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An Exploratory Study of Biology Teachers' Online Information Seeking Practices

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teachers are able to make use of these resources in their instructional planning and what this means to the collaborative efforts between school library media specialists and teachers.

This exploratory study collected data regarding teachers' online information seeking practices and how these practices influenced their instructional planning. The study was intended to address the gap in this area of research and uncover potential areas of collaboration with school library media specialists. There were two phases of data collection. Phase I was an online survey of seventy-two New York State biology teachers. The survey captured: (1) a snapshot of the biology teachers' online information seeking practices during summer and fall 2004, and (2) their perceptions regarding how their online practices influenced their instructional planning. In Phase II, ten study participants were interviewed to explore in greater detail the consequences of their online information seeking practices on their instructional planning.

Review of the Literature

The convergence of two major events during the last decade has significantly influenced science education in the United States. First, science curriculum reform suggests that students learn best through active student-centered, inquiry-based learning (National Research Council [NRC], 1996; Wallace, Krajcik, and Soloway, 1996). Second, the shift from an industrial era to an information age offers, through such developing technologies as the Internet, a vast amount of educational resources previously unavailable to teachers. The intersection of these two changes influences how teachers plan, instruct, and assess their students and fosters unlimited opportunities for collaboration with school library media specialists to positively influence student learning.

Changing Science Standards

The National Science Education Standards (NRC, 1996) call for teachers to create active, inquiry-based learning environments where students have the opportunity to construct their own knowledge around science concepts (NRC, 1996; Wallace et al., 1996). Teachers operate as facilitators in their students' learning experiences in these inquiry-based learning environments, rather than as transmitters of information. Some teachers have always worked from this pedagogical perspective; however, the development of the National Science Education Standards (NSES) promotes inquiry as a goal for all science teachers.

Science teachers are seeking out all types of multimodal resources and materials they need to support the type of teaching, learning and hands-on activities called for in the Standards (NRC, 1996). Multimodal resources represent texts in print format, as well as the new and evolving modes of communication and expression in multimedia formats (National Council of Teachers of English [NCTE], 2005). Teachers are aware of the possibilities of these online resources and what the possibilities might mean in terms of instructional benefits for them and their students. Many teachers are convinced that the Internet can help with instructional planning and the creation of learning activities for their students (Fitzgerald, 2001; Hedtke et al., 2001; NetDay,

overwhelming to teachers since the profusion of online resources began in the early nineties and has continued unabated. Kuhlthau (1997) called the endless stream of resources the “new rules of abundance” (citing McClintock 1996). Although the Internet has the potential to offer the multimodal resources they seek, teachers may not adequately access the information because they lack the necessary online search skills to efficiently find, and effectively use, the online resources that range from digital libraries to electronic discussion lists. Varying gaps in knowledge and skills by teachers with respect to online information seeking and information literacy (Levin and Arafeh, 2002), offer potentially meaningful points of intersection for collaboration with school library media specialists. Traditionally, while subject knowledge and pedagogical knowledge have been key domain strengths of teachers, advanced information literacy skills are a primary domain strength of school library media specialists. In Model D: Integrated Curriculum, one of four collaboration models proposed by Morrison (2005), both teachers and school library media specialists share degrees of fluency in both domain areas thereby leading to stronger contributions from each to the collaboration and potentially resulting in a more positive outcome on student learning.

Teacher Planning

Teacher planning, also referred to as instructional planning, includes the decisions and processes that occur before the teacher goes into the classroom. It is also called the pre-stage (Sard Brown, 1993). Teachers' short and long-term planning activities typically rely on several sources, including previous lessons, resource files, and ideas drawn from their colleague's work (Sard Brown, 1990). Teacher planning has typically been influenced by the

use, while two respondents indicated nonuse. Both nonuse respondents indicated No Need for any of the online tools, one of them also noted Lack of Time.

Of these seventy biology teachers who reported using the Internet during summer or fall 2004 for instructional planning purposes, there were:

- x forty females and thirty males
- x twenty-one (30 percent) from urban districts, fourteen (20 percent) from rural, and thirty five (50 percent) from suburban

Teachers reported number years of experience ranged from:

- x Less than one year: 4 (5 percent)
- x 1-5 years: 14 (20 percent)
- x 6-10 years: 15 (22 percent)
- x 11-20 years: 17 (25 percent)
- x More than 20 years: 19 (28 percent)

One teacher did not report years of experience.

More than half of the survey respondents had eleven or more years of teaching experience and almost 30 percent had more than twenty years, making this group fairly experienced.

The survey was intended to capture a snapshot of the biology teachers' online information seeking practices during summer and fall 2004 and their perceptions regarding how their online

Table 1. To what degree do you feel your daily lessons during the fall 2004 were influenced by information or resources you obtained from the following online tools:

	Not at all	Very Little	Moderately	Significantly	Greatly
Search Engines					
Specific Web sites					
Digital Libraries					
Online Databases					
Electronic Discussion Lists					
Print Resources					

Table 2. During the summer or fall of 2004, how often did you forward on information or resources to your colleagues that you found from the following online resources:

Never Rarely Sometimes Often Always

teacher population as a whole. They did represent though a series of biology teachers in terms of demographics and use of online resources as evidenced below.

Interview recruitment emails were sent directly to forty New York State biology teachers in the upstate New York area to obtain the ten participants:

- x seven females and three males
- x two urban teachers, two rural teachers, and six suburban teachers;
- x Of the six suburban teachers, they were evenly distributed--that is, two across districts of low, medium, and high socioeconomic classifications.

The ten in-depth interviews played an important role in this exploratory study; they offered the opportunity to talk at length with the biology teachers and to probe their thinking about connections between their information seeking practices and their instructional planning. The semistructured interviews went beyond the baseline data collected in the survey and resulted in conversations that reflected richness in detail, complexity of reflection, and a large body of data for analysis. Interviews offered a means to probe and clarify survey responses. The interviews extended the findings of the survey and explored in more detail the related dimensions of the innovation's consequences. As defined previously in this paper, consequences are the "changes that occur to an individual or to a social system as a result of the adoption or rejection of an innovation" (Rogers, 2003, 470).

Interviews were audiotaped, transcribed, and then coded and analyzed using established qualitative research method. Additionally, field notes were recorded after each interview and also analyzed. Transcripts were coded using open coding procedures. Codes developed and used in accordance with established guidelines (Creswell, 2005) and continuous refinement and revision of the codes occurred.

The emergent concepts were next considered with regard to the dimensions offered in the Consequences of Innovation (Rogers, 2003) framework. Rogers (2003) proposed these dimensions as a taxonomy to assist in classification of the consequences of an innovation: "(1) desirable versus undesirable, (2) direct versus indirect, and (3) anticipated versus unanticipated" (470). The dimensions were used as a framework in analysis of the data corpus to assist in classifying and understanding the complex nature of an innovation's effects on both the individuals and the systems in which they participated.

Interview questions included:

- x

use [online tool] to access information or resources for information or resources for instructional planning during the summer or fall of 2004? Table 3 summarizes replies of the seventy respondents who reported using the Internet for instructional planning. Ninety-nine percent of the respondents reported using search engines, and 89 percent of them reported use of specific Web sites. In contrast, only 20 percent of respondents reported using digital libraries and 24 percent of respondents indicated use of online databases. Fifty percent of teachers reported using electronic discussion lists, while 50 percent of them reported no use. Given the number of digital libraries and online databases specifically designed to support educators' teaching and learning needs, the low percentage of use of these tools by the teachers is a notable finding and a potential area for future research. It highlights a key area of potential collaboration between school library media specialists (SLMS) and teachers.

Table 3: Tool Use for Instructional Planning Purposes

Specific Search Engines	Specific Web Sites	Digital Libraries	Online Databases	Electronic Discussion Lists
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Q: When you did instructional planning during the summer or fall of 2004 how often did you use the information or materials you obtained from [choice of online tools]:

Perceptions of Proficiency

Overall, teachers perceived themselves possessing an Average to Excellent proficiency level with online tools to find information or resources for their instructional planning (see figure 2 complete results). Teachers reported a strong proficiency with search engines with 86 percent (n=70) of respondents indicating they possessed a Very Good to Excellent skill level. 80 percent (n=70) of teachers reported a Very Good to Excellent proficiency with the use of Web sites for instructional planning purposes. It is important to remember, though, that this study captured the teachers' perception of their skill level, rather than measuring their ability to use the different online tools.

Influence on Instructional Planning: Daily Lessons and Unit Plans

Teachers were asked to what degree they felt that their daily lesson and unit plans were influenced by information or resources obtained from the five different online sources considered in this study. Results are found in figure 4

Figure 4. Perceived Influence on Teachers' Daily Lessons

Q: To what degree do you feel your daily lessons during the fall 2004 were influenced by information or resources you obtained from [instructional planning components]:

Respondents reported a Significant to Great influence on daily lessons resulting from use of:

- x search engines: 49 percent (n=70)
- x online databases: 12 percent (n=68)
- x specific Web sites: 56 percent (n=70)
- x electronic discussion lists: 16 percent (n=67)
- x digital libraries: 2 percent (n=68)
- x print resources: 58 percent (n=69)

Results showing that respondents rate the influence of using online tools for daily planning as Significantly or Greatly represent notable findings for this study. It presents concrete evidence of the shift in planning practices due to the Internet. The lower influence figures for digital libraries, online databases, and electronic discussion lists perhaps reflect in part, their relatively low use

numbers. Interestingly, a number of interview participants specifically mentioned how their use of print resources has decreased and it is no longer always the first source to which they turn.

After rating influence on lesson plans, respondents were asked to rate the influence of the online tools to their unit plans. Results are shown in figure 5

Figure 5. Perceived Influence on Teachers' Unit Plans

Q: To what degree do you feel your unit plans during the fall 2004 were influenced by information or resources you obtained from [instructional planning components]:

Respondents reported a Significant to Great influence on unit plans resulting from use of:

- x search engines: 43 percent (n=69)
- x online databases: 7 percent (n=68)
- x specific Web sites: 49 percent (n=70)
- x electronic discussion lists: 14 percent (n=66)
- x digital libraries: 9 percent (n=68)
- x print resources: 57 percent (n=67)

Across the board, for each tool, respondents chose the rating of Significant to Greatly less often than in the lesson plan question. It is worth noting that 68 percent of respondents (n=68) indicated no influence or very little influence on unit plans from their use of digital libraries. 72 percent (n=68) of respondents also reported very little to no influence on planning from online databases.

Findings from this study's survey and interviews reflect a pattern whereby the numbers for use of online tools, and the perceived degree of influence with regard to daily lessons and unit plans, measured higher for search engines and specific Web sites versus lesser used digital libraries, online databases, and electronic discussion lists.

The interviews yielded in-depth and detailed responses regarding how these biology teachers seek information and materials online for their instructional planning purposes; what they do with it after they locate it; and what influences it has on their planning process. During the ten interviews, the biology teachers described in detail how their information seeking practices impacted their instructional planning. The participants described a range of influences on several instructional planning components. When one teacher, who had between five and ten years of experience and taught in a rural district, was asked to what degree did she feel that the online tools impacted her daily lessons or unit plans, she was quite emphatic in her answer. She replied:

DM: It impacts my daily life (laugh). Significantly! Lately, I would say more. Today, that's where I start with everything with my instructional planning. For everything! (laugh).

A second veteran suburban teacher echoed this point and replied "Greatly" when asked about influence on instructional planning. Teachers plan in a variety of ways and their planning styles can influence, and be influenced, by their Internet use. This point is reflected in BD's comments below when she describes how she plans heavily in advance to meet her students' various approaches to learning.

BD: The method [for planning] I use effects the influence [of her online information seeking practices] heavily because the way that I plan my classes' activities might be a little different than many other teachers. I do a lot of planning upfront; very heavy planning upfront so that I take in to account the very wide diversity of abilities that I have in my classes. From people who are really able to do entry level university work to people that read at a fourth-fifth-grade level and they are all in the same class. I have to be very clear myself on what is the absolute minimum standard that is necessary for my students to learn within the curriculum and to do well on the exam at the same time I don't want the people who are more capable to be short changed. I do want them to be challenged. I do a lot of planning in advance on how I am going to set up my units.

Throughout the interview BD elaborated that the Internet offers her access to key resources that support the instructional planning she believes is crucial to her students' learning and success.

Several teachers mentioned the advantages of using the Internet to plan for new courses. In the excerpt to come, JC, an experienced suburban teacher, describes how using the Internet to plan a course resulted in more confidence in her personal understanding and created a bigger circle of colleagues from whom to seek help.

JC: Certainly confidence for somebody who is teaching a new course. If you're collaborating with other teachers, you sit down with somebody who has done it for years and you say help me out with it... You don't always have access to people who would be willing to do that. Online, you've got a whole group of people who do that. So that's been helpful. It's given me confidence and helps me save time in the long run.

When asked about some specific examples JC described how she goes online to get background information. She states:

If I have to teach something and I don't really get it. It will give me the background and actually with the electronic discussion lists I can go online and say, would you please explain that? They're wonderful. Actually, I learn from other people. I don't always get online, but I've done it a couple of times. Other people asked and someone explained it. They'll ask the question, and then "I get it now!" It's been wonderful for teaching AP.

This help from colleagues, both known and unknown that JC describes, exemplifies one of the emergent themes from the data analysis: Webs of Sharing.

LC, also a suburban teacher, spoke about how he revamped a nutrition project due to a website he found through his online information seeking activities. He described a nutrition lab, which traditionally took multiple class periods over several days, that was transformed into a one project that freed up time for other teaching and learning projects without sacrificing learning objectives. He states:

Like this period we just did a nutrition project which is an interesting site because it's

Well, I already had a list of key ideas that I have typed out and I got those, I looked around on the Internet to see if anybody had done that before and I couldn't find one that I liked, so I found the book and I came up with key ideas from there and I changed them to fit my students so that they understand them. But for the vocabulary words I actually went on and I went to a webpage that I know is actually from another school district, where another teacher has taken a **word** links and one of those links was the vocabulary words broken down into different sections.

The biology teachers interviewed frequently spoke of using the Internet to get ideas. JC stated: "I use it to get to try to get more creative ideas, especially for labs. Is there an easier way to do a lab? If there's a better way to demonstrate a concept, it's usually an activity of some kind." The

- x 43 percent (n=66) of teachers report Never or Rarely finding exactly or very close to what they were looking for when using digital libraries, yet 64 percent (n=69) of the same group of teachers rate their proficiency with digital libraries as either, Average (30 percent), Very Good (19 percent), or Excellent (14 percent);
- x 44 percent (n=66) of teachers report Never or Rarely finding exactly or very close to what they were looking for when using online databases; but 69 percent (n=70) describe their proficiency with online databases as either Average (30 percent), Very Good (30 percent), or Excellent (9 percent);
- x 50 percent (n= 66) of teachers report Never or Rarely finding exactly or very close to what they were looking for when using electronic discussion lists, yet in terms of proficiency with electronic discussion lists, 68 percent (n=69) of teachers rated their skills at either Average (23 percent), Very Good (23 percent), or Excellent (22 percent).

These findings show a pattern of teachers rating their search proficiency highly, yet reporting low success rate in the search process. This discrepancy should be addressed in future research and also taken into consideration when developing professional development.

Although findings like this study's inform the work of online resource developers, the researcher intends, first, to use the baseline data collected from the surveys, along with the findings gleaned from the interviews, to inform professional development of in-service and pre-service teachers in the area of information literacy skills.

Reasons for Nonuse of Specific Online Tools

A follow-up question asked the survey respondents what caused them not to use search engines, Web sites, digital libraries online databases, electronic discussion lists, or print resources for planning during the summer or fall of 2004. They could select multiple responses or write in a reason. Results are in figure 6

Figure 6. Reasons for Nonuse of Tools

Q: What caused you not to use the following tools more frequently for instructional planning during the summer or fall of 2004 (choose all that apply)

Survey respondents (n=70) cited Lack of Time as the primary reason for nonuse of 41 (58 percent), Digital Libraries (37 percent), Online Databases (39 percent), electronic discussion lists (33 percent), and Print Resources (14 percent). Respondents (34 percent) indicated Too Many Results as the primary reason for not using search engines. Coming in as the second most frequently cited reason for not using any of the listed online tools was the choice: Books and Other Print Resources More Effective.

The reason of Not Comfortable Using was cited for digital libraries, online databases, and electronic discussion lists by more than a quarter of the respondents. It is a notable finding that a relatively high number of teachers report not being comfortable with key resources developed with the intent to support their teaching and learning goals. Results show that:

- x 30 percent of respondents indicated Not Comfortable Using as a reason for their nonuse of digital libraries;
- x 27 percent of respondents selected Not Comfortable Using as a reason for their nonuse of online databases; and
- x 27 percent of respondents selected Not Comfortable Using as a reason for their nonuse of electronic discussion lists.

evidence of the steps these teachers as professionals will go to meet students' diverse learning needs, particularly if provided the opportunity and means to do so.

Several additional findings in this study point to how online resources appear to change teachers' instructional planning process. They include:

- x use by teachers of a wider variety of resources than in the past, and development of new skills to manage them;
- x access to a broader selection of multimodal resources and current information are leading to more dynamic learning activities;
- x teachers are taking more steps, and delving deeper via online sources, to find answers to students' questions; and
- x lesson plans are changing more frequently with less emphasis on lectures.

There is not yet enough evidence at this point to definitely make the claim that these are trends, yet the findings suggest they are part of a shift in teachers' planning, and further research is needed. This exploratory study is intended as a first step in a longer term research project focusing on teachers' information literacy skills. The study extends recent research that examined "how teacher access, select and use information and communication technologies for use in their professional practice" and answers the call for a deeper understanding of online information behaviors and their consequences (Recker et al., 2004, 1).

Finally, results of this study show troubling evidence that the majority of study participants are limited

Underuse of resources by teachers may reflect a lack of the necessary online search skills they need to efficiently find, and effectively use, the online tools. Existing disparities among teachers' online information seeking skills will likely impact their abilities to take advantage of the medium, and in turn, impact how they serve as models and mentors to their students (Levin and Arafeh, 2002).

Steps must be made to support

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