A Case for Media Literacy in the Context of Socioscientific Issues

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Abstract

Background: The call for a scientifically literate citizenry necessitates individuals who are able to understand and make decisions regarding socioscientific issues. Socioscientific issues are social dilemmas with no definite solutions that have captured the attention of media sources nationally and internationally. This implies that scientifically literate individuals also need to be media literate and able to critically analyze socioscientific information presented in the media. Because teachers are considered the most influential factor in promoting student achievement and literacy, it is imperative that teachers be scientifically and media literate as well.

Goals: The purpose of this study is to examine the types of media and criteria that preservice science teachers use to select and evaluate information pertaining to socioscientific issues presented in multimedia texts intended for use with k-12 students.

Research Methods: Exploratory study using course artifacts generated by 40 middle childhood science preservice teachers. Data sources were analyzed for frequencies and emergent patterns.

Results: Preservice teachers selected a variety of multimedia resources to teach socioscientific issues. They reexamined the selected multimedia resources with readability criteria for use with middle childhood students. The preservice teachers suggested the addition of four new criteria to the readability checklist to make it science specific. These four criteria provide a basis for informal reasoning processes.

Key Words: Socioscientific Issues, Media Literacy, Informal Reasoning

涉及科學理解的社科議題內涵中的傳媒素養淺論

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摘要

*背景：*具科學素養公民質素的個體，應具備對涉及科學理解的社科議題，有足夠瞭解和作決定的能力。社科問題是國內及國際傳播媒介都關注，卻未有解決定案的爭議話題。這意味著具科學素養公民質素的個體，也需同時具傳媒素養，即是有能力分析和批判傳媒提供的資訊。教師既是同學學習成效和素養修業的促進者，教師自身的科學和傳媒素養也不可或缺。

*目的：*本研究的目的在查驗職前科學科教師常用以篩選及評鑑由傳媒提供，擬用作指導K-12班學生，以多媒體文字方式表達，涉及科學理解的社科議題。

*研究方法：*以40位準備教中童班級的職前科學教師製作的真實課業，作為開放式探索研究的資料，以數據頻率分析法抽出浮現的現象。

*結果：*職前受訓教師廣選多種媒體資源，作為教導涉及科學理解的社科議題的素材。他們關注素材文本吸引中童的可讀性，用多種可讀性標準尺度覆驗素材。這群職前受訓教師建議，在選定的可讀性檢測清單上多添四則新的標準，以求更具體切合科學思維。這四則新標準為非正式的推理過程提供了評鑑的基礎。

關鍵詞：涉及科學理解的社會議題（社會性科學議題）、傳媒素養、非正式的推理

The overall aim of science education is to prepare scientifically literate students (AAAS, 1993; Bybee, 1997; NRC, 1996). Scientifically literate citizens are knowledgeable about the science underlying socioscientific issues (such as genetic screening, diet, medical treatment, biological and chemical weapons) and use informal reasoning to evaluate the pros and cons of the issue to make decisions that impact their personal and social lives (NRC 1996; Sadler, 2004). Socioscientific issues consist of "social dilemmas with conceptual or technological ties to science" (Sadler, 2004, p.513). Typically, socioscientific issues tend to be ill structured and necessitate informal reasoning (Wu & Tsai, 2007). Sadler (2004) defines informal reasoning as the process of generating and evaluating different positions in response to complex issues that lack a clear-cut solution.

Socioscientific issues, their consequences, and impact are widely addressed in the media. Evaluating the accuracy of media reports and considering for whom and for what purposes they were written allows students and preservice teachers to critically participate in the arena of public debate. Informal reasoning through critical problem-solving, issue-analysis and decision-making prepares students to thrive in the 21st century. Becoming media literate is a necessary precursor to the analysis of issues addressed in the public arena of websites, podcasts, blogs, news articles, and news reports. Since teachers are the most influential factor in promoting scientific and media literacy in students, this study aimed to explore how preservice science teachers select and evaluate information pertaining to socioscientific issues presented in multimedia texts intended for use with k-12 students.

Conceptual Framework

This study employs recent conceptions of literacy and informal reasoning involving media literacy, information literacy, and technology skills, each of which requires abilities advanced by the Partnership for 21st Century Skills (http://www.p.21.org/). Media literacy refers to the ability to analyze media and create media products. Information literacy refers to the ability to access, evaluate, use and manage information. Technological literacy refers to the ability to apply technology effectively. Information and communication technologies literacy is defined as the ability to use "digital technology, communications tools, and/or networks to access, manage, integrate, evaluate, and create information in order to function in a knowledge society" (International ICT Literacy Panel, 2002, p.2).

Using these abilities to analyze and think critically about media texts also depends on the employment of various modes of informal reasoning strategies. Two types of informal reasoning strategies are scientific-oriented and social-oriented (Yang and Anderson, 2003). Scientific-oriented reasoning uses scientific information and social-oriented reasoning uses social information. Informal reasoning can be further described as rationalistic, emotive, or intuitive (Sadler and Zeidler, 2005). Rationalistic informal reasoning describes reason-based considerations; emotive informal reasoning describes care-based considerations; and intuitive informal reasoning describes considerations based on immediate reactions to the context of a scenario.

New Literacies in the K-12 Classroom

The importance of developing media literacy, information literacy, and technology skills in students has recently been magnified. Over the last decade the

daily experience of adolescents has been drastically transformed by the developments in electronic media as the computer, the Internet, and cell phones have become the daily tools of communication, information, and amusement for a majority of adolescents (Brown & Martin, 2009). Similarly, adolescents are exposed to a wide range of reading material outside of school, including comic books, magazines, video games, web pages, and the Internet. For these digital natives, the written textbook should not be the only source of learning. Instead, they should be exposed to a broad array of reading materials that are reflective of the digital world they inhabit (Conley, 2008). Thus, preparing preservice science teachers should include the development of a systematic approach for selecting both digital and nondigital reading materials for use in the classroom.

Reading in the Science Classroom

Not all students are able to adequately read teacher-selected materials in the science classroom. According to the 2007 Reading Report by the Nation's Report Card (http://nationsreportcard.gov/reading_2007/r0005.asp) 27% of eighth graders read below the Basic level with as many as 38% in some states. For these readers learning science content will be even more of a challenge. Giving a 250-page science textbook to a 9th grade struggling reader is a set-up for failure.

Content area literacy refers to the ability to use reading and writing for the acquisition of new content in a given discipline (McKenna & Robinson, 1990). In order to teach content area knowledge, all teachers of grades 6-12 students need to assume a responsibility to teach the language and organization of their particular content areas, to cultivate critical thinking, and to promote the understanding of complex concepts through various multimedia tools.

It then falls to the teacher to select reading materials that are both appropriate and engaging. The teacher should also provide students with strategies and scaffolds that aid in text comprehension. Five important strategies have been identified for successful learning in a technological world (Leu, Zawilinski, et al., 2007). These strategies include (a) reading to identify important questions; (b) reading to locate information; (c) reading to evaluate information critically; (d) reading to synthesize information, and (e) reading and writing to communicate information. Within these five areas reside the skills, strategies, and dispositions that are distinctive to online, as well as offline, reading comprehension.

Socioscientific Issues in the Media

The reading of science also extends far beyond the classroom. Socioscientific issues are the target of many fictional and nonfictional articles, television shows, movies, radio broadcasts, podcasts, and websites. Students' reading and media literacy skills greatly impact their perceptions of socioscientific issues, science, and any concomitant decision-making. Skepticism and critical thinking skills are vital to the development of deep conceptual understanding of the science at the heart of the socioscientific issues and the "making of well-grounded and unbiased decisions" about these issues (Miller, 2006).

Strategies for reading comprehension, including reading to evaluate information critically and reading to synthesize information have become critical aspects of media literacy. Several strategies have been proposed in the literature on socioscientific issues to help students analyze, compare, and judiciously use information provided in media text and messages.

Scientific inquiry and skepticism are at the heart of most strategies (Grant et al., 2009; Pace & Cronin-Jones, 2009; Their, 2008; Their & Daviss, 2002; Bartz, 2002). The Key Media Literacy Questions (Their and Daviss, 2002) target the development of a healthy skepticism of media. Questions are:

1. Who created this message? Why are they sending it?
2. What techniques are used to attract my attention?
3. What kinds of words are being used? Is the writer using words to stir emotion?
4. What lifestyles, points of view, and values are represented in the message?
5. How might different people understand this message differently from me?
6. What is implied? Read between the lines.
7. What is omitted from the message?

Another strategy suggested by Bartz (2002) promotes "amiable skepticism" through a step-by-step process triggered by the acronym CRITIC:

C Claim (Spell out the claim)

R Role of the claimant (Who is making the claim and what's in it for them?)

I Information backing the claim (What evidence is there to support the claim?)

T Test (Can we design an adequate test?)

I Independent agreement (Has an unbiased source carried out an independent test that agreed with the claim?)

C Cause proposed (What is described as a causal explanation for the claim? Is it consistent with current scientific understanding?)

Using these strategies to analyze socioscientific issues in the media creates a bridge to literacy and reinforces inquiry science in the classroom (Their, 2008). By developing the scientific attitudes and skills associated with skepticism, such as questioning and searching for evidence, students can improve their reading skills.

In short, selecting and evaluating media reports is an essential component of media literacy in the context of socioscientific issues. The evaluation process necessitates adequate reading in the content area skills and the use of informal reasoning. Since teachers play an influential role in the development of students' socioscientific and media literacy, they need to understand and use multiple multimedia texts to supplement written textbooks, address students' reading needs, and facilitate active participation in discussions about socioscientific issues. They also need to be prepared to select and evaluate materials from a wide variety of resources for use in their classrooms.

Purpose of the Study

The purpose of this study is to examine the types of media and criteria employed by preservice teachers to select and evaluate information from multimedia texts on socioscientific issues intended for use with k-12 students. Specific research questions are:

1. What kinds of media sources do preservice science teachers use to gather information on socioscientific issues?
2. What criteria did preservice science teachers use to select and evaluate their resources?
3. How readable were the selected resources for use with middle school students?
4. What additional science specific criteria would preservice teachers use to assess appropriateness of resources for use for socioscientific issues?

Context

The study took place in the context of a science methods course that engages preservice science teachers in discussions of the foundations, curriculum, and methodologies of science teaching over a period of 10 weeks. The National Science Education Standards (NRC, 1996), 21st Century skills, inquiry, safety in science, the nature of science, and scientific literacy are examples of topics addressed in the course. One of the culminating assignments of the course, "Does it Matter," provided students an opportunity to demonstrate learning of several of the topics listed in the context of socioscientific issue analysis. The assignment took place in the last three weeks of the quarter. Preservice teachers were given the choice to work in a group or to work alone.

Participants

The study occurred in two sections of the middle childhood science methods course with a total enrollment of 40 preservice teachers. Twenty-seven of the participants were female. All but one were white. As part of their teacher preparation program, the preservice teachers had previously taken an educational technology course that addressed the use of the Internet for information gathering, the need for assessing the appropriateness of Internet-based resources for use in the classroom, and the importance of teaching students to evaluate information gathered from the Internet. The preservice teachers had also previously taken or were concurrently enrolled in a reading in the content areas course that emphasizes the importance of performing readability checks on resources to be used with students, as well as strategies for improving students' comprehension of texts.

Data Collection

Data collection occurred during the last three weeks of the science methods course. For the majority of this time period, the preservice teachers were engaged in the Does it Matter assignment, which required them to analyze and make a decision about a socioscientific issue. Preservice teachers were given the opportunity to choose a socioscientific issue from a list provided by the course instructor (Slesnick, 2004), or to choose another issue of interest to them. Selected issues from Slesnick (2004) included:

- Are we ready for clones?
- Cats: what's the dilemma?
- Should embryonic stem cell research be permitted?
- Can new incapacitating weapons lead to humane warfare?
- Should we genetically screen newborns?
- Should modern humans hunt?

Additional issues selected included, among others:

- Genetically modified plants
- Should we use coal?
- Biofuel
- Deforestation
- Nuclear energy

This assignment also required preservice teachers to assemble at least four relevant media resources that they would use to support middle school students' understanding of a socioscientific issue. Media resources were described as journal articles, newspaper or magazine articles, books, and podcasts, wikis, YouTube videos, and blogs, editorials, news segments and so forth. The preservice teachers were given 1 week to select and assemble their resources. They were asked to clearly identify the criteria they used to decide if the resource was

usable for the assignment. The preservice teachers were not prompted to use any specific selection criteria (e.g. accuracy, authority, and readability) at this stage to find out what criteria, if any, they would use intuitively.

After the resources were gathered, the preservice teachers were instructed in the importance of media literacy and were given the readability checklist (Conley, 2008) as an example instrument for evaluating media texts. The preservice teachers were then asked to evaluate the resources they selected for the assignment using the readability checklist. The resource readability checklist (Irwin & Davis, 1980) consists of seven sections: authority, accuracy and bias, understandability, usability, interestability, summary rating, and statements of strength and weakness. (See Appendix 1). The readability checklist asked preservice teachers to evaluate a text by indicating a Yes, Sort of, or No for 27 items within the five sections of authority, accuracy and bias, understandability, usability, and interestability.

One section of the final exam was also used as a data source for this study. The preservice teachers were asked to use the criteria on the readability checklist to rate a resource and then to identify other criteria that they believed important enough to add to the readability checklist. Here are the questions:

- The questions above asked you to evaluate the media clip using the following criteria of the readability checklist: authority, accuracy and bias, understandability, usability, and interestability. Are there other criteria that you would add to this checklist that would make it appropriate for use in a middle grades science classroom?
- For each criterion you suggested, construct at least one statement (similar to: "Color and graphics are used to make the text/website more appealing.") that you would add to the readability checklist.

Data Analysis

To answer the first research question, the resources used in the Does it Matter assignment were grouped by type, such as book or book chapter, journal/magazine article, and commercial, governmental, educational, or organizational website. Then, frequencies were calculated for each resource type. Finally, the distributions of the different types of resources in each assignment were compared.

To answer the second research question, the rationales that the preservice teachers provided for the selection of their resources were read in order to identify patterns and trends. Analysis of this data was consistent with inductive analytic procedures described by Lincoln and Guba (1985). Emergent categories were consolidated and revised through the constant comparison method (Glaser & Strauss, 1967). Four categories emerged and are described in the results section.

To answer the third research question, the completed readability checklists were examined. The number of "No" and "Sort of" responses to the sections on "Authority" and "Accuracy and Bias" were totaled and combined. A "No" response was an indication that the media resource should not be used, and a "Sort of" response was an indication a media resource should be used with caution. These responses were used to determine the percentage of media resources that were re-evaluated as unusable or to be used with caution after their initial selection in the first phase of the study.

Percentages were also calculated for the number

of preservice teachers who would not use a website or text selected in the first phase of the study because of a perceived weakness in the other three sections of the readability checklist. "No" responses were considered an indication that preservice teachers did not use the readability criteria when making their original selection of the text or website. Similarly, the "Sort of" responses to each of the items within the same four sections were tallied. Frequencies were used to represent the number of preservice teachers who would use a resource with caution because of a perceived weakness in each of the sections.

To answer the fourth research question, the preservice teachers' responses to the two questions on the final exam were examined and patterns identified. Emergent categories were collapsed as each preservice teacher response was compared to previously identified categories. Four science specific criteria emerged from the analysis. The frequency distribution for each criterion was calculated based on preservice teachers' responses.

Results

The purpose of this study was to explore how preservice science teachers evaluate information pertaining to socioscientific issues presented in multimedia texts intended for use with k-12 students. This section reports the findings of this study organized by research questions. Examples or quotes from the data are used to support research findings where appropriate.

Types of Media Sources Used by Preservice Science Teachers

A total of 68 media sources were used. Of those sources, 96% were Internet-based. The majority of the Internet-based resources, 51%, were commercial sites such as Arms and Influence: The Political Uses of Violence, for Good or Bad (http://armsandinfluence.typepad.com/), Google News (http://news.google.com/), ABC News (http://blogs.abcnews.com/) and The Washington Post (http://www.washingtonpost.com/). Five percent of the selected commercial websites consisted of articles from magazines such as National Geographic, Scientific American, and Current Science. Another 6% of the commercial sites consisted of YouTube videos of programs such as CBS News' 60 Minutes. The remaining 45% of Internet-based resources were evenly split between educational (15%) such as North Dakota University Agricultural communication news (www.ag.ndsu.edu/news) and a podcast retrieved from University of Melbourne's Up Close podcast site (http://upclose.unimelb.edu.au/episode/4), organizational (15%) such as Popular Issues (http://allaboutpopularissues.org/), and governmental sites such as Oak Ridge National Laboratory (http://www.ornl.gov/) and the Ohio Department of National Resources (http://www.dnr.state.oh.us/).

In addition to the Internet-based resources described above, 4% of the selected resources were non-Internet based, consisting of books, book chapters, and research journal articles. These resources were retrieved from the university library onsite, or through one of its electronic databases (e.g., Journal of Wildlife Management). In all cases, assignment reference sections tended to consist of references from a variety of sources. No individual or group used resources from only one type of source. For example, one group referenced resources from the Desert News courtesy of Google (www.google.com), The New York Times (www.nytimes.com),, the Journal of Wildlife Management, and Polar Biology.

Criteria Used to Select Resources

The preservice teachers used four criteria to select resources for use in the assignment. All were related to the quality of arguments supporting, opposing, or explaining the issue. Each is listed below with an example.

1. The resource defines the issue and provides current, relevant examples and facts.

The preservice science teachers valued the availability of current and relevant information about the socioscientific issue provided by the resource. For example, the Does it Matter assignment on hunting cited the Ohio Department of Natural Resources (ODNR) website as one of its resources because it provides current, relevant facts and examples on the topic. The rationale for the selection of the ODNR resource read:

> [ODNR] provides people with information about hunting, fishing and gaming and how to partake in these acts legally. This is something that we used to lean us [sic] toward the side of approving hunting because it give [sic] all of the rules and regulations that must be followed in order to partake in these events. Also this resource showed us that over the past 5 years the hunting accident rate has decreased.

2. The resource provides arguments supporting the stance opposing the one intuitively adopted by the preservice teachers.

The preservice teachers believed it was important to examine arguments supporting opposing positions on the issue. An example comes from the "Ban Free Roaming Cats" because of their impact on wildlife assignment. One of the resources was selected because it provided reasons that support the opposing stance. The assignment rationale stated, "The article was chosen because it presents the side of the issue that supports free roaming cats. It focuses on the positive side more so than the negative."

Similarly, the "Use Nuclear Energy" issue listed a particular resource because it provided an overview of the supporting and opposing arguments used as arguments for different stances on the issue. The rationale stated, "I chose this article because it discussed the advantages and disadvantages of nuclear energy by listed the pros and cons of nuclear power."

3. The resource provides several logical reasons that support at least one stance on the issue.

The preservice teachers were also inclined to select a resource based on the extent to which the arguments it presented seemed logical and in line with their intuitive ideas about the issue. For example, one of the resources referenced in the "Ban Free Roaming Cats" assignment was selected because it provided logical reasons in support of the adopted stance on the issue. The rationale argued:

> This article was chosen because it discusses the side of the issue calling for cats to be locked up. It mentions several examples and reasons why cats should be locked up that seem very logical. It also talks about how many cats often reproduce above sustainable levels when they are permitted to free roam.

4. The resource provides several scientific reasons that support at least one stance on the issue.

Finally, the preservice teachers seemed to select resources for use in the Does it Matter assignment based on the availability of scientific evidence or explanations to support arguments presented. For example, the "Allow Stem Cell Transplants" assignment provided the following rationale for the selection of listed resources:

> Desired content of these resources included medical research and scientific perspectives. Any medical research and scientific information was referenced from credible journal articles and educational, organizational, and governmental websites that may be considered to contain less bias toward the issue.

Similarly, one of the rationales provided for a resource used for the "Use Genetically Modified Plants" assignment stated, "The article provided scientific reasons involving pesticides and herbicides that warrant for GM plants to be banned."

In short, the preservice science teachers selected particular resources because they provided an overview of the topic or issue, a balanced view of its opposing stances, and logical and scientific arguments in support of each at least one of the stances.

Readability of the Selected Resources

After gathering of their resources, preservice teachers were encouraged to evaluate the readability of the resources they selected for use with middle school students. The five criteria given for the assessment consisted of authority, accuracy and bias, understandability, usability, and interestability (Conley, 2004). The following sections will describe how the preservice teachers rated the resources they previously selected using these criteria.

Authority, accuracy, and bias.

Seven percent of the preservice teachers indicated that they would not use the previously selected resources with middle school students on the grounds of authority, accuracy, and bias. These preservice teachers mainly cited the absence of a description of the resource creator's qualifications or no clear distinction between points of view, opinions and factual information. Eight percent of the preservice teachers said they would use the previously selected resources with caution because the texts and images of people, places and events were not accurate or fair.

Understandability.

Twenty two percent of teachers stated that they would not use the previously identified resources with middle school students on the grounds of understandability. These preservice teachers cited inappropriate assumptions about students' vocabulary, lack of linkage to students' prior knowledge, and preponderance of irrelevant details. Fifty-five percent of the preservice teachers stated they would use the previously selected resources with caution because new ideas were not introduced one at a time with sufficient explanation and examples, and definitions were not always understandable. These teachers believed it was necessary to look things up or follow hyperlinks to understand new concepts.

Usability.

Thirty percent of the preservice teachers believed that the resources they had previously selected were not very usable with middle school students because of the absence of illustrations and pictures that are supportive of website information. Twenty

two percent of the preservice teachers indicated that they would use the resources with caution because important terms were not italicized, boldfaced, or hyperlinked, and the color combinations of text and background were not well coordinated, making the website difficult to read.

Interestability.

Thirty seven percent of the preservice teachers believed that the resources they had previously selected would not be interesting to middle school students because of the absence of appealing colors and graphics. Fifty two percent of the preservice teachers indicated that they would use the resources with caution because the sites do not always provide positive and motivating models for both sexes as well as for other racial, ethnic, and socioeconomic groups.

Additional Science Criteria Used

Preservice teachers suggested the addition of four new criteria to the checklist to make it appropriate for use in a middle school science classroom. The four criteria are (a) absence of alternative conceptions (33% of preservice teachers suggested this criterion), (b) attention to safety in science (22%), (c) emphasis on science skills (25%), and (d) emphasis on scientific attitudes (20%). The preservice teachers provided statements to include in the checklist to support each of the criteria they proposed. For "absence of alternative conceptions," sample statements included "Valid information is provided to explain to students the topics" and "Materials are up-to-date and do not have misconceptions as part of their information."

For the "attention to safety in science" criterion, sample preservice teacher statements included "The material displayed does not model any behaviors that could put the students in danger" and "Were the correct safety measures demonstrated or discussed?" For the "emphasis on science skills" criterion, sample statements included "The text/website includes a list of connection that can lead students to scientific based inquiry thinking" and "Does the material enhance the ability of students to make connections, observations, and inferences?" Finally, for the "emphasis on scientific attitudes" criterion, sample preservice teacher statements included "The material displayed goes beyond simple science facts and promotes scientific attitudes" and "Does it demonstrate that scientists always question findings to find out if they are right?"

Discussion and Implications

The results of this study indicated that preservice teachers selected material from a wide variety of media resources. Their original criteria for selecting these resources were related to the quality of arguments supporting, opposing, or explaining the issue. It appeared their main concern was how well suited the material was for the assignment. However, when asked to systematically re-evaluate the material for readability, some previously selected materials were rated as unusable or to be used with caution. Interestingly, the preservice teachers identified four additional science specific criteria for evaluating the material. These findings and their implications will be discussed in more detail in the paragraphs that follow.

When selecting and evaluating multimedia resources for the purpose of socioscientific analysis, preservice teachers relied on several types of websites including commercial, governmental, educational, and organizational websites. Even though the overwhelming majority of preservice teachers seem to use a combination of authority, accuracy, and bias as a main criterion for resource evaluation (only 7%

questioned the expertise of the source), they did not seem to ascribe more authority, accuracy, or bias to a particular type of website as evidenced by the variety of website types selected per group or per individual. Additional instruction in the relationship between domain names, validity, and credibility for the purpose of evaluating website authority is necessary.

Despite experience with teaching reading in the content areas, some of the preservice teachers did not apply text readability criteria in selecting web resources for use with middle childhood students. In many cases, the preservice teachers did not rely on principles of understandability, usability, or interestability when selecting resources for the assignment.

Three explanations are suggested for this finding. First, it may be that preservice teachers did not take middle school students' reading abilities into consideration as they were selecting their resources. Second, it may be a lack of transfer of knowledge and skills learned in the reading in the content areas course to other contexts. The latter reason implies the need to integrate media literacy education in science- and other content-specific teacher education courses. Third, it may be that the preservice teachers were more concerned with how well suited the resource would be for the purposes of the assignment than its readability. The four criteria that the preservice teachers did use in selecting their media resources centered on the explanations and supporting information offered by the resources. The use of these criteria is consistent with patterns of informal reasoning identified in the science education literature (Sadler & Zeidler, 2005; Yang & Anderson, 2007). Criteria such as "providing logical reasons to support at least one stance on the issue and "providing an overview of opposing arguments" serve as bases for rationalistic reason-based considerations.

Furthermore, the criterion "providing several scientific reasons to support at least one stance on the issue" serves a basis for scientific-oriented reasoning. Finally, the criterion "defines the issue and provides current, relevant examples and facts" provides a basis for social-oriented reasoning. This finding implies that it may be helpful to use the patterns of informal reasoning described in the literature as criteria for promoting media literacy in the context of socioscientific issues. To be more effective, science teacher preparation programs should provide preservice teachers with explicit instruction about strategies to improve informal reasoning and reading in the content areas.

Interestingly, the preservice teachers suggested the addition of four new "science specific" criteria to the readability checklist. The "absence of alternative conceptions" criterion would naturally fit in the accuracy section of the readability checklist. Alternative conceptions or misconceptions are scientifically incorrect explanations that learners construct as they attempt to make sense of natural phenomena during formal instruction or encounters in their daily lives (Mintzes, Wandersee, & Novak, 1998). Alternative conceptions are personal constructions of students and thus resistant to change (Driver, 1983). With the preponderance of media use in science classrooms today, it is important that teachers continue to act as "filters" (Abimbola & Baba, 1996; Ford, 2006), evaluating media sources for accuracy and the presence of alternative conceptions.

Another criterion suggested by preservice teachers consisted of "attention to safety." Safety is a cornerstone of science instruction. The National Science Education Standards (NRC, 1996) state

that students should "utilize safety procedures during scientific investigations." It further advocates for teachers who "design and manage learning environments that provide students with the time, space, and resources needed for learning science. In doing this, teachers ensure a safe working environment."

The "emphasis on science skills and science attitudes" criteria suggested by the preservice teachers are very science specific. Science skills consist of processes that are common to most forms of scientific inquiry (Moreno, 2007). Observation, classification, prediction, communication, controlling variables, and graphing are some examples of science process skills. Scientific attitudes are mental predispositions towards science and the conduct of science (Martin et al., 2009). Perseverance, a positive approach to failure, skepticism, and a desire for evidence are examples of scientific attitudes. Examples of science process skills and attitudes that may be relevant to the evaluation of information about socioscientific issues presented in the media are observations, inferences, skepticism, and a desire for evidence. These criteria fit under the accuracy and bias section of the readability checklist and allow students and teachers to assess elements such as objectivity and evidence-based claims or arguments.

In summary, preservice teachers did not initially apply readability criteria for selecting media resources, but were able to use scientific argument as a basis for making judgments and to later add four new science specific criteria. These findings imply that more and better-integrated media literacy education is needed in teacher preparation programs. Survey courses in instructional technology and reading in the content areas are necessary to introduce preservice teachers to new strategies and to promote competencies associated with media literacy.

However, survey courses are not enough. Preservice teachers need more opportunities to engage in focused, concrete, and content specific experiences that enable them to apply media literacy strategies that include informal reasoning and discipline specific criteria. Such instruction should show preservice teachers how they can apply existing skills in a variety of informational settings in order to think critically about information provided through different forms of media. Designing instruction that draws on the content specific knowledge of preservice teachers could be an important means of facilitating instruction in media literacy.

Conclusion

Socioscientific issues are effective contexts for the promotion of media literacy. Preservice teachers in this study had some hands on experience evaluating and selecting media resources for use in their future classroom; they used readability criteria and elements of informal reasoning to evaluate media resources focusing on socioscientific issues; they selected resources from a variety of domains as additional instructional materials to written textbook; and preservice teachers proposed the addition of four science-specific criteria to the readability checklist (Conley, 2008). The addition of science specific criteria and elements of informal reasoning to the readability checklist makes it an effective tool for selecting multimedia resources for science classrooms. Providing preservice teachers with concrete, content specific opportunities to use informal reasoning and media literacy is a way to raise their awareness of the multiple multimedia resources available to help meet their students' needs and interest in learning with digital texts.

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Appendix 1

In the blank before each item, indicate Y for "yes, " S for "Sort of," or N for "no." An N or S next to any of the items under AUTHORITY or ACCURACY AND BIAS means that the text or website should either be used with caution or not be used at all.

AUTHORITY

____ 1. The organization or person responsible for the text/website is identified, along with a way of verifying the identity (via email, a phone number, and a postal address).

____ 2. The organization or person's qualifications for creating the text/website are clearly stated or evident.

ACCURACY AND BIAS

____ 1. Sources for information are clearly listed so that they can be verified.

____ 2. Text and images of people, places, and events are accurate and fair.

____ 3. Points of view and opinions are clearly labeled or are evident and distinguished from factual information.

UNDERSTANDABILITY

____ 1. The assumptions about students' vocabulary knowledge are appropriate.
____ 2. The assumptions about students' prior knowledge are appropriate.
____ 3. The text/website explicitly states complex relationships among ideas and concepts.
____ 4. New ideas and concepts are linked to students' prior knowledge.
____ 5. Abstract concepts are accompanied by concrete explanations and examples.
____ 6. New ideas are introduced one at a time with sufficient explanation and examples.
____ 7. Definitions are understandable. It is not necessary to look things up or follow hyperlinks to understand new concepts.
____ 8. The text/website avoids irrelevant details.
____ 9. The text/website pages are well formatted (graphics, menus, links, etc. enhance and do not interfere with reading).

USABILITY

____ 1. Titles, headings, and subheadings represent the content of the text/website.
____ 2. Any charts and graphs are easy to read and are supportive of text/website information.
____ 3. Illustrations and pictures are of high quality and are supportive of text/website information.
____ 4. The print size of the text/website is appropriate for the level of the readers and for good readability.
____ 5. Important terms are in italic, boldface, or hyperlink text.
____ 6. Color combinations of text and background are well coordinated, making the text/website easy to read.

INTERESTABILITY

____ 1. Titles, headings, and subheadings are interesting and capture the reader's attention.
____ 2. The writing style of the text/website is appealing to the students.
____ 3. The layout and overall appearance of the text/website are interesting (e.g., the author uses colorful language and/or humor).
____ 4. Color and graphics are used to make the text/website more appealing.
____ 5. The text/website provides positive and motivating models for both sexes as well as for other racial, ethnic, and socioeconomic groups.

SUMMARY RATING

Circle one choice for each item
The website rates highest in /understandability/ /usability/ /interest/

The website rates the lowest in /understandability/ /usability/ /interest/

STATEMENT OF STRENGTHS

STATEMENT OF WEAKNESSES

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