What Does All This Data Mean and Where Did it Come From???

Embedded Librarians in the Undergraduate Sciences

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Abstract

Information literacy instruction is increasingly important in higher education, as students must learn to effectively use information resources, and to apply what they learn to their discipline. The paper reviews the literature to provide an overview of embedded librarianship, including where, when, and how embedding may be useful. A discussion on the practicalities of embedding, especially with limited financial and staffing resources, is also included. Although embedded librarians may be equally beneficial to any discipline, this paper focuses on examples of embedded services in undergraduate sciences, where students must continually evaluate new research and information due to the fast progress of the discipline.

Introduction

"Embedded librarian," according to Drewes & Hoffman (2010), has become a buzzword in undergraduate and distance education over the past five years (p. 75). Embedded refers to the fact that the librarian is integrated within a user population, which enables her to experience the daily life of these users. Embedding can be done physically, but also metaphorically. Embedded librarians may engage with science students through a variety of outlets—online courses, face-to-face courses, physical office hours located in a specific department building, special workshops or labs, etc.—and the services provided by embedded librarians may be task-oriented (e.g. how to perform Boolean searches), or more cognitive (e.g. search strategies). Many college courses, especially those with an online option, make use of embedded librarians to help their students most effectively utilize the resources of the library from a distance. However, a librarian does not have to be embedded only virtually; in-person interactions with faculty and students can also be very successful.

The services of online librarians are becoming increasingly important as information literacy becomes a more essential and widespread goal of undergraduate degree programs. This paper discusses the growing importance of information literacy, as well as the role of embedded librarians, in the context of the undergraduate sciences, even though most of the content could just as easily be applied to other disciplines. In doing so, the author hopes to provide a cohesive framework of examples and case studies for the audience.

Why the Undergraduate Sciences Need Information Literacy Instruction

Information literacy is "a set of abilities to identify the need for information, procure the information, evaluate the information, and subsequently revise the strategy for obtaining the information, to use the information and to use it in an ethical and legal manner, and to engage in

lifelong learning" (ALA/ACRL/STS, 2006). It is a crucial, yet sometimes overlooked, component of higher education. A task force between the American Library Association (ALA), Association of College and Research Libraries (ACRL), and the Science and Technology Section (STS) of ACRL determined how information literacy expectations must be modified for science, engineering, and technology disciplines (2006). In short, information literate science students must be able to 1) establish the scope of their information need; 2) acquire the necessary information from appropriate sources, including original research; 3) evaluate the gathered information and, if necessary, use their evaluation to modify the information search process; 4) use information ethically and legally; and 5) acknowledge that they must engage in continuing education in order to stay current in their field (ALA/ACRL/STS).

Consider, for example, a lower-division biology student writing a summary research paper. According to the ACRL standards above, the student's being information literate may mean 1) needing to find information about pathogens in California black oak trees, and recognizing that research has likely been done on this topic; 2) using effective search terms and databases to review the literature; 3) synthesizing and analyzing the literature, then modifying the search to specify a type of pathogen; 4) citing sources correctly and effectually; and 5) using this experience as a base of understanding for future learning. Upper-division biology students may find that a literature review or other existing sources do not provide the information they need. In this case, being information literate means the students are prepared to design and conduct original research to fulfill their information needs.

Although all higher education fields require information literacy instruction, in the sciences students need information literacy instruction not only to effectively find and use standard written materials, but also to design experiments, conduct research, and evaluate non-

traditional information sources, such as unpublished, cutting-edge research, or unique formats of data presentation (ALA/ACRL/STS, 2006). Science fields tend to progress quickly, which means students must be adept at keeping up with and evaluating new research constantly (Barr, 2010). Without information literacy skills, students lack the ability to find and use these sources.

Why Information Literacy Instruction Needs the Undergraduate Sciences

Many colleges and universities have information literacy standards for their graduates (Winterman, Donovan, & Slough, 2011; Fain, 2011; Gehring and Eastman, 2008). But creating standards and ensuring that graduates actually possess these standards are two different problems. Information literacy instruction that is more course-integrated tends to have a higher rate of success, although it increases the time and effort required from librarians and instructors (Dewey, 2005; Porter, Wolbach, Purzycki, Bowman, Agbada, & Mostrom, 2010; Gehring and Eastman, 2008). However, Winterman *et al.* (2011) argue, along with Grafstein (2002), that information literacy instruction cannot be separated from a discipline without losing its deeper context and purpose. To this extent, Winterman *et al.* state that "information literacy standards must be integrated with the values and processes of the discipline," (p. 38), and strongly suggest tying information literacy standards to course learning outcomes.

Fain, a librarian and researcher based at Coastal Carolina University, conducted a five-year longitudinal survey of undergraduate information literacy assessments, and found that "first year college students exhibit information searching skills that seem to rely on ranking provided by internet search engines rather than careful analysis of the results," (2011, p. 109). This underscores a clear need for information literacy instruction. At Coastal Carolina University, information literacy instruction consisted primarily of a one-shot library workshop (p. 112). Yet Fain found that students consistently improved on survey questions about resources they were

required to use for course assignments over those that were generically covered by the workshop (p. 113). For example, students showed significant improvement in identifying specialized databases between pre and posttest—53-55% versus 77-89% (p. 116). This further supports the mission to include information literacy instruction in discipline-specific settings.

Grafstein (2002) concurs, saying that research is conducted differently in different fields, and students do not absorb critical thinking or information literacy skills in a vacuum. Rather, they need the context of their discipline to truly understand and be able to evaluate information within the discipline. By embedding information literacy within academic departments, such as those of the sciences, librarians can increase relevance and retention for their students.

Gehring and Eastman's (2008) study also underlines the relevance of providing information literacy instruction within the milieu of a discipline. The article discusses the results of integrating an information literacy component into an upper-level undergraduate developmental biology course at Connecticut College. Students learned how to aggregate, discriminate, and evaluate primary sources within the context of their course. Additionally, they used these skills in two inquiry-based laboratory assignments. Gehring and Eastman assessed the results both qualitatively and quantitatively, and their findings suggest success both from the librarians' and instructor's perspectives, as well as that of the students.

Information literacy remains irrelevant for students unless contextualized with discipline-specific instruction. Therefore, as much as the undergraduate sciences need information literacy instruction, information literacy instruction needs the undergraduate sciences.

Who is an Embedded Librarian?

Shumaker and Talley (2009) define an embedded librarian as one who provides "delivery in context," and is "dependent on domain knowledge," (p. 9). The embedded librarian works

closely with faculty or instructors in a specific department or course. This allows embedded librarians to offer services designed for very specific user populations, which usually results in increased use of library resources by the target population (Hoffman, 2011).

Embedding developed from necessity when academic libraries maintained branch collections in different departments, where librarians worked closely with faculty to maintain relevant resources (Drewes and Hoffman, 2010, p. 77). Today, embedded librarians may have a variety of functions, including facilitating information literacy-themed discussion boards or assignments in online courses, offering face-to-face instruction through library workshops or course-integrated labs, or holding office hours in a department building. Shumaker and Talley (2009) expand on the roles of embedded librarians, who:

- may work in the location of the people they serve
- engage in "relationship-building activities"
- have specialized knowledge related to their user population
- perform complex analysis
- train users
- provide quick reference, as well as more in-depth topic research assistance
- develop resources for their target population

Hoffman (2011) distinguishes between embedded librarians who have their offices physically located in other departments, and those who "participate in a particular online course by logging into the course management system," (p. 453). For these distance learners, embedded librarians help ensure that students receive library services "equivalent to those provided for students and faculty in traditional campus settings," as mandated by the ACRL (2008). Francis (2012) remarks that in the 2007-2008 academic year, 20% of all undergraduates took at least one

online course, and that this percentage is rising. The importance, therefore, of creating effective library resources for these distance students is real. Francis continues that embedded librarian interactions can help distance learners feel engaged in the academic community, which increases retention.

Not all embedded librarians work in academia. In fact, Shumaker and Talley's (2009) survey results showed only 28% working in academic settings, with the majority of others working for private or special libraries (p. 36). For the perspective of this paper, however, we will limit ourselves to embedded librarians working in colleges and universities.

Why Should Information Literacy Instruction be Provided by Embedded Librarians?

Students want efficiency, and librarians want thoroughness. For this reason students often use faculty as research guides and bypass librarians to access library resources (Pritchard, 2010). Through embedding, librarians can make themselves more accessible by being directly involved with the professor and students of a class or department. Although professors often provide some level of information literacy instruction, librarians are often better positioned to offer consistent services that ensure all students graduate with the necessary information literacy competencies (Tumbleson and Burke, 2010, p. 976). According to Dewey (2005), "The embedded librarian, who is truly integrated into the academic, administrative, athletic, cultural, research, and learning arenas of the university provides quality and depth to the total campus experience," (p. 16). But why is this? Why can't faculty or teaching assistants provide the same level of quality and depth?

As mentioned above, students are no longer accustomed to turning to librarians for assistance; instead, they seek research direction from their instructors. This is fine, except Pritchard (2010) reports that teaching faculty may be "ill-prepared or unwilling to provide support for the development of information literacy… in their courses," (p. 374). As academic

institutions develop or renew their commitment to campus-wide information literacy standards, there must be a central body responsible for ensuring that all students receive equal access to information literacy instruction.

Faculty and instructors may also benefit from the domain expertise of embedded librarians. Edwards and Black (2012), in their experience embedding in an online health science course, note that collaboration with the instructor allowed the librarian to "capitalize on knowledge of both the subject matter and course content as well as information science centric domain knowledge," (p. 298). While the librarian needed the subject expertise of the instructor, the instructor and students significantly benefited from the presence of an information science expert.

Another reason embedded librarians are especially important for undergraduate information literacy is because the traditional in-person academic course delivery is changing. Enrollment in online courses has been steadily increasing over the past decade (Francis, 2012). The problem of creating effective library resources for these distance students is real, because it is less likely that distance learners will seek out the library on their own.

As Dewey (2005) says, "librarians are in the business of research support, but on most campuses, have little direct contact with research centers," (p. 9). This comment is insightful and further supports embedded librarians fulfilling a vital niche in undergraduate sciences information literacy instruction. Embedded librarians must view themselves as professionals with essential information expertise to contribute, and must make an effort to become a part of the culture of the department in which they embed (Pritchard, 2010, p. 388).

Constructing Effective Information Literacy Instruction

Whether librarians are embedded virtually or in person, there are several core elements to an embedded program design. First, the librarian must ensure that students learn basic task-oriented information literacy skills, such as finding or citing documents. Second, the librarian should engage students in more cognitive information literacy learning. Francis (2012) recommends basing instructional design on constructivism, i.e. actively applying new information within a student's knowledge structure. Constructivism fits well with department-specific embedded librarianship, as it encourages students to apply their information literacy skills to a relevant course assignment. In 2011, Fain discovered that students who used a library resource or service as part of a class assignment showed statistically significant improvements on an information literacy assessment. Embedding allows librarians to design programs with this in mind.

MacMillan (2010) also demonstrates the benefits of constructivist information literacy instruction design in his analysis of an information literacy lab included as part of an undergraduate biology course at the University of Calgary. Students are introduced to a range of resources for researching genetic information, and a poster assignment helps them reinforce their learning (p. 1). "In order to familiarize biology students with the ways of learning and knowing practiced in genetics and related disciplines, it is necessary to provide opportunities for them to explore and use the current, cutting-edge tools," (p. 2). MacMillan emphasizes that the three steps in his lab are important for full information fluency: first, a structured demonstration of available resources; second, an exploratory lab assignment; and third, a final assignment that requires synthesis and analysis (p. 2). The resources students are introduced to during this lab—such as the National Center for Biotechnology Information's "Genes and Disease" encyclopedia,

or BLAST, an online sequencing tool—are discipline specific and provide information not generally available through Google or other generic search engines (p. 6-7).

While embedded librarian roles vary greatly in scope and subject, keeping in mind the need for basic information literacy skills, as well as more cognitive, constructivist-oriented learning can help these librarians design effective programs.

Determining Where to Embed

Librarians may embed, or provide embedded services, in many different facets of the college learning experience. As mentioned above, embedding can take place virtually, through a course management system (CMS), or physically, in different department spaces and classes. With the advent of the internet, research no longer "swirls around the reference desk," (Tumbleson and Burke, 2010, p. 974), meaning librarians must venture out to bring information literacy to the new research centers.

Bowen (2012) demonstrates the value of placing course-level research guides within course management systems through her research in a general education communications course (p. 449). Embedding library resources within the CMS allows the embedded librarian to 1) highlight relevant and specific resources for students within their course learning environment, and 2) provide instruction on using these resources (p. 450). Bowen mentions a few options for embedded resources, including links to subject research guides (often known as LibGuides), direct links to subject resources at the time of need, information literacy modules, and opportunities for the librarian to interact with students, e.g. through course discussion boards (p. 452). Although all of these resources may be available through the main library website, Bowen found that they were better utilized in the CMS environment. For instance, undergraduate students were twice as likely to use a LibGuide than Google when the LibGuide was prominently

embedded within their CMS (p. 462). They were also seven times more likely to use the LibGuide than Wikipedia (p. 462).

Barr (2010) agrees that "embedding library resources in course content management systems optimizes their exposure," (p. 289). Although subject research guides are a long-time library strategy for providing students with specific research tools, students must know these guides exist, and they must also know how to access and use them (p. 289). Links through the CMS provide a constant visual reminder of the library resources available to students, and also allow embedded librarians to customize resources for a specific course, or even a specific assignment. Additionally, all enrolled students have immediate access to the content embedded (Tumbleson and Burke, 2010, p. 973).

At Harvard University, Barr's experience as an embedded librarian with the Ernst Mayr Library and Cabot Library offers a good example of embedding library resources in the CMS. The libraries, which provide resources for Harvard's science departments, began collaborating on embedded resources in 2008-2009 with a generic "science resources" page, and moved to a more specific "life sciences research toolkit" after feedback from faculty suggested a need for more specialized links (Barr, 2010, p. 292). This toolkit was dispersed on all science course CMS sites, and Barr conducted a usability study after a year, which indicated that although participants were satisfied with the content, they wanted a "simpler, more dynamic page" (p. 293). By continuing to work with faculty, teaching assistants, and students, Barr and her team created a modified toolkit that instructors could further tweak for specific courses. The project was prompted by her observation that although libraries often provide links to resources, students often do not use these links because they were either not visible, or not relevant enough.

Anecdotal evidence from Barr's project suggests that students enrolled in the trial classes did use and appreciate the course-specific resources, as did the courses' teaching fellows.

Embedding virtually may allow librarians to reach greater amounts of students, but embedding in person is also a popular and successful technique. At Indiana University, Winterman *et al.* (2011) analyzed an example of physical embedding, in which a librarian partnered with the instructor of an upper-level molecular biology class (p. 42). Students in the class were familiar with the subject matter and thus ready to synthesize and analyze new research material (p. 43). The embedded librarian modified an existing course assignment to facilitate information literacy goals: students were to write a research proposal on a topic of their choice. Information literacy standards included narrowing down the topic (ACRL Standard 1), synthesizing research to identify gaps that their proposal would fill (ACRL Standard 3), and citing literature correctly (ACRL Standard 4) (p. 44). The presence of the embedded librarian meant students had an expert researcher at their disposal to assist them in mastering these core information literacy skills.

Somerville and Vuotto (2005) relate their experience at the California Polytechnic State University library working on a project that blended both virtual and in-person embedded librarianship by creating a digital research portfolio in collaboration with the College of Agriculture. They underline the importance of providing a "digital knowledge base of embedded information literacy content, which delivers value added advantages," (p. 84). In their design, librarians were responsible for designing digital research portal content with input from faculty, while paraprofessionals maintained most direct interface with students at the reference desk, and when approached with questions beyond their expertise, referred the student on to a subject librarian (p. 90). The final digital research portal was a "centerpiece for the new subject

specialist model… information literacy that has been transformed from a library-centered notion to a core educational concept integrated seamlessly in disciplinary curriculum," (p. 91). The library created, in essence, a digital reference desk for research to "swirl around," in the words of Tumbleson and Burke.

Determining When to Embed

The typical length of an undergraduate degree program is four years. At the beginning of these four years students may be undecided as to their major, and may be taking a wide variety of general education courses. During the last two years, students typically have a major defined and engage in higher level, disciplinary learning. For embedded librarians, the question is when the most effective time to embed in these students' courses is. From an institutional standpoint, it may be more *efficient* to embed librarians in a general education course that all students must take, such as a core composition class. This way everyone is exposed to the same information literacy instruction. From a departmental standpoint, exposing students to information literacy may be more *effective* during their upper level courses, when the content is more applicable. We will examine several case studies supporting both of these ideas.

In the first study, VanScoy and Oakleaf (2008) surveyed over 500 students at a large university in the southeastern United States, and found that a majority of first year students often need to find specific web, journal, or book resources, so would benefit from more information literacy instruction (p. 572). The authors recognize that the traditional method of information literacy instruction is a "tiered" approach, in which students are provided different levels of information literacy instruction depending on their degree progress. However, they recommend that this approach be reexamined and that embedded program designers consider what students are actually being required to do for their courses (p. 566). To this extent, VanScoy and Oakleaf

suggest surveying syllabi and curricula across campus to determine the most appropriate point at which primary information literacy instruction should occur (p. 566).

In the second case study, Gehring and Eastman (2008), both librarians at Connecticut College, participated in an upper-level undergraduate developmental biology course that included an information literacy tutorial, assignments utilizing primary literature analysis, and two lab research projects. Prior iterations of the course involved using primary literature, but students tended to have difficulty finding appropriate resources, and so benefited from Gehring and Eastman's designed coursework (p. 55). Librarians lead class discussions about resources found, and students became more comfortable analyzing them (p. 58). In a pretest assessment, students enrolled in the course were asked to find a source answering the question "Where is Sonic hedgehog transcribed during Xenopus development?"; only 30% of the class derived their answer from a primary source, while 60% used an indirect source and 10% found no answer. In the posttest assessment, when students were asked, "Where is FGF10 expressed during chick development?" 100% responded with a direct source (p. 59). Students were also given a self-assessment, in which the majority indicated that they appreciated the information literacy assignments and felt more competent to deal with future biology coursework (p. 61).

Porter *et al.* (2010) strike a balance between VanScoy & Oakleaf and Gehring & Eastman in their report on a project between the Departments of Biological Sciences and Information Science at the University of Sciences in Philadelphia. The project's goal was to introduce first year biology students to primary literature sources, and additionally to help them assess and analyze the information found. By incorporating these goals early in the students' education, Porter *et al*. hoped that undergraduates would build on these information literacy skills throughout their education (p. 536). The course lasted five weeks, and consisted of several

different course modules involving finding, evaluating, and analyzing a scientific article (p. 538). Student learning was assessed with a pre- and posttest, and showed significant improvement in students' ability to find and recognize relevant resources (p. 541). Porter *et al.* conclude that although their embedded program was highly successful in incorporating information literacy goals in the classroom, students must continue to be exposed to information literacy instruction *throughout* their college career (p. 541).

The answer to "when to embed?" then, is "from start to finish." As VanScoy and Oakleaf (2008) point out, even first-semester freshmen have information literacy needs. Yet as Gehring and Eastman (2008) show, upper level classmen require more specific information literacy instruction. Porter *et al.* (2010) support both arguments by demonstrating how information literacy instruction can benefit students who are only just beginning in their major courses. Embedded librarians cannot feasibly be incorporated into every course, however, which is why Pritchard (2010) recommends a unified department or campus strategy that "optimizes staff resources and expertise, reaches as many students as possible early in their academic programs, and provides support in subsequent years that builds on the competencies students have developed, " (p. 387).

Building Relationships

Building relationships with faculty, students, and administrators is a key component to the continuing success of any embedded program design, because the embedded librarian must have a solid understanding of his patrons' needs. Effective working relationships can help embedded librarians determine these needs, and also assess whether or not they are meeting them (Matava, Coffey, & Kushkowski, 2010, p. 166). Faculty relationships can also lead to more

accurate information literacy instructional content, and may help secure support and funding for embedded programs.

In terms of content and instructional design, MacMillan (2008) notes that communication with course instructors is not only important for the successful incorporation of information literacy modules with the syllabus, but also because the instructor likely has a current understanding of the discipline and may be able to contribute updated resource suggestions (p. 8). The ultimate goal of teaching students to be information literate is to produce graduates who are able to effectively navigate the information waters of their field. Although librarians have expertise in the information domain, faculty and teaching assistants may be more exposed to new resources, and also better able to evaluate their usefulness.

Faculty support for embedded librarians is essential to the growth and funding of an embedded program. Shumaker and Talley (2009) observed that successful embedded librarian programs all benefited from word of mouth advertising, the use of printed promotional materials, and presenting to fellow employees (p. 7). Drewes and Hoffman (2010) noticed that, "As faculty members realize the expertise available from their library colleagues, they are often compelled to promote the library and its services to students (p. 78). Word of mouth publicity is likely the most difficult to acquire and yet also the most effective because it engages interpersonal trust.

Drewes and Hoffman (2010) recommend socialization as a key aspect to embedding, because it allows librarians to develop trusting relationships with their constituencies (p. 80). The first step in trust is familiarity. Embedded librarians can build familiarity by working with teaching fellows, who have considerable direct contact with students (Barr, p. 296). Pritchard (2010) recommends librarians also engage with faculty both formally—at meetings with department chairs, or presentations at department gatherings—and informally, via drop-in

conversation with instructors (p. 381). During the librarian's transition from consultant to partner, Pritchard underscores the importance of trust and respect, and how formal and informal relationships serve to build familiarity (p. 383).

Olivares (2010), like the authors above, recognizes that relationship building is necessary for embedded librarians, but she also takes the scenario a step farther by asserting that targeted marketing can make the most out of an only partially successful embedded program. Although most of the literature chronicles successful embedded experiences, the reality is that embedded services often have trouble initiating or maintaining momentum (p. 140). Olivares, a librarian at Saint Cloud State University, decided rather than try to initiate a comprehensive embedded program, she would focus on marketing the potential embedded services to faculty, and building relationships with only those faculty who were enthusiastic and saw the library's services as a true benefit (p. 145). After successful semesters working with certain professors, Olivares would ask to be recommended to other professors, thus networking her services further (p. 146). Even professors that did not include Olivares in their courses still benefited from the networking by being able to refer students specifically to her, rather than with a generic "Go see the reference desk," (p. 148). Thus, Olivares exhibits how relationship building can maintain a baseline level of embedded presence, even if full-fledged programs are lacking.

Mitigating Cost

As with any expansion of services, embedded librarian programs may be difficult to sell to library administrators because they detract from the librarian hours spent at the main location. Cost is a relevant issue, particularly in recent economic times when most higher education institutions are facing budget cuts. However, when embedded librarians use business tactics to demonstrate that the costs of their programs are outweighed by the benefits, cost becomes a

bargaining tool for, rather than against, the librarian. The literature suggests several primary opportunities for reducing embedded program initial and operating costs: shared resources, generic but modifiable resources, and the use of paraprofessionals. The specific use of certain cost mitigations may be determined by tiered embedding.

Tumbleson and Burke (2010) experienced major budget cuts at the Miami University Middletown just as their library's embedded services program was getting underway; they report that collaboration with other academic libraries can be a way to expand programming within the constraints of a tight budget (p. 981). For instance, the Animated Tutorial Sharing Project (http://ants.wetpaint.com/) offers open source information literacy tutorials, helping to cut down on in-house creation costs. Because information literacy is a common goal of academic institutions, much of the content an embedded librarian may desire has likely been created already elsewhere. Therefore, sharing resources is an effective way to mitigate embedded program costs.

Similarly, embedded librarians may also make use of generic but modifiable resources, which provide a platform to build from. Kelley (2012), a librarian at the College of DuPage, explains how rather than designing individualized embedded programming, the library instead used widely-applicable information literacy instruction modules to reach students both online and in face-to-face courses (p. 335). One of the resources the College used is a University of Washington tutorial titled "Research 101," which may be modified under a Creative Commons license, and is currently used by over 100 institutions (p. 338). The College also modified "Research 101" into library information literacy modules that each contained content to help students fulfill general education information literacy requirements (p. 340). Faculty could optionally include the modules in their courses, and those that did reported positively. Many

faculty also reported that they would consider modifying the modules to be more course specific in the future (p. 343).

Tiering can help embedded librarians determine what level of resources should be invested in different courses, e.g. if a generic but modifiable module (as discussed above) would be sufficient, or if a fully embedded librarian would better benefit the students. Again at the College of DuPage, Kelley (2012) relates how the library developed a program entitled *The Embedded Librarian: Levels of Involvement*, which allowed librarians to determine the amount of time and resources it was appropriate to put into any given course (p. 336-337). "Liaison Link" offers basic, static resources such as course lib guides or redirection to a subject librarian. "Export & Copy" is the second level, and recommends that the librarian create embeddable content for online courses to use or not use. Level three is "The Embedded Librarian," a fully included member of the course instruction in an online environment. Similarly, the University of Guelph also provides three forms of support: supplemental, integrated, and embedded. Supplemental support is user initiated, integrated may involve a specific course assignment, and embedded requires that a librarian collaborate with a faculty member as co-instructors (Pritchard, 2010, p. 377-378).

Utilizing cost mitigation techniques is a financially smart choice for embedded librarians, but does not alone provide them with the ability to leverage cost as a bargaining tool. Hoffman (2011) used quantitative data, coupled with interviews, to assess embedded librarian programs at six academic institutions (p. 444), and she argues that libraries must act more like businesses. When embedded librarians use cost-benefit analysis to demonstrate the true implications and efficacy of installing embedded programs, then they hold the bargaining power (p. 449; Shumaker and Talley, 2009, p. 7).

Initiating an Embedded Program

In terms of best practices for embedded librarianship, the most important factor for success is to build faculty relationships, as discussed above. Second, embedded librarian programs are often costly, so it is important to start small with a pilot program. In designing the pilot program, think ahead to when the program may be scaled up. This means keeping the overall design general, but allowing it to be modified for specific courses or departments. This also means assessing the program's success throughout the pilot phase so that faculty and staff understand the benefits of embedding. The embedded librarian should also clearly define his or her role in the pilot program. For instance, will the librarian be active in coursework throughout the semester, or will she design elements to be carried out by the instructor, teaching assistant, etc.? Lastly, the embedded librarian must be technically competent, particularly if he is to be embedded in an online course.

Hoffman (2011) notes the importance of embedded librarians in accomplishing ACRL's information literacy guidelines. On an organizational level, her comparison of embedded librarians at six different universities shows that while these institutions see real benefits from embedding librarians, they also face real difficulties in allocating librarian time and scaling up from pilot projects to campus-wide integration. On an individual level, participating librarians expressed that defining their role for being embedded in a course was one of the largest challenges.

Maintaining Momentum

As discussed above, embedded librarian programs can be costly, and they generally take away from the regular duties of university libraries. So how can librarians convince their colleges that not only is embedding a worthwhile idea to test, but also that it is an important

program to *continue*? Hawes (2011) suggests a cyclical process with ample opportunities for feedback, modification, and assessment (p. 58). She also stresses that embedded librarians must tie their programs to the overall library and/or university's goals (p. 62). Embedded programs can provide vital information instruction, and are particularly important to undergraduate science majors, who must deal with a constant barrage of new research.

Shumaker and Talley (2009) state that successful embedded programs benefit from using qualitative assessments and metrics to justify continuing their embedded services (p. 7). Qualitative assessments and metrics fit into Hawes' cyclical scheme well. Embedded librarians should track their time spent, student and instructor feedback, student performance results, etc. They should also develop in-house assessments to construct a researched image of the success of their program. Through these methods, embedded librarians may modify their programs to better suit the needs of their users.

In addition to tracking results and using them in a cyclical process of improvement, institutionalizing embedded librarian programs is another factor for positive momentum. Current embedded programs often result from the innovative spirit and motivation of individual employees, Shumaker and Talley report (2009, p. 7). Although such employees are obviously beneficial to the library as a whole, placing the success of a large-scale program in the hands of a single person is not sensible.

According to the American Library Association, "information literacy forms the basis for lifelong learning. It is common to all disciplines, to all learning environments, and to all levels of education," (2004). Embedded librarians are well poised to facilitate information literacy instruction within the context of undergraduate sciences. Even if programs are not spread throughout the department or throughout a student's undergraduate career, Hoffman (2011)

maintains that “greater student comfort with a librarian may mean students’ willingness to ask questions and search for library resources in future courses (even those without an embedded librarian),” (p. 453). Thus, embedded librarian programs, no matter how small, should be considered a vital component of any college or university’s information literacy standards.

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