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Evaluation of Web Resources by Pre-Service Teachers

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Paula Storm and Laura Eidietis have collaborated on a chapter that deals with information literacy and preservice teachers. Eidietis, who teaches classes on biology education for future elementary teachers, became concerned about the poor job her students sometimes did when searching for Internet resources for use in their classes. She combined with Paula Storm, EMU's Science and Technology Librarian, to develop and assess workshops aimed at helping students perform more productive Internet searches on scientific topics. The two authors report here on their study; they demonstrate that the criteria students use in assessing Internet sites are often rather different from those used by an expert. This paper includes a valuable description of the criteria students used, with explanations derived from student assignments.

As one who concentrates somewhat on information literacy in my classes, I find this work to be particularly valuable. It is thoughtful work on a critical topic. More than this, Storm and Eidietis' discussion of issues of professionalism is quite persuasive. The biggest fear this work raises is that our preservice teachers may not be acting in a professional way when they choose the easy way to do Internet searches rather than doing better searches in a more time-consuming manner. One hopes that students begin to view themselves as professional educators more as they proceed in their teacher education program.

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Focus of the Investigation

Questions

While teaching science methods classes to preservice teachers, Laura Eidietis found that students first tend to go to the Internet for information and resources. The American Library Association offers a description of an information literate person in their Competency Standards for Higher Education (ALA 2000). Using the definition offered by the ALA, Eidietis' students often were not able to "access the needed information effectively and efficiently" and "evaluate information and its sources critically" (ACRL 2000), while searching on the Internet. Therefore, according to the ALA's very reasonable definition of information literacy, these preservice teachers are not information literate.

In response, Eidietis collaborated with Paula Storm, the science and technology librarian at Eastern Michigan University, to create a workshop-based approach to increase the ability of students to find what they need on the Internet. This partnership is a "teaching alliance" (Mackey and Jacobson 2005), meaning that Eidietis and Storm, scientist and expert, respectively, collaborated to work with particular library resources to plan specific assignments and utilize teaching technology. In this case, the library resources were databases and directories appropriate for the professional development of teachers in the area of elementary science education. These resources included some that require library subscription (e.g., Biology Digest from Plexus Publishing) and others that are publicly available (e.g., ERIC). The assignments were within *Life Science for Elementary Teachers*, a required science content and teaching methods class for preservice teachers. Each assignment helped students find information that they needed for other projects in the class. The teaching technologies included the use of tools for finding information on the Internet (databases, directories, search engines, etc.), an online Microsoft PowerPoint presentation with embedded sound for virtual lectures, and an Internet-based platform for course instruction (WebCT Vista).

This life science course has a stated goal related to information literacy: "Become familiar with textbook and Internet resource mate-

rials used in elementary school science. Select appropriate resources when designing instructional materials." Information literacy is a prerequisite for completing many of the assignments in this life science and elementary science methods class. Thus, this project arose not from an esoteric value for a course in information literacy, but rather from a practical need of students at a particular point in their professional development.

This approach to technology literacy makes excellent sense in terms of generally accepted educational theory. Students learn best when learning is grounded in authentic, meaningful tasks (see Sparks-Langer et al. 2004 and sources therein). An authentic approach to technology learning is not new (Bird and Rosaen 2005), but has not been reported within a similar context to that of our project.

The students' assignments provided a wealth of information regarding how these preservice teachers seek information on the Internet. For this report, we will focus on describing and interpreting the student behaviors that we observed. The focus of the investigation surrounds the following three questions:

- How do students search for resources on the Internet?
- Can students effectively evaluate resources from the Internet?
- How do students evaluate resources from the Internet?

The analysis of the effectiveness of the course implementations will be left for another report.

Alignment with Currently Accepted Learning Goals

Life Science for Elementary Teachers is a professional development course for preservice teachers. As such, instructors are professionally obligated to align course implementations with national and state standards that outline skills that preservice teachers must master. Within the spirit of this professional context, we will comment on how our analyses of student behaviors address some relevant national standards for higher education. First, our analyses address points in the ALA's "Competency Standards for Higher Education", which suggest that the information-literate student "accesses needed information ef-

fectively and efficiently [by constructing and implementing] effectively designed search strategies" (Standard 2) and "evaluates information and its sources critically and incorporates selected information into his or her knowledge base and value system" (Standard 3) (ALA 2000). Second, our analyses address the following teacher-preparation standard of the National Science Teachers Association:

> To show that they are prepared to create a community of diverse learners, teachers of science must demonstrate they… successfully use technological tools, including but not limited to computer technology, to access resources, collect and process data, and facilitate the learning of science. (Standard 5: General Skills of Teaching) (NSTA 2003)

Evidence Gathered

Life Science for Elementary Teachers enrolled approximately 160 students during this project; these students are both traditional, four-year students (74%) and non-traditional undergraduates including students who are not full-time and those who are working on second degrees. Over 30% of the students are above 26 years of age. Approximately 89% of these students are female. For these analyses, we considered sub-samples of students. Sub-samples were anonymous and were chosen without reference to race, gender, age, or whether students were traditional or nontraditional. All members of the sub-samples participated in the entire project; that is, we excluded any student who did not submit one or more portions of the project. All members of the sub-samples offered us use of their work for scholarly purposes, under the condition of anonymity. For the analyses regarding the questions "How do students search for resources on the Internet?" and "How do students evaluate resources from the Internet?" the sub-sample included 40 students. For the question "Can students effectively evaluate resources from the Internet?" we compared responses of 20 students to opinions formed by Paula Storm, the science and technology librarian at EMU.

Life Science for Elementary Teachers was a hybrid course; students completed 2 contact hours per week of instruction on the Internet-based WebCT platform. The entirety of this project was conducted on WebCT. Thus, although we developed the tools used in this study, we did not implement the instruction and did not administer the Internet-based tools (a separate instructor ran the WebCT portion of this course).

During the pre-assessment, students conducted a search on the Internet for information about connecting a life science topic to the real world of children. We offered no guidance in terms of searching technique. This activity supported a large, summative assessment: students developed an extensive, researched lesson in life science and taught this lesson in an elementary classroom. Then, students participated in an online workshop that consisted of PowerPoint slides with an embedded audio lecture and a short quiz. The workshop was designed to be interactive, so the PowerPoint presentation and lecture were presented to the students within the context of quiz questions. At the end of the workshop, students were asked to do a search on the Internet, but this time they were directed to use the databases and directories that were introduced within the workshop. This second search was for information about the habitat of an animal; this activity supported a concurrent laboratory activity. Finally, in a post-assessment, students were asked to find a hands-on activity for use in an elementary classroom. As in the pre-assessment, we offered no guidance in terms of searching technique.

This report focuses on student answers to the following questions from the assessments:

Pre-assessment

1. Where or how did you find this resource? Explain how you searched.

Examples: First, I "yahooed" the keywords "apple tree" using quotation marks around the phrase. That turned up junk. Then, I yahooed "pbs" because I know that Sesame Street usually has good children's information…. First, I went to the FunScience website that I learned about in another class, and then….

2. How confident are you in the quality of this resource?
   (Please rate your confidence.)
     0 - not confident 1 - confident 2 - very confident

3. What criteria did you use to rate your confidence in the quality of this resource?

Workshop assessment

1. Where or how did you find this resource? Explain how you searched.

2. How confident are you in the quality of this resource? (Please rate your confidence.)
   0 - not confident 1 - confident 2 - very confident

3. What criteria did you use to rate your confidence in the quality of this resource?

Post-assessment

1. Key words that led you to this resource OR the hierarchy of browsing terms that led you to this resource.

2. How confident are you in the quality of this resource? (Please rate your confidence.)
   0 - not confident 1 - confident 2 - very confident

3. What criteria did you use to rate your confidence in the quality of this resource?

Answers to the first question were used to help us answer the question, "How do students search for resources on the Internet?" The second question helped us answer the question, "Can students effectively evaluate resources from the Internet?" The third question was useful for answering the question, "How do students evaluate web resources from the Internet?" Also, to investigate the question, "Can students effectively evaluate resources from the Internet?" Paula Storm

compared the students' confidence levels against her assessment of the sites that the students found on the Internet, ranking her confidence in the resources from the Internet as "not confident", "confident", and "very confident", just as the students did. She used normal and accepted criteria for a specialist in information.

Emerging Results

How do students search for Internet resources? The Google Addiction

Prior to attending the workshop, students chose to use search engines to find information on the Internet. We found that 70% of the responses that we analyzed reported that students used the Google search engine to seek resources online during the pre-assessment (85% used some sort of search engine). Initially, we hypothesized that the addiction to Google occurred because students did not have a better search strategy; we thought that once their eyes were opened to the richness of edited databases, indices and directories, students would gravitate towards these more reliable sources.

Indeed, our online workshop helped most students gain competency in using databases and directories. During the online workshop, students were asked not to use a search engine and to instead explore databases and directories. When so directed, only 8% of the students reported that they used a search engine. Certainly, given that this was a graded assignment, skepticism regarding the truthfulness of student responses is appropriate. However, students generally named a specific database, index or directory (e.g., Sciris by Elsevier) suggesting that the students did explore resources other than search engines.

After the workshop, students were again asked to find an online resource, but no directive was given as to the search method. Unfortunately, the tool used to gather student data did not clearly direct students to communicate their methods of searching. Despite this lack of clarity in our research tool, 35% of the students spontaneously reported using a search engine to find online resources. Despite a demonstrated competency in using edited sources of websites, students reverted to their Googling propensities when not specifically directed towards edited databases and directories.

Our pedagogical training allowed us to interpret these results in terms of learning objectives. Our students mastered the cognitive objectives necessary for using edited databases to obtain information regarding a specific topic. In addition, the students mastered the psychomotor skills for navigating through the library web sources. However, many students did not come to value edited databases and directories as a first resource for finding information needed for professional development. This failure of many students to attain our preferred affective learning objective caused some frustration on our part and inspired a question: Why, if she knows how to use a superior source and if she has a list of such sources available at her fingertips, would a student revert to the use of an inferior source of information?

Most likely, the explanation for student behavior varies among students. One student gave us a possible explanation by communicating that she was searching for an activity and felt that "because of the way this lesson is explained there is not much that could be misleading. The lesson offers a book to read and how to follow it up with an activity. The person who used this lesson [idea] needs to implement it with the correct information." In other words, the student felt that the portions of learning activities that are stage directions (rather than content, such as life science, etc.) are easier to judge than the portions of learning activities that require specialized content knowledge. The post-assessment asked students to retrieve activity ideas, as opposed to content knowledge. Perhaps students simply felt safer retrieving unedited activity ideas, as opposed to unedited scientific ideas. In addition, students may have felt safer self-evaluating information that was seemingly familiar to them (i.e., activity ideas) as opposed to self-evaluating less familiar information (i.e., scientific information). These students have experienced many sets of directions for activities in their preservice teacher classes. If students are comfortable in their own ability to serve as reviewers of resources, then perhaps they do not see a need to access pre-edited databases and directories.

Another likely explanation is provided by Wilder (2005) when he recognizes that a typical college freshman finds that "Google provides her with material she finds good enough, and does so instantaneously." Why would a busy student take the time to navigate through

a series of mouse clicks and several minutes of reading, when a simple Google search will allow her to finish the assignment quickly and to do it well enough? Even if, as in the case of our students, the activity is to be utilized in a real classroom, perhaps the student believes that she is a trained teacher. If she gets a decent idea off the Internet, she can probably modify it into a great idea, utilizing her extensive training in pedagogy. As long as the source is good enough, a busy preservice (or maybe even inservice) teacher simply does not have the luxury of the time to find a perfect source, unless directed to do so by an outside motivator, such as a grade.

Can students effectively evaluate Internet resources? The Overconfident Information Seeker

Students reported high confidence in the resources that they found on the Internet. Both before and after the workshop, 100% of a subsample of 20 students reported that they were at least "confident" in the quality of their resource; most (65%) reported that they were "very confident" in the quality of their resource.

Student opinions regarding their resources differed markedly from that of an expert. Storm was "not confident" in 40% of student resources from the preassessment and 35% of resources from the post-assessment. In general, students showed more confidence in their re-sources than did Storm for 55% of the sources in the preassessment and 75% of the sources in the postassessment; this difference was sta-tistically significant for both assessments (Wilcoxon Signed Ranks Test for paired samples, p<0.003).

As shown above, there was a striking difference in Paula Storm's confidence in the students' resources and the students' confidence. Moreover, the trend was disturbing. Presumably, these are the types of resources preservice teachers would use for professional development and classroom use upon becoming certified to teach elementary chil-dren. These future teachers were overrating the quality of the resources that they found on the Internet. Such lack of evaluative ability in a teacher could lead to similar problems for their future students.

However, when rating the quality of a resource, different peo-ple, particularly people of different professions, may value different

criteria. Thus, we must consider the criteria that our students utilized for evaluating resources on the Internet. If these criteria are differet from an expert in information, then we must consider if these alternative criteria are more, less, or equally valid, based upon the context of the need for information.

How do students evaluate resources from the Internet? A Taxonomy of Criteria

Throughout the three assessments in this project, students used a variety of types of information when evaluating resources from the Internet (Figure 6-1).

Figure 6-1: A Taxonomy Describing Students' Criteria for Evaluating Web Resources
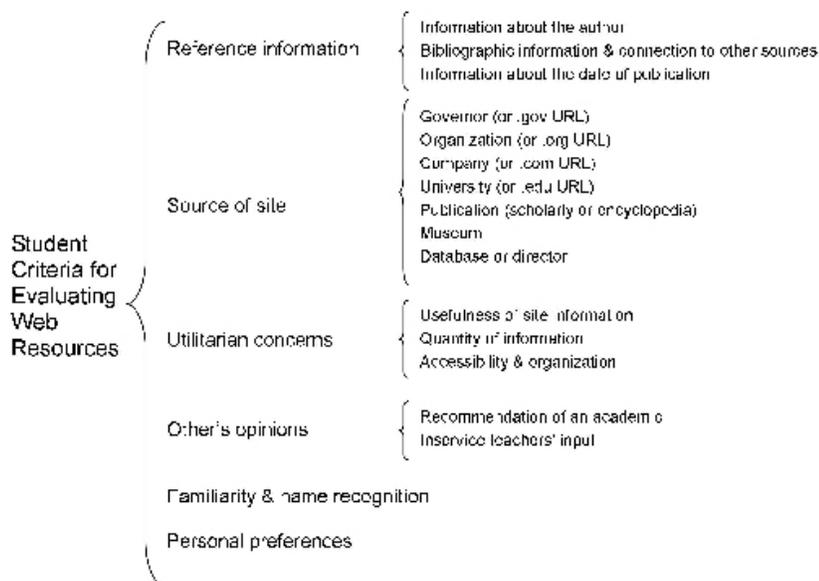
For most of the types of criteria, students either did use these criteria on both the pre- and post-assessments or did not use these criteria on both the pre- and post-assessments (Table 6-1). One exception was the use of the source of the site as a type of criteria for evaluating a website. In this case, 40% of students originally used these criteria, but opted not to use these criteria on the post-assessment. Also, 50% of students originally considered utilitarian concerns when evaluating an Internet

source but decided not to use this type of criteria during the post-assessment. In general, though, the classroom implementations did not substantially alter this aspect of student behavior.

Paula Storm used five main types of information for determining her confidence in the resources that our students discovered on the Internet. These were information about the author, information about the domain (URL) or source of the website (e.g., the National Institutes of Health as opposed to "The Smeet Frog WebSite", (members.aol.com/smeetfrog), references provided in the website, links in the website, and information about the date in the website.

Table 6-1: Student Change in Using Criteria in Pre-Assessment and Post-Assessment *(n=40)*

Criteria	Negative Change	Positive Change	No Change
Reference Information	17.5%	10%	72.5%
Source of Site	**40%**	**20%**	**40%**
Utilitarian Concerns	**50%**	**20%**	**30%**
Others' Opinions	0%	12.5%	87.5%
Familiarity and Name Recognition	5%	1.75%	93.25%
Personal Preferences	17.5%	7.5%	75%

Note: Negative change means criterion was used in pre-assessment but not in post-assessment. Positive change means criterion was used in post-assessment but not in pre-assessment. No change indicates no difference in whether or not criterion was used.

Some of the information used by students aligned with the criteria that Storm utilized. For example, students considered information about the date of publication (Figure 6-1). This was not unexpected, particularly during and after the online workshop, as information about the date of publication is a source of information that information specialists suggest that students use when evaluating websites. Accordingly, Storm also used information about the date in the website. Similarly, both Storm and the students considered reference information such as author information and bibliographic information, and

both students and the librarian considered the source of the site as an important piece of information.

However, students also used criteria that differed substantially from the information that an expert considered when evaluating Internet resources. For example, many students considered utilitarian issues when evaluating a resource from the Internet. These concerns ranged from the amount of information on the site to their ability to apply the site information to the task at hand. Students also reported a variety of personal preferences that they used to evaluate the quality of the source. These included the opinions of others, including the input of inservice teachers and aesthetic preferences (e.g., "colorful").

The students' reasons for their evaluation of a website served to educate us about our own biases. Our assessment tool asked students to rate their confidence in the "quality" of a resource from the Internet (see question 3 in the assessment tools described above). When an expert, such as Paula Storm, or a scientist, such as Laura Eidietis, evaluates the quality of a website, she ranks the reliability of the website above all other considerations. Thus, "reliability" becomes synonymous with "quality" when first determining if a website is even worth reading. Our students had a much broader definition of "quality" than did our expert. They considered issues such as whether or not the website was visually pleasing when evaluating "quality".

We believe that we asked the students the wrong question, if our goal was to compare our students to an expert. Rather than asking whether students were confident in the "quality" of the resource, perhaps we should have asked if the students were confident in the "reliability" of the resource. Certainly, once an expert categorizes a group of websites as highly reliable, she may then preferentially choose to spend time at a site that is more pleasing to look at, more comprehensive, or easier to navigate. Thus, an expert may have more than one tier of criteria when evaluating sources. The disturbing pattern within the students' responses is that they did not always communicate a similar, multi-tiered approach to evaluation.

Some students only noted the utility or aesthetics of the website, without any real information to determine whether or not the website was reliable. For example, in this worst case scenario, the stu-

dent communicated that she was "confident" in a web source in the following words, "Since the site is very basic I rated it as a 1 [confident]. It has very understandable text and use of graphics/pictures." More commonly, students threaded together types of evaluative criteria without any clear reference to any information being more or less important. An example of this is the following explanation from a student who communicated that she was "very confident" in her source:

> The site where I found the pdf file is www.arborday. org, which is run by The National Arbor Day Foundation. This is a highly respected organization. The file started off with an excellent attention-grabbing paragraph. It contained several high-quality graphics and very descriptive text. It also provided several activities that can be done in the classroom.

If students are searching for sources to illustrate information in which they are already experts, then the lack of a multi-tiered approach may not be terribly problematic. For example, Laura Eidietis can search in Google for lesson plans about plant life cycles, scan the lesson plans, and pick out the most pleasing websites. She will not pick websites with poor information, because she is an expert in biology and pedagogy; as an expert, she automatically disregards outdated or misleading information. The downside of this approach is that the reviewer must read the entire site to ensure quality, before suggesting the site to another (e.g., a student). As a counter-illustration, Laura Eidietis often needs to find information on the life cycle of a specific plant with which she is not familiar. Then, she does not use Google. Instead, she will search a database wherein she knows that she can find reliable information. The *Life Science for Elementary Teachers* students are not experts in biology or pedagogy. Presumably, the reason they are searching for information is ignorance regarding that information. Given this, it is unfortunate when students do not consider the reliability of their source of information, no matter how pleasing the website may be.

Criteria type 1: Reference information

An expert considers the availability and quality of reference information within a source when evaluating it. Some of the students (28-38% of a 40 student subsample) considered reference information when evaluating their sources (Table 6-2). This percentage did not significantly differ among the preassessment, workshop assessment, and postassessment (chi-square test). The reference information that students highlighted fell into three categories: information about the author, bibliographic information or connection to other sources, and information about the date of publication (this included a reference to a recent date). The three basic categories of criteria within the grouping of reference information were reasonably evenly distributed, with 5-6 out of 40 students using each of these in the preassessment, and during the workshop. Only one student considered bibliographic information and connection to other sources in the postassessment, but, otherwise, the pattern was similar in all three assessments.

In order to interpret these results, it is helpful to recall that students were asked to find connections to the real world of children, information on animal habitats, and activity ideas for teaching Life Science lessons. Certainly, for the first and second task, reference information is critical for determining if a website is high in quality. At the very least, information connecting the science to the world of modern, current children and scientifically accepted information on animal habitats ought to be current. Students need to consider dates when looking at published sources.

Even with regard to activity design, though, it surprised us that students did not communicate a consistent concern for who wrote the activities that they found on the Internet. We were concerned that this behavior indicated a lack of professionalism. To illustrate, a professional doctor (or medical student) would not attempt to try a procedure that she found on the Internet, unless she was confident in the expertise of the author of the procedure. This is because medicine is a profession, and there are professional standards. Similarly, we would prefer if a professional teacher would not attempt an activity that she found on the Internet, unless she was confident in the expertise of the author. This is because, just as medicine has professional standards, so

too does science teaching. Disregard for such professional standards and expertise in these standards may serve to degrade confidence in teachers as professionals.

Table 6-2: Reference Information – What the Students Said

Information About the Author	Bibliographic Information and Connection to Other Sources	Information about the Date of Publication
• unable to find author(s) • it just didn't have anything as far as their credentials … so it makes me a little bit skeptical of some of the links • did not give much information such as the author; did not (have) much information … contact information • is a graduate of the University of California who has a degree in physiology and cell biology • a section where we can learn all about the creators of this site; most of them are education specialists • author available at the top of the article • gives email addresses, phone numbers • I can trace back the actual contributors to this article meaning the information was not generated from compilation of computer information	• lists references • had a list of resources that it used • cited his sources • compiled using a variety of sources • author provides bibliographic information to books that he/she referenced in his/her article • based on research • how well it could back up the information given • there was a page that contained all of the bibliography information, which made the information even more reliable	• publication date available at the top of the article • listed the date that it was created • has an updated date at the bottom of the page • page was last modified less than a year from now • from 1995 so that material may or may not be a little bit out dated • did not gve much information [such as] specific dates • copyright of the web page was a recent year so that I know that the web page is updated • copyright was 2006, which means the information is up-to date

Criteria Type 2: Source of Site

Just as Storm considered the source of the site as important for evaluating resources, many students reported using the source of the

Table 6-3: Source of Site – What the Students Said

Government (or .gov URL)

- "USDA Agricultural Research Service" designed the website
- supported by the National Science Foundation
- more likely choose websites ending in ".org" or "gov" rather than ".com" because they tend to be more reliable
- resource comes from a government created website, therefore the information from this source is most likely credible and factual

Publication (scholarly or encyclopedia)

- it is an encyclopedia so it is guaranteed factual information
- from a reputable publication
- magazine "Science World" is published by Scholastic, and I trust Scholastic
- Wikipedia is a very accurate and reliable resource
- resource came out of a published journal called Science Teacher… a peer reviewed article
- resource was from a scholarly journal
- scholarly nature journal… criteria for being selected in the journal lets me know that it is a quality resource

Organization (or .org URL)

- from an actual organization and not an individual… increases my confidence in the accuracy…
- from a .org web address, and we learned in my English class that .org websites are usually trustworthy
- has an ".org" ending which means it is a non-profit organization
- trust PBS to be thoughtful, informative and well- documented
- Annenberg Foundation is a non-profit organization that distributes materials to public schools and universities
- by the National Wildlife Federation
- Wikipedia is a highly reliable free online encyclopedia that I have seen some cooperating teachers in my… [field experience] use when looking for information
- official Wyoming state game fishing website
- since I don't know anything about Kidsworld, I can't be super confident in my resource

University (or .EDU URL)

- from a university which makes it more likely to be accurate and of good quality; URL has a ".edu" address which is reserved for education purposes (2 answers)
- by a state funded university, Arizona State University; supported by the University of Michigan's Zoology department (2 answers)
- from the University of Illinois Extension program so I am confident in the quality of this resource
- by two professors at Florida State University's Biological Science Department
- from the University of California-Berkeley's website... an institution of this stature would only include credible sources on its page

Museum

- by the National Health Museum
- Smithsonian is obviously a fabulous science resource
- I know from research in other classes that museums usually have interactive websites with accurate information

Company (or .com URL)

- from a company, which made me feel more comfortable to the resource's validity
- written by a company whose focus is learning which adds quality to this particular resource
- from a .com rather then a .edu or .gov, this means anyone can post lessons
- did not feel very confident in my resource was because it was a .com website
- it does make me nervous that it is a .com site, but it is made by a company which built my confidence a little

Database (or directory)

- came from a database and I know these are much more reliable because they are reviewed
- came from a database instead of a search engine, which alone lead me to believe it was a credible source of information
- from a database that is geared towards elementary grade students
- restricted to sites that were carefully selected by an editor
- found on a reputable/reliable source (ERIC) (Michigan Teacher Network) (Biology Digest) (3 separate answers)
- searched through the National Science Digital library; from Scirus database (2 answers)

site to evaluate a website (Table 6-3). There was no statistically significant change across the assessments in the use of the source of the site as a criterion for judging a website. Use of this criterion ranged from 58% of the students in the preassessment to 43% in the postassessment. The students used several categories of criteria within the grouping of "source of site;" students did not mention each of these types of sources consistently. For example, students did not all communicate, "This site came from (or did not come from) a .gov, .org, or .edu website. In the preassessment, students most commonly (32%) noted whether the site was from an organization or whether they trusted the organization that was the source of the site.

The second most common comment (15%) on the preassessment was whether the site was from an educational institution. After the workshop (postassessment), the most commonly noted criterion was whether the source of the site was an organization and whether the students trusted the organization (20%).

A shift occurred during the workshop, as 25% of the students focused on whether the source was from a database or directory. Of course, students were directed to utilize these directories during the workshop. During the workshop, 18% of the students communicated that they used the criterion of whether or not the site was from a university or .edu website.

We found it comforting that many students recognized that they could inform decisions about site quality by considering where they found the site. This factor can be used to better organize information resources when we present them to the students. If we list resources based on their affiliation to universities, museums, or whether or not they are found in respectable directories, then students may better understand the relative quality of these sources. For example, we have previously introduced students to the Animal Diversity Web (University of Michigan 2007). Perhaps, if we wish students to value this resource better, we should introduce this source as the "University of Michigan's Museum of Zoology Animal Diversity Web." The reference to the university and the museum may cue into students' very reasonable evaluative criteria.

On the other hand, we found it troubling that, even when stu-

dents knew to look at the source of the website, they did not always know how to use this piece of information. For example, one student communicated that "Wikipedia is a highly reliable free online encyclopedia that I have seen some cooperating teachers… use when looking for information" (Table 6-3). In fact, Wikipedia is not a reliable source, because of its public nature.

Criteria type 3: Utilitarian Concerns

Paula Storm did not consider utilitarian concerns when assessing the quality of websites. However, our students very commonly communicated utilitarian concerns as a basis of judgment about websites (Table 6-4). Use of this criterion ranged from 63% of the students in the preassessment to 33% of the students during the workshop to 45% during the postassessment. Students seemed to move away from this type of criteria during the assessment within the workshop, and this change was statistically significant in comparison to before the workshop. However, this change did not continue after the workshop.

The students used several categories of criteria within the grouping of "Utilitarian Concerns". In general, the Usefulness of Site Information criterion was communicated most often. The explanation for this pattern may be similar to the notion articulated by Wilder (2005), as cited earlier. That is, students may have been looking for information that was "good enough" for the task at hand. Contrast this with an expert. Paula Storm searches for excellent science websites, because, as a librarian, this is her profession. In her case, the excellence of the website is most important, and she generally does not have a specific task in mind. Similarly, Laura Eidietis often searches for websites that will be good to offer students. In her case, she seeks good websites; her primary goal is to find excellent resources. Our students may not have the luxury of time to seek out excellent resources. Their mindset may be more towards finding a useful website that answers the question in the assignment in front of them or shows an activity that can fill two empty hours of time in an elementary classroom. Perhaps, at their stage of professional development, these students are more concerned with quickly finding something that is good enough and lessconcerned with more slowly finding some-

thing that is excellent. This is a possibility worthy of further study.

Table 6-4: Utilitarian Concerns – What the Students Said

Quantity of Information	Usefulness of Site Information	Accessibility (or Organization)
• I am uneasy … the article is very short • very rich in information; page with links to other sites kids can go to if they want to learn more • great resources on any topic you can think of and it all relates to children • tons of resources for teachers, not just about science, but about other subjects … • list of learning activities as opposed to just one lesson plan • extensive vocabulary presented • wide range in content • pictures show detail • very thorough • answers the question in depth • briefly explained the [subject] but didn't go into much detail	• [state] benchmarks were all included and accurate • fits with the grade level content expectations… • provides facts and information about my topic • explained certain types of bugs and how they affect our everyday life; since I do not know much about bugs I cannot be all that confident in how the website would work… • how helpful the article would be in giving myself, as a teacher and a student new knowledge on the topic at hand • teacher's guide available for use • activity looks easy and effective • not located in [our state] and we would not be able to make a field trip • we live in [our state] and studying the clouds would make clear sense considering we experience it quite frequently; they would be receiving the first hand knowledge right outside their classroom window… • built for homework help to students • didn't have a lesson plan to go with it… • has a link for teachers to look at for lesson plans on these special topics, and also a special link for parents…	• very descriptive text • understandable text; very basic, use of graphics/pictures • clear and concise information • each definition also gives a visual example • to really utilize it involves a purchase. With school regulations and budgeting, it may be difficult to introduce a new program • had everything in both Spanish and English • I would give this article to a fifth grade class to read, but no younger, because the language is kind of sophisticated and younger children would not be able to understand some of the article. • liked the fact that this database rated the articles as "reading level: easy" or "reading level: more difficult" • easy for adults to navigate • easy for children to use and search through and read the information • easy to look around; not a lot of text at first to scare the students away • … focus around the central topic • has a search tool bar so I can search within the website or do a web search for a topic • has a legend at the top to help guide students in finding the proper article according to reading level and lets the researcher know if there are pictures available for view…

Criteria Type 4: Others' Opinions

Aside from relying on edited databases, Paula Storm did not consider recommendations from other professionals when evaluating websites. This criterion was not communicated by students during the preassessment. However, 15% of students communicated that they considered this criterion during the workshop, and 13% of students communicated that they considered this criterion in the postassessment. The students used several categories of criteria within the grouping of "Opinions of Others" (see Table 6-5). Interestingly, during the workshop, the students who mentioned this type of criteria referred to the recommendation of an academic. After the workshop (postassessment), the students who communicated this type of criteria referred to teachers having input into the development of the content in the website.

Table 6-5: Others' Opinions – What the Students Said

Recommendation of an Academic	Inservice Teachers' Input
• one of the recommended [by instructor] websites … these sites are reviewed by real people • comes from a scholarly list of recommended sites • suggested by the [university] library • … high confidence because it was recommended by a professor …	• maintained by a couple of guys that rely on the input and contributions of teachers for information that goes into the site • lessons submitted by teachers • although it is a teacher-submitted lesson plan … • created by an elementary school • [activities] have been used in the classroom; this helps educators, for it shows that the activity can be successful • since all the activities are from active teachers I can at least have the background knowledge that this lesson was administered to a class and actually worked well

The use of this type of criteria suggests that our students value the concept of a forum in which teaching professionals can share, critique and utilize others' ideas. If used correctly, this sort of elementary teaching virtual "teachers' lounge" conversation could be very useful to young teachers. Unfortunately, though the instinctual need for professional conversations existed in our students, it was not common. Moreover, students were not rigorous in their pursuit of such recommendations. For example, if students desired to find activities that

were tried, edited and reviewed by other teachers, they could consider the journal *Science and Children* (available online at Eastern Michigan University or for members of the National Science Teachers Association). All of the activities within this journal emerge from classroom experience. Instead, several students simply looked at the website and noted that it was "created by an elementary school" or other such rather unregulated criteria.

Criteria Type 5: Familiarity

Several students communicated that they used their familiarity with a source from the Internet as a criterion for judging the reliability of the source. This was a small group of students (5% in the preassessment and during the workshop and 18% during the postassessment). This differed from our expert's evaluation behaviors (Table 6-6).

Table 6-6: Familiarity – What the Students Said

- from a web site I have been to many times before
- used the periodicals at [this university] for other classes and they always seem to have what I am looking for and they have been a great resource so far
- well known to teachers, parents, students and administrators
- seen some videos that were distributed by the organization in several of my science classes
- found this web site to be reliable in the past
- used this website before as a resource when locating lesson plan ideas for other classes
- popular website for education
- already thought of doing worms and an experiment similar to this one

We expected that students may tend to use familiar resources; as noted by Choo, Detlor and Turnbull (2000) Internet users have previously been found to return to a small number of familiar sources repeatedly. However, we were surprised to find that students claimed that familiarity correlated with quality. In some cases, students indicated that they had previously evaluated this familiar source, such as the student who claimed that she "found this website to be reliable in the past." Other students confused us by stating that a site was "well known

to teachers, parents, students and administrators" and connecting that statement to the quality of the website.

To offer an example of why this behavior could cause problems, consider the Discovery Institute website (www.discovery.org). This resource is extremely well known to life science educators around the globe. Also consider Wikipedia.org, another very well known resource. However, neither of these resources is a good resource for biological information. The Discovery Institute is an organization dedicated to falsifying the theory of evolution using pseudoscience, while Wikipedia is not edited. We worry that some students are extending the adage that "all press is good press" in an inappropriate context.

Criteria Type 6: Personal Preferences

Unlike Storm, some students communicated that they based their judgment of sources on their own personal preferences or what they predicted about the personal preferences of elementary students. Personal preferences ranged from judgments about aesthetics and fun to judgments about interest levels. The number of students who mentioned personal preferences in their judgment criteria ranged between 23% during the preassessment to 5% during the workshop and 15% during the postassessment (Table 6-7).

There is an old adage that one should not "judge a book by its cover." Unfortunately, we do not believe that this wisdom has transferred into the Internet age for some of our students. If the purpose of the information-seeking exercise is to search out accurate or professional information, than whether or not the "webpage has a nice, clean layout" is not a very good evaluation criterion. Consider the "Save the Tree Octopus" webpage at zapatopi.net/treeoctopus. This website is visually stimulating, has a clean layout, is colorful, and we are reasonably sure that children would enjoy this page. However, the page is also a hoax.

Alternatively, as a secondary evaluation criterion, the aesthetics of the webpage may be important, especially if that page is going to be used by young children. That is, once she has determined that a group of sites include high quality information, then, a teacher certainly may want to rank these sites according to their appeal to children.

Table 6-7: Personal Preferences – What the Students Said

- graphics were very colorful
- a lot of pictures next to the links to other websites, not extremely colorful
- high quality graphics
- included pictures to supplement the text
- artistic
- web page has a nice, clean layout
- kids will think this site is fun and interesting.
- opening page is not very exciting, which might affect a child's excitement about the subject … once they click a link, the story will change …
- children would enjoy it
- wanted to read an article that was not some "boring science stuff" and more along the lines of it being interesting and something I had no idea about
- not as interactive as other sites may be
- students would enjoy the audio-visual presentation … allows students to actively participate in the presentation by asking questions frequently
- liked how this activity incorporated the use of a hand lens so that way students could see the small parts of a flower up close

Conclusion

At the beginning of this report, we set out to answer these questions:

- How do students search for resources on the Internet?
- Can students effectively evaluate resources from the Internet?
- How do students evaluate resources from the Internet?

The students in question were preservice elementary teachers, and the context of the searches on the Internet was *Life Science for Elementary Teachers*, a required science methods and content class.

We found that our students primarily search for resources on the Internet using search engines, and their search engine of choice is Google. Nonetheless, when trained and required to do so, students can use edited databases, directories, and indices to find information on the Internet. We witnessed this within an online workshop and associated assessment. The choice of Google is not due to ignorance, as students reverted back to using Google, even after an online workshop support-

ing the use of other search methods. We also found that our students tended to be overconfident in the quality of their resources found on the Internet. They had much higher confidence in their sources than did an information expert. Thus, we are not confident that these students can effectively evaluate resources from the Internet.

When considered as a group, our students used all of Storm's criteria for evaluating resources from the Internet. However, our students also used a group of evaluative criteria not considered by our expert. These included utilitarian concerns, others' opinions, familiarity, and personal preferences. These differences may account for the differences in confidence in the sources, when comparing student opinion to expert opinion. We suggest that the use of the students' criteria is not necessarily bad. Rather, these criteria may be very useful as secondary criteria for ranking websites that students have already evaluated as reliable and high in quality.

To return to the ALA's standards for information literate students (2000), our students were able to design search strategies that were effective for finding information that was good enough for the tasks presented to them. However, they did not succeed in effectively finding resources that were of professional quality, and they did not succeed in critically evaluating their resources in a professional manner. Because of these deficiencies, we worry that our students are not yet prepared to "create a community of diverse learners" by using "technological tools, including… computer technology, to access resources… and facilitate the learning of science" (NSTA 2003).

It is important that teachers evaluate sources from the Internet based on the criteria of an expert. This importance stems from the role of these pre-professionals in society. First, they are the portals to information for thousands of school children; they must lead children to excellent sources of information. Second, they are practitioners in a profession in which the intellectual lives of children are in their hands. They need to be as aware of the expertise in their field as are other, responsible professionals such as doctors, nurses, architects, and lawyers. We know that our students weigh competing demands on their time against the time necessary to find and evaluate high quality resources. Thus, we must somehow convince students that "good enough" is not

appropriate in a professional field.

We worry that preservice teachers do not consider themselves pre-professionals or that they are not completely aware of what it means to be a professional. Teaching has been marginalized and under-resourced. Moreover, as described by Larabee (2000), we face a situation in which "the profession of teaching is generally seen to be relatively easy. And this perception is not simply characteristic of the untutored public; it is also endemic among teacher candidates." Our students are preparing for what they see as jobs where they will be paid less than their parents who worked on assembly lines; they will be in crowded classrooms without appropriate support; and they will be doing a job generally accepted to be "easy". Why should these students consider themselves as pre-professionals, when society has deprofessionalized their profession?

To those who train teachers and to teachers who are successful, it is obvious that society's view of teaching is in error. Teaching is, in fact, one of the most emotionally draining and intellectually challenging professions available. Teaching is the antithesis of unskilled labor. The crux of the challenge is that teachers must convince students to cooperate, despite the fact that students' presence is typically coerced, while balancing conflicting needs and desires of society (Larabee 2000). This monumental task requires specialized skills and knowledge, strategies for gaining new skills and knowledge when necessary and excellent thinking skills for applying ideas to individualized situations while making a never-ending string of decisions.

If teaching is a profession, and our students are pre-professionals but not specialized experts in all fields, then how do we convince these students that they are not experts and need tools to make up for their lack of expertise? (By "tools" we are referring, specifically, to edited search directories, indices, and databases.) One pedagogical solution is to improve the authenticity of the learning experience so as to challenge the students' misconception that they are already experts. However, these students have completed over 100 hours of observations of elementary learning and they are typically 1-2 terms away from student teaching. Also, our students use the fruits of their Internet searches when they take a researched lesson plan into an el-

ementary school and teach it. It is difficult to see how much more authentic this learning experience could be within the constraints of a university program.

Perhaps additional authenticity is not possible within a pre-professional program and, instead, we must wait until our students are in the classroom and solely responsible to parents, administrators, and the public for the learning that occurs within their classroom. Just as in all professions, teachers must participate in continuing education after their initial certification. We know that our students are capable of using professional tools to search for information on the Internet. It may be that our best strategy is to provide accessible means for our students to refresh their knowledge once they become professionals and recognize a real need for maintaining professional standards. This possibility is realistic, but it is also frightening, because we must then hope that our teachers hold themselves to, and are held to, professional standards. We are no longer in control of our students' education once they enter the workforce. However, the professional teacher knows that she is never, truly, in control of her students' learning. Instead, she learns to carefully read situations and manipulate them in order to create learning opportunities.

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