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What Five Minutes in the Classroom Can Do to Uncover the Basic Information Literacy Skills of Your College Students: A Multiyear Assessment Study

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Abstract

Objective – Librarians at Rider University attempted to discern the basic information literacy (IL) skills of students over a two year period (2009-2011). This study aims to

explore the impact of one-session information literacy instruction on student acquisition of the information literacy skills of identifying information and accessing information using a pretest/posttest design at a single institution. The research questions include: Do different student populations (in different class years, Honors students, etc.) possess different levels of IL? Does the frequency of prior IL Instruction (ILI) make a difference? Do students improve their IL skills after the ILI?

Methods – The librarians at Rider University developed the test instruments over two years and administered them to students attending the ILI sessions each semester. The test was given to students as they entered the classroom before the official start-time of the class, and the test was stopped five minutes into the class. A pretest with five questions was developed from the 1st ACRL IL Standards. A few demographic questions were added. This pretest was used in fall 2009. In spring 2010, a second pretest was developed with five questions on the 2nd ACRL IL Standards. Students of all class years who attended ILI sessions took the pretests. In 2010-2011, the pretest combining the 10 questions used in the previous year was administered to classes taking the required CMP-125 Research Writing and the BHP-150 Honors Seminar courses. An identical posttest was given to those classes that returned for a follow-up session. Only the scores from students taking both pretests and posttests were used to compare learning outcomes.

Results – Participants' basic levels of IL skills were relatively low. Their skills in identifying needed resources (ACRL IL Standards 1) were higher than those related to information access (ACRL IL Standards 2). Freshmen in the Honors Seminar outperformed all other Rider students. No differences were found in different class years or with varying frequencies of prior IL training. In 2010-2011, students improved significantly in a few IL concepts after the ILI, but overall gains were limited.

Limitations – Many limitations are present in this study, including the challenge of developing ideal test questions and that the pretest was administered to a wide variety of classes. Also not all the IL concepts in the test were adequately addressed in these sessions. These factors would have affected the results.

Conclusions – The results defy a common assumption that students' levels of IL proficiency correlate with their class years and the frequency of prior ILI in college. These findings fill a gap in the literature by supporting the anecdote that students do not retain or transfer their IL skills in the long term. The results raise an important question as to what can be done to help students more effectively learn and retain IL in college. The authors offer strategies to improve instruction and assessment, including experimenting with different pedagogies and creating different posttests for spring 2012.

Introduction

Rider University, located in Lawrenceville, NJ, is a private, coeducational university with 5,500 students, offering 69 undergraduate programs in

business administration, education, liberal arts, the sciences, fine and performing arts, counseling, and leadership, plus 25 Masters level degrees. Librarians at the Franklin F. Moore Library (also known as the Moore

Library) have established an active library instruction program, working with teaching faculty to integrate information literacy (IL) into their courses for the past decade. Following the emphasis placed on assessment by the Middle States Commission on Higher Education, the accrediting body for Rider University, the Moore Librarians have been involved in assessment since 2002.

The learning objectives for information literacy are based on the Association of College and Research Libraries (ACRL) Information Literacy Competency Standards for Higher Education (American Library Association, Association of College and Research Libraries, 2000). This study reports on the Moore Library's assessment program that measured students' IL levels in two academic years (2009-2010 and 2010-2011) on the first two ACRL IL standards, which include the same IL learning objectives for students at Rider University. These objectives contain the basic information literacy competencies and are appropriate for lower division undergraduates:

1. The information literate student determines the nature and extent of the information needed. Students will identify a variety of types and formats of potential sources of information.
2. The information literate student accesses needed information effectively and efficiently. Students will recognize controlled vocabularies; illustrate search statements that incorporate appropriate keywords and synonyms, Boolean operators, nesting of terms, and truncation, refining the search statement when necessary; and determine the most appropriate resources for accessing needed information.

Research Questions

Most of the ILI sessions occur in the Library's two computer labs. The topics of the assignments and areas of study range widely

from business to humanities, social sciences, sciences, and technology. The librarians teach sessions for their liaison departments and share teaching responsibilities for the core Research Writing and the Honors Seminar classes.

The current study assessed the knowledge of students of all class years for the first two IL objectives in the academic year 2009-2010. For the 2010-2011 academic year, identical pretests and posttests combining these two IL objectives were used to assess the impact of ILI on students' learning in the Research Writing course. Our research questions for this study include:

- Do students' possess different levels of knowledge and skills for the two IL objectives?
- Do different student populations [freshmen (1st year), sophomores (2nd year), juniors (3rd year), seniors (4th year), Honors students, and students in different areas of study] possess different levels of IL?
- Are students' performances on the IL pretest associated with the frequency of prior ILI received?
- Do students improve their IL skills after the ILI?

Literature Review

Several approaches to assessing undergraduate students' acquisition of information literacy skills have been documented. This literature review will discuss these different methods used, including the pre and posttest system used by the authors.

Small-scale, inexpensive assessment approaches

Some assessment techniques that are on a smaller and less expensive scale include the one-minute paper (Angelo & Cross, 1993; Choinski & Emanuel, 2006; Cunningham, 2006), an attitude survey, observational assessment, a faculty assessment survey (Cunningham, 2006), short

quizzes given during a one-credit course (Hufford, 2010), online tutorials (Fain, 2011; Heimke & Matthies, 2004; Johnson, 2009; Lechner, 2005; Merz & Mark, 2002; Tronstad, Phillips, Garcia, & Harlow, 2009), interviews (Julien & Boon, 2004) and, in one case, interviews conducted by anthropologists (Kolowich, 2011).

Authentic Assessment

Authentic assessment depends on students' actual performance on tasks such as an annotated bibliography, submitted research papers, bibliographies, and worksheets as discussed by Oakleaf (2011) and Brown and Kingsley-Wilson (2010). Rubrics are designed to assess these types of documents and provide a systematic way to determine how well students have achieved the learning objectives. McCulley (2009) and Rogers (2001) discuss "Reflective Learning" where students think about their processes of learning through the use of portfolios and journals as a way to help them become better learners.

Standardized Testing

Other types of assessment include standardized testing formats used to assess baseline competencies among undergraduate students. The Educational Testing Service (ETS) and Kent State University have developed standardized tests for measuring student information research skills using scenarios: the iSkills exam (Katz, 2007; Katz & Macklin, 2007), and Project SAILS, (Radcliff, Salem, O'Connor, Burhanna, & Gedeon, 2007; Rumble & Noe, 2009) respectively. These tests allow large-scale aggregation of data amongst many institutions, but can be expensive, time consuming, and would be difficult to use for pretesting and posttesting. However, these tests can be used to assess gains over time to determine trends.

Pre and Posttest Methods

It is evident that the library literature details a wide variety of mechanisms for assessing IL skills. Moore Librarians selected the pretest and posttest method for obtaining a sense of students' understanding of different resources and search strategy skills and confirm or disprove anecdotal evidence of such skills. These tests are easy to construct using online forms via Google Docs; they can be administered quickly, and data they generate are easily downloaded and analyzed (Hsieh & Dawson, 2010). This procedure allows librarians to document students' IL skills and to measure gains over time.

There are instances of the use of pretests and posttests in credit courses. In a one-credit course taught at Texas Technology University, students were given a pretest at the start of the semester and a posttest at the very end of the semester. Both tests were identical and some questions had multiple answers. Despite IL skills taught over a 14 week period, students did not do as well as expected in the posttest (Hufford, 2010). In another example, a three-credit class conducted at the University of Rhode Island used pretests and posttests to determine student learning of Boolean operators (Burkhardt, 2007). The librarians were disappointed in the small increase between these two test scores. Gandhi (2004) detailed the assessment of a five-session model for library instruction and found students learned more than after a one-shot session. However, this may not be a very practical approach because of the many demands on the librarians' times. Further, faculty members are usually very reluctant to give up class time for such sessions.

About 85 % of 60- to 90-minute course-integrated ILI sessions taught by the Moore librarians at Rider University are single-sessions,

typical ILI offered in many academic libraries in the United States (Merz & Mark, 2002). Most of the literature reviewed for this paper involves one-shot instruction sessions. A survey developed by librarians at the University of Northern Texas used a software system that tracked websites used by students during their assessment; four questions were used as a pretest and posttest. This survey demonstrated that ILI helped students and provided information on weaknesses such as subject searching in the online catalog (Byerly, Downey, & Ramin, 2006). A review paper describing the pretest/posttest techniques raised concerns about using identical sets of questions for both tests, and the problem with the span of time placed between these two tests as the major factor in determining retention (Emmett & Emde, 2007). At Cornell University, the posttests indicated improvement in IL skills but the authors stated that a posttest later in the term would be needed to determine the amount of retention of the material (Tancheva, Andrews & Steinhart, 2007). Julien and Boon (2004) did just that. The posttest was given immediately after a library session and a post-posttest given to students three to four months later. Students showed a decline from the posttest to the post-posttest. This indicates that information is not retained well, and suggests the need for reinforcement of IL concepts throughout the semester.

Fain (2011) outlined a five-year longitudinal study using pretests and posttests administered by teaching faculty instead of librarians. The author enlisted the help of Psychology faculty for the statistical analysis of the data, similar to what Moore Librarians have done. In addition, the study emphasized the impact of the assignment on teaching information literacy skills, i.e., if journal articles are required but not books, then assessment questions related to using an online catalog or types of books will not be taught by librarians. This would affect the outcomes of any IL assessment that asks about resources such as books and skills using the online catalog.

Surveys have frequently been used to assess students' opinions or ask about their satisfaction with IL instruction (Matthews, 2007). Freeman and Lynd-Balta (2010) and Knight (2002) described studies using pretests and posttests to assess students' confidence levels in information literacy skills. However, these types of studies do not demonstrate students' knowledge or capability to apply learned IL skills. As illustrated by Dawson and Campbell (2009), computer and information literacy skills are not equivalent. Students may exhibit confidence in their search skills because of their familiarity with Google and social media. This may be a consequence of students confusing their computer skills with information literacy skills.

Method

Participants

Participants were undergraduate and graduate students at Rider University sampled from the fall 2009 semester through the spring semester of 2011. For the first year of the study (academic year 2009-2010), all students attending ILI sessions in the Moore Library computer labs were assessed to establish a baseline IL level of all students. In the second year (academic year 2010-2011), instead of testing students in all ILI sessions, the librarians narrowed the study population to students in the Research Writing and the Honors Seminar courses. This was done because the IL objectives matched the courses' objectives well. In addition, 7 of the Research Writing instructors requested a follow-up session after the first ILI, allowing the use of posttests in 15 classes to determine learning outcomes from their previous ILI.

Numbers of participants are shown in Table 1. Participants for the fall 2009 and spring 2010 semesters included all who received ILI at the Moore Library. Of these 1,986 students, 560 were freshmen, 310 were sophomores, 420 were juniors, 338 were seniors, 313 were graduate students, and 45 were reported as "other." Students in subsequent cohorts (fall 2010 and

spring 2011) included students from core writing courses only. Students not in the Honors program were enrolled in Research Writing (CMP125) course. The fall 2010 cohort consisted mainly of sophomores (129 of 177 students), whereas freshmen composed the majority in the spring 2011 cohort (362 of 436 students).

Students in the Baccalaureate Honors Program (BHP) have GPAs of 3.5 or better. They scored higher in the standardized college entrance exam Scholastic Aptitude Test (SAT) with Critical Reading and Math scores of at least 600 and Writing score of at least 550 (BHP, n.d.). The Honors students typically take the BHP-150 Honors Seminar in the spring semester during their freshmen year and therefore, almost all (121/122) were freshmen. This group did not receive follow-up sessions.

Information Literacy Instruction Sessions

All sessions took place in the computer labs of the Moore Library and were conducted by one librarian. Classes typically included up to 25 students. The basic IL concepts in the first two IL objectives are applicable in any ILI. Some concepts might be introduced more thoroughly than others in a session depending on the requirements of the assignments and students'

topics. For example, when an assignment called only for journal articles, librarians would demonstrate searching for articles in selected databases but not searching for books in the online catalog. Book sources might be merely mentioned in such a session. On the other hand, some concepts and skills such as search logic, methods of searching for articles using the library subscription databases, and locating the library's periodicals were emphasized in almost all sessions.

The IL content the librarians taught was not limited to the IL concepts represented in the tests. For each session, the librarians provided handouts that included a combination of content outlines and step-by-step instructions for their sessions. In summer 2010, the Library began subscribing to LibGuides™ for research guides, with Moore librarians gradually developing their instruction content in these online guides and using them in ILI. Librarians' teaching styles varied and individual librarians engaged students and faculty differently in their sessions. Nevertheless, most ILI consisted of lecture, search demonstration, and hands-on time during which librarians monitored and coached students in researching their topics. In the 2010-2011 academic year, of the 20 CMP-125 faculty members, 7 requested a follow-up session after

Table 1
Numbers of Students and Tests Used for Each Cohort

	N	Test	Pre1	Pre2	Post1	Post2
Fall 2009	1106	A	X	----	----	----
Spring 2010	880	B	----	X	----	----
Spring 2010 Honors	55	B	----	X	----	----
Fall 2010	177	AB	X	X	----	----
Fall 2010 Pre-Post*	44	AB	X	X	X	X
Spring 2011	436	AB	X	X	----	----
Spring 2011 Pre-Post*	115	AB	X	X	X	X
Spring 2011 Honors	67	AB	X	X	----	----

Note: An X denotes administration of the test. Pre1 = Pretest for Objective 1, Pre2 = Pretest for Objective 2, Post1 = Posttest for Objective 1, Post2 = Posttest for Objective 2, Test A includes 5 questions for Objective 1 in Appendix A; Test B includes 5 questions for Objective 2 in Appendix B. Pre-Post* = Pre- and Posttest matching records.

the first ILI to allow students more instruction, hands-on time, and coaching from the librarians. As the result, 15 of the 39 classes (38%) had follow-up sessions.

Test Development

Time is at a premium in the ILI sessions if both instruction and hands-on time are to be included, therefore, the assessment instrument had to be short and easily accessible to students in the library labs. In fall 2009, an online test with five multiple-choice questions (see Appendix A) was developed to assess the IL abilities of students on the first IL objective – identifying a variety of sources. The test was developed according to the best practices guidelines for generating tests/surveys outlined by Radcliff, Jensen, Salem, Kenneth, and Gedeon (2007) and by adapting test questions used elsewhere (Burkhardt, 2007; Goebel & Mandeville, 2007; Mery, Newby, & Peng, 2011; Schroeder & Mashek, 2007; Staley, Branch, & Hewitt, 2010). It was piloted on student workers at the Moore Library to ensure that the language in the test was clear to college level students. The librarians installed the test online using Google Docs. In spring 2010, a second test (see Appendix B) was developed in the same fashion for the second IL objective on constructing search queries.

In the second year of the study, the librarians aimed to measure student learning in the ILI sessions by developing identical pretests and posttests. The two sets of questions used in 2009-2010 were combined into a single set of questions used in 2010. Following use of this 10-item test in the fall of 2010, the Moore librarians shared the fall 2010 results with a group of teaching faculty and received feedback on the test in January 2011. Consequently, in spring 2011, the wording of several questions was modified to make them clearer without changing the IL concepts assessed. The changes are noted under each question in the Appendices.

In addition to the questions regarding IL objectives, demographic questions were included on all versions of the first- and second-year tests. These questions included the course number, class year (freshmen, sophomore, junior, senior, graduate student, or other), major area of study (humanities, business, education, science, social science, undeclared, or other), the number of prior library instruction sessions attended (on spring 2010 and later versions), and a four-digit identifying code (e.g., ID number) for matching pretests and posttests in the fall 2010 and spring 2011 cohorts.

Procedure

As students arrived for their sessions at the library class labs, they were instructed to take the online pretest. Students had until five minutes into the scheduled session time to take the test. Those arriving after that time did not take the test. Students then completed the ILI session and departed. In the fall of 2010 and spring of 2011, 7 out of 20 instructors of Research Writing (CMP125) classes had their classes return for a follow-up library session to receive additional instruction and hands-on time. These students again were tested as they arrived for their session and up to five minutes into the scheduled session time. The time from the first session to the follow-up session varied, but averaged approximately three weeks.

Design & Analysis

Analyses comprised a series of one-way and factorial analyses of variance ANOVAs for the focal hypotheses. The REGW- q multiple comparison procedure was used. In addition, chi-squared tests of association and McNemar's Test were used for analyses involving nominal scale measures. The Type I error rate for all tests was .05. Eta, a measure of nonlinear relationship, was used as a measure of effect size.

Independent variables were class year (freshmen, sophomore, junior, senior, graduate

student), area of study (humanities, science, social science, education, business, undeclared, other), course type (core, Honors), IL objective (1, 2), and test (pretest, posttest). Additionally, the number of prior IL sessions was used as a correlate of performance for certain cohorts who were asked to report this information. The dependent variable was the number of questions answered correctly (of 5) for each learning objective.

Results

In this section, a discussion of the impact of the question revision in spring 2011 leads to the combined data that revealed findings of the pretests in both years. Performances on the two IL objectives were examined separately. Comparisons were made for the cohorts by semester, class year, course (including Honors program), major area of study, and frequency of prior ILI. Following the pretests results were the comparisons of students' matching pretest and posttest records in fall 2010 and spring 2011. Findings include students' learning outcomes on the whole, by objectives and by questions.

Impact of Revised Questions in Spring 2011

After receiving feedback from some class faculty on the test results, six questions were revised (Q2, 3, 5, 6, 7, and 10) in spring 2011 to make the questions clearer to students without changing the IL concepts (changes are indicated in the Appendices under each original question). Scores for the original test and revised test were compared. Only the questions with scores that varied largely from the previous year were examined for the impact of the revision (see Figure 1). Only questions 2 and 3 yielded results warranting notice.

The decline in scores by almost 10% in Q2 indicated that the change from "A library's database/index" to "A database such as Academic Search Premier" did not help more students to choose this answer. The reason behind the change was that perhaps some

students did not understand the database/index reference, but they might be familiar with "Academic Search Premier." The lower scores in the revised version indicated that probably fewer participants recognized this database's name and therefore fewer chose it.

Question 3 asked which source one should use to search for background information on an unfamiliar topic. The question changed from "What's the first thing you should do to get started?" to "What's the best way to get an overview of this topic?" The correct answer changed from "Find out some basics on watersheds from an encyclopedia" to the same answer but included both print and online versions. The revision moved 16% more participants in the spring to choose "encyclopedia (online or print)," but the majority (52.8%) still chose the Web for their answer. The preference of most participants remained the same in both semesters. On the whole, the minor revisions to the questions in spring 2011 had minimal impact on the results because the highest scores received by the participants – Q4, Q2, Q1, Q5 in this order, and the lowest scores – Q6, Q8, Q10, were the same in both semesters and not altered by the question revision. For this reason, subsequent analyses combined data from the two versions of the test.

Pretest

IL Objectives. The pretest data revealed that the participants performed significantly better on IL Objective 1 (Q1-Q5) than on Objective 2 (Q6-Q10), $F(1,629) = 143.01, p < .001, \eta^2 = .43$. This effect of objective did not interact with year, major, or cohort.

Differences across semesters. For Objective 1, there were no significant differences across semesters, $(F(2,1784) = 1.23, p = .29, \eta^2 = .03)$. For Objective 2, the spring 2011 cohort ($Mean (M) = 1.43, SD = 1.05$) scored higher than the fall 2010 ($M = 1.15, SD = 1.10$) and spring 2010 ($M = 1.29, Standard Deviation (SD) = 1.12$) cohorts, $F(2,1558) = 6.65, p$

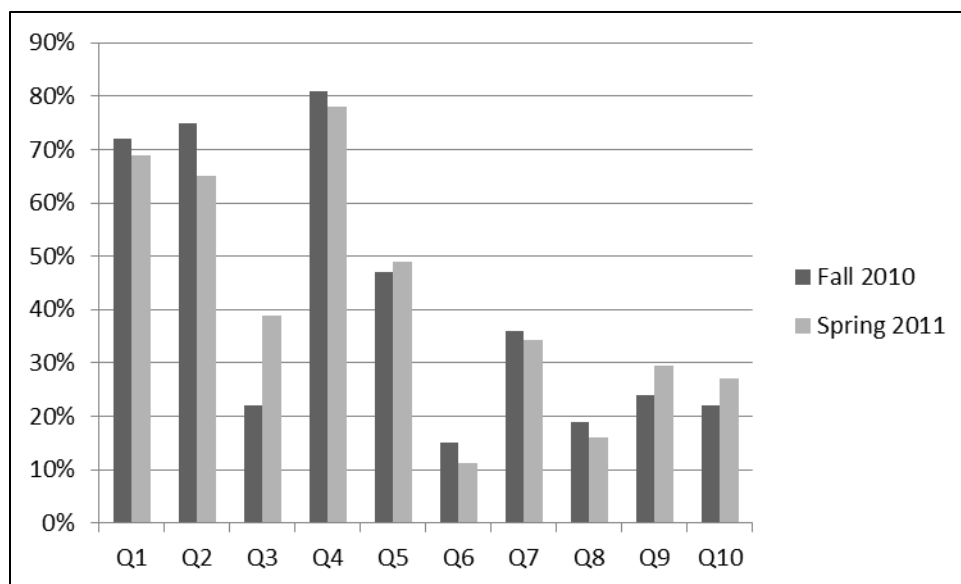


Figure 1
Accuracy rates for the original and revised questions of the pretests' participants.

= .001, $\eta^2 = .09$. However, this difference was small ($\eta^2 = .09$) and more a function of the large sample size than a meaningful difference across cohorts. For this reason, cohorts were combined in subsequent analyses.

Class year comparisons. Forty-six participants listed "other" for class year and therefore were omitted from these analyses. The full sample included 1,001 freshmen, 479 sophomores, 450 juniors, 367 seniors, and 324 graduate students. No differences were present for Objective 1, $F(4,1745) = 1.02, p = .40, \eta^2 = .04$, nor for Objective 2, $F(4,1547) = 1.07, p = .37, \eta^2 = .05$.

Course comparisons. Participants were coded as students in an Honors course, the Research Writing course (CMP-125), any other undergraduate course, or a graduate course. For Objective 1, Honors students scored higher than the undergraduate students, $F(3,1780) = 4.14, p = .006, \eta^2 = .08$. Graduate students scored equivalently to all other groups. For Objective 2, the Honors students scored higher than all groups, $F(3,1555) = 16.59, p < .001, \eta^2 = .18$. In addition, the CMP-125 students scored lower

than all other groups. Descriptive statistics for the course groups by objective are shown in Figure 2 and Table 2.

In fall 2010 and spring 2011, those completing both objectives in the pretests included only CMP125 students ($n = 611$) and Honors students ($n = 68$). The difference in total number correct for the 10 questions was significant, $F(1,677) = 26.67, p < .001, \eta^2 = .19$. The Honors group [M (mean) = 5.32, SD (Standard Deviation) = 1.88] scored higher than the CMP125 group ($M = 4.16, SD = 1.75$).

Comparisons by major area of study. Areas of study were self-identified by students but the areas do not necessarily correspond to their schools or their academic departments. For example, psychology and counseling are under the School of Education but students in these programs may consider social sciences as their area of study. With the broadly defined areas, most participants of the tests were in business, followed by social sciences and education. The percentages of participants representing

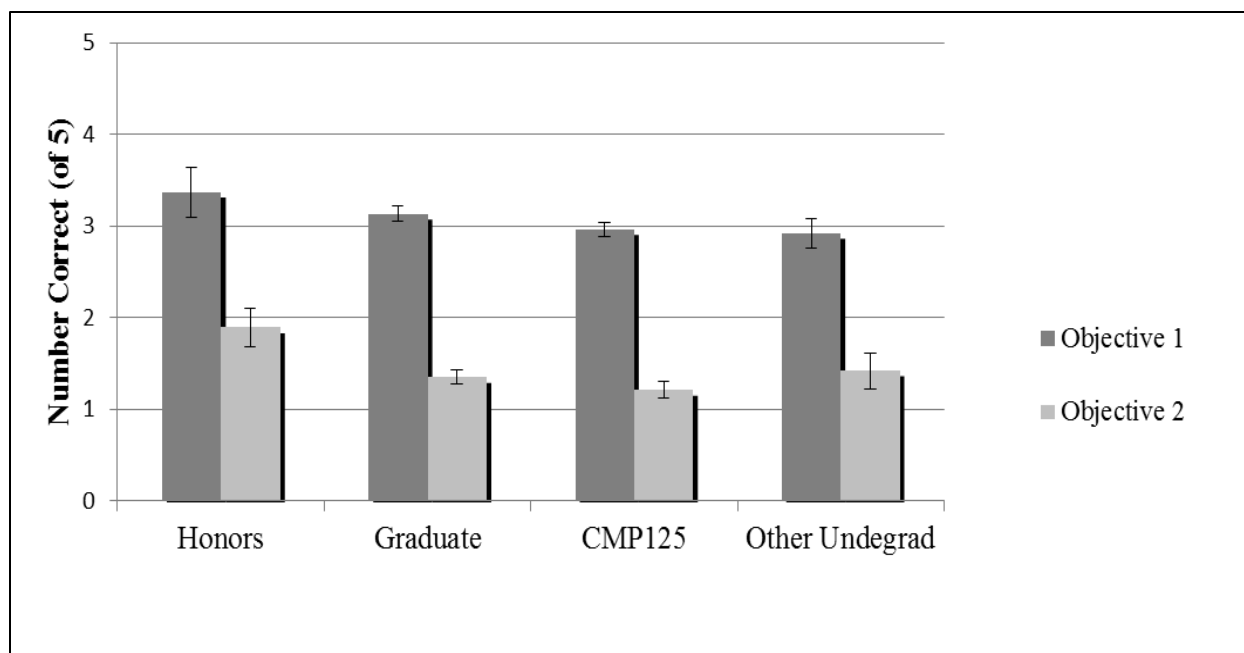


Figure 2

Mean number of correct responses (of 5) for each objective by course. Error bars denote 95% confidence intervals.

Table 2

Number of Correct Responses for each Group for Objectives 1 and 2

		Honors	CMP-125	Other Undergrad	Graduate
Objective 1	M	3.37	2.96	2.92	3.13
	SD	1.13	1.19	1.20	1.05
Objective 2	M	1.89	1.21	1.42	1.48
	SD	1.19	1.05	1.02	1.16

sciences, the humanities, undeclared and other were all in the single digits.

There was a significant effect of area of study for Objective 1, $F(6,1777) = 7.544$, $p < .001$, $\eta^2 = .16$. Multiple comparisons indicated that business, undeclared, and other categories scored lower than did the other four groups. There was no difference across majors for Objective 2. For the CMP125 students in fall 2010 and spring 2011 who took the tests for both Objective 1 and Objective 2, there was a significant effect present, $F(6,673) = 5.33$, $p < .001$, $\eta^2 = .21$. The humanities and science students scored higher than the business and other students.

Descriptive statistics are shown in Figure 3 and Table 3.

Frequency of Prior ILI. The question regarding the frequency of prior ILI from Rider University first appeared in the test in the spring of 2010 and was included in the following year. From the self-report of the participants, 62% of freshmen, 43% of graduate students and 20% – 30% of undergraduates other than freshmen never had a prior ILI session (see Figure 4). The number of prior ILI sessions was not significantly correlated with any outcome variable (i.e., numbers correct for Objective 1, Objective 2, or combined).

Table 3
 Number of Correct Responses by Major Area of Study (N = Number)

	Mean	SD	N
Humanities	5.04	1.89	45
Science	4.89	2.01	71
Business	3.99	1.71	225
Education	4.21	1.62	123
Social Science	4.50	1.84	132
Undeclared	4.09	1.66	45
Other	3.61	1.70	38

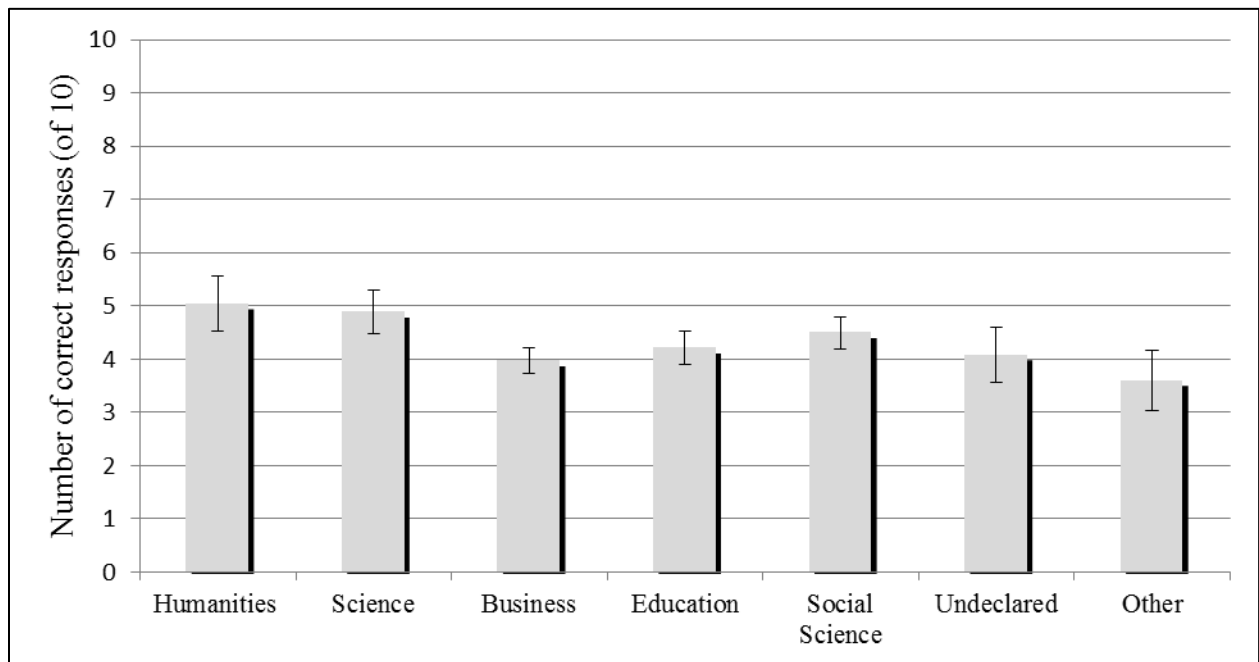


Figure 3
 Mean number correct on the combined pretests by major area of study. Error bars denote 95% confidence intervals.

Pretest & Posttest Comparisons

Performances of 159 CMP-125 students (44 fall 2010, 115 spring 2011) who took both pretests and posttests, were compared using a 2 (Group: fall 2010, spring 2011) x 2 (Test: pretest, posttest) x 2 (Objective: 1, 2) factorial ANOVA. This analysis found significant differences between the groups, $F(1, 157) = 4.43, p = .037, \eta^2 = .13$, and objectives, $F(1, 157) = 311.17, p < .001, \eta^2 = .81$. The spring 2011 group ($M = 4.77, SD = 1.65$)

scored significantly higher than did the fall 2010 group ($M = 4.17, SD = 1.44$). Participants scored higher on Objective 1 ($M = 3.20, SD = 0.97$) than on Objective 2 ($M = 1.41, SD = 0.98$). There was no change from pretest to posttest.

McNemar's Tests were performed to determine whether accuracy rates varied across tests (pretest vs. posttest) for each question. Significant increases in accuracy were seen only for questions 6 (subject search in the catalog, $p =$

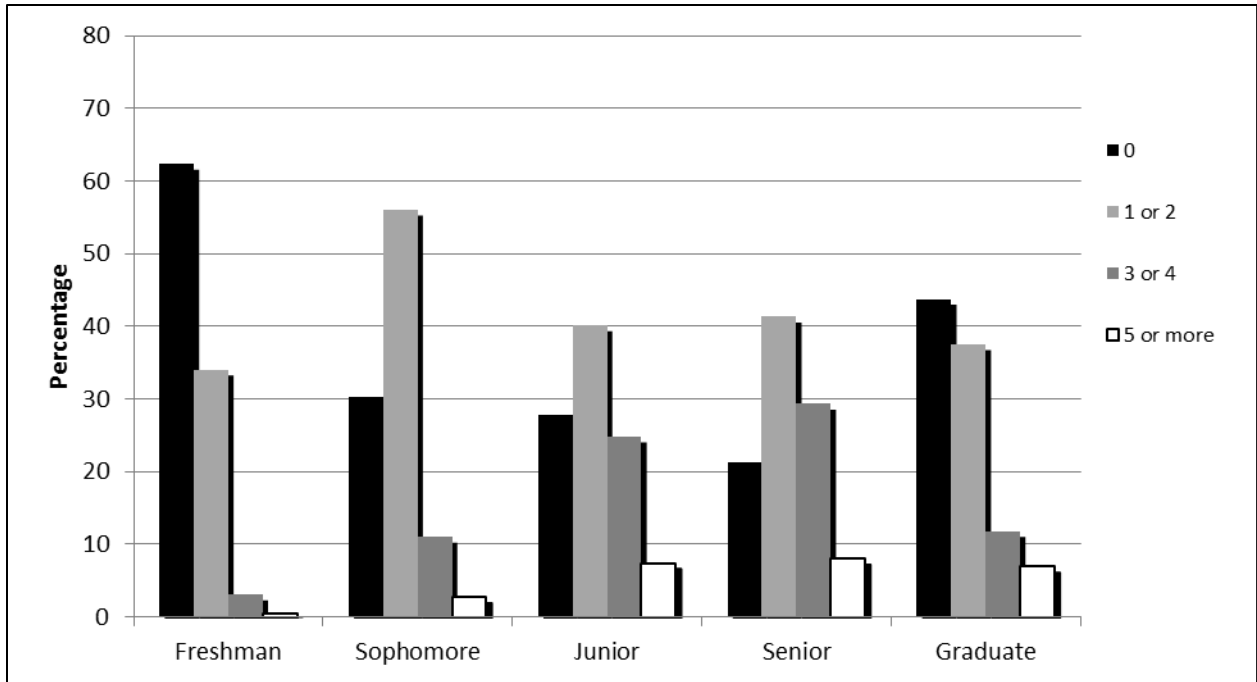


Figure 4
Percentage of students with each indicated number of prior ILI session by class year.

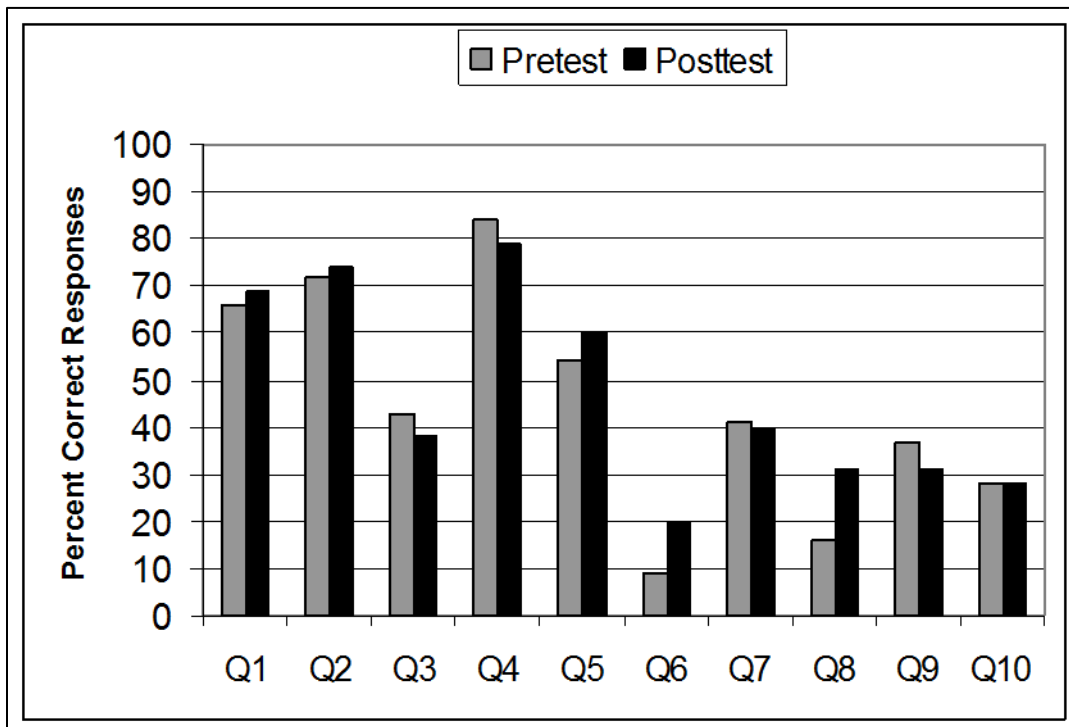


Figure 5
Percentage of correct responses for each question on the pretest and posttest 2010-2011.

.003) and 8 (truncation, $p < .001$), even though the posttest scores for both questions were still rather low. These increases were evident in both semesters. The differences between the pretests and posttests for the other questions were not significant (see Figure 5).

For the first IL objective on identifying a variety of sources (Q1 to Q5), participants performed the best in differentiating scholarly journals from popular magazines (Q4). They did relatively well on the purposes of the catalog and the library's databases (Q1 & Q2). More than half of the population knew how to find the library's full-text journals (Q5). Less than half of the participants would use encyclopedias to search for background information of an unfamiliar topic (Q3). Most chose to use a Web search engine for this purpose.

Among the five questions on Objective 2, participants performed the best on the combination use of Boolean AND and OR (Q7) with around 40% accuracy rate. They received the lowest scores on using subject search to find books on the critiques of Shakespeare's *Romeo and Juliet* in the online catalog (Q6). More of them would search by title and by keyword, and very few chose the correct answer, "By subject." The posttest scores of this question improved significantly from 10% to 20%.

The tests revealed further that a great majority of participants were unfamiliar with the use of truncation (Q8) and the Boolean connector OR (Q9). Very few would consider using books for a reliable and thorough history on a common topic (Q10). Most chose to use scholarly journals.

Discussion

Do students' possess different levels of knowledge and skills for the two IL objectives?

Participants had higher scores on the first IL objective than the second IL objective, indicating that although a majority of Rider students could

identify a variety of sources, few could construct their searches efficiently using these resources.

Do different student populations (class years, Honors students, area of study) possess different levels of IL?

Faculty members often assume that students have received their IL training before entering their class, and expect students to know how to search for information (Kolowich, 2011; Lindsay et al., 2006). The finding that upperclassmen performed no differently than their lower division counterparts defies the assumption and raises an important question about the long-term effectiveness of the ILI that students receive in and prior to college.

The Honors group, composed mainly of second semester freshmen, demonstrated higher IL levels than their peers. It is worth noting that two other studies found positive correlations between students' IL levels and their GPAs (McDermott, 2005; Silvernail, Small, Walker, Wilson, & Wintle, 2008). Do these findings suggest that the Honors students are efficient in doing research and would not need IL training? The average pretest scores of 67% on the first objective and 38% on the second objective for this group suggest that they have ample room for improvement, especially on the second objective (search queries), and could benefit from IL instruction. The findings of Johnson, Anelli, Galbraith, and Green (2011) agree with those of the present study: their Honors students demonstrated the same problems as the others in locating the library's resources.

As explained earlier, the areas of study were broadly defined and do not necessarily correspond to the participants' majors. The findings revealed that the humanities and science students scored higher than business students. Additional research is needed to determine whether students perform better on discipline-specific IL concepts than on general IL concepts. One business librarian found no such correlation (Campbell, 2011) for her business students. In the future, other researchers may

wish to investigate students' IL in relation to their majors.

Are students' performances on the IL pretest associated with the frequency of receiving prior library instruction?

Participants did report having multiple ILI sessions during their undergraduate years at Rider University. Whereas the majority (63%) of freshmen reported having no prior ILI at Rider, by senior year nearly 80% had experienced one or multiple ILI sessions. The finding of no correlation between the frequency of participants' prior ILI and pretest scores suggests that students might not develop IL skills through the "law of exposure" (Matthews, 2007). What they learn may not be retained for or transferred to another research experience. Julien and Boon (2004) reported a similar finding of students not retaining their IL learning three or four months after the ILI. Numerous other studies also came to the same conclusion that it is erroneous to assume that one or more ILI sessions in the early college years will prepare students well for higher levels of research work, and students do not become IL proficient from the single-session ILI (Stec, 2006; Lechner, 2005; Johnson, 2011; Mokhtar & Majid, 2011; Wong & Webb, 2011). It can be inferred from these findings that more intensified IL training than the current single-session model needs to take place during the four-year period for students to retain basic IL skills.

Do students improve their IL skills after the ILI?

The pretest data revealed that the IL level of all students was relatively low. The overall differences between the pretests and posttests in the CMP-125 students were not significant. This supports other findings that students' learning from single-session ILI is limited (Mokhtar & Majid, 2006; Portmann & Roush, 2004; Hsieh & Holden, 2010). While the credit IL course is not the preferred or the primary way for IL training on most college campuses (Tancheva et al., 2007), some librarians have embedded

themselves in the classroom over a period of time (Steiner & Madden, 2008), or have actually gained grading power (Coulter, Clarke, & Scamman, 2007). Moore Librarians need to investigate other means for working more closely with the professors to integrate IL into their courses in the future in order to increase the short- and long-term impact of ILI.

Reflections on constructing test items

Analysis of responses to several individual test questions provided significant insight regarding students' knowledge and misconceptions. More participants chose to use "a web search engine for a complete list of references on the topic" instead of "an encyclopedia" to find background information on an unfamiliar topic (Q3). The answer for encyclopedia was revised in spring 2011 to include online encyclopedias. As in the previous semester, the majority of participants chose to use the Web over an encyclopedia. Many faculty members agreed with students and considered a Web search engine a better tool than encyclopedias for background information. Even though librarians prefer encyclopedia sources for their reliability, it is hard for the library reference sources to compete with the easy access of Web search engines. This preference of users, including faculty members, for using the Web over traditional reference sources is an established trend that was documented a decade ago in Rockman's (2002) study. Considering the development of the Web sources over the past decade, the Web could be considered acceptable for this question on most topics, if not all.

Participants' accuracy rates for the Boolean operators (AND/OR) in Q7 and Q9 were in 30% to 40% range. Biddix, Chung and Park (2011) observed that library databases, with their subject, thesaurus and Boolean operators search systems, are too complicated and problematic for students. Burkhardt (2007) was dissatisfied with students' improvement on Boolean operators over a three-credit IL course. The authors of the current study agree with

Kolowich (2011) that the majority of students do not understand search logic and would have great difficulty finding good sources. To master the basic search logic, students need to learn the operators' functions correctly and need practice to reinforce their learning.

Few students reported they would search for critiques of literary works by subject in the catalog as indicated in Q6. Rider students were not exceptional when compared with those in the study of Byerly et al., (2006) where only 1.6% of students chose the correct answer for the question on subject search. Many more studies in the literature also found students' lack of knowledge on subject or controlled vocabulary (Matthews, 2007; Brown & Krumholz, 2002; Lindsay et al., 2006; Riddle & Hartman, 2000). In discussions with Rider faculty members about the question, some of them disagreed with the importance that librarians tend to place on subject searching; they preferred keyword searches instead. As experienced researchers in their fields, these faculty members may know how to use the appropriate keywords to find relevant items with considerable efficiency. They are also motivated to spend the time to sort through large numbers of returns for their studies. But the same knowledge and search mode cannot be expected of most freshmen and sophomores. Even though librarians would like to teach students about the concept of subject and controlled vocabulary, various factors, including ingrained personal preferences and habitual research patterns may make learning this concept a challenge.

Few participants had prior knowledge about the use of truncation (Q8, Figure 7). Students in other institutions also had trouble with this concept (Matthews, 2007; Furno & Flanagan, 2008). Even though participants improved significantly in the posttest, it remains the case that a minority (30%) scored correctly on the question after the ILI.

More participants chose journals than books as their source even when books may have been

more appropriate (Q10). Other researchers also noticed that college students are overlooking the value of books and printed materials (Rockman, 2002; Head, 2012) and do not understand the limitations of scholarly journals (Furno & Flanagan, 2008; Schroeder & Mashek, 2007; Stec, 2006).

The finding that students were weak in constructing search queries prompted the Moore librarians to spend more time explaining the search concepts in the sessions. Vocabulary may play a part in students' understanding. Defining terms such as "truncation" or avoiding library jargon may improve students' search skills. Video clips and tutorials were included in the class research guides to help students learn and review the search logic and processes. Knowing that those students who had prior ILI sessions might not remember or transfer that knowledge in more advanced classes, some librarians used the inquiry method to determine what these upper class students might already know about IL. If a majority of students could answer the questions correctly, then the librarians would skip teaching those concepts. The assessment findings also helped librarians work more closely with the class faculty to include IL concepts in their assignments.

Limitations

Moore librarians, in teaching the course integrated one-session ILI, face serious limitations and obstacles that the teaching faculty does not. Professors in a variety of disciplines request ILI and have different requirements for their assignments. Further, even though the librarians were aware of the common IL objectives for students as well as the items on the tests, they necessarily taught to the assignments, not to the tests. Some IL concepts received greater emphasis than others during the ILI sessions. This lack of uniformity and control by librarians in teaching IL is common for the single-session ILI in most colleges. It would help if, in the future, librarians record which IL concepts they teach in each session.

This will allow for more precision in assessment by relating what is taught to what students learn in the sessions.

Owing to the limited class time in the session, the test instruments were very brief and used only multiple-choice questions. The number of questions was not large enough to provide a comprehensive picture of students' IL skills. Multiple-choice questions are limited when it comes to assessing participants' higher order thinking skills (Oakleaf, 2008). Nevertheless, the format is still widely used by researchers and educators because access, data gathering, tabulation, and analysis are comparatively easy (Hsieh & Holden, 2010). As suggested by Suskie (2007) and Oakleaf (2010), there is no single instrument that can provide a comprehensive picture of IL competency. When practicable, it is best to use multiple instruments— at least enough to supplement the perspective gained from a single assessment tool. These could include students' reflections on their learning, one-minute papers and librarians' reviewing of students' papers to evaluate students' application of research concepts and methods in actual productions. In addition, performance measures, such as timing how long it takes students to complete searches, may be useful, even though this method would be highly sensitive to individual differences and learning styles.

The tests used in the current research were developed over the course of two years. The participants taking each test were the students in the ILI sessions of each semester. There is a certain limitation in making comparisons among the different cohorts because each cohort may have experiences that are different from the other cohorts (Furno & Flanagan, 2008). Nevertheless, the tests on the same concepts over the semesters captured accumulated snapshots of data that revealed the strengths and weaknesses of not only the specific cohorts at specific moments in time, but also over the longer-term, in this case two years.

The librarians found it challenging to develop perfect questions. Even though the librarians encouraged students to use reference resources that are considered more reliable than the freely available but, qualitatively, highly inconsistent sources on the Web (Q3), and they would also like students to learn about subject searching in the catalog because it is an efficient search method (Q6), these questions could arguably have more than one correct answer depending on user preferences and topics. The minor revision in the test questions in spring 2011 may have also affected test results albeit the impact seemed insignificant. The authors continue to improve the assessment instrument, including developing questions with multiple correct answers and the opportunity to select multiple responses for each question. These changes will reduce the impact of guessing and increase the psychometric quality of the items. The librarians also intend to develop alternate versions of the test so different pretests and posttests can be employed. This will reduce the effect of memory for prior responses on performance and provide a better estimate of learning.

Conclusions

Despite the described limitations, the brief tests yielded meaningful information about the students' IL abilities for the Moore librarians, allowing for adjustment of IL instruction and future assessment. Among the findings, the IL program reached over 70% of the undergraduates beyond their freshmen year. Students' IL levels on the first two IL objectives were relatively low, but significantly higher for IL Objective 1 than for IL Objective 2. This means their skills in identifying needed resources (ACRL IL Standards 1) were higher than those related to information access (ACRL IL Standards 2). More importantly, students' basic IL levels correlate positively with their academic levels (e.g. the Honors group), but not with their class years (e.g. freshman, sophomore) or with the number of prior IL instruction they received. The pretests and posttests of the Research Writing classes

revealed that students' gains over one-session ILI were limited. Participants did improve significantly after the instruction on two IL concepts: truncation and subject searching in the catalog.

The finding that students did not improve their IL skills significantly via single-session ILI is not new to the literature. On the other hand, the literature contains very few investigations into students' longer term learning outcomes in IL. This study shows participants not demonstrating progress in IL despite possibly multiple prior ILI over a span of years. This finding suggests that students in all class years (including graduate students) need continued reinforcement of basic IL concepts and skills.

The findings raise the important question as to what can be done to help students learn and retain IL more effectively in college. More – and multiple – teaching strategies, including a combination of online, face-to-face, embedded librarian, credit course, and curriculum mapping may be considered in the library's future instruction program as resources are made available. The librarians have also considered other curricular changes such as providing students and/or teaching faculty with answer sheets with rationales for each response for continual learning. In addition, the Moore librarians planned with professors in experimenting different pedagogies to reinforce student learning of IL in the following semester. One had classes preview IL research guides and take a graded quiz before ILI, another included interactive learning activities during the ILI, and the other had multiple ILI and follow-up sessions. Comparisons of these approaches will help determine which teaching methods might be the most effective means for helping students improve their IL skills.

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Appendix A

Test Questions for IL Objective 1 (Questions 1 - 5) [Correct answers are *italicized*]

1. Typically a library's online catalog contains:
 - a. *Information about books, videos, and other nonprint items in the library*
 - b. The complete text of the journal articles in the library
 - c. Information about the college's courses
 - d. Full-text books
 - e. Don't know

2. Which of the following would be the best tool to use to obtain journal articles for your topic "autistic children"?
 - a. The library's online catalog
 - b. *A library's database/index*
 - c. An encyclopedia
 - d. Google
 - e. Don't know

* Answer b changed to "A database such as Academic Search Premier" in spring 2011.

3. You have gotten an assignment on "watersheds" which you know very little about. What's the first thing you should do to get started?
 - a. Browse the library shelves for books on watersheds.
 - b. Type "watersheds" in a web search engine for a complete list of references on the topic.
 - c. Ask your friends if any of them know about your topic.
 - d. *Find out some basics on watersheds from an encyclopedia.*
 - e. Ask the professor if you can change topics.

* Changed the question to:

You have gotten an assignment on "watersheds" about which you know very little. What's the best way to get an overview of this topic?

* Answer d changed to "Find out some basics on watersheds from an encyclopedia (online or print)" in spring 2011.

4. Which of the following are characteristics of scholarly journals?
 - a. Contain colorful, glossy pages and typically accept commercial advertising.
 - b. Mainly for the general public to read.
 - c. Report news events in a timely manner.
 - d. *Articles include detailed references.*
 - e. Don't know.

5. What is the easiest way to find out if the library has the 1998 issues of *Journal of Communication*?
- Search the library's periodical shelves.
 - Search "Journal Holdings" on the library Web page.*
 - Search Google Scholar.
 - Search NoodleBib.
 - Don't know.

* Question changed to "What is the best way to find out if the Rider University Libraries have the full text articles of the"

Appendix B

Test Questions for IL Objective 2 (Questions 6 - 10) [Correct answers are *italicized*]

To find the critiques on William Shakespeare's play *Romeo and Juliet*, in the Online Catalog, I would do a search:

- By title
- By keyword
- By subject*
- By author
- Don't know

* Question changed to "What is an efficient way to find critiques on William Shakespeare's ..." in S6.

7. Which is the correct search strategy to combine terms with the operators (AND, OR)?
- Death penalty or capital punishment and women
 - Death penalty or (capital punishment and women)
 - (Death penalty or capital punishment) and women*
 - (Death penalty and women) or capital punishment"
 - I don't know

* Question changed to "Which search statement is correct when you search for information on the topic 'Should women be exempt from death penalty?'" in spring2011.

8. *Truncation* is a library computer-searching term meaning that the last letter or letters of a word are substituted with a symbol, such as "*" or "\$". A good reason you might truncate a search term such as *child** is that truncation will
- limit the search to descriptor or subject fields
 - reduce the number of irrelevant citations
 - yield more citations*
 - save time in typing a long word
 - I don't know

9. In order to find more documents on my topic I can include synonyms in my search statement. To connect those synonyms in my statement, I use:

- a. AND
- b. +
- c. NOT
- d. OR
- e. I don't know

10. Choose the best place to find a reliable and detailed history of television in the US for a research paper.

- a. Book
- b. Website
- c. Magazine/newspaper
- d. Scholarly Journal
- e. I don't know

*Question changed to "Choose the best place to find a reliable and thorough history" in spring 2011.