Direct Assessment of Information Literacy using Writing Portfolios

by Davida Scharf, Norbert Elliot, Heather A. Huey, Vladimir Briller, and Kamal Joshi

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An investigation into the effectiveness of information literacy instruction for undergraduates at a technological university suggested some deficiencies in students' information literacy skills. Also shown is that a careful and rigorous approach to assessment can provide the basis for improvement.

Davida Scharf is Director of Reference and Instruction, Van Houten Library, New Jersey Institute of Technology, Newark, NJ 07102, USA <davida.scharf@njit.edu>;
Norbert Elliot is Professor, Department of Humanities, New Jersey Institute of Technology, USA <norbert.elliot@njit.edu>;
Heather A. Huey is Information Literacy Librarian, Van Houten Library, New Jersey Institute of Technology, USA <heather.a.huey@njit.edu>;
Vladimir Briller is Director of Strategic Planning and Institutional Research, Pratt Institute, USA <vbriller@pratt.edu>;
Kamal Joshi is Database Manager, Office of Institutional Research and Planning, New Jersey Institute of Technology, USA <jk3@adm.njit.edu>.

Introduction

While academic librarians have taken the lead in defining and characterizing information literacy, authentic assessment models are needed. As the concept of information literacy becomes an increasingly important part of the nation's higher education agenda, faculty, librarians, and administrators need tools to evaluate the information literacy abilities of students. This paper addresses that need.

Librarians and administrators have thus far focused primarily on assessment methods using surveys and multiple-choice tests. These methods can be difficult and costly to develop and administer and often provide limited information about performance. Nevertheless, as the stakes are raised, will educators have no choice but to use a national standardized multiple-choice test of information literacy? Such a limited-response test could provide the opportunity for cross-institutional comparisons, and such comparisons are important. Yet such tests may not be well-suited to the task of evaluating higher-order skills, such as a student's ability to integrate new information. Take for example a typical question where selection of a multiple-choice answer asks a student to distinguish between books and journal articles, or select the optimal search terms for a given topic. These may be good predictors of basic search skills, but it is difficult to devise questions to adequately assess a student's ability to use new information analytically to achieve a defined purpose. As well, such tests will not necessarily address the information literacy needs of a particular group of students within a defined university community, skills that may vary according to institutional mission or academic major.

"...we noticed parallels between teaching and assessing writing that could be applied to teaching and assessing information literacy."

Seeking an alternative assessment method that would allow us to investigate the context of information literacy within our university, we noticed parallels between teaching and assessing writing that could be applied to teaching and assessing information literacy. Both writing and information literacy

are iterative processes that require evaluation of information, critical thinking and reasoning, revision and integration. Both involve learning a complex set of skills. Our humanities faculty colleagues assured us that the experience of college composition instructors documents many of the same problems and questions we began to ask about the teaching and assessment of this newly defined literacy. So Lindauer's suggestion that one of the arenas for assessment may occur during the collaboration between the classroom instructor and the librarian led us to look carefully at our own programs for an appropriate assessment arena.[1] Our existing writing portfolio assessment program seemed a good fit. Student writing portfolios, vehicles that capture student work on a longitudinal basis, allow insight into process and product.[2] As defined by Huot they are "part of a tradition in the visual and performing arts that looks at multiple products and processes, hoping to discover and document the progress of an individual student or learner." The assessment program had been successful in achieving important improvements in the New Jersey Institute of Technology (NJIT) writing program and had the added benefit of overcoming negative attitudes toward assessment while integrating assessment and teaching.[3]

Thus began our project to employ replicable yet authentic research methods for information literacy assessment. Librarians have shown leadership in raising awareness of information literacy in higher education, but we can continue to make significant contributions by employing a rigorous yet context-sensitive approach to its assessment. Such an assessment methodology should be possible without undue burden on the university community, we felt, and it should provide meaningful data to librarians, faculty, and administrators in order to make valid inferences about student and institutional performance for the purpose of continuous improvement of instruction. Librarians and classroom instructors want to assess the skills of their students within their own institutional contexts and specific courses. Such local assessment, often termed "authentic assessment," has the power to improve student performance and provide insight into learning.[4] The more librarians and instructors know about the contact zone in which information learning occurs, the better the chance of realistically implementing a continuous circle of improvement in which the results of assessment are used in the classroom in order to enhance student performance.[5] This study illustrates a method of evaluation that offers quantifiable assessment of the effectiveness of the information literacy component of an undergraduate post-secondary education.

Objectives of the Study

There were three objectives of this study: (1) to create an adaptable and replicable assessment model using student portfolios, (2) to employ this model to design a baseline assessment of the information literacy abilities of our own students, and (3) to use the results of the assessment to address instructional issues raised by the assessment.

Literature Review

Our literature review focused on assessment of information literacy and sought to uncover instances of authentic assessment of student work product, especially those using a quantitative approach. A search for early studies on the effects of information literacy on student performance revealed only a relevant 1989 recommendation in the Final Report of the American Library Association's Presidential Committee on Information Literacy.[6] One suggestion for the national research agenda addressed outcomes of what was termed "information management skills." The Committee asked research librarians to study how information management skills affect student performance and retention. In 2000, following review by the ACRL Standards Committee, the ACRL Board formally approved five standards and guidelines for information literacy: that the information literate student determines the nature and extent of the information needed; that the information literate student accesses needed information effectively and efficiently; that the information literate student evaluates information and its sources critically and incorporates selected information into his or her knowledge base and value system; that the information literate student, individually or as a member of a group, uses information effectively to accomplish a specific purpose; and that the information literate student understands many of the economic, legal, and social issues surrounding the use of information and accesses and uses information ethically and legally.[7] The ACRL Board, however, did not address the issue of assessment at that time. The ACRL "Research Agenda" of February 2003 called for evaluation of instructors and programs, learning outcomes, and transferability of successful programs.[8] In June 2003 the ACRL Board approved the "Characteristics of Programs of Information Literacy that Illustrate Best Practices: A Guideline" which provided some detail on program assessment. Category 8 in that document called for assessment planning, integration with course and curriculum assessment, measurement, and suggested that multiple methods for program evaluation would be needed.[9]

Higher education's accreditation agencies agreed and the ACRL Standards were adopted by the ACRL Board, the American Association of Higher Education (AAHE), the Council of Independent Colleges, and the Middle States Commission on Higher Education (MSCHE), the accrediting body for the Northeast. When accreditation agencies such as the Middle States Commission refocused their "characteristics of excellence" to include information literacy, they ensured that institutional commitment and research on learning outcomes in information literacy would expand beyond the library.[10] Yet to the extent that accreditation agencies set goals but do not provide strategies, these agencies give little guidance; if we look to such agencies, there is little to be found on methods of information literacy assessment. This is not a new challenge. Although accreditation agencies had already called for assessment of higher-order learning skills in general, by 2000 few institutions had done soperhaps because of the complexity of the task, perhaps because of the absence of assessment models as noted by Lazerson.[11] Since our study was undertaken, Middle States Commission has published a brief guide to "Assessing Student Learning and Institutional Effectiveness," but it describes characteristics of desired assessments rather than models.[12] The Collegiate Learning Assessment Project was initiated in 2000 to devise an assessment instrument that would measure "not the particular facts students have memorized but, rather, how well they have learned to *think*," but this tool is not specific to information literacy.[13] Meulemans's review article traced the roots of information literacy assessment in the coming together of the higher education assessment movement, strategic planning, and Total Quality Management, with information literacy initiatives.[14] Hernon and Dugan's book on outcomes assessment in higher education provides some theoretical guidance on issues

and challenges in developing tools for direct assessment of student work product.[15] Little, indeed, has emerged since Lazerson's assessment in 2000 as evidenced most recently in "Measuring Up 2006," the National Report Card of the National Center for Public Policy and Higher Education. In that report, as Peter Ewell comments, "More authentic and comprehensive assessments – ideally constructed to examine how much students have grown during the college experience are badly needed."[16]

Contemporary Assessment Methods

In discussing the trend in higher education toward outcomes assessment and the implications for information literacy assessment, librarians Pausch and Popp mention using portfolios of student work as an assessment method.[17] A more recent case study by Carol Rutz[18] of writing portfolio assessment showed that faculty participation provided significant effects in the curriculum and student learning. Snavely and Wright documented their experiences and provided a model for using research portfolios for information literacy assessment in an undergraduate honors program, but nothing is empirically known about the abilities of readers to reach consensus on the assessment of information literacy.[19]

While most academic libraries provide some form of library instruction, quantitative assessment studies thus far have been relatively rare. Authentic assessment of student performance has been even rarer. As noted above, librarians typically use indirect assessment employing interviews, focus groups, and survey techniques to measure information literacy. For example, Valentine[20] used focus groups to study undergraduate research behavior. Most studies of library quality assess service rather than learning outcomes though satisfaction with library instruction may be included.[21] Many libraries, including our own, the Van Houten Library, conduct focus groups to evaluate library and improve services in general, but rarely publish the results. These studies can provide some practical insights into the level of familiarity with library services and resources, but provide little insight into the information literacy of the participants, or effectiveness of the instructional programs. Singh, for example, surveyed faculty teaching in programs accredited by the Accrediting Council on Education in Journalism and Mass Communications (ACEJMC) in 20022003 to measure their perceptions of their students' information literacy skills.[22]

Typical among direct information literacy assessment tools is the test or questionnaire. O'Connor, Radcliff, and Gedeon, librarians at Kent State seeking to develop a standardized tool for measuring student information literacy at the institutional level, conducted a literature review in 2002.[23] They recognized three categories of literature on information literacy assessment: (1) those studies describing the need for assessment, (2) theoretical articles about types of assessment; and (3) reports of assessment projects. Out of this work they developed Project SAILS, a Web-based standardized test of information literacy skills, based on ACRL standards. The SAILS assessment instrument employs item response theory as the measurement model and is intended to enable libraries to document information literacy skill levels for groups of students and to pinpoint areas for improvement.[24] The authors expressed the hope that it will be widely used both to assess students individually, collectively, and longitudinally and to provide for institutional assessment and benchmarking.

Concurrent with the development of Project SAILS at Kent State, the movement to develop a test of information literacy was well under way in the California State University system led by librarians Breivik and Rockman.[25] Dunn's "Progress Report" on information literacy at the California State University in 2002 outlined a multi-pronged and multi-phased assessment approach that relied heavily on questionnaires and surveys.[26] It also described their intention to use innovative scenario-based testing that has evolved into a relationship with the Educational Testing Service to tackle the problem of information literacy assessment within a computer-mediated environment.[27] Another computerized test, the Information Literacy Test (ILT) was developed collaboratively by the James Madison University (JMU) Center for Assessment and Research Studies (CARS) and the JMU Libraries. ILT is a multiple-choice test similar to Project SAILS that does not assess ACRL Standard 4. Standard 4 requires students to use information to accomplish a purpose. Thus, a task requiring student initiated work, rather than passive selection among a limited number of responses, would be more conducive to evaluation of the high-order thinking skills needed to create new knowledge, a kind of thinking "which requires a constructed response for evaluation."[28] The Collegiate Learning Assessment (CLA), developed by the Council for Aid to Education (CAE) and the Rand Corporation, takes a scenario-based approach similar to that of the Educational Testing Service and is the only computerized test found that attempts to measure constructed responses. However, the CLA aims to assess general education outcomes only broadly including information literacy.[29] At this writing many libraries are still creating locally developed tests, but SAILS and the new ETS Information Communication and Technology (ICT) Literacy Assessment are emerging as the two most likely to become the standard indirect assessment and cross-institutional benchmarking tools, and neither includes student-constructed responses.

An alternative methodology that sought to evaluate student work directly rather than by multiple choice test was described by Cooney in a case study model designed to simultaneously improve and assess information literacy in a graduate business course at Long Island University.[30] Their model combined collaboratively setting instructional goals for information literacy, and designing assessment tools to evaluate the effectiveness of the instruction within one business course. The assessment toolbox included a "Learning Outcomes Checklist" which consisted of twenty outcomes that were assessed on a five-point Likert scale by the faculty and librarians "as a means to evaluate the outcomes of the students' information literacy as evidenced in the written term project." In that study the outcomes checklist focused exclusively on the abilities of students to identify, evaluate, and cite their sources. We sought to adapt that tool to include evaluation of the higher-order information literacy skills we believed would also be evidenced in the student work. Over time, we hope to use it on a larger scale to assess the effectiveness of cumulative instruction over several years.

Portfolios as Vehicles for Assessment

Since 1996, the Department of Humanities at NJIT has conducted an undergraduate writing portfolio assessment project. In the early twenty-first century, informed portfolio assessment is understood as a valid choice in its promise to link classroom instruction and assessment practices. Model pro-

grams have received extensive documentation, and new conceptual models have been offered that emphasize the values of local institutions. Such model programs underscore the significance of feedback, a process that allows the results of the assessment to be used to inform teaching, faculty development, learning outcomes, and transform the curriculum itself.[31] "When time and resources permit and leadership is well informed," writing assessment specialist Edward M. White has observed, "a writing assessment today will be a portfolio assessment."[32] At NJIT, portfolios are used within a series of courses offered from the first to the senior year, to gain information about student performance in courses such as first-year writing, cultural history, technical writing, and senior seminars.[33] It was on this foundation that the information literacy assessment described here was built.

Study Design

Seeking a baseline assessment of the effectiveness of a four-year college education in teaching information literacy skills, researched term papers were selected from the writing portfolios of graduating seniors taking a required capstone seminar in the humanities at NJIT, a public comprehensive technological university in the Northeast U.S. Four analytic scores and one holistic score were given to the final research papers in the student writing portfolios. A set of five traits tied to the ACRL standards were used to measure independent variables of performance on a six-point Likert scale. A standard six-point scale was used because it has been found by raters in the NJIT writing portfolio assessment project to yield acceptable reliability. Our hypothesis was that students near completion of an undergraduate degree would exhibit the traits of an information literate person in their written work, and we thought their performance might correlate positively with their course grades and overall (cumulative) GPA. While correlations with course grades would provide information about the place of information literacy within the subject matter at hand, correlations with the overall GPA would yield information about the place of information literacy within the undergraduate curriculum. While many variables are clearly in play within an undergraduate education, both course grades and cumulative GPA are standard comparative "markers" in educational research. Relationships with admissions test, other traditional markers, would also be examined.

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Community Formation: Librarians and Instructors

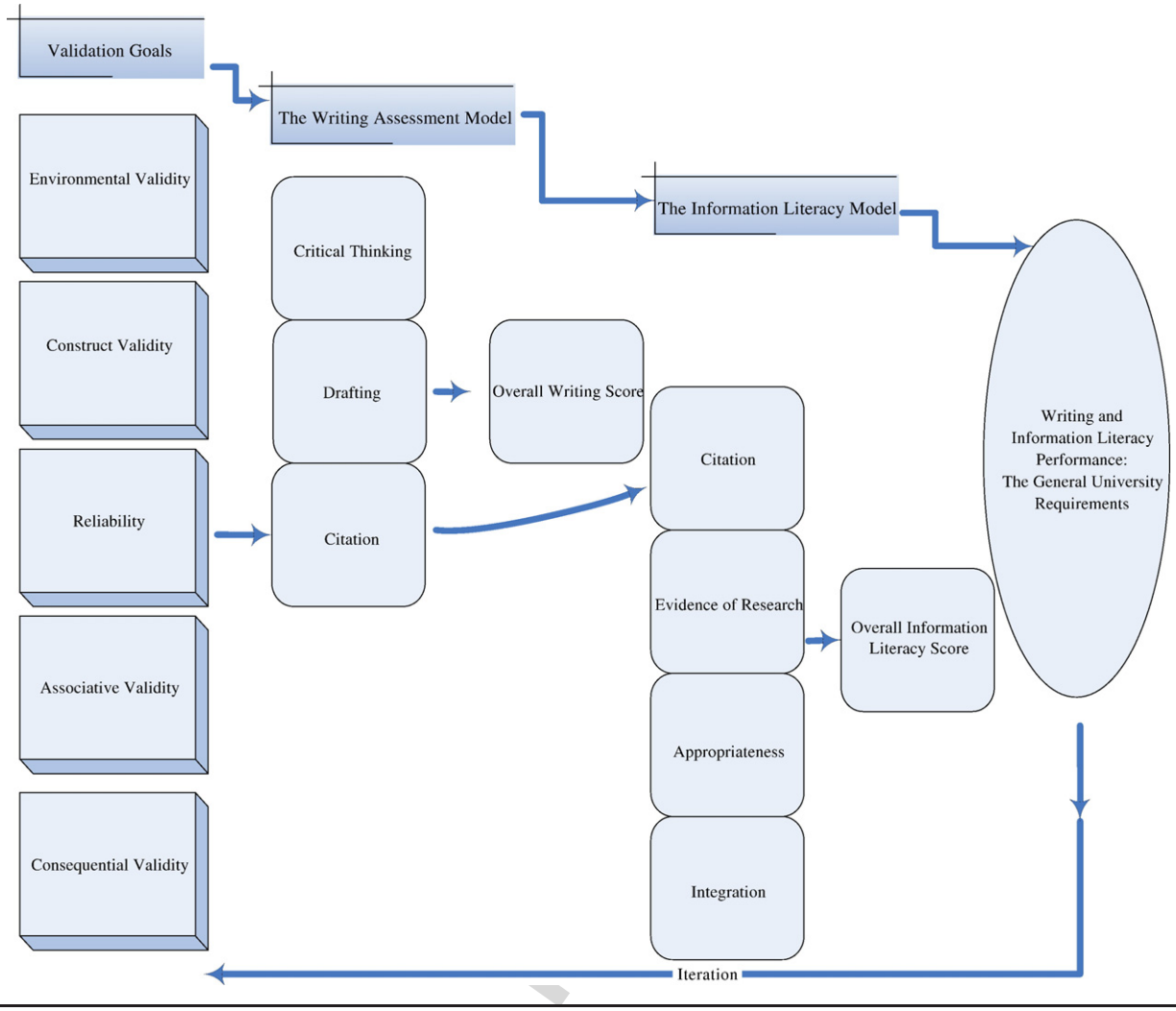
During the spring of 2005, two librarians became an integrated part of the Department of Humanities, whose focus in a technological university is centered on the university's undergraduate General University Requirements (GUR) in various areas of the humanities such as composition, literature, history, and philosophy. English literature is not offered as a major at NJIT. The senior-level courses in the present study were taken by students enrolled in all NJIT technically oriented majors. Following the model offered by Lindauer, each of the librarians began to work closely with the instructors in the senior seminars to provide information resources for topics within the seminars and to deepen the concept of information literacy.[34] Thus, the librarians became integrated into an academic unit teaching basic critical thinking, reading, writing, and research skills. While studies of citation behavior such as that performed by Carlson must sample across multiple departments, the Department of Humanities with members holding advanced degrees in anthropology, history, philosophy, and policy studies hosts classes across the entire undergraduate curriculum for approximately 7000 students each year.[35] Thus, our cross-curriculum study could be undertaken within one academic unit. Throughout the spring semester the librarians worked with the academic unit on the basis of an assumption of shared responsibility, an acknowledgement of interconnectedness, and a commitment to integrity that has developed around a common purpose.[36]

Development of Criteria: The Variables of Information Literacy

Both librarians and instructors recognized that students had difficulty citing sources, as scored in the writing assessment as the citation variable the previous semester. Analysis of the results of the fall 2004 portfolio reading of students enrolled in the NJIT capstone seminars – a cohort of humanities courses taken by all senior-level students indicated that these students were doing poorly in their ability to cite sources, one of the three independent variables of the writing model that assessed citation, critical thinking, and drafting. In assessing the portfolios of these senior-level students ($n = 80$), we found that the scores on critical thinking and drafting met the cut score but that the citation variable received scores that were unacceptably lowa finding validated by the senior seminar instructors who had repeatedly reported weak research skills among our students.[37] So the librarians carefully examined the portfolios collected for the fall 2005 assessment to articulate a local information literacy model that would meaningfully explore information literacy beyond simple citation. Five assessment variables were developed and each variable was defined in the assessment scale shown in Appendix A, each chosen to align with ACRL competency standards 1–5 shown in Appendix B. The variables chosen for evaluation were ones deemed by the librarian team to be assessable solely from the written work. Due to time constraints, it was the decision of the research team to limit this study to the student work as presented. Though evidence of process as exhibited in the writing portfolio is usually limited, inclusion of multiple drafts can provide some insight into the pathways and choices made by the student as the work progressed. Librarians and instructors did have access to the course syllabi during criteria development and portfolio reading and earlier drafts of the research papers.

Though fairly complex, each variable was given a simple label: Citation, Evidence of Independent Research, Appropriateness, Integration, and Overall Information Literacy Portfolio Score. While we will turn to an elaboration of the model in Fig. 1, it is important to recognize that librarians and instructors

Figure 1
The NJIT Writing and Information Literacy Assessment Models



intended, from the beginning, to design a relational model to capture the variables of information literacy. The model, we reasoned, would be given initial validity by the ACRL Information Literacy Competency Standards and would achieve further validity if the variables could be identified along a continuum in the portfolios of students.

Identifying Participants: The Sampling Plan

After the end of the spring 2005 semester, writing portfolios were selected for inclusion according to a sampling plan designed to yield the smallest number of portfolios that could be read while allowing confidence in the sample.[38] Our study employed the same plan used for the writing assessment program that has consistently been found to be highly representative of the NJIT undergraduate population. First calculations are made to determine a meaningful sample size (yielding a confidence interval of no less than 75 percent) that can feasibly be read by the number of available instructor-readers. The student participants are randomly selected using the student information system during the last weeks of class—a period selected to minimize instructor bias in portfolio preparation and to include only those students who have remained beyond the withdrawal date. Then instructors are notified which portfolios must be collected, and these are retained in the department after the close of the semester. We used this method during the spring of 2005, with twenty-one sections of senior seminars offered to 404 students, to gather a sample of 100 writing portfolios containing research papers for our assessment.

The sampling plan yielded a solid representation of the demographic diversity present in the graduating class. During the spring of 2005, the demographic profile of our diverse senior students was as follows: male ($N=1282$, 79.9 percent), female ($N=322$, 20.1 percent), African American ($N=162$, 10.1 percent), Asian American ($N=162$, 22.5 percent), Hispanic ($N=215$, 13.4 percent), Caucasian ($N=564$, 35.2 percent), and unknown ($N=212$, 13.2 percent). Comparatively, the 100 students in our sample had a similar demographic profile: male ($n=74$, 74 percent), female ($n=26$, 26 percent), African American ($n=11$, 11 percent), Asian American ($n=29$, 29 percent), Hispanic ($n=14$, 14), Caucasian ($n=31$, 31 percent), and unknown ($n=15$, 15 percent). Our sampling plan, used since

1996, had served us well in providing a representative group of NJIT senior-level students.

Elaboration of the Model

For many years, information literacy at NJIT was woven into the curriculum as a function of faculty interest combined with librarian advocacy, but was not taught explicitly in any specialized credit-bearing course. In academic year 2005–2006 a systematic program was instituted that provides basic bibliographic instruction by a librarian to all freshman in at least two class periods from the required freshmen composition course and required first year seminar course, but this was not the case for the seniors in the cohort we studied. Because little formal attention had been given to information literacy, we designed a fully articulated description of our variables that was also used as the scoring sheet (Appendix A). We turn now to a discussion of each of the variables.

Citation

In previous assessment work by Humanities faculty, the citation variable was judged as the ability of students to properly cite their sources according to Modern Language Association (MLA) style. The meaning of this trait was expanded for our purposes. It was believed that citing sources so they could be found was more important than strict adherence to a standard citation style. If all the elements necessary to easily locate a referenced work were present and clear, it would seem to be strong evidence that a student understood the particular attributes of a source, even if the punctuation or capitalization might be non-conforming, thereby evidencing competence in ACRL Performance Outcomes 2.5, c and d. Competence would be exhibited if students differentiated between types of sources and included all pertinent information in the varying cases so that sources could be retrieved by a reader without undue burden. For example, in the case of a print source, the place of publication of a book is not as important to locating it as the date of publication. Locating a cited article using only an author, and article title, but no source, date, or volume and issue number, would place an undue burden on the reader, requiring a multi-step search to verify the full citation in order to locate the full text. Similarly, a URL without a sponsoring organization, author, or other identifying information, could prove impossible to locate should the site change or disappear. A multi-line URL copied from a commercial database as a substitute for an article reference would indicate a lack of understanding of how information is produced, organized, and disseminated, a failure to show evidence of ACRL Performance Outcome 1.2.a. Finally, consistently following proper citation style and usage for both in text and cited works seemed to us to comply with ACRL Standard 5 because it shows that the student acknowledges the intellectual property issues surrounding information use in our society.

Evidence of Independent Research

We sought evidence in student papers that relevant research had been conducted that went beyond the syllabus and sources recommended by the instructor. We believed that if the student sought ideas from a variety of additional sources to become truly informed about the topic at hand, it would be good evidence that the ACRL Standards 1 and 2 were being met. Papers with little variety or diversity of sources in scope, subject, and format, were less likely to have been well-researched.

Appropriateness

In this measure, we sought to determine if students chose good quality sources that were not only relevant, but had a high probability of being accurate and authoritative. If so, they were meeting Standards 1 and 3 that require the information literate student to evaluate information and its sources critically and to incorporate selected information into his or her knowledge base and value system. Standard 4 states that ''The information literate student, individually or as a member of a group, uses information effectively to accomplish a specific purpose.'' If a student was able to use outside information as part of the knowledge base on which an essay was developed, we considered this standard had been met.

Integration

In this measure we sought to determine if sources were fully integrated into the paper. To judge the work against ACRL Standards 3 and 4, the reader is now asked to begin to evaluate the arguments and ideas presented in the work. Were the sources consulted merely cosmetic in nature, or included solely to fulfill a source requirement? Evidence of integration would include the use of concepts from outside sources to build a foundation, compare, contrast, and refute arguments. The use of in-text citations relevant to concepts and arguments made would be further evidence. Could the evidence and arguments presented in the paper have been made without the outside reading? We sought to measure the degree to which a student was able not only to summarize the main ideas from sources consulted (ACRL Performance Indicator 3.1), but to synthesize ideas to construct new concepts (ACRL Performance Indicator 3.3). To meet Standard 4, to use ''information effectively to accomplish a specific purpose,'' the sources cited should have been used reflectively in the paper. Specifically, if a student was able to use outside information as part of the knowledge base on which the essay was developed, we considered that ACRL Performance Indicator 4.1 had been demonstrated.

Overall Information Literacy Portfolio Score

The overall score was designed to address the overarching ACRL demand for information literacy, the totality of information literacy, rather than a sum of the local criteria. There are certainly many more criteria that could be identified as information literacy skills that we did not include specifically in our assessment rubric. Hence, following the writing assessment model, we included this holistic score to represent the overall student competence.

Planning the Reading, Analyzing the Results

As is the practice each semester, the 13 humanities instructors who had taught the 21 sections of capstone seminars read the sample of students' portfolios according to the traditional writing model. Following that reading, the instructional faculty with the addition of 4 librarians were invited and participated in a second reading of the same portfolios to evaluate students' information literacy. On the first day of the reading, sample portfolios were used as models to orient readers to the assessment process. The seventy-five minute orientation included independent scoring by readers of the samples followed by

Table 1
Means, Standard Deviations, and Range for the Two Assessment Models

	Mean	SD	Range
The information literacy variables			
Independent variables			
1. Citation	6.68	3.01	2,12
2. Evidence of independent research	6.46	3.25	2,12
3. Appropriateness	6.24	3.0	2,12
4. Integration	6.05	2.86	2,12
Dependent variable			
5. Overall information literacy portfolio score	6.14	2.90	2,12
The writing portfolio variables			
Independent variables			
1. Critical thinking	8.94	1.46	4,12
2. Drafting	7.73	2.65	2,12
3. Citation	7.45	2.61	2,12
Dependent variable			
4. Overall writing score	8.89	1.50	4,11

group discussion that enabled readers to calibrate their assessments and come to agreement about the parameters that would ensure consistency. A three hour reading followed the orientation and two additional hours of readings the following week were needed to complete the scoring of the 100 portfolios and to make any necessary adjudication. The combination of the scoring sheet shown in Appendix A and the sample portfolios selected for training ensured that readers would score according to the functional performance level expressed in the scoring sheet (a criterion-referenced approach) as well as calibrate performance within the range of student sample portfolios (a norm-referenced approach). Each portfolio was read independently by two readers, and steps were taken to make sure that the readers did not know each other's scores. In addition, none of the instructors read their own students' portfolios. Each portfolio score would be the total of two reader's scores so that discrepancies would not be masked by averaging. Following the writing assessment model, the information literacy assessment model held that any score on any of the four independent variables or on the overall information literacy portfolio score would have to be adjudicated by a third reader if the first two readers did not award matching or adjacent scores. Thus, a portfolio receiving a score of 5 (indicating that the first reader strongly agreed with the statement provided in the scoring sheet) and a score of 3 (indicating that the second reader disagreed with the statement) would be sent to third reader who would then make an independent judgment and resolve the discrepancy. For consistency, in cases where a third reading could be resolved in either direction (e.g., reader 1 = 4, reader 2 = 2, reader 3 = 3, then the higher score (7)) would be awarded. Three estimates of inter-reader reliability would be calculated: a weighted Kappa, Cronbach's *a*, and Pearson's *r*.[39]

After the reading was completed, correlations of the variables to the course grade, as well as to each student's cumulative grade point average, were calculated. Relationships of the variables to admissions tests (the SAT Reasoning Tests in mathematical and verbal ability used before the 2005 College Board revisions) would also be performed. An estimate of the probability value obtained in a .05 test level of significance a control against Type 1, or blindness, error was established for all correlations.

Results and Discussion

As Table 1 demonstrates, the mean scores for all traits on the information literacy model fell below 7 on our scale of 2–12, although each of the writing traits met or exceeded the cut score. On this scale, the faculty developers determined that scores of 6 or below should be considered unsatisfactory, a scoring system in place for a decade in the writing assessment model. Thus, it appears that the writing model suggests that students may be performing satisfactorily in terms of an assumed ability to write researched essays, but the information literacy model demonstrates that such is clearly not the case. Indeed, it appears that the students handled the least complex variable, citation, acceptably

Table 2
Inter-reader Reliability: Senior Seminars, Spring 2005 (*n* = 100)

Variables	Non-adjudicated Weighted kappa	Adjudicated Weighted kappa	Non-adjudicated Cronbach$^{\alpha}$	Adjudicated Cronbach$^{\alpha}$	Non-adjudicated Pearson *r*	Adjudicated Pearson *r*
Information literacy assessment model						
Citation	.587**	.758**	.831	.955	.712**	.914**
Evidence of independent research	.615**	.774**	.866	.960	.765**	.923**
Appropriateness	.604****	.813**	.822	.962	.700**	.928**
Integration	.511**	.750**	.746	.942	.596**	.892**
Overall information literacy portfolio score	.613**	.799**	.835	.953	.718**	.911**

**$p < 0.01$ (two-tailed).

in the writing model ($M = 7.45$, SD 2.61), although this score is below an acceptable level of performance when understood within the information literacy model ($M = 6.68$, SD 3.01). Within this model, students were unable to present the sources used in their research papers so that they could be located by a reader without additional research. As the difficulty of the information literacy variable increased, the scores decreased. Students could find and cite sources better than they were able to judge their relevance and authority, and were even less able to use information they gathered to support their arguments. In that readers did not hesitate to use the full range of scores from 2–12, we have further evidence of the ability of the model to capture the identified variables.

The weakest score in the writing model, for citation, evaluated the ability of the student to cite sources according to MLA style. In our information literacy model it was defined differently—as the ability of students to include all the information necessary to locate a source. Thus, sources with minimal but correctly formatted citations were no longer acceptable and citation scores in the information literacy model fell into the unsatisfactory range. The most abstract skill in the writing model, critical thinking, received the highest scores, while the most abstract of the independent variables in the information literacy model, integration, received the lowest scores. Since these are both higher-order thinking skills, the most likely reason for the discrepancy may be a lack of emphasis in the course on integrating the outside sources into the argument of the paper.

Reliability

A common concern in much educational and social science research involves inter-reader reliability. Was there consistency in the application of the scoring system among readers? Our results showed moderate to high inter-reader reliability. Sixty-nine percent of the portfolios needed no adjudication by a third reader. More significantly, no agreement rate fell below 78 percent. The scores shown in Table 2 are more precise estimates of reliability measured by a weighted kappa, Cronbach's alpha (α), and Pearson's product moment correlation (r). The lowest level of inter-reader reliability was $r = .51$ ($p < .01$) for the non-adjudicated score of the integration variable as measured by the weighted kappa; the highest level of agreement was $\alpha = .962$ for the adjudicated score of the variable of appropriateness. No adjudicated reliability score – the score used to perform the associative analysis – fell below $r = .75$ ($p < .01$). As Moss suggests, evidence of reliability is offered for discussion as part of a comprehensive system designed to reflect a range of educational goals.[40] The solid reliability coefficients reflect the reality that is likely the result of a network of solid communication and understanding built over time; reliability may thus be understood as a consequence of interactions that range from librarian and instructor e-mails regarding instruction and assessment to the discussions following scores reported in statistical tables.

Internal Consistency of the Model

Another important measure is the internal consistency of the model. That is, how well do the traits used in the study relate to each other? Can the dependent variable be predicted by the independent variables? Regression analysis of the information literacy model demonstrates high internal consistency. Relating the overall information literacy score (the dependent variable) to citation, evidence of independent research, appropriateness, and integration (the independent variables) reveals a strong coefficient of determination ($r^2 = .909$, df (4,95), $F = 238.051$, $p < .001$). That is, for the spring of 2005 the first use of the information literacy model it is not by chance that 91 percent of the variability of the overall information literacy portfolio score (the dependent variable) can be explained by the variability of the independent variables (citation, evidence of independent research, appropriateness, and integration). These statistical tests reflect the ability of the assessment model to capture the information literacy behaviors of our students and relate them to their overall information literacy performance. Indeed, the model appears to have predictive value. That is, the information literacy as represented by the overall portfolio score can be predicted by the scores on the four traits. Librarians and instructors employ such evidence to increase their confidence in making judgments about the quality of submitted portfolio work.

Associations Between the Information Literacy Model, the Writing Model, and Other Variables

Beyond investigating the internal relationships of the model and the abilities of readers to reach consensus and consistency, librarians and instructors wanted to know if relationships existed with other measures of student ability. The writing model and the information literacy model were examined for their relationships to each other, and with criterion-based performance levels of the students: admissions tests, course grade, and cumulative grade point average. The information literacy scores showed a significant correlation with the writing scores. The overall score on the writing model was associated at .497 ($p < .01$) with the overall score on the information literacy model. As Table 3 demonstrates, statistically significant correlations were demonstrated among all variables in both models. The relationships confirmed our expectation that the two literacies are related and that assessment of one set of skills does have some associative value for the other. This study provides a quantitative measure illustrating the relationship between composition and information literacy with implications for instruction of these overlapping skills.

While information literacy variables correlate well with variables in the writing model, they do not correlate as well with other measures of student performance. The academic comparison is made with two markers: SAT Math and Verbal scores; and cumulative grade point average. During the spring of 2005, the admissions tests scores were as follows: SAT Math ($M = 594$), SAT Verbal ($M = 522$). Comparatively, the 100 students in our sample had a similar admissions profile SAT Math ($M = 582$), SAT Verbal ($M = 524$). The average grade point average for seniors during the spring 2005 was 2.94; the cumulative grade point average for the 100 students in the sample was somewhat higher at 3.07.While our sample was clearly representative, there was no association between the SAT scores and our model. While there was a relationship between the overall information literacy portfolio score and both the course grade and the cumulative GPA, the writing assessment model did show a somewhat stronger correlation with both. This finding suggests to us that the concept of information literacy is not yet a significant factor used in grading by individual writing instructors. An instructor in a senior seminar in humanities may well focus on having students read and think critically about a Shakespearean tragedy or a modern short story or essay without going beyond the text. Within the humanities at our institution,

Table 3
Associative Analysis: Senior Seminar Portfolio Scores, Spring 2005

	Writing Model			Info Literacy Model									
	1	2	3	4	5	6	7	8	9	10	11	12	13
Association	Crit. Think	Drafting	Citation	Overall	IL Citation	Evid. of Res.	Approp	Integration	Overall	Crse Grd	GPA	SAT Math	SAT Verbal
Writing Model													
1. Crit. Thinking													
2. Drafting	.543**												
3. Citation	.579**	.677**											
4. Overall Score	.771**	.555**	.676**										
Information Lit. Model													
5. Citation	.399*	.482**	.605**	.566**									
6. Evid. of Research	.414**	.478**	.533**	.516**	.812**								
7. Appropriateness	.402**	.569**	.561**	.500**	.779**	.822**							
8.Integration	.373**	.550**	.531**	.459**	.738**	.826**	.905**						
9. Overall Score	.353**	.504**	.559**	.497**	.834**	.893**	.908**	.909**					
Concurrent Validity													
10. Course Grade	.471**	.206*	.352**	.445**	.239*	.348**	.273**	.279**	.281**				
11. CumGPAS05	.406**	.262**	.308**	.422**	.222*	.260**	.223**	0.193	.223**	.521**			
Admission Tests													
12. SAT Math	−0.089	−0.101	0.016	−0.103	−0.086	−0.05	−0.123	−.302*	−0.162	−0.003	0.019		
13. SAT Verbal	0.154	−0.139	−0.081	−0.014	0.006	−0.01	−0.131	−0.206	−0.16	0.263	0.149	.480**	

Correlation between Overall Writing Score and all Info Literacy variables.

Citation to Citation Correlation

Independent variables correlate highly with Overall Information Literacy Score.

Low correlation between Overall Info Literacy Score and Course Grade or GPA

No correlation between Overall Info Lit Score and SATs

*$p < 0.05$; **$p < 0.01$.

and probably many others, the tradition of composition instruction remains largely a formalist undertaking, focusing on textual analysis and writing. Information literacy is a relatively new concept for this group and represents a challenge to those in higher education who seek to integrate it across the curriculum.

Indeed, as the student moves through an academic program and away from the required humanities courses to the wider curriculum, and in our case, away from writing intensive general education requirements into science and engineering majors, there may be less emphasis on traditional library research skills. Thus based on our findings we may conclude that after four years of college at our technological university, the information literacy skills of many of our graduating seniors are in need of improvement.

Validity

To be acceptable to the humanities faculty, the rubric and procedures employed in the study must not only be statistically valid, but they must also appear to measure what they were intended to measure. Faculty were already familiar with the writing assessment process, results, and favorable outcomes of the methodology. Thus the new model, evolved from the old, made sense to a faculty already used to programmatic assessment that had proven to foster continuous improvement in the writing curriculum and instruction. Perhaps equally important to the development process were the social consequences among humanities faculty and librarians of program assessment. Post-secondary program assessment differs from student testing. Testing is often an isolated process in which an instrument (validated by those external to the institutional context) is administered (to each student within a designated sampling plan) and results are reported (primarily to administrators). In contrast, program assessment demands that the assessment exercise be undertaken and embraced by the individual members of the institutional community. Administration of the assessment must be manageable in that it does not place extraordinary demands on students and their instructors that compromise instructional time, yet be sustainable if continuous improvement is one of the goals. At the end of the day, the information literacy assessment model met each of the validation goals noted in Fig. 1: environmental validity (sustainable effort), construct validity (authentic definition), reliability (communal judgement), associative validity (concurrent relationships), and consequential validity (fair use). As was the case with the writing assessment model, the information literacy assessment model allowed validity to be understood as a unified concept, one that allowed many kinds of evidence to be brought forward in its support.

Limits of the Study

One weakness of this study is that there are many intervening variables during students' years at college that might affect their information literacy, and not all are related to academic experience. Indeed, simple maturation of the students – who may have become better critical thinkers and researchers for developmental reasons rather than instructional ones – is at play. And, of course, the curriculum, faculty, and instructional programs change over time. While it is partially the intent of this study to encourage improvement of the information literacy instructional component across the curriculum, it would be unrealistic to assume that students receive the same treatment year after year. Thus, to increase the validity of the findings, such studies should be conducted longitudinally, including freshmen, sophomore, junior, and seniors, thus allowing enough time to accumulate a large pool of data. Increasing the length of the study, as well as the sample size, should help mitigate some of these threats to the validity of our conclusions. At present, we are undertaking such work.

What We Learned

This study fulfilled our objectives by providing a model that allowed a quantitative base-line assessment of the information literacy skills of a representative sample of our students. In that our methodology was based on a decade's worth of direct assessment procedures, it promises to be replicable in subsequent semesters. The assessment process has had the additional benefit of bringing the community of shareholders together around a shared vision of continuous assessment and improvement and provided us all with real insight into weaknesses in the learning zone. We learned that class assignments must make the research process explicit, so we will experiment with research journals and annotated bibliographies that make appropriateness of sources and integration of research more visible in the coming years' portfolios. We will articulate the assessment criteria as part of instruction to see if such focus can improve outcomes. As with the writing program, sharing information about the assessment variables with the students should fix more firmly in their minds the new goals and processes required. Tighter integration of writing and research should improve teaching and learning. The collaborative model of faculty and librarians that had been solidly established over many years has served the NJIT community well in enabling the rapid spread of the awareness of information literacy throughout the university.

"This study fulfilled our objectives by providing a model that allowed a quantitative base-line assessment of the information literacy skills of a representative sample of our students."

The Way Forward

Our investigation into the effectiveness of information literacy instruction for seniors in the spring of 2005 showed that within the limits of our model graduating students' information literacy skills needed improvement. Our approach to assessment helped to provide the basis for appropriate corrective action based on shared values across the NJIT community. A fall presentation at the Committee on Academic Affairs brought increased awareness of the importance of information literacy. That presentation led to establishment of the Provost's special task force on Information, Communication, and Technology Literacy. The work of that Task Force culminated in a recommendation that information literacy be integrated across the curriculum, and a new university-wide committee was established to provide leadership and oversight. In addition to the establishment of a university-wide information literacy committee, NJIT has added a second composition

course to the first-year curriculum, a new course that will stress the relationship between writing and information literacy. A junior-level technical writing course – taken by the vast majority of first-time and transfer students – has embraced the concept of information literacy. The course director is presently adding components of the model to all sections of the course. In both the second first-year composition course and the junior-level technical writing course, program developers will integrate lessons learned from researchers such as Wang who have studied the lasting impact of credit-bearing library instruction.[41] As well, the work of Holliday and Fagerheim will serve as a valuable model for unifying writing and information literacy instruction.[42] The shareholders at our university will continue to monitor the ACRL research agenda in its call for evaluation and transferability of programs.[43] Instructors and administrators will continue to address information literacy in ways that are beyond cosmetic, by methods that acknowledge how truly difficult it is to extend effort beyond the syllabus and textbook, to select voices that are appropriate for a given context, and to truly integrate those new voices with one's own.

Following up on the initial research study, in Spring 2006 NJIT collaborated with the Educational Testing Service (ETS) on their ICT Literacy Assessment to explore the validity of alternative assessment methods. In that both the ETS ICT Test and the NJIT Information Literacy Scale are based on the same ACRL Standards, analysis of commonalities between the tests and student performance could greatly enhance validity efforts. Ultimately a combination of nationally normed (such as SAILS or the ETS ICT) and locally developed assessments, such as ours, could afford opportunities to test different areas of information literacy by means of different tasks extending beyond the domain of those tasks within humanities courses. To this end, NJIT is currently sponsoring collaborative research with ETS, research that may yield a broader sampling plan as well as an alternative view of the construct as it is presently defined in our university. Additionally, identification of transfer students is possible through the student information system; this should be incorporated into the research design in subsequent studies.

Authentic assessment of student work has already made a significant contribution to the understanding of a central question to the field of librarianship: "When is a person information literate?" At NJIT our assessment model is helping to illuminate a collaborative and instructional way forward for librarians, faculty, and administrators. The concept of boundary spanning, borrowed from the field of organizational communication, helps to describe the role academic librarians are well-suited to play in making information literacy integral to learning in higher education. As Tushman wrote, "Boundaries can be spanned effectively only by individuals who understand the coding schemes are attuned to the contextual information on both sides of the boundary, enabling them to search out the relevant information on one side and disseminate it on the other."[44] Although successful integration of information literacy must be collaborative, promoting the emerging concept of information literacy across the curriculum, perhaps, is best accomplished by librarians, boundary spanners *par excellence*.

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Appendix A
Information Literacy Scoring Sheet
NJIT Assessment Scales: Information Literacy

Reader's Name: _____	Date: _____
Student's Name: _____	Course: _____

The Middle States Commission on Higher Education defines information literacy as "an intellectual framework for identifying, finding, understanding, evaluating and using information. It includes determining the nature and extent of needed information; accessing information effectively and efficiently; evaluating critically information and its sources; incorporating selected information in the learner's knowledge base and value system; using information effectively to accomplish a specific purpose; understanding the economic, legal, and social issues surrounding the use of information and information technology; and observing laws, regulations, and institutional policies related to the access and use of information." It is the presence and extent of such literacy that we are assessing as it exists within undergraduate courses offered by the Department of Humanities at NJIT.

1. Citation: This portfolio includes sources that are documented so that the original source can easily be found. Discussion: All information needed to identify a source must be present. The audience-centered ability of students to present a source that may be *retrieved without undue burden* is more important than stylistic adherence to a particular citation system.

The contents of the portfolio demonstrate that the student has cited sources so that the original source can be easily found.

Very Strongly Agree	Strongly Agree	Agree	Disagree	Strongly Disagree	Very Strongly Disagree

2. Evidence of Independent Research: This portfolio includes evidence of research independent of sources indicated within the course syllabus. Discussion: While it is important that students reference information from textbooks, readers, and bibliographies provided by the instructor, researched work demands that students have sought, evaluated, and used information *beyond the syllabus*. An authentically researched assignment demonstrates that the student has sought ideas from a variety of sources to become truly informed about the topic at hand.

The contents of the portfolio demonstrate that the student has performed independent research.

Very Strongly Agree	Strongly Agree	Agree	Disagree	Strongly Disagree	Very Strongly Disagree

3. Appropriateness: The sources used in this portfolio are appropriate to the topic the student addressed. Discussion: Academic integrity demands that authoritative sources must be used in researched work. Research that is appropriate to the topic at hand will be sensitive to issues such as *validity, timeliness, and sufficiency*. An authentically researched assignment will demonstrate a student's ability to identify valid sources that have been reliably reviewed by those recognized as knowledgeable about the topic at hand, to select sources that offer time-appropriate views on that topic, and to ensure that the sources used are adequate to support the demands of the topic.

The contents of the portfolio demonstrate that the student has used appropriate sources.

Very Strongly Agree	Strongly Agree	Agree	Disagree	Strongly Disagree	Very Strongly Disagree

4. Integration: The sources cited in this portfolio have informed the course work. Discussion: Authentically researched work will demonstrate that the student has incorporated information in order to deepen critical thought. Authentic integration will demonstrate that the student has used sources to *interpret, deepen, and reflect* on the topic at hand.

The contents of the portfolio demonstrate that the student has integrated sources.

Very Strongly Agree	Strongly Agree	Agree	Disagree	Strongly Disagree	Very Strongly Disagree

5. Overall information literacy portfolio score: The contents of the portfolio demonstrate that the student has employed an information literacy framework.

Very Strongly agree	Strongly Agree	Agree	Disagree	Strongly Disagree	Very Strongly Disagree
The materials in the portfolio demonstrate *superior* information literacy skills.	The materials in the portfolio demonstrate *very good* information literacy skills.	The materials in the portfolio demonstrate and an *acceptable* level of information literacy skills.	The materials in the portfolio demonstrate *below average* information literacy skills.	The materials in the portfolio demonstrate information literacy skills at a *level near failure*.	The materials in the portfolio demonstrate information literacy skills at a level of *failure*.

Appendix B
Local Criteria Mapped to National Standards*

Local Criteria Category	Local Criteria Performance Indicators	ACRL Standards+Performance Indicators	ACRL Performance Outcomes
Citation	Can correctly designate different types of sources.	1.2. Identifies a variety of types and formats of potential sources for information.	a. Knows how information is formally and informally produced, organized, and disseminated.
	Differentiates between the types of sources cited and understands the elements and correct syntax of a citation for a wide range of resources.	2.5. Extracts, records, and manages the information and its sources.	c. Differentiates between the types of sources cited and understands the elements and correct syntax of a citation for a wide range of resources.
	Records all pertinent citation information for future reference.		d. Records all pertinent citation information for future reference.
	Follows a citation style as a guide to include all necessary information.	5.3. Acknowledges the user of information sources in communicating the product or performance	a. Selects appropriate documentation style and uses it consistently to cite sources.
Evidence of independent research	Puts effort into obtaining outside sources outside of those references in the syllabus.	1.1. Defines & articulates the need for information	c. Explores general information sources to increase familiarity with the topic.
	Recognizes the need for more research.		f. Recognizes that existing information can be combined with original thought, experimentation, and/or analysis to produce new information.
	Obtains resources not only from the Web, but also books, articles, and other materials when necessary.	2.3. Retrieves information online or in person using a variety of methods	a. Uses various search systems to retrieve information in a variety of formats.
Appropriateness	Knows when a Web site, article, or book is appropriate.	1.2. Identifies a variety of types and formats of potential sources for information.	c. Identifies that value and differences of potential resources in a variety of formats.
	Uses scholarly materials when necessary.		d. Identifies the purpose and audience of potential resources.
	Chooses sources reliable, authoritative sources that are appropriate to the topic the student addressed.	3.2. Articulates and applies initial criteria for evaluating both the information and its sources.	a. Examines and compares information from various sources in order to evaluate reliability, validity, accuracy, authority, timeliness, and point of view or bias.
	Chooses sources reliable, authoritative sources that are appropriate to the topic the student addressed.	3.4. Compares new knowledge with prior knowledge to determine the value added, contradictions, or other unique characteristics of the information.	a. Determines whether information satisfies the research or other information need.
			b. Uses consciously selected criteria to determine whether the information contradicts or verifies information used from other sources.

APPENDIX B (*continued*)

Local Criteria Category	Local Criteria Performance Indicators	ACRL Standards + Performance Indicators	ACRL Performance Outcomes
			f. Integrates new information with previous information or knowledge.
			g. Selects information that provides evidence for the topic.
	Finds resources that include enough evidence to support the thesis	3.7. Determines whether the initial query should be revised	a. Determines if original information need has been satisfied or if additional information is needed.
			c. Reviews information retrieval sources used and expands to include others as needed.
Integration	Uses sources listed on the works cited page reflectively in the paper.	3.1. Summarizes the main ideas to be extracted from the information granted.	a. Reads the text and selects main ideas.
	Uses sources to sharpen critical analysis.		b. Restates textual concepts in his/her own words and selects data accurately.
	Identifies verbatim material that can be then appropriately quoted.		c. Identifies verbatim material that can be then appropriately quoted.
	Demonstrates evidence that thought has been given to the resources.	3.2. Articulates and applies initial criteria for evaluating both the information and its sources.	c. Recognizes prejudice, deception, or manipulation.
	The sources used are not merely cosmetic in nature.		d. Recognizes the cultural, physical, or other context within which the information was created and understands the impact of context on interpreting the information.
	Uses sources to sharpen critical analysis.	3.3. Synthesizes main ideas to construct new concepts.	a. Recognizes interrelationships among concepts and combines them into potentially useful primary statements with supporting evidence.
			b. Extends initial synthesis, when possible, at a higher level of abstraction to construct new hypotheses that may require additional information.
	Uses concepts from several sources to build new knowledge in support of the project at hand.	4.1. Applies new and prior information to the planning and creation of a particular product or performance.	c. Integrates the new and prior information, including quotations and paraphrasing, in a manner that supports the purpose of the product or performance.

*Association of College and Research Libraries. *Information Literacy Competency Standards for Higher Education* (Chicago: American Library Association, 2000) 8–14. Available: http://www.ala.org/ala/acrl/acrlstandards/standards.pdf and http://www.ala.org/ala/acrl/acrlstandards/informationliteracycompetency.htm (June 28, 2006).

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35. Carlson investigated bibliographies across six departments: Art, Classics, English, History, General Humanities, and Religion. In the present study, courses addressing each of these areas are offered within the unit. While Carlson found variance in citation behavior in academic discipline and level of course, such infrastructure issues (as they impact assessment and subsequent instruction based on the assessment results) are lessened in the Department of Humanities, a unit in which the majority of instructors teach courses from the first through the senior years. See Jake Carlson, "An Examination of Undergraduate Student Citation Behavior," The Journal of Academic Librarianship 32 (January 2006): 14–22.
36. This definition of community is informed by George S. Wood and Juan C. Judikis, *Conversations on Community Theory* (West Lafayette, IN: Purdue University Press, 2002), 12–17. As well, the commitment to civil inquiry – "overcoming the fragmentation of consciousness without illegitimately distorting or suppressing any of its modes" (24) – is taken from Glenn Tinder, *Community: Reflections on a Tragic Ideal* (Baton Rouge, LA: LSU Press, 1980).
37. In assessing the portfolios of these senior-level students ($n = 80$), we found that the scores on critical thinking ($M = 7.82$, $SD = 1.55$) and drafting ($M = 7.08$, $SD = 2.13$) met the cut score of 7. (That is, as two readers independently award a score from 6 (high) to 1 (low), a score on any variable below 7 suggests below average work and is cause for concern.) Indeed, the overall portfolio score (the dependent variable), a holistically oriented reading by the instructors, was also acceptable ($M = 8.10$, $SD = 1.70$). The citation variable, however, received scores that were unacceptably low ($M = 6.37$, $SD = 2.32$).
38. Elliot, Briller & Joshi, "Portfolio Assessment: Quantification and Community" 5–30.
39. While Cronbach's α provides a general index of reliability, Pearson's r allows an estimate of the probability value obtained in a 0.05 test level of significance and a control against Type 1, or blindness, error. In that a non-specific direction of the reliability was assumed (e.g. $\text{Reader}_1 > \text{Reader}_2$ or $\text{Reader}_2 > \text{Reader}_1$), a two-tailed p value was used for the later measure.
40. Pamela Moss, "Can There Be Validity without Reliability?" *Educational Researcher* 23.2 (1994): 5–12; See also Michael Williamson, "The Worship of Efficiency: Untangling Theoretical and Practical Considerations in Writing Assessment," *Assessing Writing* 1 (1994): 147–173.
41. Rui Wang, "The Lasting Impact of a Library Credit Course," *portal: Libraries and the Academy* 6 (January 2006): 79–92.
42. Wendy Holliday & Britt Fagerheim, "Integrating Information Literacy with a Sequenced English Composition Curriculum," *portal: Libraries and the Academy* 6 (April 2006): 169–184.
43. ACRL, "Research Agenda for Library Instruction and Information Literacy," *College and Research Libraries News* 64 (March 2003): 108–113.
44. Michael L. Tushman & Thomas J. Scanlan, "Boundary Spanning Individuals: Their Role in Information Transfer and their Antecedents," *The Academy of Management Journal* 24 (June 1981): 289–305.