Training LIS Students as Mobile Technology Consultants for Libraries and Not-for-Profit Organizations

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Mobile devices are a ubiquitous accessory in daily life for millions of people. These devices can be used to effectively meet a user's information needs. Librarians can assist users with the skills to select, purchase, design, develop, deploy, and maintain mobile applications and related technologies (MAT). Project MISSILE (Mobile Information Skills and Solutions in Library Education), funded by the Institute of Museum and Library Services, created an interdisciplinary curriculum plan for training library and information science (LIS) students to serve as mobile technology consultants (MTC) for libraries and not-for-profit organizations including schools and churches. This paper introduces the curriculum designed from an assessment by the experts on our advisory board. Our unique curriculum includes hands-on training gained through practica, guest speaker series, and field visits under the collaborative interdisciplinary mentorship of researchers and practitioners. The MISSILE curriculum builds twenty-first-century skills in information, communications and technology literacy, critical thinking, and problem solving.

Keywords: cross-disciplinary learning, human-computer interaction, information seeking and use, LIS curriculum, LIS students, mobile applications, mobile devices, mobile technology consultants, not-for-profit organizations

Mobile devices are becoming central to information gathering and communication, which means libraries must be prepared to make their services available to their users whenever they are required and wherever the user is located (Krishnan, 2011). In addition, mobile learning in academia has increased as universities have adopted mobile access options. Bomhold (2013) found that 76% of surveyed students had used their mobile phone to access academic information. The "millennial" generation (i.e., people born between 1984 and 2000), in particular, are digital natives who have views and expectations that align with quick, convenient information access from handheld, internet-ready devices. Students surveyed about academic library use have shown interest in using their mobile device to use research databases, search the library catalog, and access reference and circulation services (Potnis, Deosthali, & Pino, 2017; Potnis, Deosthali, Zhu, & McCusker, 2018; Seeholzer & Salem, 2010). Libraries must keep up

KEY POINTS:

- Project MISSILE (Mobile Information Skills and Solutions in Library Education) develops an interdisciplinary curriculum for training LIS students to serve as mobile technology consultants for libraries and not-for-profit organizations.

- The MISSILE curriculum consists of four clusters: (1) IT and programming for developing secured mobile applications for libraries; (2) business administration and management for consulting with libraries; (3) human-computer interaction for managing the user experience to better serve library patrons; and (4) information science for providing the skills and domain knowledge necessary to work as mobile technology consultants for libraries.

- The MISSILE curriculum opens up unconventional job opportunities for LIS graduates, enhancing the appeal and market value of LIS degrees across the United States.

with these interests and expectations in order to remain relevant and central to communities' information needs (Griffiths, King, & Choemprayong, 2009; IMLS, 2015).

Although the importance of mobile access to library resources has increased in the last decade, it is not a new or passing concept; projects designed to deliver services to users on handheld devices have been around since at least 1993, as evidenced by the collaborative "Library Without a Roof" project (Dresselhaus & Shrode, 2012). Since then, most libraries and information providers have progressively realized the importance of keeping up with their users' mobile-centered information worlds. A 2010 study found that the majority of academic librarians had already implemented or were planning to implement mobile technologies (Thomas, 2012). In another survey, 71 percent of librarians in one survey responded that all or a wide variety of library resources should be made available on mobile applications (Dresselhaus & Shrode). However, only slightly more than one-fourth of respondents indicated that the in-house electronic resources librarian was in charge of providing this mobile access. Most libraries are seeking outsourced products for services such as SMS reference and other mobile application services (Thomas).

In response to the rising popularity of mobile applications and related technologies (MAT), and considering MAT's importance to communities, libraries are increasingly investing their limited resources in MAT. However, libraries often lack the in-house information technology (IT) expertise required to (a) make the best choices in selecting, purchasing, designing, developing, deploying, or maintaining MAT; (b) attain maximum return on investment, including patron satisfaction for using MAT in libraries; and (c) reduce reliance on expensive IT consultants

who typically work for businesses with fundamentally different missions, information needs, and resources than those of libraries (Potnis, Cortez, & Allard, 2015; Walsh, 2012). Libraries need affordable mobile technology consultants (MTC) who can help them select, purchase, design, develop, deploy, and maintain MAT effectively and efficiently.

Related work

Building an understanding of the problem and the expertise of MTC required was an important step to considering what an MTC-focused curriculum should address and consisted of two steps. First, we selected and analyzed over 75 articles published in top-tier LIS journals, books, conference proceedings, technical reports, and other scholarly resources, which focused on the stories, experiences, and advice offered by librarians and IT professionals engaged in developing mobile applications and mobile sites for libraries over the last 10 years (Potnis, Regenstreif-Harms, & Cortez, 2016). This qualitative analysis, with inter-coder reliability of 85%, revealed the specific skills and knowledge required to design and develop mobile applications for libraries. For instance, we identified four mutually exclusive core competencies and six mutually exclusive supplementary competencies that LIS students will need to have in order to meet the growing MAT needs of libraries. The four core competencies, which are mainly related to IT, include (1) mobile application development with a focus on web programming; (2) human-computer interaction (HCI); (3) computer networking; and (4) planning and management of mobile technologies. In addition, there are six supplementary competencies that will help LIS students serve as a mobile workforce for libraries in the future: project management (including communication management), change management, data curation and management, policy management, and grant writing (Potnis & Regenstreif-Harms, 2016; Potnis, Regenstreif-Harms, Deosthali, Cortez, & Allard, 2016).

Second, we surveyed coursework of ALA-accredited LIS graduate programs in the United States and Canada. As of 2017, none offered a combination of graduate coursework with the interdisciplinary skills and knowledge required to select, purchase, design, develop, deploy, and maintain MAT in libraries.

Project MISSILE: A solution

Project MISSILE (Mobile Information Skills and Solutions in Library Education) was undertaken to fill this gap by developing an interdisciplinary curriculum for training LIS students to serve as MTC for libraries and not-for-profit organizations, including schools and churches. Our curriculum plan focuses on a combination of coursework to equip students with twenty-first-century management and IT skills that LIS graduate programs do not traditionally offer, by including business administration and management, accounting, and a variety of information technology-focused

coursework. This coursework, combined with students' hands-on, research-intensive practica and internships in information organizations, could also provide opportunities for LIS graduates in lucrative non-traditional career choices, such as mobile technology consulting.

Since our past research identified four core competencies and six supplementary competencies for LIS students to serve as MTC (Potnis & Regenstreif-Harms, 2016; Potnis, Regenstreif-Harms, Deosthali, et al., 2016), the MISSILE curriculum was designed to equip students with the skills and knowledge related to those 10 competencies. We divide the training into the following clusters: (1) IT and programming for developing secured mobile applications for libraries; (2) business administration and management for consulting with libraries (e.g., strategic planning, budgeting, change management); (3) human-computer interaction (HCI) for managing user experience (e.g., creating user-centered designs and interfaces) to better serve library patrons; and (4) information science (e.g., data curation and management) for providing the skills and domain knowledge necessary to work as MTC for libraries.

Cluster 1: IT and programming for developing mobile applications

During the IMLS planning grant period, we began curriculum development by introducing a new three-credit course created by Potnis and titled "Mobile Application Development," based on hybrid mobile app development techniques (Potnis, Regenstreif-Harms, & Cortez, 2016). Unlike existing online courses available on Lynda.com, KhanAcademy, and others, our course is focused specifically on meeting the information needs of various functional areas of libraries (e.g., reference services, digital archives, etc.). The core modules of this course are the following:

(a) fundamental concepts related to mobile commerce and mobile business,
(b) strategic planning and management of mobile apps,
(c) mobile users,
(d) fundamentals of object-oriented programming, and
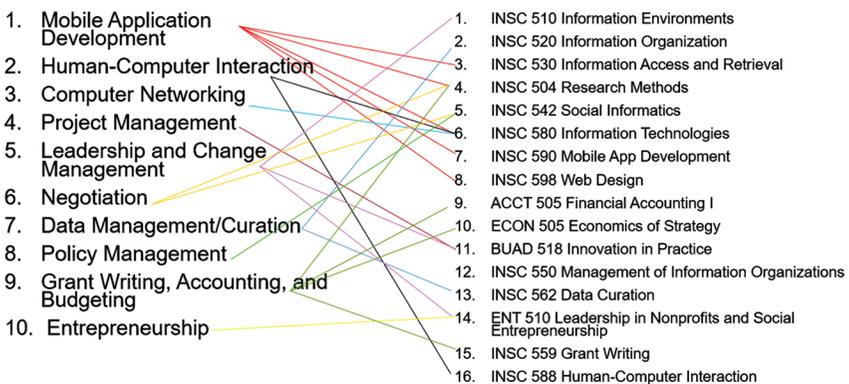(e) hybrid design and programming with hands-on assignments and in-class activities.

This course offers a flipped-classroom experience for students, where they learn theoretical knowledge through lecture slides, book chapters, and videos at home before every class session. The instructor devotes the class time to in-class exercises, hands-on mini-projects, and in-depth discussions, where students get an opportunity to reflect on their learning experience.

For this cluster, MISSILE students also complete courses that already exist in many schools' course catalogs, including courses about information technologies and web design. The information technology course should cover fundamentals of networking and web programming, two

of the technical competencies that Potnis, Regenstreif-Harms, Deosthali, et al. (2016) identified as requirements to serve as MTC. Figure 1 demonstrates how the MISSILE curriculum would map onto existing courses at the University of Tennessee, which could be replicated at other sites.

For example, the information technologies course (INSC 580) covers modules such as "Evaluating, Buying, Building, and Implementing Mobile Technologies in Libraries" and "Contract Negotiation with IT Vendors." In addition, this IT foundation course helps emerging LIS professionals build the IT vocabulary necessary to communicate and troubleshoot some of the most frequently experienced IT issues at work. This course introduces students to an evolving IT landscape and emerging IT applications for LIS professionals. Hands-on training, real-world IT solutions, expert advice, cutting-edge IT concepts, case studies, research articles, case examples, short videos, and assignments covered in this course equip students for assuming a variety of IT positions in libraries and information-intensive work environments. This practitioner-oriented course covers several topics equipping students with the skills and knowledge necessary to perform IT-related jobs advertised by public, academic, and special libraries, and other organizations hiring information science professionals. Sample topics include networking (e.g., topologies, protocols, types of networks, IEEE standards, and physical, virtual, and port addresses); web design using web editors and Unix; integrated library systems; hardware (e.g., storage, system unit, input devices, output devices, etc.); designing databases from entity-relationship diagrams; an introduction to usability; library 2.0; and security, safety, ethics, and privacy of information and devices.

Another example is INSC 598, which provides hands-on experience with creating websites using cutting-edge website design tools and techniques as well as a theoretical insight into emerging trends and techniques. It emphasizes understanding the foundations of web design,

Figure 1: Mapping competencies on MISSILE coursework at the University of Tennessee. Created by Potnis and Allard (2018) under https://creativecommons.org/licenses/by-sa/4.0.

website creation, and evaluation and covers the basics of usability testing and search engine optimization (SIS, n.d.).

Cluster 2: Business administration and management

MISSILE students can benefit from business courses, which are typically offered to MBA students. These courses build knowledge of innovation practices, accounting, social entrepreneurship, and the economics of strategic decision making. Catalog descriptions of the courses we included in our curriculum plan from the Haslam College of Business at the University of Tennessee are as follows:

(a) BUAD 518 Innovation in Practice: A 3-credit course with topics such as consulting practices, project management, business planning, and transformational change leadership;
(b) ACCT 505 Financial Accounting I: A 1.5-credit course focusing on financial accounting principles;
(c) ECON 505 Economics of Strategy: A 1.5-credit course on microeconomics relating to organizations' strategic decisions; and
(d) ENT 510 Leadership in Nonprofits and Social Entrepreneurship: A 3-credit course for developing business-minded thinking and leadership skills in the future leaders of organizations with societal and nonprofit missions.

MISSILE's interdisciplinary training makes LIS students more employable by providing them with the skills and knowledge needed to respond to the global technology landscape. For instance, BUAD 518 provides an applied learning experience for student teams to solve challenges faced by not-for-profit organizations, including libraries. They will develop a statement of work (e.g., a statement of procuring MAT for libraries); innovative problem solving; MAT consulting practices with libraries; business planning for libraries; and transformational change leadership, project management, and messaging.

Other existing information science coursework will be integrated into this cluster as well. As noted in Figure 1, INSC 542 and INSC 550 will equip students for managing MAT for libraries. For example, INSC 542 covers social consequences of information and communication technologies (ICT) at the micro (e.g., personal), meso (e.g., organizational), and macro (e.g., information society studies) levels. It presents myriad applications of ICT for businesses, government, and society, exposing students to a range of contemporary global issues and phenomena shaped by ICT-mediated information (SIS, n.d.). It also touches on information ethics, privacy, security, policy, patents, trademarks, and copyrights, using case studies from the *Harvard Business Review* and MIT's *Sloan Management Review*. As part of the final class project, this course requires students to serve as information consultants for local small businesses and not-for-profit organizations, including

libraries, churches, and schools, and equips them with the skills to do so. Leveraging the principal investigator's partnership with the Knoxville Chamber of Commerce and his professional network in the Knoxville metropolitan area, this course introduces students to local organizations for pro-bono consulting opportunities. We also developed a new module on "Making Smart IT Choices" to cover topics such as strategic uses of IT in business processes, analysis of business processes, and IT project management.

The other existing course, INSC 550 Management of Information Organizations, covers supervisory, management, and leadership concepts, strategies, and techniques applicable to information professionals working in libraries, archives, records management, and other information organizations (SIS, n.d.). In particular, it covers topics such as managing yourself, management and leadership competencies, emotional intelligence, strategy, influence and persuasion, conflict management, negotiations, human resource management, and project management and financial planning.

Cluster 3: Human-computer interaction (HCI)

An understanding of human-computer interaction (HCI) is essential to being an effective MTC. In keeping with the approach that the MISSLE curriculum plan should integrate as many existing courses as possible, Figure 1 shows that INSC 588 Human-Computer Interaction maps onto this competency. The course illustrates the kind of material that should be covered to develop the skills of an MTC. It introduces HCI with a focus on the design and evaluation of the interfaces to information systems, covering topics such as interaction design, describing user competencies, defining user requirements, user interface design, and evaluating interaction success. In addition, students gain hands-on experience with user interviewing, user interface design specification, and test construction (SIS, n.d.). The course thus introduces human and technological factors of importance to the design of usable information systems. Basic phenomena of human perception, cognition, memory, and problem solving, as well as the relationship to user-centered design, are studied. Methods and techniques for interaction design and evaluation are explored (SIS, n.d.).

Cluster 4: Information science

The final cluster is a core of LIS education and should account for the most credit hours in the curriculum. This would be 18 credit hours in the University of Tennessee master's program, which requires 36 hours for graduation. These courses establish the foundation of our field. Using the University of Tennessee courses as example, this cluster might look something like this:

(a) INSC 504 Research Methods for Information Professionals: Research methods in a variety of information environments; primary and secondary research; research project design; research results interpretation; analysis of published research; techniques supporting research process;

(b) INSC 510 Information Environment: Generation, production, management, dissemination, and use of information. Roles of information in society, information seeking and user behavior, information industry, economics of information products and services, technological and organizational change, information professions, and issues;

(c) INSC 520 Information Representation and Organization: The structure and organization of intellectual content regardless of format. Emphasis on how content is created, exchanged, and stored so it can be found. Includes standards and best practice for describing and characterizing intellectual content;

(d) INSC 530 Information Access and Retrieval: Information access, retrieval, and use. Information seeking, user interfaces, information services and tools. Database structure, search engines, query logic, and evaluation of retrieval system performance;

(e) INSC 559 Grant Writing: Develops grant-writing and strategic relationship management skills for information professionals who may benefit from external funding opportunities and proposals. Creates and manages community partnerships to provide innovative information services to various constituencies such as underserved populations, public libraries, special libraries, and others in diverse information-related environments;

(f) INSC 562 Digital Curation: Explores the lifecycle, value-added management and maintenance of scholarly and scientific digital content. Examines the diverse set of skills to select, execute and administer a range of approaches and procedures across the lifecycle of digital objects, from conceptualization, creation, appraisal and selection, and ingest through preservation, storage, access, use and re-use. Digital curation occurs across a broad array of professional, disciplinary and organizational contexts. Introduces principles and practices to inform digital curation planning and practice for application in a variety of organizational settings, including archives, libraries, museum, data centers, and other cultural heritage and information agencies). (SIS, n.d.)

The MISSILE curriculum plan begins with students establishing a firm foundation in the field by taking LIS foundational courses in their first semester and specialized LIS courses in their second semester. The business-focused courses begin after students have a thorough understanding of the library and non-profit information environment so they can contextualize what they are learning about economics, accounting, and entrepreneurship. This approach can be applied at any LIS graduate school. Figure 2 outlines a sample timeline and specific sequence of courses that our Advisory Board assisted in developing for the University of Tennessee. This demonstrates how MISSILE students would complete

Fall 2018 (9)	Spring 2019 (9)	Summer 2019 (0)	Fall 2019 (9)	Spring 2020 (9)	Summer 2020 (0)	Fall 2020 (9)
INSC 510 Information Environments (3)	INSC 504 Research Methods in Information Sciences (3)	1st Internship with Local Not-for-Profits	ACCT 505 Financial Accounting I (1.5) ECON 505 Economics of Strategy (1.5)	BUAD 518 Innovation in Practice (3)	2nd Internship with Local Not-for-Profits	ENT 410 Leadership in Nonprofits and Social Entrepreneurship (3)
INSC 520 Information Representation and Organization (3)	INSC 542 Social Informatics (3)		INSC 590 – NEW COURSE – Mobile App Development (3)	INSC 550 Management of Information Organizations (3)		INSC 559 Grant Writing (3)
INSC 530 Information Access and Retrieval (3)	INSC 580 Information Technologies (3)		INSC 598 Web Design	INSC 562 Data Curation (3)		INSC 588 Human-Computer Interaction (3)

Figure 2: Sample timeline and sequence of courses. Created by Potnis and Allard (2018) under https://creativecommons.org/licenses/by-sa/4.0.

a rigorous academic training of 45 credit hours after completing 16 interdisciplinary courses from four clusters as part of the required curriculum to serve as MTC for libraries and not-for-profit organizations.

The rise in the investment by libraries in offering mobile-based services suggests a greater demand for MTC in the future. For instance, libraries would like to recruit graduates who understand the fundamentals of library and information science and are comfortable designing, developing, and maintaining mobile technology-based solutions for better serving library patrons. In addition, MTC can also work independently for other not-for-profits in their area. Due to the potentially high return on their investment, LIS students would be willing to pay for this degree in order to develop a unique combination of interdisciplinary skills to serve as MTC for libraries and not-for-profits.

Practica and internships

An integral part of the MISSILE curriculum are the hands-on training opportunities such as practica, internships, field visits, and talks led by existing MTC as guest speakers. The key is utilizing the experience of the advisory board and their connections. MISSILE students will complete at least one practicum of 150 hours to apply their classroom understanding of the tasks and responsibilities related to selecting, purchasing, designing, developing, deploying, and maintaining MAT at libraries under the supervision of seasoned IT and/or information professionals, thereby gaining real-world experience. Host sites will compensate students for their time in the practica or internships.

Field visits

Students will visit a variety of libraries in order to learn about their needs, the existing constraints, and the resources available to select, purchase, design, develop, deploy, and maintain MAT effectively and efficiently. MISSILE students will also go on field visits to the libraries and information

organizations that have already invested in MAT, which will help them learn from such organizations and get a feel for how they can implement the skills and knowledge they have gained from the program in the workplace.

Guest speaker series

We will identify and contact MAT experts who work not only for libraries but also with the corporate world. These speakers will expose MISSILE students to a number of cutting-edge business and technological advancements and practices so that MISSILE students can bring a fresh perspective when working as MTC for libraries upon graduation.

Assessment

A program's effectiveness is identified through formal assessment activities. For the curriculum planning phase of MISSILE, we have formed an advisory board of world-renowned MAT experts working for a variety of libraries, including Austin State University, Cornell University, the German National Library of Economics, Oklahoma State University, the University of Maryland, the University of Pittsburgh, and Yale University. Input from the Project MISSILE advisory board, consisting of researchers and practitioners from libraries and the information technology industry, helped us assess the feasibility and utility of the proposed curriculum. Positive feedback received from our advisory board, our recent journal publications on this topic, and several MAT experts working in libraries, who have already committed to guide MISSILE students as part of our proposed guest-speaker series, underline the need, significance, and timeliness of Project MISSILE. We also gathered feedback and guidance from 2018 Association for Library and Information Science Educators (ALISE) Conference attendees. Finally, the professional success of MISSILE students in terms of securing internships, part-time jobs, and full-time jobs for managing MAT in not-for-profit organizations, including libraries, will be the most appropriate indicator of the success of Project MISSILE.

Conclusion

The mission of ALISE (2017), and one of its strategic directions, is to engage with graduate programs of cognate disciplines such as management, business information systems, and human-computer interaction, by developing relationships to promote education and research. The MISSILE curriculum promotes cross-disciplinary education to open up a wide range of unconventional job opportunities for LIS graduates, enhancing the appeal and market value of LIS degrees across the United States.

Any LIS program interested in implementing the MISSILE curriculum would need to collaborate with business- and IT-related academic programs on their campuses. LIS programs should ensure that they create hands-on training opportunities for students to apply their skills and knowledge to serve as MTC. Although there is a lot of flexibility in

terms of timeline and sequence of courses students can take, we strongly encourage students to understand and strengthen their foundation in LIS by taking core courses.

With the help of MISSILE graduates, libraries will be able to offer better patron-centered services using MAT, leading to better community engagement. LIS graduates with training to serve as MTC will be equipped with user-instruction skills to teach library staff and to work in a specialized fashion with library users. If newly trained LIS professionals come into the library to train other staff and to work more effectively as IT/library professionals, then it will be less likely that the library will have to hire outside consultants or outsource the management of MAT. In an era of economic strains, the MISSILE curriculum could help libraries better manage their scarce financial resources.

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Acknowledgement

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