The Impact of Physically Embedded Librarianship on Academic Departments

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abstract: Academic librarians have been engaged in embedded librarianship for nearly 15 years, yet there are few published research studies on the impact of physically embedded librarians, who work alongside departmental faculty. This study leveraged a change in reference service to analyze what happened when subject librarians moved from the library services desk to spending a significant part of their workday in the academic departments they serve. Reference and instructional transactions increased significantly, and novel instances of collaboration and integrations arose. Based on the results, this study proposed a developmental model for physically embedded librarianship.

Introduction

The presence of academic librarians within departments has a long history, starting from the nineteenth century when academic buildings housed subject libraries.¹ In the past three decades, the trend has been for library systems to consolidate branch libraries into fewer libraries or a main campus library. A number of factors have motivated consolidation, including the advent of electronic resources, competition for campus space, and shrinking library budgets. More recently, librarians have tried to reverse the separation from clients, exacerbated by the declining use of in-library reference services, by establishing embedded services.²

Librarians have embedded both online and physically to close the gap between the campus community and the academic library.³ Embedded librarians in online courses conduct a wide range of activities, from providing links to library resources in the virtual classroom to collaborating with faculty on course content, design, and teaching. Physically embedded librarians also run the gamut from answering questions at a station

in an academic building for several hours a week to having permanent offices in their assigned departments.

Stephanie Schulte found after an extensive literature review that seven qualitative and three quantitative studies have used methods other than the case study to measure the impact of embedded services.⁴ The majority of these investigations analyzed the effects of librarians embedded in online courses or librarians as co-teachers of courses.

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However, there is a gap in the literature when it comes to research studies of the outcome when librarians maintain a physical presence in academic departments.

The purpose of this study is to explore the impact of librarians who are physically embedded in academic units. The overarching research question is: Does embedding a

subject librarian within a department lead to increases in interactions, collaboration, and integration with faculty and students? To answer this question, the researchers carried out a natural experiment, a study of the effects of a change not planned by the researchers. The change studied was the establishment of physically embedded services by three subject librarians at the University of North Texas (UNT) in Denton.

Literature Review

Definitions of Embedded Librarianship

The concept of the academic embedded librarian appeared in the literature early in the 2000s. The librarians were variously labeled, for example, “field librarian” at the University of Michigan in Ann Arbor⁵ and “mobile librarian” at the University of Minnesota in Minneapolis.⁶ The term *embedded librarian* emerged in a 2004 article by Barbara Dewey, dean of libraries at the University of Tennessee in Knoxville. Dewey borrowed the concept from the practice of “embedding” journalists in military units during the Iraq War, where the reporters experienced and reported on soldiers’ daily lives.⁷ Subsequently, there has been a flurry of publications about embedded librarianship, with entire journal issues and a blog devoted to the topic.⁸

While embedded services are a popular topic, the definition of an embedded librarian is not at all clear. One definition is a librarian who has a virtual presence in an online course within a course management system (CMS), the software a university uses to create and distribute course content, manage student enrollment, and track student performance.⁹ The activities of the librarian embedded in a course management system range from providing links to library resources for the course to collaborating on course content and co-teaching.¹⁰ Virtually embedded librarians also step beyond department courses and create a library “course” or “organization” in a CMS that can be used by all students to locate resources and services.¹¹

Another definition for the embedded librarian is one who shares a location with the target clients.¹² In academic librarianship, the location is usually a department or college, and in special librarianship, a business or medical unit. As with virtually em-

bedded librarians, the activities of these librarians vary greatly. While some perform mainly reference duties, others collaborate in research and teaching. Time spent in the department ranges from a few office hours in the target unit¹³ to having a permanent office there to which the librarian is assigned.¹⁴

Another view of embedded librarianship is that location, whether online or on-site, is not a defining characteristic. Nicole Covone and Mia Lamm suggest an expansive definition, with the embedded librarian being immersed “within not just the course curriculum but also the community and culture” to build relationships.¹⁵ In their 2010 study, David Shumaker and Mary Talley narrow the definition of *embedded* to those who provide “specialized services,” including such activities as “in-depth research, competitive intelligence, training that is conducted off-site (away from library facilities) and shared instructional responsibility with subject faculty.”¹⁶ No matter where they are, embedded librarians have evolved beyond providing general reference and information literacy instruction to serving as research and teaching partners.

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Goals of Embedded Librarianship

Despite the variation in definitions of *embedded librarian*, most academic libraries have common goals that motivate the physical or online embedding of services. The shared goals can be collapsed into three: increased interaction, collaboration, and integration with the target community. Barbara Dewey mentions all three goals in her call for librarians to become embedded. She encourages “purposeful interaction,” “comprehensive collaborations,” and “comprehensive integration” with the campus community.¹⁷ Early embedded librarians have been pleased to discover that their attempts to increase transactions with patrons bring the unexpected benefits of collaboration and integration with the target department.¹⁸ More recent embedded programs have set heightened collaboration and integration as goals from the outset.¹⁹ While individual librarians may be satisfied with meeting these goals, the library organization generally sees interaction, collaboration, and integration as steps to the all-encompassing goal of demonstrating the value of the library to the campus community.

The literature suggests that increased interaction helps counter the decline in reference transactions within the library and helps build relationships, which necessarily precede collaboration and integration within a department. Numerous authors identify declining interactions with faculty and students in the library as the impetus for embedded services.²⁰ Physical and online interactions with the department can take many forms—for example, handling reference, technical, and referral questions; encouraging students to use library resources; engaging in casual,

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face-to-face conversations with faculty and students; and participating in discussion lists and e-mail exchanges. Throughout the interactions, Martin Kesselman emphasizes that “a strong service ethic is central” for the success of the embedded librarian, whose service ethic and demonstration of expertise builds a strong, trusting relationship with the department.²¹

Collaboration occurs after the subject librarian gains the trust of faculty, staff, and students. Collaboration for embedded librarians usually refers to taking part in academic endeavors, particularly teaching and research, in which the librarian serves as a major partner. Subject librarians create customized information modules for online classes,²² serve on teams that design new courses,²³ and co-teach courses.²⁴ Embedded librarians collaborate in research activities by conducting literature searches for faculty grant applications and potential areas of faculty research, and they may even serve as coprincipal investigators with faculty on research projects.²⁵

Integration as a goal for embedded librarianship refers to the librarian’s immersion in the service community. Librarians who have succeeded in developing trusting relationships within a department begin to experience the daily life of the unit, usually through invitation or acceptance. Academic departments invite embedded librarians to participate in administrative and social events. At the University of Calgary in Alberta, Canada, embedded librarians participate in departmental meetings and committees and in graduate student admissions.²⁶ Librarians partner on reaccreditation reports and on reviews and revisions of curriculum.²⁷ On the social side, the School of Art and Design at the University of Michigan includes the art librarian in “show openings, holiday parties . . . and even staff bowling night.”²⁸

Studies of Embedded Services

The majority of studies published on embedded librarianship use the case study method. This is expected in the early scholarship about a new service, and such investigations are usually followed by studies using other qualitative and quantitative research methods. However, Schulte identifies few research studies in an extensive literature review of articles that specifically use the term *embedded librarian*.²⁹ While acknowledging the usefulness of case studies that present transaction counts, usage of reserve materials and subject databases, and valuation of services, she stresses the need for more rigorous studies to demonstrate the importance of embedded librarianship.

Of the 10 qualitative and quantitative studies Schulte identifies, half were studies of physically embedded librarians. The research methods in these five studies varied, as did the roles of the librarians. Two studies examined the impact of librarians teaching in a course on the students’ written assignments and citation patterns, where they found little or no improvement in student performance.³⁰ Shumaker and Talley surveyed the characteristics of embedded librarians and successful embedded programs.³¹ Librarians Kathryn FitzGerald, Laura Anderson, and Helen Kula estimated the value of their services at an innovation center and found they generated a tenfold return on licensed resources at the center.³² The fifth study surveyed faculty and staff at a graduate school for library and information science after one year of having a physically embedded librarian.³³ Faculty and staff appreciated the librarian’s presence but indicated they had not increased their use of library services.

Schulte states after her literature review, "No study evaluated an embedded librarian who was physically and culturally integrated into an academic or business unit."³⁴ This review of the literature confirms Schulte's conclusion. Subsequent publications continue to share best practices based on literature reviews and case studies, but they lack quantitative or qualitative research.³⁵ Furthermore, the literature on embedded librarianship lacks any natural experiments that measure variables before and after the presence of an embedded librarian in a unit. This study proposes to fill that gap in knowledge. Between 2010 and 2014, the UNT Libraries had the opportunity to conduct a natural experiment when three subject librarians became physically embedded in departments. Records of walk-up, reference, and instruction transactions allowed us to measure the impact of these librarians.

History of UNT Libraries Embedded Services

UNT is one of the largest universities in Texas with a student population of 36,216. It offers 99 bachelor's, 83 master's, and 36 doctoral degree programs.³⁶ Traditional centers of excellence at UNT have been the College of Music, the College of Visual Arts and Design (CVAD), and the College of Education. The UNT Libraries provide access to more than 6 million print and digital items through four libraries and two storage facilities.³⁷ In 2014, more than 1.5 million UNT community members used the libraries.

Reference services at the UNT Libraries changed dramatically between 2011 and 2013 in response to budget and patron trends. Willis Library, the main library, had seven service desks on its first floor in 2010, including a reference desk staffed by librarians and graduate library assistants (GLAs). The dispersion of services required a significant number of student employees for desk coverage. A decreasing library budget made it difficult to justify maintaining all the service desks. For years, the number of reference questions asked by patrons had been decreasing,³⁸ casting doubt on the value of staffing the reference desk with librarians. By spring 2012, the assistant dean of public services determined to make changes in access services and reference delivery.

In June 2012, the Willis Library consolidated its seven service desks into two, one a shared library services desk for access services and reference, and the other a 24-hour desk for technology help. The library services desk had one reference workstation that was staffed by GLAs and two librarians (one of whom supervised the GLAs). Access services staff handled the other workstations. The subject librarians maintained an on-call schedule to handle referrals from the GLAs, but the new arrangement otherwise freed them to try new interactions with their assigned departments. From the fall 2012 through the fall 2013 semester, fewer than 25 reference questions were referred to the on-call librarians, and the assistant dean for public services ended the on-call program. The GLAs at the library services desk continued to refer questions as needed, but the librarians were no longer required to be in the office during scheduled hours.

Three librarians made the transition from the library services desk to physically embedding in their assigned departments between spring and fall 2012. The art librarian started with two hours per week embedded at the CVAD Art Building during the spring 2012 semester and then increased her embedded time in fall 2012 by adding two hours per week in the library housing the art collection. The biology librarian began an em-

bedded service in the Life Sciences Complex and worked her last semester at the library services desk in fall 2012. The education librarian embedded full-time in the College of Education in fall 2012. By spring 2013, all three librarians did embedded librarianship only; none worked at the library services desk.

The Art Librarian

The art librarian has had a long-term relationship with CVAD. She attended UNT as a student for six years, earning both a BFA in art history and an MFA in painting and drawing, with a minor in metalsmithing and jewelry. After earning her MLIS degree in 2000, she joined the UNT Libraries as a librarian in preservation. In 2002, she became the art subject librarian for CVAD. The college has 30 undergraduate and graduate degree programs, more than 2,100 students, and 125 faculty and staff members. CVAD's classrooms are in the Art Building and in seven other buildings where the students use lecture halls or studios.

Before establishing the service, the art librarian sought the advice of the faculty representative to the libraries in CVAD to determine if the service was desired, and if so, when it should be offered. The faculty representative thought the service would be useful and suggested a two-hour block on Monday, when many classes were taught. Mondays were also typically days when more students focused on completing assignments compared to the end of the week. After consulting with the faculty representative, the art librarian obtained permission to offer the service from the dean of CVAD, who was receptive and supportive of the idea.

The embedded location in the Art Building is on the second floor in an open, cantilevered room visible from the second and third floors. The room is referred to as the "Laptop Lounge." The students and faculty in the Laptop Lounge are predominately associated with CVAD. The lounge is near the largest lecture room in the building and is surrounded by offices of faculty in the Department of Art History and Art Education and the Department of Design, which includes the programs in Interior Design and Communication Design. Traffic on this floor varies according to what classes are being taught. The hallways fill with students coming and going to class twice during the art librarian's two-hour shift. Some students come to the Laptop Lounge to wait for classes, work on their assignments, brainstorm with fellow students, eat a meal, or play games. The art librarian sits at a bistro-style table with two chairs, taking whatever table is available. She uses a netbook computer to answer reference questions.

The location of the embedded reference services in the Willis Library is near the art collection stacks. The art librarian sits at a table visible to students entering the floor from the building's central elevators.

At both locations, the art librarian wears a nametag labeled "Art Librarian." To promote the service, she places a letter-sized sign in an acrylic glass frame on the table. The librarian also promotes the embedded service in her course guides and in a departmental publication called *The Art Librarian's Newsletter*, distributed via e-mail to all faculty and staff in CVAD during the fall and spring semesters.

The Biology Librarian

The biology librarian has been an academic librarian since 2004, when she began working at UNT. She holds a BS in biology from the University of Utah in Salt Lake City and a Master of Philosophy (all but dissertation) in experimental pathology from the University of Utah School of Medicine. After moving to Texas, she earned her MLS from Texas Woman's University in Denton. The biology librarian has been assigned to the Department of Biological Sciences for more than 10 years. Initially she served as co-subject librarian for the department with another science librarian, and then became the sole subject librarian in 2006.

The Department of Biological Sciences has seven undergraduate degree programs, nine graduate degree programs, and three certificate programs. There are 2,250 undergraduates in the department, 211 graduate students, 43 faculty members, and 9 adjuncts. The department is mainly housed in and holds courses in the Life Sciences Complex, composed of Life Sciences Buildings A and B.

After being taken off the library services desk schedule, the biology librarian approached the chair of the Biological Sciences Department and proposed having a station in one of the biology buildings for a couple of hours per week, where students could ask questions. The department chair immediately accepted the proposal and suggested a high-traffic area near the main door of Life Sciences Building A. The department ordered a portable, folding table for the librarian, which is stored in the department office when not in use.

The biology librarian started embedded services for two hours one morning per week in Life Sciences Building A in October 2012. She sets up the folding table in front of a bench that runs along a wall near the main entrance. The location is also near the men's room and stairs that lead to the other three floors. There are two large lecture halls, each of which holds more than 100 students, on the first floor, and two consecutive classes meet in the halls over the course of the embedded hours. A vertical pop-up banner stating, "Librarian on Location: Ask your library research questions here," stands next to the table to advertise the service. The biology librarian uses a tablet computer to answer reference questions and a notebook to record the questions, which are later entered in the library's Reference Statistics Database (RSD). She normally stocks the table with business cards, library buttons, pens, and candy. Although the majority of faculty and students encountered are associated with the Department of Biological Sciences, some come from other departments but have classes in Life Sciences Building A.

The biology librarian uses a variety of methods to promote the "Librarian on Location" service. She reminds faculty about the day and hours for the service in a newsletter sent every fall and spring semester. In addition, she sends out an e-mail twice in the first month of the semester to remind faculty to send their students to visit the Librarian on Location station. In the first month of each semester, the biology librarian also contacts faculty members who teach courses during the embedded hours and requests to visit their classes. These visits last 10 to 15 minutes and are meant mainly to introduce the students to the librarian, the Librarian on Location service, and the course guide if there is one for the class. The hours for the Librarian on Location are also advertised on all subject and course guides related to biology.

The Education Librarian

The education librarian, like the art librarian, earned her MLS from the Department of Library and Information Sciences at UNT. Her undergraduate degree is also in library science. She started work at the UNT Libraries in 1985 and has served as the subject librarian to the College of Education (COE) since 1990.

COE offers 20 undergraduate and 46 graduate degree programs, plus 9 certificate programs in the following four areas: (1) counseling and higher education; (2) educational psychology; (3) kinesiology, health promotion, and recreation; and (4) teacher education and administration. It is one of the largest colleges on the UNT campus with approximately 230 faculty and 5,000 students (doctoral, graduate, and undergraduate). The education librarian has been the sole subject librarian assigned to the college for 25 years. The main building for COE is Matthews Hall; three COE programs are housed in other buildings. COE also includes numerous clinical and research centers on and off-campus, which call on the librarian for instruction and reference services.

In fall 2012, the COE dean and the UNT Libraries' dean recommended an experiment in which the education librarian would become fully embedded. They arranged for her to move to an office in Matthews Hall, part of a suite of offices shared with the COE's Development and External Relations team and faculty and graduate students in educational psychology. The librarian spends approximately 36 hours in the office per week, and she also visits other COE buildings and the library for instruction sessions and meetings.

The education librarian's office is not visible from the corridors of Matthews Hall. She therefore promotes her embedded service through a variety of channels: at library instruction sessions, on the UNT Libraries' and COE's websites, and on her subject and course guides. Matthews Hall has a digital sign posted near the dean's office, and the librarian has also uses this sign to alert faculty and students to her services.

Research Questions

This study leverages the initiation of physically embedded services by three librarians to conduct a natural experiment. The purpose is to determine the impact of the new service on students and faculty by measuring any changes in transactions, collaboration, and integration after the librarians embedded in their respective departments. The specific questions posed are:

1. Do the librarians experience more walk-up transactions with faculty and students in the embedded locations than they did at the services desk in the library?
2. Do the librarians experience an increase in the number of reference and instructional transactions with their target departments after starting the embedded service?
3. Is there a relationship between the number of walk-up transactions at the embedded sites and the number of reference and instruction transactions conducted?
4. Do any novel instances of integration and collaboration occur between the librarians and their assigned departments after the embedded service starts?

Methods

Natural Experiments

The changes in reference services at the UNT Libraries from 2011 through 2012 created the situation to conduct a natural experiment, comparing behavior of students and faculty before and after embedded service. A natural experiment is a research method frequently used in economics and sociology.³⁹ Natural experiments take advantage of situations in which a sudden change in policy or environment affects a population to measure the population's behavior before and after the change. The shift at the UNT Libraries was the transition of three librarians from the library services desk to locations in their assigned subject departments. The pre-embedded service ran from the fall 2010 through the fall 2011 semesters. A transitional period, during which the art and biology librarians worked at both the library services desk and their embedded locations, began in spring 2012 and continued through the fall of that year. All three librarians provided only embedded services from spring 2013 to spring 2014. The change in service location in this study was the treatment or independent variable. The dependent variables were the interactions of the department faculty and students with their subject librarians. Natural experiments are not truly randomized or controlled, but they still may yield valuable results.

There were at least two variables that threatened the internal validity of the study, possibly influencing the post-treatment observations and measurements, according to the description of natural experiments by Bruce Meyer.⁴⁰ Librarians at the UNT Libraries record all patron questions they answer in the libraries' home-grown Reference Statistics Database (RSD). The librarians in the study did not know the department affiliation of students when handling walk-up transactions at the library services desk or the embedded locations, unless it was obvious from their questions. The library staff records walk-up questions quickly in the RSD and usually with less detail than needed to identify department affiliation. For this reason, the analysis included all walk-up transactions conducted by the librarians in the library and in the departments, so as not to bias the measurement for the conditions before and after embedding. On the other hand, when analyzing e-mail, phone, and appointment reference transactions, the librarians could review the more detailed records in the RSD and identify whether a question came from their department. This allowed the librarians to compare the change in e-mail, phone, and face-to-face reference appointments within their departments before and after the embedded librarian program. This process eliminated any questions they may have answered from students in other majors who happened to have courses in the embedded locations, thus making it possible to measure changes in the departments' behaviors only.

The study also contained two threats to external validity, which might impact the generalizability of the results.⁴¹ The first is that the results came from patrons in three different broad disciplinary areas: humanities, social sciences, and life sciences. Results from any one population may not apply to a general university population, though they may shed light on the behavior one could expect from a broad discipline. The second obstacle to generalizing the study results was the three different embedded locations of the librarians. The behavior of patrons in one environment might not be applicable to another arrangement. The investigators considered the influence of these two variables in the analysis of the results.

Data Sources

The data for the study encompassed records from the fall 2010 through the spring 2014 semesters. That period provided one and a half years of contextual data on either side of the transition to embedded librarianship. A semester was defined as the first through the last day of class. The three patron behaviors analyzed in the study—walk-up transactions with the librarian, reference and instructional transactions, and initiation of department integration and collaboration—are recorded in three different locations at the UNT Libraries. All staff who interact with the public enter the walk-up and reference transactions in the RSD. For each transaction, the following information is collected: staff member's department, location, format of question (walk-up, e-mail, phone, appointment, and so on), type of question (reference, directional, and so on), and patron status if known (student, faculty or staff, or community). Reports for an individual librarian and selected dates can be pulled from this database at any time.

The other two data sources are Microsoft Outlook, an e-mail and calendar application, and librarian performance agreements. Library instruction sessions requested by faculty are booked as meetings in Outlook and labeled with the course codes, instructor names, librarian names, and numbers of students. Reports are pulled from this database on a monthly basis. Course guide creation and collaborative and integrative activities are all recorded in the librarians' annotated performance agreements, which are submitted annually. The three librarians reviewed these documents to identify relevant activities.

Definitions

These were the definitions of frequently used terms for data in the study. The method of selection for the data was included in the definitions:

1. Walk-up transaction: A face-to-face question-and-answer interaction between a patron and the librarian. The question can be of any type: reference, directional, referral, technical, or comments about the library. These are all recorded in UNT Libraries' RSD.
2. E-mail reference: A question e-mailed to the librarian asking for assistance in using library resources or services. The librarian must use the library's website or resources to answer the question. This has its own category in the RSD.
3. Phone reference: A phone call to the librarian from a patron asking for assistance in using library resources or services. The librarian must use the library's website or resources to answer the question. This has its own category in the RSD.
4. Reference appointment: A transaction in which the patron has requested to meet with the librarian for assistance using the library resources. These meetings usually last at least an hour. This activity has its own category in the RSD.
5. Instruction transaction: A faculty member, teaching fellow, or teaching assistant asks the librarian to visit a class or meet with the class in the library to instruct students in the use of library resources. These sessions are recorded through Outlook e-mail when a room is booked for the instruction. The reservation includes the course code and number of students.
6. Course guide transaction: A faculty member asks the librarian to create a course guide for students who need direction in what library resources to use to complete

an assignment. Librarians record the number of course guides created in their annotated annual performance agreements.

7. Collaborative activity: This is a partnership with a faculty member or graduate student to complete a project or product within the librarian's subject area. The librarian must have made a significant contribution. An example would be the literature search for a grant proposal.
8. Integrative activity: An activity that incorporates the subject librarian into the social or administrative life of the department. Examples are committee assignments, student club sponsorship, or invitations to parties.

The researchers analyzed the services provided for e-mail and phone references, reference appointments, and instruction and course guide transactions and counted only those pertaining to a librarian's subject. They drew the data for collaborative and integrative activities from the librarians' annotated annual performance agreements.

Statistical Analysis

The researchers applied descriptive statistics to the walk-up, reference, and instructional transactional data. To enable both summation and comparison of walk-up data from all three librarians, the number of transactions each librarian conducted at the library services desk and the embedded location was normalized by the number of hours the librarian worked at that location.

The investigators marked graphs of the transactional data to indicate the periods before embedded service, during the transition to embedded service, and post embedded service. The central tendency of each period was measured using the median. The measure is less sensitive to extremes in data distributions, which makes it a good choice for data that are vulnerable to semester cycles.

Results

Walk-Up Transactions

To answer the first research question, whether walk-up transactions would increase at the embedded location, the librarians normalized their numbers of walk-up transactions by the number of hours each librarian worked at a site. The resulting rates of walk-up transactions per hour were combined and charted.

Figure 1 shows the decline in walk-up transactions at the library services desk during the shifts worked by the three librarians for all three periods in the study. The combined rate of walk-up transactions dropped 45 percent from fall 2010 to spring 2012. The rate of walk-up transactions reached the lowest point in three years in spring 2013, the first semester in which all three librarians had left the library services desk entirely and provided reference service only in the embedded locations. This decrease was not surprising, because historically most UNT librarians have had fewer walk-up requests for service in the spring than the fall. Indeed, the rate of transactions rebounded to 7.14 per hour in the fall 2013 semester.

The median was determined for all three periods to compare the rate of walk-up transactions in the pre-embedded and post-embedded periods. The median for the

Figure 1. Combined walk-up transactions per hour at the library service desk and the three locations for embedded librarians. BEM = before embedded service median; TEM = transition to embedded service median; AEM = after embedded service median.

Table 1.
Walk-up transaction rates for the three librarians per semester

	Spring 2013	Fall 2013	Spring 2014
Art librarian	1.18	0.88	0.70
Biology librarian	3.86	2.42	5.80
Education librarian	0.14	0.16	0.18

pre-embedded period is 7.92, that for the transitional period is 6.85, and that for the post-embedded period is 4.92. This result indicates that walk-up transactions for the three librarians decreased by approximately three people per hour after they physically embedded in their departments.

To investigate whether the combined rate concealed significant variations, the investigators examined the rates for the individual librarians in the post-embedded period. The biology librarian handled substantially more questions per hour than the art and education librarians in all three semesters. The rates in Life Sciences Building A reached a high of nearly six patrons per hour in fall 2013 and never fell below two patrons per hour. The art and education librarians consistently had a rate of less than one patron per hour, with the exception of the fall 2013 semester, when slightly more than one patron per hour asked questions of the art librarian.

Figure 2. Combined e-mail reference transactions conducted per semester for the three librarians. BEM = before embedded service median; TEM = transition to embedded service median; AEM = after embedded service median.

E-Mail and Phone Reference Transactions

The second research question this study explored was whether the librarians would experience increased reference and instruction transactions with faculty and students when embedded in departments. As seen in Figure 2, the number of e-mail reference transactions conducted by the three librarians increased sharply following commencement of embedded services in their departments. The median number of transactions from before to after embedded services increased by 371 percent. The most rapid increase in e-mail reference began in the transitional fall 2012 semester, when all three librarians were embedded but the biology librarian still staffed the library services desk as well. The increase from 20 transactions in spring 2012 to 69 transactions the following semester constituted a 245 percent jump.

The graphs for the individual librarians show the beginning of an interesting trend. Typically, UNT librarians handle more transactions and teach more classes in the fall than the spring. This pattern is visible in Figures 1 and 2 from fall 2010 through spring 2012. A new pattern emerged in fall 2012 and spring 2013, during the transition to embedded services. Figure 3 shows the surge in e-mail reference transactions for all three librarians that overrode the usual dip in spring transactions. The surge seems to have thrown the librarians' activities into a new cycle, with peak activity in the spring 2013 and 2014 semesters. The education librarian had the greatest change in magnitude from spring 2012 on, but all three librarians experienced the same pattern.

The combined phone reference transactions per semester fell sharply even before the librarians entered the transitional period. The peak of 54 transactions occurred in the pre-embedded period, and the median that period was 42. The median stayed at 19 during both the transitional and post-embedded periods.

Figure 3. E-mail reference transactions conducted per semester by the three librarians. BE = before embedded service; TE = transition to embedded service; AE = after embedded service; Art Lib = art librarian; Bio Lib = biology librarian; Edu Lib = education librarian.

The researchers analyzed the phone reference data for the individual librarians to investigate reasons for the decrease in transactions. The education librarian, who formerly had her office in the Willis Library, contributed the majority of phone reference transactions. The peak of phone reference for her was in fall 2011, with 42 transactions. Transactions fell to 12 after her office relocated in fall 2012.

Reference Appointments

The number of reference appointments handled by the three librarians began to increase during the transitional period and continued after they embedded, but the rate of increase was more gradual than that of the e-mail reference transactions. Figure 4 shows that the median number of appointments for the team of librarians increased from 8 in the pre-embedded period to 30 in the post-embedded period, a 275 percent increase. The increase started during the transitional period, when all three librarians embedded (although the biology librarian still also staffed the library services desk). The drop in spring 2014 is similar to the fall-spring cycle in reference transactions seen at the UNT Libraries in the past.

Data for the individual librarians were analyzed again to reveal possible patterns based on discipline, location, or other variables. Figure 5 shows that the education librarian experienced a doubling in reference appointments in her first embedded semester, fall 2012. Her transactions eventually reached a peak of 26 in fall 2013, a 420 percent increase from spring 2012. The art and biology librarians also had increased reference appointments, with the art librarian hitting a peak of 15 in spring 2014, and the biology librarian a peak of 15 in spring 2013.

Figure 4. Combined reference appointments conducted per semester by the three librarians. BEM = before embedded service median; TEM = transition to embedded service median; AEM = after embedded service median.

Figure 5. Reference appointments conducted per semester by the three librarians. BE = before embedded service; TE = transition to embedded service; AE = after embedded service; Art Lib = art librarian; Bio Lib = biology librarian; Edu Lib = education librarian.

Figure 6. Combined instruction sessions conducted per semester by the three librarians. BEM = before embedded service median; TEM = transition to embedded service median; AEM = after embedded service median.

Instruction Sessions

All three librarians teach information fluency to undergraduate and graduate students during the academic year. The fall semesters have traditionally been the busiest for the biology and education librarians, but the art librarian typically has more instructional activity in the spring. The graph in Figure 6 of instruction sessions before and after embedded librarianship does not resemble the earlier figures in this study, which showed a sudden increase in transactions in the fall 2012 semester. The lowest point for instructional activity in the four years was fall 2012, and the number of instruction sessions climbed to the highest point in fall 2013. Despite the fluctuations in the graph, the medians for the pre-embedded, transitional, and post-embedded periods were close, at 26, 26, and 29, respectively. Embedded librarianship caused a slight increase in instruction sessions of 11.5 percent over the study period.

Course Guides

Course guides are considered instructional materials at the UNT Libraries and are created with Springshare's LibGuides software, which librarians can use to develop Web-based research guides. Typically, when a librarian teaches a class, he or she creates a course guide of related resources for the students. Occasionally, a faculty member will request a course guide only, without a visit to the class.

As shown in Figure 7, requests for course guides rose slowly over the embedded service of the three librarians. The median number of course guides created or updated before embedded librarianship was 28. The transitional period had a slightly higher median of 31.5 guides. In the post-embedded period, the median for course guides was

Figure 7. Combined course guides created and updated per semester by the three librarians. BEM = before embedded service median; TEM = transition to embedded service median; AEM = after embedded service median.

43, a 54 percent increase over the pre-embedded period. The cycle of more course guide creations in the spring appears in the data for all three librarians before and after embedded service. Based on observations, this pattern arises from the art librarian teaching more courses and creating more course guides in the spring, and from all faculty having more time to plan in the spring and so to request guides for spring and summer courses.

Relationship between Types of Transactions

The third research question in this study was to investigate a possible relationship between the number of walk-up transactions at the embedded sites and the number of reference and instructional transactions after the start of the embedded program. The investigators expected an increase in walk-up transactions followed by a rise in reference and instructional transactions. To explore this question, the reference transactions—e-mail, phone, and appointment—were first totaled to produce a graph to compare them with the rate of walk-up transactions.

Based on the graphs in Figure 8, there appears to be no relationship between the rate of walk-up transactions at the embedded sites and the reference transactions. The reference transactions rose steadily starting in spring 2012, while the rate of walk-up transactions remained relatively unchanged. In fact, the slope of the walk-up transaction graph is opposite that of the reference transactions graph in each segment from fall 2012 through spring 2014. During the pre-embedded period, there was no apparent link between the walk-up transaction rate and other types of reference transactions.

To further investigate the possible impact of the walk-up transaction rate, the researchers totaled the numbers of course instructions and guides to create a graph for comparison. While the difference in magnitude is less than that in Figure 9, no link

Figure 8. Combined walk-up transactions compared to reference transactions per semester for the three librarians. BE = before embedded service; TE = transition to embedded service; AE = after embedded service.

Figure 9. Combined walk-up transaction rates versus combined instruction sessions per semester for the three librarians. BE = before embedded service; TE = transition to embedded service; AE = after embedded service.

Table 2.

Selected collaborative and integrative activities by embedded librarians

Collaborative	<ul style="list-style-type: none">• Worked with art departments to order and create reserve collections with special designations to aid access.• Conducted literature searches for two National Science Foundation (NSF) proposals.• Created two extended course guides for introductory biology courses with instructor; jointly selected multimedia content.• Served on a project team that created a database of science literature.• Assisted in preparation of UNT General Education grant.• Participated in poster session with faculty member at 2014 International Federation of Library Associations and Institutions Satellite Meeting in Limerick, Ireland.
Integrative	<ul style="list-style-type: none">• Invited to multiple art department meetings to share services and discuss faculty library needs.• Invited to meeting of art graduate student association to give presentation.• Appointed to position of assistant faculty sponsor for biology honor society.• Invited to judge a graduate research event by biology graduate student organization.• Invited to speak at transfer orientation for education majors.

appears between the rate of walk-up transactions and post-embedded instructional transactions. In two of the three semesters after fall 2012, the two graphs diverge into opposite slopes. As in Figure 8, there seems to be no connection between the walk-up transaction rate and the other activities of the embedded librarians.

Collaboration and Integration

The fourth question in this study explored whether the librarians would experience novel collaborative and integrative activities with their departments after becoming physically embedded. The literature suggests that many librarians develop working relationships leading to these activities when they share a location with faculty and staff. The UNT librarians indeed experienced novel interactions with their assigned departments that fall into both categories between the fall 2012 and fall 2014 semesters. Table 2 categorizes selected collaborative and integrative activities of the embedded librarians.

Discussion

Transactions

The literature on physically embedded librarianship predicts increased interaction with students and faculty on campus. The results of this study indicate that the colocation of a librarian in a department increased most types of interactions, but not all. When working at locations in their respective departments, the three librarians handled fewer

walk-up transactions per hour than they had fielded at the library services desk. There are at least two possible reasons for this result, starting with the amount of foot traffic in the buildings. The Willis Library has one of the highest door counts of any building on campus, whereas the department buildings

The colocation of a librarian in a department increased most types of interactions, but not all.

have fewer people walking through them. Besides having access to fewer people, two of the librarians were less visible than they were at the library desk. The art librarian sat in a lounge on the second floor of the Art Building, and the education librarian was in a suite of offices in the education building. The biology librarian likely had a significantly higher rate of transactions because she sat near the entrance of the biology building. Students had to pass her to reach the large lecture halls.

The results of this study align with predictions of increased interactions in the literature about embeddedness when turning to the results for reference and instructional transactions. E-mail reference and reference appointments increased, as did creation of course guides and instruction sessions. Phone reference is the only interaction that dropped, and that can likely be attributed to the relocation of the education librarian. The art and biology librarians had few phone reference transactions before and after embedding. When the education librarian had her office in the library, her phone transactions were high because she had students and faculty contacting her from multiple locations on campus. Once she embedded, they could simply talk to her in the halls of the education building or when she visited other campus sites.

The greatest increase in interactions during the study occurred in e-mail reference transactions, with a 371 percent increase from the pre-embedded to post-embedded

period. The increase even pushed the transactions out of their usual semester cycle. Possible explanations are suggested by observations made by all three librarians, although the reason for higher transactions in spring has not yet been determined. The biology librarian frequently saw students and faculty in the hallway on their way to classes or meetings. They would tell her they had questions for her and would e-mail

The presence of the subject librarian in a department building serves as a visual reminder to patrons that the library's resources and services are available to them.

mail later. Faculty and students briefly stopped by the Laptop Lounge in the Art Building to let the art librarian know they had questions or needed class or research materials, but because they had to rush off to classes or meetings, they would e-mail their requests

later. The education librarian had similar experiences, plus was specifically told by a number of e-mail patrons that classmates or faculty had referred them. The presence of the subject librarian in a department building serves as a visual reminder to patrons that the library's resources and services are available to them and that they can follow up with the librarian virtually.

The reference appointments increased by 275 percent after embedded services were introduced but were about half as numerous as e-mail requests. UNT has a large percentage of part-time and commuting students; therefore, it is not surprising that virtual reference would be used more frequently than a reference appointment. Undergraduates researching in-depth assignments, graduate students working on their theses or dissertations, or students seeking technical assistance with bibliographic management software are usually the patrons who request appointments for extended library assistance. These students likely contacted the librarians in greater numbers because they saw the librarians in the academic buildings or were referred by faculty who had become more aware of the librarians because they were embedded.

Embedding increased by at least 11.5 percent the number of instruction sessions taught by the three librarians. The biology librarian taught the fewest sessions during the period covered by the study. Most biology undergraduate courses do not have assignments requiring library research, so faculty hesitate to have the librarian use class time. The instructors of biology graduate courses are also protective of class time but are happy to have course guides created for their classes. The art and education librarians regularly teach in undergraduate and graduate courses, and they have been assigned to their departments for 13 and 25 years, respectively. They may have neared the saturation point, where they are already involved with a high percentage of the courses that need instruction. These factors may explain why the number of instruction sessions increased little despite the introduction of embedded librarians.

There were more requests for course guides, an increase of 54 percent, after the librarians embedded in their departments for at least three probable reasons. The first is that many faculty did not know about the course guides. With a librarian present, they heard about them for the first time and wanted guides for their courses. Another possible explanation is that the embedded librarians had more opportunities to recommend library instruction and course guides to faculty. The education librarian has worked with some faculty who have decided to drop a required textbook and use a reading list of linked articles and books in the course guide as the "textbook." This movement toward "free textbooks" could also account for the increase in course guides over the study period.

Analysis of the transitional period, spring 2012 through fall 2012, produced intriguing results for all transaction types. E-mail reference transactions and reference appointments shot up during the fall 2012 semester. A reasonable explanation for this is that all three librarians were finally embedded in their departments. Phone reference transactions dropped in fall 2012 because the education librarian, who communicated this way the most, moved into the building with the faculty and students who might otherwise have called her. Instruction sessions dropped during the transitional period, which was unexpected based on previous semesters (see Figure 7). The drop during fall 2012 was unusual, and the contributing variables are unknown. Requests for course guides climbed slightly during the transitional period, peaking in spring 2012. That was

the semester the art librarian embedded, and she typically creates and updates more guides in spring than in fall.

Variables in Embedded Librarianship Development

Besides analyzing numbers of transactions before and after embedded librarianship, this study examined the relationship between types of transactions at the embedded sites. It would be reasonable to expect a link between the rate of walk-up transactions and the number of reference and instructional transactions conducted by the librarians. Speaking to people face-to-face and answering their questions seems a logical way to generate more reference questions and opportunities for library instruction. However, the study did not discover such a connection. The data show no positive or negative relationship between walk-up transactions and reference and instructional transactions. Further evidence for the lack of relationship is that the biology librarian had the highest rate of walk-up transactions but the lowest number of all other transaction types.

What, then, are the variables that drive the increases in reference and instructional activities? One factor that our method could not measure, but the librarians observed,

All three librarians had casual conversations with faculty while on-site but did not record them. Out of these conversations came invitations to do class instructions, to create course guides, and to work on collaborative or integrative projects.

is the impact of faculty on the dynamics of embedded librarianship. All three librarians had casual conversations with faculty while on-site but did not record them. Out of these conversations came invitations to do class instructions, to create course guides, and to work on collaborative or integrative projects. Faculty discovered that the library already

offered services they needed and would consider new services the librarians suggested. Seeing a librarian served as a visual reminder for faculty to e-mail a question later or to refer students to the librarian for assistance. One faculty member can encourage hundreds of students to use the library, which may explain the huge difference between walk-up transactions and the reference and instructional transactions.

Casual student interactions with embedded librarians, again not recorded, may drive up reference transactions. All three librarians had “regulars” who would visit to share triumphs and concerns with a caring listener. The regulars included first-generation undergraduates, teaching fellows needing support in a new role, and graduate students struggling to manage work, family, and school. These students might not ask library questions initially but eventually asked multiple reference questions over a semester, and they likely referred their classmates to the librarians for assistance.

The number of hours a librarian is embedded is another potential variable at play in increasing reference and instructional transactions. For every type of transaction, the education librarian had higher semester totals, with the art and biology librarians significantly lower. The education librarian worked about 36 hours a week in an office in her department. On the other hand, the art librarian was embedded four hours a

week in her department and in the art collection, and the biology librarian for only two hours a week.

Another temporal factor is how long the librarian has worked for the department before embedding. A longer time can imply a stronger relationship and more trust, which translates into willingness for faculty to collaborate with the librarian. The education librarian has worked with her department for 25 years, the art librarian for 13 years, and the biology librarian for 7 years. Looking back at the reference and instructional transactions, the total for the education librarian was highest, then the art librarian, and finally the biology librarian.

Oddly, the academic discipline—art, biology, or education—does not seem to be a variable in the impact of the embedded librarians. When the results for individual librarians are examined, they frequently have similar patterns (see Figures 3 and 5) with only a difference in magnitude. The numerical differences are more likely caused by the number of hours spent in the department by the librarian and the size of the service population. In this study, the education librarian, who had higher numbers of transactions in all areas, has a service population two times the size of the art and biology librarians' populations.

Over three semesters of embedded librarianship, most reference and instruction activities have continued to increase. The trend indicates students and faculty are noticing the embedded librarians, requesting reference and instructional services, and returning for additional help based on the quality of previous assistance. This is likely the process by which a department develops respect and trust for an embedded librarian.

Collaboration and Integration

The study shows the speed with which the embedded librarian's relationship with a department can develop from walk-up transactions and casual conversations to cooperating on in-depth projects with department members. The collaborative and integrative activities experienced by the three librarians varied greatly and occurred as early as the first year of embedded librarianship. They ranged from typical librarian activities such as creating course guides to unusual projects such as assisting in the creation of a science literature database. The activities also included scholarly work—writing and giving a presentation at an international conference—and service work—visiting and sponsoring student associations. The range and depth of the activities demonstrate that faculty and students respect the librarians and trust them to make valuable contributions.

Many of the factors mentioned previously likely affect how rapidly an embedded librarian develops a collegial relationship with a department, such as the time a librarian

Over three semesters of embedded librarianship, most reference and instruction activities have continued to increase. The trend indicates students and faculty are noticing the embedded librarians, requesting reference and instructional services, and returning for additional help based on the quality of previous assistance.

has been assigned to a department and the amount of time spent per week. An additional factor to consider in regard to collaboration and integration is a librarian's education in the subject area. The art and biology librarians both have master's degrees in their subject areas. The education librarian does not but knows her subject area thoroughly after 25 years. Demonstrating dedication to the department and subject area seems to be key for integration. As an example, the art librarian was invited to department meetings to speak and discuss library issues. These are rare invitations for librarians and show that the faculty trust the librarian to respect their time and departmental procedures and to make valuable contributions.

Model of Embedded Librarianship

Becoming an embedded librarian is a process of developing relationships with faculty and students characterized by awareness, trust, and respect for expertise. Figure 10 is

Becoming an embedded librarian is a process of developing relationships with faculty and students characterized by awareness, trust, and respect for expertise.

a visual representation of the relationships that an embedded librarian builds when colocated in a department. The librarian develops an increasing sphere of influence through three types of interactions. He or she starts by being involved in primary interactions, which can be walk-up transactions, casual conversations with faculty and students, or simply being seen by the faculty and students. The primary interactions build awareness of the librarian's presence and of the services he or she can offer.

As awareness builds, faculty and students begin to ask for reference and instructional services, which are referred to here as secondary interactions. As the librarian delivers these services with expertise and reliability, the faculty and students develop respect and trust for the librarian. The final stage of development is reached when the librarian is invited to collaborate on faculty and graduate student projects and is integrated into the department's culture. These are tertiary interactions which demonstrate that the librarian has become a member of the department.

Conclusion

This study gives a partial picture of the impact of embedded librarianship on academic departments because it only measures changes in reference and instructional services. Subject librarians at the UNT Libraries and at most academic libraries also handle a wide range of additional duties. Regular communications with departments about library policy and services, technology instruction and troubleshooting, collection development, and assistance with department accreditation reports are a few of their activities. Future studies could ask: Does the embedded librarian become the library technology expert for a department? Do faculty participate more in communications about collection development when there is a subject librarian colocated in their department? These are quantitative questions that could be answered using the natural experiment method and transactional analysis applied in this study.

Figure 10. Developmental model of physically embedded librarianship.

The literature on embedded librarianship mentions the difficulty of assessing programs. The model emerging from the UNT Libraries study of physically embedded librarianship demonstrates why assessment is a challenge. Embedded librarianship involves much more than transactions. It is a relationship between a librarian and a department that develops over time, which cannot be measured by outputs alone. Qualitative research studies are needed to explore how the relationship develops. Focus groups and individual semi-structured interviews with faculty and students could be used to test the proposed model. Further studies are needed to provide evidence for the progression and variables involved in the relational development between an embedded librarian and a department.

To further prove their value, physically embedded librarians need to link their activities to issues at the forefront in universities. Two issues worth targeting are student

Librarians bring money into universities when they collaborate on successful grant proposals. They also save universities money when they collaborate with faculty to do work the faculty would normally have performed alone.

success and retention, and revenue generation. Embedded librarians need to broaden their research beyond learning outcomes and transactional analyses to examine whether their activities actually affect grade point averages, years to graduation, and retention. Librarians bring money into universities when they collaborate on successful grant proposals. They also save universities money when they collaborate with faculty to do work the faculty would normally have performed alone. Future studies will surely confirm that the physically embedded librarian is a valuable asset to higher education, one who benefits individual patrons, the academic department, and the university as a whole.

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