figure1). Based on the students' scores, it appears that this approach was effective, although this was a small sample that would need to be replicated before findings could be generalized.

Inductive Assessment: Final Reflection Paper

In the final course reflection, researchers asked students to evaluate 1) what was "the most important thing" they learned in the course, and 2) how their media evaluation had changed since taking the course. One-third of the students who turned in completed responses (12) reported the most important thing they had learned was "how to evaluate media and articles" and "how proper journalistic practices ties into democracy." Others discussed "how important it is for news outlets to follow journalistic practices [because they] did not realize the consequences of [biased] articles." Other students identified the most important thing they had learned in the class included: "the value of diverse viewpoints," "appreciation for discussion-based learning," "the challenges of psycho-analytics in social media," and "the privacy issues surrounding the collection of big data."

When asked how their media evaluations had changed, student responses inductively aligned into three major categories: 1) evaluation of the news outlet itself, 2) evaluation of evidence within the news story, and 3) being able to separate persuasion from verifiable information (Table 2).

Overall, the combined results demonstrate that students developed a critical media analysis framework designed to help them evaluate media outlets for accuracy and separate credible coverage of science information from inaccurate, biased, or incomplete news coverage. Specifically, students learned to check media sources for the six criteria: accuracy, sources, completeness, evidence and facts, objectivity, and language, and to recognize journalistic practices of objectivity. These results support previous work that indicates individuals retain a better understanding of how to use media appropriately and understand science more broadly with formal educational interventions (Miller, 1998). The need for students well trained in media literacy has been emerging in the fields of education (Hammer, 2011), political science (Kellner and Share, 2018), and mass communication (Hobbs, 2011) within the last decade. However, the need for critical media literacy in agriculture, science, and environmental issues is equally, if not more pressing, as students grapple with complex issues such as climate change, gene editing, and food insecurity. This pilot study is one of the first to explore how critical media literacy could be incorporated into Colleges of Agriculture and Natural Resources courses.

Although the combined assessment results suggest that critical media analysis training was successful, this discussion would not be complete without mentioning the limitations of this approach. In addition to the critical media analysis curriculum, the upside-down pedagogy included a range of active-learning techniques and an interactive classroom equipped with high-end interactive technologies that allowed for group sharing. This approach's elements contributed to the high student scores for the critical media analysis unit cannot be determined by this research. Further research would be needed to establish which elements, or combination of elements, contributed most heavily to student success. Secondly, a baseline of students' media literacy skills at the beginning of the media analysis unit would inform gains made within the unit more accurately. Finally, while encouraging, this study's small sample size does not allow for generalization to the larger population of undergraduate students without further replication and validation. Despite these limitations, overall, the triangulated findings from the four assessments provide a strong foundation for further research on the efficacy of a critical media analysis unit in helping students develop an internal framework for critical analysis of mediated science information.

Summary

As access to science information in the digital age continues to accelerate, the critical need to evaluate accurate science information is emerging as one of the core skills necessary for communication students in the 21st century. This research provides preliminary evidence that a critical media analysis curriculum can help students become "media literate" in the digital age by developing an internal framework to identify, critique, analyze, and apply accurate science information through classroom training. This skill set is particularly critical for those going into agricultural, environmental, or science communication who must translate the emerging complex science issues that move our society forward to address the increasingly complex challenges of the 21st century.

Literature Cited

Ad Fontes Media. 2020. Interactive Media Bias Chart 5.1. Using the internet for publication. https://www.adfontesmedia.com/interactive-media-bias-chart-2/ (Accessed August 1, 2019)

American Library Association. 2006. Information Literacy Glossary. Using the internet for publication. http://www.ala.org/acrl/issues/infolit/overview/glossary (Accessed June 5, 2020) Document ID: 78734a76-2dcf-f244-f5e4-ead8187d35fe

Beichner, R.J. 2011. The Student-Centered Active Learning Environment for Undergraduate Programs (SCALE-UP) Project. In APS New England Section Spring Meeting Abstracts. (Abstract).

Bonwell, C.C. and J.A. Eison. 1991. Active learning: Creating excitement in the classroom. 1991 ASHE-ERIC Higher Education Report. Washington, D.C.: ERIC Clearinghouse on Higher Education.

Breivik, P. 2005. 21st century learning and information literacy. Change: The Magazine of Higher Learning, 37(2), 21-27. DOI: 10.3200/CHNG.37.2.21-27

Brigati, J., B. England, and E. Schussler. 2019. It's Not Just for Points: Teacher Justifications and Student Perceptions About Active Learning. Journal of College Science Teaching, 48(3), 45-55. DOI: 10.2307/26901282

Brossard, D. 2013. New Media Landscapes and The Science Information Consumer. Proceedings of the National Academy of Sciences, 110 (Supplement_3), 14096–14101. DOI: 10.1073/pnas.1212744110

Campbell, D.T. and J.C. Stanley. 2015. Experimental and Quasi-Experimental Designs For Research. Ravenio Books.

Craven, L. and D.R. Fredrick. 2018. The Effect of Active Learning Spaces on Students' Writing Proficiency. Proceedings, 2(21), 1318. DOI: 10.3390/proceedings2211318

Daud, W., H. Hanafi, A. Laepe. 2018. The Impact of Collaborative Learning On Students' Writing Ability And Their Motivation in Writing At MTs Negeri 1 Konawe. Journal of Language Education and Educational Technology 3(1). DOI: 10.33772/jleet.v3i1.6705

Flipse, S. and P. Osseweijer. 2013. Media Attention to GM food cases: An Innovation Perspective. Public Understanding of Science (Bristol, England). 22. 185-202. 10.1177/0963662512458631.

Freeman, S., S.L. Eddy, M. McDonough, M.K. Smith, N. Okoroafor, H. Jordt, and M.P. Wenderoth. 2014. Active Learning Increases Student Performance in

Science, Engineering, and Mathematics. Proceedings of the National Academy of Sciences of the United States of America 111.23. 8410-415. DOI: 10.1073/pnas.1319030111

Frost, J., R. Levitt, and S. Kosslyn. 2018. Fully Active Learning. Building the Intentional University: Minerva and the Future of Higher Education. Cambridge, MA: The MIT Press.

Fung, D., V. Hung, and W.M. Lui. 2018. Enhancing Science Learning Through the Introduction of Effective Group Work in Hong Kong Secondary Classrooms. International Journal of Science and Mathematics Education, 16(7), 1291–1314. DOI: 10.1007/s10763-017-9839-x

Hacisalihoglu, G., D. Stephens, L. Johnson, and M. Edington. 2018. The Use of an Active Learning Approach in a SCALE-UP Learning Space Improves Academic Performance in Undergraduate General Biology. PLoS ONE, 13(5), E0197916. DOI: 10.1371/journal.pone.0197916

Hammer, R. (2011). Critical Media Literacy as Engaged Pedagogy. E-learning and Digital Media, 8(4), 357-363. DOI: 10.2304/elea.2011.8.4.357

Hargittai, E., T. Füchslin, and M.S. Schäfer. 2018. How do young adults engage with science and research on social media? Some preliminary findings and an agenda for future research. Social Media+ Society, 4(3), p.2056305118797720. DOI: 10.1177/2056305118797720

Hasanuddin, D., E. Emzir, and S. Akhadiah. 2019. Improving Students' Scientific Writing Ability through Blended learning-Based Collaborative Learning. International Journal of Emerging Technologies in Learning (iJET), 14(20), 34-43.

Hobbs, R. (2011). The State of Media Literacy: A Response to Potter. Journal of Broadcasting & Electronic Media, 55(3), 419–430. DOI:10.1080/08838151.2011.597594

Huber, E. and A. Werner. 2016. A Review of the Literature on Flipping the STEM Classroom: Preliminary Findings. ASCILITE 2016 - Conference Proceedings - 33rd International Conference of Innovation, Practice and Research in the Use of Educational Technologies in Tertiary Education: Show Me the Learning, 267-274.

Jensen, E. 2005. Teaching with the Brain in Mind (2nd Edition). Alexandria, VA: Association for Supervision and Curriculum Development.

Jones-Jang, S.M., T. Mortensen, and J. Liu. 2019. Does Media Literacy Help Identification of Fake News? Information Literacy Helps, But Other Literacies Don't. American Behavioral Scientist, p.0002764219869406. DOI: 10.1177/0002764219869406

Kellner, D. and J. Share. 2007. Critical Media Literacy is Not an Option. Learning Inquiry, 1(1), 59–69. DOI:10.100711519-007-0004-2

Kosslyn, S. 2018. The Science of Learning: Mechanisms and Principles. Building the Intentional University: Minerva and the Future of Higher Education. Cambridge, MA: The MIT Press.

Kovach, B. and T. Rosenstiel. 2010. Blur: How to Know What's True in the Age of Information Overload. New York: Bloomsbury.

Kovach, B., and T. Rosenstiel. 2014. The Elements of Journalism: What News People Should Know, and the Public Should Expect. New York, NY: Three Rivers Press.

Listerman, T. 2010. Framing of Science Issues in Opinion-Leading News: International Comparison of Biotechnology Issue Coverage. Public Understanding of Science, 19(1), 5-15. DOI: 10.1177/0963662505089539

Macpherson, K. 2004. Undergraduate Information Literacy: A Teaching Framework. Australian Academic and Research Libraries, 35(3), 226-241. DOI: 10.1080/00048623.2004.10755273

Markant, D., A. Ruggeri, T. Gureckis, and F. Xu. 2016. Enhanced Memory as a Common Effect of Active Learning. Mind, Brain, and Education, 10(3), 142-152. DOI: 10.1111/mbe.12117

Marks, L.A., N. Kalaitzandonakes, L. Wilkins, and L. Zakharova. 2007. Mass Media Framing of Biotechnology News. Public Understanding of Science, 16(2), 183–203. DOI: 10.1177/0963662506065054

Metzger, M., A. Flanagin, and L. Zwarun. 2003. College Student Web Use, Perceptions of Information Credibility, and Verification Behavior. Computers and Education, 41(3), 271-290. DOI: 10.1080/23808985.2003.11679029

Miller, J. D. 1998. The Measurement of Civic Scientific Literacy. Public Understanding of Science, 7(3), pp.203-224. DOI:10.1088/0963-6625/7/3/001

Murcia, K. 2009. Science in the News: An Evaluation of Students' Scientific Literacy. Teaching Science, 55(3), 40-45.

IES-NCES The National Center for Educational Statistics at The Integrated Postsecondary Educational Data System, https://nces.ed.gov/ipeds/use-the-data

Nisbet, M.C., and M. Huge. 2006. Attention Cycles and Frames in the Plant Biotechnology Debate. Harvard International Journal of Press/Politics, 11(2), 3–40.

DOI: 10.1177/1081180x06286701

Nisbet, M.C., D.A Scheufele, J. Shanahan, P. Moy, D. Brossard, and B.V. Lewenstein. 2002. Knowledge, reservations, or promise? A media effects model for public perceptions of science and technology. Communication Research, 29(5), pp.584-608. 10.1177/009365002236196

Sjoberg, L.M. and S.L. Ahlfeldt. 2010. Bridging the Gap: Integrating Information Literacy into Communication Courses. Communication Teacher, 24(3), 131–135. DOI: 10.1080/17404622.2010.489193

Twardowski, T. and A. Małyska. 2015. Uninformed and Disinformed Society and the GMO Market. Trends in Biotechnology, 33(1), 1-3. DOI: 10.1016/j.tibtech.2014.11.006

Williams, M. and T. Moser. 2019. The Art of Coding and Thematic Exploration in Qualitative Research. International Management Review, 15(1), 45-72.

Young, D., and K. Anderson. 2017. Media Diet Homogeneity in a Fragmented Media Landscape. Atlantic Journal of Communication, 25(1), 33-47. DOI: 10.1080/15456870.2017.1251434