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Problems and Promises of Using LMS Learner Analytics for Assessment

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Title: Problems and Promises of Using LMS Learner Analytics for Assessment: Case Study of a First-Year English Program

Abstract: Learning management systems (LMS) are widely used in education. They offer the potential for assessing student learning, but the reality of using them for this is problematic. This case study chronicles efforts by librarians at Marquette University to use LMS data to assess students' information literacy knowledge in Marquette's first-year English program.

Discussion covers:

- the development, implementation, and analysis of effectiveness of an online tutorial on students' learning
- the difficulties involved in trying to use LMS data for performance assessment instead of surveys or quizzes
- the impact of inadequate LMS reporting tools on instructors' willingness to use the tutorial

Keywords: assessment, learning management system (LMS), information literacy, embedded librarianship, learner analytics

Project focus: assessment methodologies, techniques, or practices; information literacy assessment; organizational practices (i.e., strategic planning); user behaviors and needs; data use and technology; assessment concepts and/or management

Results made or will make case for: proof of library impact and value, improvements to the tutorial

Data needed: LMS SCORM data from tutorial

Methodology: qualitative, quantitative, mixed method

Project duration: greater than 1 year

Tool(s) utilized: Articulate Storyline, LMS, Qualtrics, Excel, SPSS; instructional designer, statistics consultant; staff time for IRB informed consent, data collection, analysis

Cost estimate: < $100

Type of institution: university—private

Institution enrollment: 5,000–15,000

Highest level of education: doctoral

Chapter 20

Problems and Promises of Using LMS Learner Analytics for Assessment

Case Study of a First-Year English Program

Valerie Beech and Eric Kowalik

Section 3

Context at Large

Information literacy (IL) is considered crucial for managing information overload in both the workplace and everyday life.[1] While librarians have been teaching relevant IL concepts and skills for many years, they have had limited opportunity to assess the learning of their students. In this case study, the authors argue that by leveraging a learning management system (LMS) and online tutorials, performance assessment of students' IL skills can be implemented at scale in a required course program.

A core aim of academic libraries is to help students develop IL competencies so that they are equipped with the skills to be proficient swimmers and capable of more than just treading water in the expanding digital ocean of information. Although tests lack similarity to real-world situations,[2] standardized tests tend to be the most frequently used data collection method to assess IL skills.[3] Despite IL being considered a crucial skill for success in higher education and in life,[4] there are relatively few instruments available to assess this set of skills; ETS recently discontinued its iSkills test.[5] There are at least two multiple-choice tests available commercially that have been shown to provide a reliable and valid way of measuring IL.[6] Other approaches used to assess IL skills include information search tasks, portfolios, analysis of term paper bibliographies, and use of integrated approaches based on several instruments.[7] A final type of assessment approach is performance assessment,[8] which require students to do more than choose an answer from among several options. According to Leichner and colleagues, performance assessment is seen as a way to assess complex competences instead of factual knowledge, which is at the core of information literacy skills.[9] While performance assessment is a better way to assess complex competences, standardized tests are easier to administer and assess. However, by leveraging embedded librarianship (the presence of librarians in an LMS) and the learner analytics accessible in an LMS, libraries have an opportunity to more easily implement performance assessment.

Mattingly, Rice, and Berge define learner analytics as a focus on how students access information, how they navigate through materials, how long it takes them to complete activities, and how they interact with the materials to transform the information into measurable learning.[10] One way libraries can access data for learning analytics is through a campus LMS. Leeder and Lonn state that LMS adoption in higher education institutions has been rapid and widespread.[11] The LMS also tracks a variety of data about the students, their progress, and their interactions in the online course. Several studies have explored the relationship between this data and students' performance: for example, how accessing supplemental online resources benefits undergraduates; the link between LMS activity and student grades; and the significant relationship between time spent in the LMS and grades, especially for students who obtained grades between D and B.[12] Other researchers have examined how analyzing student discussion post responses can yield understanding of student interaction patterns.[13] However, Ifenthaler and Pirnay-Dummer argue that the use of an LMS is usually limited to only a few technological features and that utilizing more features of the LMS can promote meaningful learning environments.[14] More recently, Alamuddin, Brown and Kurzweil discuss the continuing difficulties in adopting learning analytics on a large scale, including the problem of pulling data from multiple platforms and finding ways to analyze it.[15]

In the library profession, embedded librarianship became more visible in the mid-2000s.[16] According to Tumbleson and Burke it allows librarians, through their presence in the LMS, to be as close as possible to where students are receiving their assignments and experiencing instruction.[17] By having access to the LMS site of

a course the librarian is working with, the librarian can post information literacy tutorials, review assignments, interact with students at the point of need, and develop a relationship with students that is not always possible during a one-shot instruction session. Despite the ability to better meet student and instructor needs, Leeder and Lonn note that academic libraries and librarians are rarely integrated into their institution's LMS due to political and institutional factors such as lack of involvement in administration and management of the LMS, the difficulty of negotiating with faculty for permission and access to a course site, and lack of a pre-existing librarian-specific roles in the LMS.[18]

The drawbacks of one-shot instruction sessions lamented by librarians since the 1960s continue to persist today.[19] Tumbleson and Burke contend that utilizing an LMS can remedy some of these drawbacks.[20] A number of case studies in the literature describe how librarians have utilized an LMS to address an instructional need.[21] However, these case studies focus mainly on custom creation of research guides or links to subject-specific databases and do not offer research into the usage patterns of the tools by actual users except through webpage view counts. In their chapter on assessing the impact of embedded librarians in an LMS, Tumbleson and Burke add a caveat that even basic LMS usage statistics are generally limited to how many times a given resource has been opened and that the shallowness of this information does not give the librarian a good picture of student activity among the embedded resources in the LMS.[22]

One way to address this issue is to develop a tutorial, or suite of tutorials, that allow librarians to utilize the LMS to gather more detailed information about student performance toward achieving a certain IL skill or concept. Tutorials of this type can be developed using the sharable content object reference model (SCORM). A tutorial developed using SCORM can "talk" with any SCORM-compliant LMS, which includes most major LMSs. With the advent of rapid e-learning development tools such as Adobe Captivate and Articulate Storyline, it is now possible to develop highly interactive, SCORM-compliant modules without advanced programming knowledge.

Context at Marquette University: The First-Year English Program

Since 1980, the Marquette Raynor Memorial Libraries have supported and participated in the Marquette English department's first-year English (FYE) program. For many years, this meant that up to 75 percent of incoming first-year students came to the library for a one-shot fifty- or seventy-five-minute workshop that addressed a specific assignment in the first semester freshman English course and introduced them to the Marquette Library resources and services. In fall 2013, this collaboration began a new phase when the library developed and incorporated online information literacy modules into the program. During the summer of 2013, a small team of librarians worked with the libraries' instructional designer to develop a suite of SCORM modules. The team talked with FYE instructors and other librarians to determine competencies

students would need and had struggled with in previous semesters. After determining the learning outcomes for the modules and reviewing the literature on developing effective e-learning, the team employed three concepts during module development: (1) segmenting of lessons, (2) use of conversational style, and (3) incorporating practice opportunities.

According to Clark and Mayer, it is important to break e-learning lessons into manageable parts and resist the temptation to develop a "kitchen sink" product.[23] Following this guideline, the development team decided on discrete modules for each key IL topic instead of a larger, comprehensive tutorial that addressed IL skills as a whole. Having the IL concepts or tasks in discrete modules allowed them to be more easily integrated into instructor lesson plans. For example, some instructors may not feel that students need a lot of citation help, but do need practice on narrowing a topic. Keeping content in separate modules also ensures students won't be confused by unnecessary information. Research supports the idea that the tone and style of writing in an e-learning module impacts its effectiveness, and in particular, conversational style should be used over formal style.[24] To ensure students better retain the information from an e-learning module, students need to apply their understanding of the concept to an actual example, which requires a deeper level of processing than a multiple-choice test question.[25] However, they note that there is a paradox to practice: it must be deliberate practice (1) that focuses on a specific skills gap, (2) for which explanatory corrective feedback is given, and (3) that builds skills that transfer from the learning environment to the real environment.

The paper prototyping method espoused by Snyder was used to create initial versions of all modules,[26] and production versions were created in Articulate Storyline and exported as SCORM packages. A website with demo versions of the packages as well as instructions on how to install the modules and review student submitted data was developed as a support resource for faculty and librarians and can be viewed at http://mu.edu/library/lor/first-year-english/.

These modules were used in several ways in the FYE program: as student homework prior to the workshops (a flipped instruction model) or as in-class activities, and as study or review materials available within Marquette's LMS. The libraries collaborated with Marquette's Information Technology Services department, which administers the LMS, to have a special librarian role created in the LMS. Librarians are automatically enrolled in the LMS course sites they are working with. The librarian role provides the same level of functionality as an instructor role, that is, ability to post materials and create discussion forums, surveys, and quizzes, with the exception that the librarian role does not have the ability to view or assign grades. For some librarians, enrollment in the LMS course simply offers an easy avenue for students to contact their class librarian. In other sections, and often dependent on the relationship between the instructor and librarian, the librarian facilitates online discussions, responds to student research drafts, or posts library-related content to their course page. To ensure a minimum standard of library familiarity for all students,

there was a requirement that each section devote one class period to a "research day" with their librarian.

To maximize the class time librarians had with students during the research day, a flipped classroom model supported by interactive online modules was encouraged. Instructors from a variety of disciplines cite strengths of the flipped model, including efficient use of class time, more active learning opportunities for students, increased one-on-one interaction between student and teacher, student responsibility for learning, and addressing multiple learning styles.[27] Several studies have shown that online interactive modules can be just as effective as in-person classes.[28]

After a successful pilot in fall 2013, in fall 2014 individual instructors and librarians negotiated which modules to load into the LMS course sites. In fall 2015, the entire suite of SCORM modules was loaded in draft mode into the LMS course sites of all seventy-seven sections of FYE by the libraries' instructional designer, and then the instructor and librarian decided which modules to make visible. Although there were eight SCORM modules, FYE instructors were encouraged by their librarian and the FYE program faculty director to assign only the Introduction to Academic Research module to their students. Instructors were encouraged to ask students to complete the module prior to the in-class research day. With the module embedded directly into D2L (the LMS used at Marquette), both librarians and instructors could view student completion rates, as well as read the open-text responses to the practice search activity. This information allowed librarians the possibility of tailoring their instruction to the students' demonstrated ability with IL concepts and skills; it gave instructors the possibility of awarding points for completion of the module. With many introductory elements of instruction presented and available for review, librarians had several options for how to direct class time. Some started by opening the discussion with questions raised by students' experience with the module and then segued into more complex examples and sophisticated search strategies. Some allowed for peer-led instruction, having students demonstrate or describe for the class how they began their search, and others used the time for higher-level discussions of evaluating resources, including how to find information on a news publication to help determine credibility and bias.

In fall 2014, the authors collected data from the Introduction to Academic Research tutorial and analyzed it with the sole intent of determining which parts of the tutorial worked well and which did not. This led to revisions in the language used in the tutorial and in the layout of some screens. In fall 2015, after getting institutional review board approval, one instruction librarian coordinated with three other instruction librarians to visit their seventeen sections of FYE, to provide information about the research study, and to distribute consent forms to the students. Table 20.1 shows the broader context of the sample of 177 students who were recruited for this study, as well as the how widely the tutorial was deployed or visible and used.

Table 20.1
Student Participation

	# of Students	% of Total
Students enrolled in 77 sections of ENGL 1001	1,361	100.0
Tutorial visible to students in LMS	550	40.4
Students who completed tutorial	383	28.1
Students enrolled in 17 sections given informed consent presentation	301	22.1
Students enrolled in 17 sections who signed consent forms for sharing their data	280	20.6
Students in 17 sections who completed tutorial	207	15.2
Students in 17 sections who completed tutorial and shared their data	177	13.0

Of the likely 301 students who heard the informed consent presentation, approximately 93 percent (280) consented to the sharing of their data (it is not known if all were present on the day of the presentation), though in the end only 68.8 percent (207) of the 301 students completed the tutorial. The 177 students who both completed the tutorial and consented to share their data represent 13 percent of all students enrolled in the course.

Upon completion of the library research day, the libraries' instructional designer accessed the D2L course sites of the participating sections and pulled the SCORM data from student submissions for the Introduction to Academic Research module. D2L does not offer an "easy button" to export SCORM data as an Excel or even CSV file. SCORM data is shown only in an HTML table inside the SCORM Reports page of D2L. To get the SCORM data in a usable format, the instructional designer had to engage in data cleanup, entailing the use of the Firefox add-on "Copy as Plain Text" to get a clean copy of the data from D2L. Then the text was pasted into Excel, where nonessential data, such as weighting, was removed and desired data, such as the student name and responses, was kept. To ensure student anonymity, an eight-character alphanumeric code was randomly generated to replace the student names. Once the Excel spreadsheet contained the responses from the 177 students, the Directory feature in Microsoft Word's Mail Merge function was used to pull the responses from the Excel spreadsheet into a single document containing the listing of student responses that made reviewing and coding the responses much easier.

Analyzing the Tutorial Submissions

The Introduction to Academic Research tutorial is comprised of four parts:

1. a brief video explaining different source types by comparing them to the different types of maps one would use in different scenarios (finding a restaurant vs. finding elevation change),
2. a brief textual explanation of the differences between a library database and an internet search engine,

3. a brief video demonstrating a sample search in Academic Search Complete, and
4. an interactive practice search assignment where students state their research topic and choose two keywords and a Boolean operator for their initial search statement, then utilize their search statement in Academic Search Complete. Last, they provide publication information for a sample article and write a short reflection about the exercise.

The interactive search assignment was the part of the tutorial with performance assessment, and the data from that activity was the basis for this analysis. SCORM data collected from the LMS was comprised of the following data submitted by students:

- **Student topic, or research question:** short sentences or questions describing their topics. (Students were asked to work on a topic or question of their own choosing; the intent was to better engage their interest so that they would work on the tutorial seriously.)
- **Search statement elements:** student choices of two keywords for their topic and a Boolean command.
- **Article identification elements:** article title, journal title, date of publication.
- **Reflection:** analysis of student responses to three open-ended reflection prompts.

Utilizing guidelines in Saldaña's *Coding Manual for Qualitative Researchers,* two codebooks were developed before reviewing the 177 submissions.[29] One codebook focused on the more concrete data elements (the search statement and article information), and the other codebook focused on the reflections. Initial development of the codebooks involved reading the responses through two to three times and making note of recurring phrases, problems, and topics, and then trying to organize them into broader themes or groups. Developing the codebook (see appendix 20.1) was an iterative process that necessitated several meetings between the researchers and sample coding of ten randomly pulled reflection submissions. Development of a codebook for the search statement and article information was fairly straightforward; in contrast, the reflection codebook development was much more difficult. All reflections were coded twice because the results of the first coding, using the third iteration of the reflection codebook, convinced the authors that yet another codebook revision was necessary. The fourth version of the reflection codebook was considerably compressed: sixty-seven codes were reduced to thirty-seven. Once the codebook was set, it was exported to a Qualtrics form to make capturing the coded data easier and ensure the coded data could more easily be exported in a format that would be compatible with SPSS. For all items except the reflection, the codes were single answers (radio buttons); for the reflections, the codes were multiple answers (check boxes). After the data was coded, the authors worked with Marquette's Assessment Director Sharron Ronco on the statistical analysis, which was comprised of occurrence or frequency tables for all codes and tables for coder divergence.

Two coders coded each student response. Saldaña provides a summary review of the literature on rationales for coding collaboratively,[30] which range from ensuring

multiple viewpoints, interpretations, and potentially a better analysis, to simple sharing of the labor. For this research project, coding collaboratively simply seemed a logical extension of the building of the codebook. One drawback of coding collaboratively, without the aid of software to ensure inter-coder consistency (e.g. NVivo), is that the coding is not always consistent. One solution might have been to revise the codebook once more, with tighter definitions, and to recode the data yet again. The researchers employed a solution suggested by Marquette's Assessment Director: on responses where codes diverged, a new n.5 code category was created for the analysis, called "split decision." For example, a 2.5 code means that the response was coded as 2 by one coder, and as 3 by the other coder. The justification for doing so is that the main focus of the analysis is and always was meant to be on the students' responses, not whether or not the two coders were completely in agreement.

Tutorial Submissions: Major Findings

The general conclusions the authors draw from analyzing the tutorial submissions are summarized in table 20.2. More detailed discussion follows.

Table 20.2
Major Findings

Search statement construction
• 90% of students chose appropriate Boolean commands.
• 55% of students chose good keywords for their research topics.
• 35% of students chose poor keywords.
Publication title recognition
• 60–70% of students clearly recognized journal/magazine titles in database records.
• 21–30% of students had difficulty recognizing journal/magazine titles in database records.
Themes that students wrote about
• 65% described what they did when searching.
• 60% mentioned relevance/irrelevance.
• 31% mentioned specificity.
• 22% mentioned credibility.
• 20% mentioned evaluation.

Subject Consistency: Student Research Question, Keywords, Article Title

To determine if the students were working on the tutorial in good faith, the authors looked at subject consistency among the responses for student topic, two keywords, and the article title. If at least two to three of the items entered were on one topic—that is, clearly related—the authors considered that the student was working in good faith. Data in table 20.3 demonstrates that 95 percent of student responses included at least some subject consistency (ratings 3, 3.5, or 4), and 71 percent of responses were coded

4 (4 or 3.5) and have a strong level of subject consistency. From this code, the authors inferred that 95 percent of the students worked on the tutorial in good faith. This code was a validity check.

Table 20.3
Subject Consistency in Responses, a Validity Check

Code	Definition or Description	# of Codes	Percentage
1	Not a serious answer	0	0
2	No subject consistency (but student seems on task)	0	0
2.5	Split decision (2 or 3)	8	4.5
3	2 or 3 items consistent	42	23.7
3.5	Split decision (3 or 4)	55	31.1
4	4 items consistent	71	40.1
	Total responses coded	**176**[a]	**99.4**

a. One response was inadvertently skipped by one coder for this part of the analysis..

Search Statement Elements: Keywords

To see how well students could decide on keywords for their research topic, the coders rated the student keyword choices as: poor choices—not on topic; technically functional but not the best; and good choices. An example of a response that was coded as "functional, but not the best" is "obesity AND world" for the topic statement, "Is obesity increasing around the world?" The search terms are functional in that they will return some usable results, but there are more effective keywords one could use to get better results. An example of a good choice would be "women AND refugees," for the research topic "How are women refugees treated in comparison to men refugees?" The addition of an additional keyword would certainly make this search more effective; however, the tutorial provided space for only two keywords. (This was a result partly of screen layout constraints, and partly of the fact that two keywords often are enough to start a database search.) Results in table 20.4 show that 55 percent of students chose their keywords well (as coded by at least one coder, i.e., both the 3 and 2.5 codes added together); 35 percent of students chose keywords that would yield some good results, but their choices were not the best; while 10 percent of students made poor choices.

Table 20.4
Search Statement Construction—Keyword Choices

Code	Definition or Description	# of Codes	Percentage
1	Poor choices	0	0.0
1.5	Split decision (1 or 2)	17	9.6
2	Functional, but not the best	62	35.0
2.5	Split decision (2 or 3)	49	27.7
3	Good choices	48	27.1
	Total responses coded	**176**	**99.4**

Search Statement Elements: Boolean Command Choices

Analysis of student's choice of Boolean commands consisted of the following ratings—poor choice; functional technically but not the best; and good choice. An example of a poor choice would be "Genetically Modified Foods NOT Outside of America" for the topic "Do genetically modified foods hinder american [*sic*] health?" An example of functional technically but not the best would be the selection of keywords and command "Psychological Disorders OR Refugee Health" for the question "Are psychological disorders a common occurrence in refugee health?" The results of the analysis are show in table 20.5. A key takeaway is that 90 percent of students chose the functionally most correct command.

Table 20.5
Search Statement Construction—Boolean Command Choice

Code	Definition or Description	# of Codes	Percentage
1	Poor choice	0	0.0
1.5	Split decision (1 or 2)	10	5.6
2	Functional technically, but not the best	6	3.4
2.5	Split decision (2 or 3)	1	.6
3	Good choice	159	89.8
	Total responses coded	**176**	**99.4**

Article Identification: Publication Title

There were five choices for the code for recognition of publication titles: not a serious answer; not from a database; not a source title; probably popular, trade, or news; and probably scholarly. The modifier *probably* was added because, though for some publication titles the authors did research the publication title, they did not verify the publication or its type for all publication titles. Some titles were already known to the authors, so they could label it from prior knowledge; for other titles they made educated guesses as to the type (e.g. *The New York Times* is a well-known newspaper; *JAMA* is a well-known scholarly medical journal; and a good guess for *Journal of the XYZ Association* is that it's scholarly). Findings for this code are shown in table 20.6 and demonstrate that 60 percent of students, and possibly as many as 70 percent (if the 3.5 split decision codes are included), could correctly identify their publication or source title in the database record. More than half, 52 percent (if the 4.5 split decision codes are included), chose scholarly articles for their examples, and this happened without any explicit instructions to do so. As many as 30 percent (if the 3.5 split decision codes are included) were not able to identify the publication title for their article. Instead these students typed in phrases such as "journal article," "academic journal," or "Ebsco."

While it may be comforting to think that students have already learned to recognize and value scholarly sources over popular, it's also possible that given the nature of their search topics (many were health-related), it may simply be that more scholarly sources

were retrieved. The fact that 21 percent, possibly as many as 30 percent of students (if the 3.5 split decision codes are included), were not able to identify the publication or source title for their article in a database record confirms the anecdotal experience of many librarians working at a reference desk: understanding how to decipher a database record is a problem for many students.

The analysis of the results for this code provided a second validity check on students' good faith efforts. Compared to the subject consistency code discussed earlier, where the authors estimate that 5 percent did not work in good faith, a slightly higher percentage, 9 percent, did not use the database to locate their sample article (e.g., www.cbsnews.com was entered as a publication title). Alternate explanations for why students did not use the database could include that they did not understand the instructions or did not see or understand the link in the tutorial that would open a new browser window with the database in it.

Table 20.6
Recognition of Publication Titles

Code	Definition or Description	# of Codes	Percentage
1	Not a serious answer	1	.6
2	Not from database	14	7.9
2.5	Split decision (2 or 3)	1	.6
3	Not a publication title	37	20.9
3.5	Split decision (3 or 4)	17	9.6
4	Probably popular, trade, or news	14	7.9
4.5	Split decision (4 or 5)	6	3.4
5	Probably scholarly	86	48.6
	Total responses coded	**176**	**99.5**

Analysis of Reflections

The second part of the qualitative analysis involved coding student responses to the reflection prompts at the end of the research activity. This is where the coding and analysis were more difficult and time-consuming. The three reflection prompts in the tutorial were

- What did you do after entering your initial search statement?
- What challenges did you have?
- What did you learn about the academic research process?

In the fourth iteration of the reflections codebook, the major code groups drawn from the student reflections were

- **Volunteered information:** about past experience, emotional expression, Google comparison

- **Response contents:** basic description of items mentioned by the student. E.g., instances of the student mentioning or describing: Boolean commands, keywords, search results, research question / topic; credibility, efficiency, specificity; evaluation or evaluation criteria / process.
- **Specific details about database searching** (e.g., searching, features, limits, etc.). These tend to be found in longer responses.

Reflection Code Group: Volunteered Information

There were too few responses coded for volunteered information to analyze them in any depth with statistical reliability. Although these topics were not specifically addressed in the reflection prompts, table 20.7 shows that nearly 20 percent of students voluntarily addressed them. (Since 142 responses, or 80.23%, were coded N/A for this code, the authors deduce that 35 responses, or 19.77%, received this code.) Sample student responses included

- **Past experience:** "I've done this stuff before," "I've never seen resources like these before."
- **Emotional expression:** "This made me anxious," "I was relieved at how easy it was."
- **Google comparison:** "This is harder/easier/faster/more reliable than Google or a web search engine."

Table 20.7
Volunteered Information in Reflections

Topic	# of Responses Coded by at Least One Coder	% of Total Responses (177)
N/A, none	142	80.23
Past library experience	15	8.47
Emotional expression	13	7.34
Google comparison	29	16.38

Reflection Code Group: Response Contents

Coders could potentially have selected almost all coding choices for the response contents theme, which makes interpreting the results more complicated. Table 20.8 shows the topics that students wrote about most; the topics were predictable as they reflect the first two prompt questions. Students mentioned their research question or topic, relevance, keywords, and search results, all directly related to the task they worked on in the tutorial, database searching. Students used several words in ways that were ambiguous; context often gave a likely meaning, but not always. For example, "links" could mean articles or results; "options" could mean articles, results, or database limit features; and "sites" could mean databases or results.

Table 20.8
Response Contents in Reflections

Response Content Item. Student...	# of Responses Coded by at Least 1 Coder	% of Total Responses (177)
Mentioned research question, topic	119	67.23
Mentioned relevance or irrelevance	106	59.89
Mentioned keywords	97	54.80
Mentioned or described a challenge	92	51.98
Described search results mechanically (e.g. scrolled / skimmed through)	82	46.33
Described search results qualitatively (e.g., good/bad; relevant/not relevant)	79	44.63
Mentioned specificity	55	31.07
Described article content	48	27.12
Used terms ambiguously	46	25.99
Wrote "I had no challenges"	44	24.86
Mentioned credibility, authority	40	22.60
Mentioned evaluation	35	19.77
Described internal thought process	31	17.51
Mentioned Boolean commands	29	16.38
Mentioned efficiency	9	5.08
n/a, or none	5	2.80

Reflection Code Group: Database Searching Specifics

The codes in table 20.9, on database searching specifics, evolved through the various iterations of the codebook. They relate to phrases or topics that recurred regularly, which also fall into the broader codes in the response contents code group from table 20.8, but include more detail. They tend to indicate a lengthier response from the student. Not quite half of responses received one of these codes (48.59%). Perhaps this code group can also serve as a rough estimate for how many students were willing to write more than the bare minimum in their responses.

Table 20.9
Database Searching Specifics

Database searching theme: code	# of Responses Coded by at Least 1 Coder	% of Total (177)
N/A or none	91	51.41
Keywords: narrowed, focused	41	23.16
Searching: it's easy	38	21.47
Feature: article record feature	25	14.12
Feature: search or results display feature	25	14.12
Number of results: too few	13	7.34
Number of results: too many	12	6.78
Keywords: broadened	12	6.78
Searching: it's hard	6	3.39

Communicating Results and Impact

Summary findings from the analysis were shared with the department head of the library's instruction department, the English instructors who allowed the authors to recruit their students for the study, and the FYE program faculty director. The information was also shared at a presentation during the 2016 Wisconsin Association of Academic Librarians Conference. The data demonstrated how an e-learning tutorial and embedded librarianship can provide a means to measure information literacy skills and understanding in students. The tutorial submissions also provided some guidance for librarians wishing to tailor the precious time of their one-shot instruction sessions to better meet the skills gap of their students.

The process of extracting the data for analysis also revealed how lack of a usable interface for viewing the LMS SCORM data can be a major hindrance to the tutorial being used by faculty and librarians. These revelations led the researchers to develop a more user-friendly SCORM report using Microsoft Word and Excel. The authors hope that by sharing our workflow as well as the code for the tutorials, other libraries may use our case study as a template to assess and improve information literacy instruction and measurement at their own institutions.

Leveraging the Findings

The findings from this study were very useful to the library. The initial analysis of the fall 2014 data guided revisions to the tutorial. The fall 2015 analysis gave a more detailed view of student performance with IL tasks and concepts and an understanding of the pitfalls and limits of the LMS and SCORM environment. As universities are pressed by accrediting bodies for more programmatic assessment efforts, this type of tutorial could be a solution.

During the summer of 2016, there was a change in the leadership roles of the FYE program in both the English department and the library. The new FYE program faculty director undertook a significant curriculum revision for the FYE program, moving it away from a topical focus and traditional research papers. Instead, the curriculum now allows instructors and students more flexibility in choosing what to research and what source types to use, and the writing assignments now emphasize rhetorical analysis. This shift has greatly increased the embedded librarianship opportunities, but also means that these tutorials are no longer deployed in all sections.

Although the tutorials are no longer used programmatically at Marquette, they can be easily adapted to fit the instruction needs of any institution that has a SCORM-compliant LMS and a copy of Articulate Storyline. Though rapid e-learning development software such as Articulate Storyline has made developing these types of modules easier, Fagan and Keach state that most libraries rely on programming skills shared across a campus or library system or a relatively small web development team, making staff time to develop such systems expensive and scarce.[31] To allow other libraries to utilize and build upon the tutorial, the Marquette library decided to make the code open source. The Articulate Storyline source files were licensed using version 3 of the GNU General Public License (GPLv3). An appealing aspect of GPLv3 is its reciprocal or viral nature. If GPLv3 licensed code is incorporated into an application, the new application is "infected"—its source code must also be made freely available, unless the code is reserved for personal use or used only within an organization.[32] A GitHub page (http://marquetterml.github.io/information-literacy-modules/) for the project was developed where visitors can demo the suite of tutorials and download the Articulate Storyline files. Grand Valley State University has already done this with another Marquette Libraries' tutorial:[33] the intent and hope in making these modules open source is that a larger, diverse group of librarians and faculty can continue to use, expand, and improve on the initial modules, then share their adaptations so the twenty-first-century library community can benefit.

Reflection

Limitations of the Study and the Analysis

Despite the wealth of data collected in this case study, there were a number of data points the authors chose not to collect that can be a limitation of this study. Data not collected included

- if students received any credit for completing the tutorial; the students' final grade in the course
- when the student completed the tutorial relative to the library research day workshop, that is, before or after it
- how much time students took to complete the tutorial

With over forty instructors in the FYE program, each could decide whether the tutorial should be graded and, if so, how much weight it would have toward the final grade. Even for the few that assigned a grade for it, the amount was not large enough

to significantly impact a student's final grade. Collecting student grades would have required working with the university registrar to ensure FERPA compliance (FERPA is the federal law protecting the privacy of educational records). Pursuing student grades also may have led to more reluctance from students in agreeing to participate in the study, perhaps significantly decreasing the number of students who agreed. There was also inconsistent deployment of the tutorial, borne out by the facts that only 40 percent of enrolled students could "see" it and only 28 percent completed it. As to how much time students spent on the tutorial, there is substantial evidence already in the literature about the limitations of time-spent data collected from LMSs. An LMS simply cannot monitor if the student is focused on the activity or also using Facebook or other media.

A final limitation regards the conclusions that may be drawn from the analysis. Students completed the tutorial only once; there was no pre-test. Therefore, one cannot conclude definitively that the tutorial was responsible for any student learning: one can say only that the tutorial provides a snapshot in time of the IL skills and understanding that students could demonstrate on the day they completed the tutorial.

Rewards and Difficulties

For several years before this project, the Marquette librarians used quiz-like survey instruments to try to measure students' IL knowledge after information literacy instruction in the libraries' FYE workshops. This instrument was another multiple-choice test; it provided no opportunity for performance assessment and did not capture the students' knowledge and skills in any detail, nor offer librarians insight as to where students needed more information literacy instruction. The most rewarding part of this project was building interesting and interactive curriculum materials, which can provide more detailed and quantifiable evidence of student understanding. The project also facilitated closer librarian and faculty interactions, leading to increased and more long-term instruction collaboration between both parties.

Not surprisingly, political and social issues, not technical ones, were the most difficult hurdles to vault for this project. Building relationships, or "friend-raising," was key to having any success with this project, which entailed working with the FYE program faculty director, roughly forty instructors, ten librarian colleagues, and the LMS administrator. If a librarian could not develop a rapport with an instructor, a meaningful relationship did not start and the librarian was relegated to the traditional one-shot instruction session. For those librarians who did develop rapport with their faculty, additional opportunities to interact with the class beyond the traditional one-shot session were much more likely. But even increased rapport was no guarantee that the tutorial would be assigned to students and completed before the library session. Although librarians and some instructors asked students to complete the tutorial before the library workshops, perhaps because credit was rarely given for completing the tutorial, many students did not. Support for librarian colleagues is another area that could have been improved. This was a new process, in an online environment new to many of the librarians. While documentation on how to publish the tutorials and view

student-submitted data was available, a more robust training program consisting of workshops and one-on-one consultations could have made the transition easier and given the librarians greater confidence in their ability to support their instructors in using the tutorials.

What Next or What Differently?

Although this data was collected in fall of 2015, just before the ACRL *Information Literacy Framework* was finished and published, the authors felt it was important to see if any evidence of the knowledge practices described by the *Framework* could be found in the students' reflections. A section of the reflections codebook included codes to identify evidence of three of the six frames in the students' reflections. However, given the newness of the *Framework* at the time of the analysis, the coders' incomplete understanding of the frames, and discrepancies between the coders in applying the codes related to the *Framework*, the coding divergence for these items was simply huge. The only conclusion possible from these results was that the coders needed more time to develop an understanding of the *Information Literacy Framework* concepts. With more time, ideally the code definitions could have been tightened up and the reflections coded a third time.

During the development process, the focus was on making a tutorial that students would find engaging and easy to use, and the authors believe that goal was achieved. But there was no attempt to focus on the faculty's perception of the tutorial, especially the SCORM reports and how unwieldy they are for those who are novices or unfamiliar with the LMS. Informally, the authors learned that some instructors found the SCORM modules difficult and incomprehensible to use. This discovery led the team to focus on developing a protocol and workflow that would make the SCORM reports easier for both faculty and librarians to utilize. By making an easier way for the instructors to view and assess the students' work, the likelihood of instructors assigning the tutorials would likely increase. Another issue relevant to instructors yet to be addressed is how to grade the students' work. Currently, the tutorial does not provide any grades for student work, and the authors believe that developing a grading rubric would be a logical next step. From conversations with an instructor about another tutorial (Anatomy of Citations), the authors learned that having a grade or score for the work is very desirable.

Final Words

Embedding librarians in the LMS and performance assessment are two methods twenty-first-century libraries can leverage to better reach students and increase collaboration with faculty. Case studies inevitably raise the question of their broader implications: by sharing the Marquette experience and the source code of the tutorials, we invite you to join us in the continuing evolution of this project by replicating it at your own institution. The reward is librarians' increased ability to prioritize and assess higher-level information literacy concepts in a way that is both meaningful to the student and useful to the library and the university or college.

Appendix 20.1

2015 SCORM Search Statements Codebook

These are all single answer questions (radio buttons)
Question: anonymized ID drop-down—the code that corresponds to the student search statement
Question: Coder's name—who did the coding

1. Eric
2. Valerie

Question: Statement Topic statement/question:

1. Good faith effort, clearly understood
2. Adequate, sufficient for understanding student's intent (i.e., student was clearly on task)
3. Not a good faith response

Question: Subject consistency (research topic/question; 2 keywords; article title)

1. Not a good faith response
2. No real connection, but seems as though student was on task
3. 2 or 3 out of 4 are well connected (research topic, 2 search terms, article title)
4. All 4 (search topic, 2 search terms, and article title) are well connected

Question: Keyword choices (search terms)

1. Not on topic
2. Functional, but not very effective
3. Good choices

Question: Boolean command choice

1. Wrong choice, not clear student understood
2. Technically functional, but not the best choice
3. Good choice

Question: Publication title

1. Probably a scholarly title
2. Probably a newspaper, magazine, or trade title
3. Not a publication title (e.g. "journal," "academic article," "Ebsco")
4. Not from a database (e.g., nbcnews.com, National Library of Medicine)
5. Not a good faith response (e.g., "asdf")

2015 SCORM Reflections Codebook

Except for the anonymized ID and the coder's name, these questions are all multiple-answer questions (check boxes). At minimum, "n/a" had to be coded.
Question: Anonymized ID Drop-Down—The code that corresponds to the student reflection

Question: Coder's Name—who did the coding

1. Eric
2. Valerie

Question: Volunteered information:

1. n/a, none
2. Past experience: Student mentions some past experience (e.g., I've done this all before; same databases as my HS; never seen these tools before)
3. Emotional expression: Student mentions emotions or feelings (e.g., anxiety, confusion; surprise, relief; confidence)
4. Google comparison: Student mentions Google/web searching, makes comparison

Question: Content items (descriptive):

1. n/a, none
2. "I had no challenges"
3. Student mentions or describes a challenge
4. Student describes **internal thought process,** thinking aloud, stream of consciousness
5. Student describes **article content**
6. Student mentions **Boolean** commands
7. Student mentions **keywords** (e.g., changing, choosing; synonyms; number of; examples of more concrete responses)
8. Student describes **search results qualitatively** (e.g., too many/few; relevant or not)
9. Student describes **search results mechanically** (e.g. browsing, scrolling; limiting, choosing?)
10. Student mentions **research question/topic/problem** (may or may not include keywords, more abstract responses)
11. Student mentions **credibility, authority** (about either database or articles)
12. Mentions **efficiency**, saving time
13. Mentions **specificity** (importance or impact of)
14. Mentions **evaluation** or describes evaluation criteria/process
15. Mentions **relevance or irrelevance** (relatedness, "fit") or describes them
16. Student **used terms ambiguously**

Question: Database searching specifics

1. n/a, none
2. Searching: it's easy
3. Searching: it's hard
4. Keywords: narrowed, focused
5. Keywords: broadened (synonyms, related terms)
6. Feature: search or results display feature (e.g., date or peer-review limit/filter; full-text searching)
7. Feature: article record feature (e.g., style formatted citations; publication info; abstract/ overview)

8. Number of results: too few
9. Number of results: too many

Question: Research process, IL Framework

1. n/a, none
2. **Research as inquiry:** formulating, **revising research question**. E.g., breaking topic into smaller questions; revising, changing research question.
3. **Research as inquiry:** student talks about synthesizing info from various sources, needing background info. E.g., student understands, realizes how to go forward.
4. **Searching as strategic exploration**: **revising search strategy** based on prior searches. Searching is iterative, nonlinear; searching takes time.
5. **Searching as strategic exploration: evaluating information sources;** do the sources fit the student's need? Not finding the "perfect" source that has "everything." Student is frustrated by imperfect sources.
6. **Authority is constructed and contextual:** student uses research tools and indicators of authority to determine credibility of sources. E.g., databases are better, more credible, than Google.

Notes

1. Paul Hemp, "Death by Information Overload," *Harvard Business Review* 87, no. 9 (2009): 82–89, http://hbr.org/2009/09/death-by-information-overload/ar/1b; Michael B. Eisenberg, Carrie A. Lowe, and Kathleen L. Spitzer, *Information Literacy*, 2nd ed. (Westport, CT: Libraries Unlimited, 2004), 154.
2. Richard J. Shavelson, "On the Measurement of Competency," *Empirical Research in Vocational Education and Training* 2, no. 1 (2010): 41–63.
3. Nancy W. Noe and Barbara A. Bishop, "Assessing Auburn University Library's Tiger Information Literacy Tutorial," *Reference Services Review* 33, no. 2 (2005): 173–87.
4. Bill Johnston and Sheila Webber, "Information Literacy in Higher Education: A Review and Case Study," *Studies in Higher Education* 28, no. 3 (2003): 335–52.
5. Educational Testing Service, "The iSkills™ Assessment," accessed <August 25, 2017>, https://www.ets.org/iskills/about (page discontinued).
6. Project SAILS Information Literacy Assessment website, Kent State University, accessed February 18, 2018, https://www.projectsails.org/; Center for Assessment and Research Studies (James Madison University), *Information Literacy Test* (Boulder, CO: Madison Assessment, 2014), http://www.madisonassessment.com/assessment-testing/information-literacy-test/.
7. Heidi Julien and Susan Barker, "How High-School Students Find and Evaluate Scientific Information: A Basis for Information Literacy Skills Development," *Library and Information Science Research* 31, no. 1 (2009): 12–17, https://doi.org/10.1016/j.lisr.2008.10.008; Davida Scharf, Norbert Elliot, Heather A. Huey, Vladimir Briller, and Kamal Joshi, "Direct Assessment of Information Literacy Using Writing Portfolios," *Journal of Academic Librarianship* 33, no. 4 (2007): 462–77, https://doi.org/10.1016/j.acalib.2007.03.005; Lorrie A. Knight, "Using Rubrics to Assess Information Literacy," *Reference Services Review* 34, no. 1 (2006): 43–55, https://doi.org/10.1108/00907320610640752; Thomas P. Mackey and Trudi Jacobson, "Developing an Integrated Strategy for Information Literacy Assessment in General Education," *Journal of General Education* 56, no. 2 (2007): 93–104, https://doi.org/10.1353/jge.2007.0021.
8. Rosann Tung, *Including Performance Assessments in Accountability Systems* (Boston: Center for Collaborative Education, 2010), http://files.eric.ed.gov/fulltext/ED509787.pdf.

9. Nikolas Leichner, Johannes Peter, Anne-Kathrin Mayer, and Günter Krampen, "Assessing Information Literacy among German Psychology Students," *Reference Services Review* 41, no. 4 (2013): 660–74, https://doi.org/10.1108/RSR-11-2012-0076.
10. Karen D. Mattingly, Margaret C. Rice, and Zane L. Berge, "Learning Analytics as a Tool for Closing the Assessment Loop in Higher Education," *Knowledge Management and E-learning: An International Journal* 4, no. 3 (2012): 236–37, http://www.kmel-journal.org/ojs/index.php/online-publication/article/view/196/148.
11. Chris Leeder and Steven Lonn, "Faculty Usage of Library Tools in a Learning Management System," *College and Research Libraries* 75, no. 5 (2014): 641.
12. Richard Vengroff and James Bourbeau, "In-Class vs. On-Line and Hybrid Class Participation and Outcomes: Teaching the Introduction to Comparative Politics Class" (paper presented at the APSA Teaching and Learning Conference, Renaissance Hotel, Washington, DC, February 18, 2006), https://convention2.allacademic.com/one/tandl/tandl06/; Shane P. Dawson, Erica McWilliam, and Jen Pei-Ling Tan, "Teaching Smarter: How Mining ICT Data Can Inform and Improve Learning and Teaching Practice," in *Hello! Where Are You in the Landscape of Educational Technology? Proceedings ascilite*, (Melbourne, Australia: Deakin University, 2008), 221–30, http://www.ascilite.org/conferences/melbourne08/procs/dawson.pdf; Damian S. Damianov, Lori Kupczynski, Pablo Calafiore, Ekaterina P. Damianova, Gökçe Soydemir, and Edgar Gonzalez, "Time Spent Online and Student Performance in Online Business Courses: A Multinomial Logit Analysis," *Journal of Economics and Finance Education* 8, no. 2 (2009): 11–19, http://citeseerx.ist.psu.edu/viewdoc/download;jsessionid=BF038022BEB4BF0772FF34594C717E1F?doi=10.1.1.651.4142&rep=rep1&type=pdf
13. Liyan Song and Scott W. McNary, "Understanding Students' Online Interaction: Analysis of Discussion Board Postings," *Journal of Interactive Online Learning* 10, no. 1 (2011): 1–14; Noelle LaVoie, Lynn Streeter, Karen Lochbaum, David Wroblewski, Lisa Boyce, Charles Krupnick, and Joseph Psotka, "Automating Expertise in Collaborative Learning Environments," *Journal of Asynchronous Learning Networks* 14, no. 4 (2010): 97–119.
14. Dirk Ifenthaler and Pablo Pirnay-Dummer, "States and Processes of Learning Communities: Engaging Students in Meaningful Reflection and Learning," in *Social Media Tools and Platforms in Learning Environments*, ed. Bebo White, Irwin King, and Philip Tsang (Berlin: Springer Verlag, 2011), 81–94.
15. Rayane Alamuddin, Jessie Brown, and Martin Kurzweil, "Student Data in the Digital Era: An Overview of Current Practices," Ithaka S+R, September 6, 2016, https://doi.org/10.18665/sr.283890.
16. Beth E. Tumbleson and John Burke, *Embedding Librarianship in Learning Management Systems* (Chicago: Neal-Schuman, an imprint of the American Library Association, 2013), 2.
17. Tumbleson and Burke, *Embedding Librarianship,* 6.
18. Leeder and Lonn, "Faculty Usage of Library Tools," 641–42.
19. Barbara H. Phipps, "Library Instruction for the Undergraduates," *College and Research Libraries* 29, no. 5 (1968): 411–23.
20. Tumbleson and Burke, *Embedding Librarianship*, 5–9.
21. Kara L. Giles, "Reflections on a Privilege: Becoming Part of the Course through a Collaboration on Blackboard," *College and Research Libraries News* 65, no. 5 (2004): 261–68; Dorothy Barr, "Reaching Students Where They Go: Embedding Library Resources in Course Content," *Science and Technology Libraries* 29, no. 4 (2010): 289–97; Lynda M. Kellam, Richard Cox, and Hannah Winkler, "Hacking Blackboard: Customizing Access to Library Resources through the Blackboard Course Management System," *Journal of Web Librarianship* 3, no. 4 (2009): 349–63; Marianne Foley, "Putting the Library at Students' Fingertips," *Journal of Electronic Resources Librarianship* 24, no. 3 (2012): 167–76, https://doi.org/10.1080/1941126X.2012.706107.
22. Tumbleson and Burke, *Embedding Librarianship*, 106.
23. Ruth Colvin Clark and Richard E. Mayer, *E-learning and the Science of Instruction*, 3rd ed. (San Francisco: Pfeiffer, 2011), ProQuest Safari e-book, chap. 10.
24. Clark and Mayer, *E-learning*, chap. 9.
25. Clark and Mayer, *E-learning*, chap. 12.
26. Carolyn Snyder, *Paper Prototyping* (San Diego, CA: Morgan Kaufmann/Elsevier Science, 2003).

27. Jane E. Cole and Jeffrey B. Kritzer, "Strategies for Success: Teaching an Online Course," *Rural Special Education Quarterly* 28, no. 4 (2009): 36–40, https://doi.org/10.1177/875687050902800406; Gerald C. Gannod, Janet E. Burge, and Michael T. Helmick, "Using the Inverted Classroom to Teach Software Engineering," in *ICSE '08: Proceedings of the 30th International Conference on Software Engineering* (New York: ACM, 2008), 777–86, https://doi.org/10.1145/1368088.1368198; Maureen J. Lage, Glenn J. Platt, and Michael Treglia, "Inverting the Classroom: A Gateway to Creating and Inclusive Learning Environment," *Journal of Economic Education* 31, no. 1 (2000): 30–43, http://www.jstor.org/stable/1183338; Jerry Overmyer, "Flipped Classrooms 101," *Principal* (September/October 2012): 46–47, http://www.naesp.org/principal-septemberoctober-2012-common-core/innovation-flipped-classrooms-101; Kathleen Gallagher, "From Guest Lecturer to Assignment Consultant: Exploring a New Role for the Teaching Librarian," in *LOEX Conference Proceedings 2007,* ed. Brad Sietz, Susann deVries, Sarah Fabian, Robert Stevens, E. Chisato Uyeki, and Amy Wallace (Ypsilanti: Eastern Michigan University, 2009), 39–43, http://commons.emich.edu/loexconf2007/31.
28. Karen Anderson and Frances A. May, "Does the Method of Instruction Matter? An Experimental Examination of Information Literacy Instruction in the Online, Blended, and Face-to-Face Classrooms," *Journal of Academic Librarianship* 36, no. 6 (2010): 495–500; Penny M. Beile and David N. Boote, "Does the Medium Matter? A Comparison of a Web-Based Tutorial with Face-to-Face Library Instruction on Education Students' Self-efficacy Levels and Learning Outcomes," *Research Strategies* 20, no. 1–2 (2005): 57–68; Ligaya A. Ganster and Tiffany R. Walsh, "Enhancing Library Instruction to Undergraduates: Incorporating Online Tutorials into the Curriculum," *College and Undergraduate Libraries* 15, no. 3 (2008): 314–33, https://doi.org/10.1080/10691310802258232; Susan L. Silver and Lisa T. Nickel, "Are Online Tutorials Effective? A Comparison of Online and Classroom Library Instruction Methods," *Research Strategies* 20, no. 4 (2005): 389–96; Shiao-Feng Su and Jane Kuo, "Design and Development of Web-Based Information Literacy Tutorials," *Journal of Academic Librarianship* 36, no. 4 (2010): 320–28, https://doi.org/10.1016/j.acalib.2010.05.006; Li Zhang, Erin M. Watson, and Laura Banfield, "The Efficacy of Computer-Assisted Instruction versus Face-to-Face Instruction in Academic Libraries: A Systematic Review," *Journal of Academic Librarianship* 33, no. 4 (2007): 478–84, https://doi.org/10.1016/j.acalib.2007.03.006.
29. Johnny Saldaña, *The Coding Manual for Qualitative Researchers*, 2nd ed. (Los Angeles: SAGE, 2013).
30. Saldaña, *Coding Manual*, 34–35.
31. Jody Condit Fagan and Jennifer A. Keach, "Build, Buy, Open Source, or Web 2.0?" *Computers in Libraries* 30, no. 6 (2010): 9–11.
32. Van Lindberg, *Intellectual Property and Open Source* (Sebastopol, CA: O'Reilly Media, 2008), ProQuest Safari e-book. A lengthy discussion of open source is beyond the scope of this chapter, but Lindberg's book provides an in-depth, yet accessible exploration of the topic, especially chapters 8–10 and 12, and her analogy between a credit union and open source.
33. Betsy Williams, Rita Kohrman, Justin Melick, Valerie Beech, and Eric Kowalik, "One Tutorial, Two Universities: How Technology Can Be Adapted to Meet the Needs of Multiple Libraries," in *Learning from the Past, Building for the Future: Proceedings of the Forty-Fourth Annual LOEX Library Instruction Conference*, ed. Brad Sietz (Ypsilanti, MI: LOEX Press, forthcoming).

Bibliography

Alamuddin, Rayane, Jessie Brown, and Martin Kurzweil. "Student Data in the Digital Era: An Overview of Current Practices." Ithaka S+R, September 6, 2016. https://doi.org/10.18665/sr.283890.

Anderson, Karen, and Frances A. May. "Does the Method of Instruction Matter? An Experimental Examination of Information Literacy Instruction in the Online, Blended, and Face-to-Face Classrooms." *Journal of Academic Librarianship* 36, no.6 (2010): 495–500.

Barr, Dorothy. "Reaching Students Where They Go: Embedding Library Resources in Course Content." *Science and Technology Libraries* 29, no. 4 (2010): 289–97.

Beile, Penny M., and David N. Boote. "Does the Medium Matter? A Comparison of a Web-Based Tutorial with Face-to-Face Library Instruction on Education Students' Self-efficacy Levels and Learning Outcomes." *Research Strategies* 20, no. 1–2 (2005): 57–68.

Center for Assessment and Research Studies (James Madison University). *Information Literacy Test*. Boulder, CO: Madison Assessment, 2014. http://www.madisonassessment.com/assessment-testing/information-literacy-test/.

Clark, Ruth Colvin, and Richard E. Mayer. *E-learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning*, 3rd ed. San Francisco: Pfeiffer, 2011. ProQuest Safari e-book.

Cole, Jane E., and Jeffrey B. Kritzer. "Strategies for Success: Teaching an Online Course." *Rural Special Education Quarterly* 28, no. 4 (2009): 36–40. https://doi.org/10.1177/875687050902800406.

Damianov, Damian S., Lori Kupczynski, Pablo Calafiore, Ekaterina P. Damianova, Gökçe Soydemir, and Edgar Gonzalez. "Time Spent Online and Student Performance in Online Business Courses: A Multinomial Logit Analysis." *Journal of Economics and Finance Education* 8, no. 2 (2009): 11–19. http://citeseerx.ist.psu.edu/viewdoc/download;jsessionid=BF038022BEB4BF0772FF-34594C717E1F?doi=10.1.1.651.4142&rep=rep1&type=pdf.

Dawson, Shane P., Erica McWilliam, and Jen Pei-Ling Tan. "Teaching Smarter: How Mining ICT Data Can Inform and Improve Learning and Teaching Practice." In *Hello! Where Are You in the Landscape of Educational Technology? Proceedings ascilite*, 221–30. Melbourne, Australia: Deakin University, 2008. http://www.ascilite.org/conferences/melbourne08/procs/dawson.pdf.

Educational Testing Service. "The *iSkills*™ Assessment." Accessed <August 25, 2017>. https://www.ets.org/iskills/about (page discontinued).

Eisenberg, Michael B., Carrie A. Lowe, and Kathleen L. Spitzer. *Information Literacy: Essential Skills for the Information Age*, 2nd ed. Westport, CT: Libraries Unlimited, 2004.

Fagan, Jody Condit, and Jennifer A. Keach. "Build, Buy, Open Source, or Web 2.0?" *Computers in Libraries* 30, no. 6 (2010): 9–11.

Foley, Marianne. "Putting the Library at Students' Fingertips." *Journal of Electronic Resources Librarianship* 24, no. 3 (2012): 167–76. https://doi.org/10.1080/1941126X.2012.706107.

Gallagher, Kathleen. "From Guest Lecturer to Assignment Consultant: Exploring a New Role for the Teaching Librarian." In *LOEX Conference Proceedings 2007.* Edited by Brad Sietz, Susann deVries, Sarah Fabian, Robert Stevens, E. Chisato Uyeki, and Amy Wallace, 39–43. Ypsilanti, MI: Eastern Michigan University, 2009. http://commons.emich.edu/loexconf2007/31.

Gannod, Gerald C., Janet E. Burge, and Michael T. Helmick. "Using the Inverted Classroom to Teach Software Engineering." In *ICSE '08: Proceedings of the 30th International Conference on Software Engineering,* 777–86. New York: ACM, 2008. https://doi.org/10.1145/1368088.1368198.

Ganster, Ligaya A., and Tiffany R. Walsh. "Enhancing Library Instruction to Undergraduates: Incorporating Online Tutorials into the Curriculum." *College and Undergraduate Libraries* 15, no. 3 (2008): 314–33. https://doi.org/10.1080/10691310802258232.

Giles, Kara L. "Reflections on a Privilege: Becoming Part of the Course through a Collaboration on Blackboard." *College and Research Libraries News* 65, no. 5 (2004): 261–68.

Hemp, Paul. "Death by Information Overload." *Harvard Business Review* 87, no. 9 (2009): 82–89. http://hbr.org/2009/09/death-by-information-overload/ar/1b.

Ifenthaler, Dirk, and Pablo Pirnay-Dummer. "States and Processes of Learning Communities. Engaging Students in Meaningful Reflection and Learning." In *Social Media Tools and Platforms in Learning Environments*. Edited by Bebo White, Irwin King, and Philip Tsang, 81–94. Berlin: Springer Verlag, 2011.

Johnston, Bill, and Sheila Webber. "Information Literacy in Higher Education: A Review and Case Study." *Studies in Higher Education* 28, no. 3 (2003): 335–52.

Julien, Heidi, and Susan Barker. "How High-School Students Find and Evaluate Scientific Information: A Basis for Information Literacy Skills Development." *Library and Information Science Research* 31, no. 1 (2009): 12–17. https://doi.org/10.1016/j.lisr.2008.10.008.

Kellam, Lynda M., Richard Cox, and Hannah Winkler. "Hacking Blackboard: Customizing Access to Library Resources through the Blackboard Course Management System." *Journal of Web Librarianship* 3, no. 4 (2009): 349–63.

Kent State University. Project SAILS Information Literacy Assessment website. Kent State University. https://www.projectsails.org/.

Knight, Lorrie A. "Using Rubrics to Assess Information Literacy." *Reference Services Review* 34, no. 1 (2006): 43–55. https://doi.org/10.1108/00907320610640752.

Kowalik, Eric, Elizabeth Andrejasich Gibes and Valerie Beech. "Leveraging Articulate Storyline and an LMS to go Beyond the One Shot IL Session" (PowerPoint presentation, Wisconsin Association of Academic Librarians Conference, Green Lake, WI, April 21, 2016). http://works.bepress.com/eric_kowalik/11/

Lage, Maureen J., Glenn J. Platt, and Michael Treglia. "Inverting the Classroom: A Gateway to Creating an Inclusive Learning Environment." *Journal of Economic Education* 31, no.1 (2000): 30–43. http://www.jstor.org/stable/1183338.

LaVoie, Noelle, Lynn Streeter, Karen Lochbaum, David Wroblewski, Lisa Boyce, Charles Krupnick, and Joseph Psotka. "Automating Expertise in Collaborative Learning Environments." *Journal of Asynchronous Learning Networks* 14, no. 4 (2010): 97–119.

Leeder, Chris, and Steven Lonn. "Faculty Usage of Library Tools in a Learning Management System." *College and Research Libraries* 75, no. 5 (2014): 641–63.

Leichner, Nikolas, Johannes Peter, Anne-Kathrin Mayer, and Günter Krampen. "Assessing Information Literacy among German Psychology Students." *Reference Services Review* 41, no. 4 (2013): 660–74. https://doi.org/10.1108/RSR-11-2012-0076.

Lindberg, Van. *Intellectual Property and Open Source: A Practical Guide to Protecting Code*. Sebastopol, CA: O'Reilly Media, 2008. ProQuest Safari e-book.

Mackey, Thomas P., and Trudi Jacobson. "Developing an Integrated Strategy for Information Literacy Assessment in General Education." *Journal of General Education* 56, no. 2 (2007): 93–104. https://doi.org/10.1353/jge.2007.0021.

Mattingly, Karen D., Margaret C. Rice, and Zane L. Berge. "Learning Analytics as a Tool for Closing the Assessment Loop in Higher Education." *Knowledge Management and E-learning: An International Journal* 4, no. 3 (2012): 236–47. http://www.kmel-journal.org/ojs/index.php/online-publication/article/view/196/148.

Noe, Nancy W., and Barbara A. Bishop. "Assessing Auburn University Library's Tiger Information Literacy Tutorial (TILT)." *Reference Services Review* 33, no. 2 (2005): 173–87.

Overmyer, Jerry. "Flipped Classrooms 101." *Principal* (September/October 2012): 46–47. http://www.naesp.org/principal-septemberoctober-2012-common-core/innovation-flipped-classrooms-101.

Phipps, Barbara H. "Library Instruction for the Undergraduate." *College and Research Libraries* 29, no. 5 (1968): 411–23.

Saldaña, Johnny. *The Coding Manual for Qualitative Researchers*, 2nd ed. Los Angeles: SAGE, 2013.

Scharf, Davida, Norbert Elliot, Heather A. Huey, Vladimir Briller, and Kamal Joshi. "Direct Assessment of Information Literacy Using Writing Portfolios." *Journal of Academic Librarianship* 33, no. 4 (2007): 462–77. https://doi.org/10.1016/j.acalib.2007.03.005.

Shavelson, Richard J. "On the Measurement of Competency." *Empirical Research in Vocational Education and Training* 2, no. 1 (2010): 41–63.

Silver, Susan L., and Lisa T. Nickel. "Are Online Tutorials Effective? A Comparison of Online and Classroom Library Instruction Methods." *Research Strategies* 20, no. 4 (2005): 389–96.

Snyder, Carolyn. *Paper Prototyping: The Fast and Easy Way to Design and Refine User Interfaces*. San Diego: Morgan Kaufmann/Elsevier Science, 2003.

Song, Liyan, and Scott W. McNary. "Understanding Students' Online Interaction: Analysis of Discussion Board Postings." *Journal of Interactive Online Learning* 10, no. 1 (2011): 1–14.

Su, Shiao-Feng, and Jane Kuo. "Design and Development of Web-Based Information Literacy Tutorials." *Journal of Academic Librarianship* 36, no. 4 (2010): 320–28. https://doi.org/10.1016/j.acalib.2010.05.006.

Tumbleson, Beth E., and John Burke. *Embedding Librarianship in Learning Management Systems: A How-to-Do-It Manual for Librarians*. Chicago: Neal-Schuman, an imprint of the American Library Association, 2013.

Tung, Rosann. *Including Performance Assessments in Accountability Systems: A Review of Scale-Up Efforts*. Boston: Center for Collaborative Education, 2010. http://files.eric.ed.gov/fulltext/ED509787.pdf.

Vengroff, Richard, and James Bourbeau. "In-Class vs. On-Line and Hybrid Class Participation and Outcomes: Teaching the Introduction to Comparative Politics Class." Paper presented at the APSA Teaching and Learning Conference, Renaissance Hotel, Washington, DC, February 18, 2006. https://convention2.allacademic.com/one/tandl/tandl06/.

Williams, Betsy, Rita Kohrman, Justin Melick, Valerie Beech, and Eric Kowalik. "One Tutorial, Two Universities: How Technology Can Be Adapted to Meet the Needs of Multiple Libraries." In *Learning from the Past, Building for the Future: Proceedings of the Forty-Fourth Annual LOEX Library Instruction Conference*. Edited by Brad Sietz. Ypsilanti, MI: LOEX Press, forthcoming.

Zhang, Li, Erin M. Watson, and Laura Banfield. "The Efficacy of Computer-Assisted Instruction versus Face-to-Face Instruction in Academic Libraries: A Systematic Review." *Journal of Academic Librarianship* 33, no. 4 (2007): 478–84. https://doi.org/10.1016/j.acalib.2007.03.006.