

Title: Gauging Information and Computer Skills for Curriculum Planning

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Introduction

Due to the increased availability of information from the Internet and other electronic resources, all types of librarians are expected to possess information and computer skills to actively assist patrons in accessing information and in recognizing reliable resources. Since Library and Information Science (LIS) programs prepare graduate students, many with multidisciplinary backgrounds requiring little or no technology skills, to work in all types of libraries, mastery of information and computer skills is a high priority. In order to plan an effective curriculum, those engaged in graduate education of future librarians wonder in what ways and to what extent students possess information and computer skills when entering and exiting an LIS program.

Literature Review

One of the many responsibilities library science faculty have in educating future librarians is to make them aware of the information literacy standards issued by the American Association of School Librarians (AASL) and the Association of College & Research Libraries (ACRL) for the K-12 and higher education communities (AASL, 2007; ACRL, 2000). Librarians from all types of libraries are called upon to actively assist patrons in mastering the necessary skills to access information with efficient and effective search strategies and to recognize reliable resources (Battle, 2007; Katz, 2007a; Petruzzi & Burns, 2006). The literature effectively summarizes difficulties in information and computer competencies among patrons, frequently highlighting college students (Katz, 2007a; Mech, 2006; Snow & Katz, 2009).

When these findings are reviewed in light of educating future librarians, the information and computer competencies of students pursuing a library science degree is an interesting point

that emerges for consideration. In the last few years, the Educational Testing Service (ETS) released a standardized test designed to assess the information and computer skills of college students. Two assessments were offered, the core, directed at high school seniors and first year college students, and the advanced, directed at students transferring from a two year institution or in their second half of a four year program (Katz, 2007b). Since the literature generally reports on the difficulties college students encounter with information and computer literacy and the various ways exams were used to gauge the abilities of undergraduate college students (Gilchrist, 2009), in general, a question arose concerning the abilities of a targeted group of undergraduate students, specifically those pursuing library science. Therefore, a preliminary pilot study with undergraduate school library students conducted during 2007-2008 in the Library Science Department at Clarion University of Pennsylvania revealed that 77.8% of the participants taking the core assessment scored at or above 165 (Krueger, 2008), the cut score for minimum information and computer literacy skills determined by ETS (Tannenbaum & Katz, 2008). Since the graduate program prepares students for work in a variety of libraries with diverse service populations, the mastery of these same skills carries equal significance. Therefore, the research questions that emerged were:

- Would graduate students perform above the cut score designated by ETS for the advanced exam?
- Could the exam be used as a screening tool for entering students and an assessment tool for exiting students?
- Would the exam results point to areas for improvement in the curriculum?

Methodology

Originally, the methodology for this study was to be a pre- and post-test design using the ETS *iSkills*TM advanced exam. The researchers were interested in learning if students would perform better after a period of instruction in the MSLS program. This design was abandoned after the changes with the *iSkills*TM exam, described in the next section, prevented the second testing session. Instead, the researchers statistically analyzed the overall and individual scores that were available and obtained additional data by individually interviewing the students who did not pass the *iCritical Thinking*TM exam and by holding a focus group session with all the students who participated. A content analysis was performed on the interview transcripts and focus session notes for recurring themes and patterns.

Participants

Students enrolled in the MSLS face to face program at the authors' university were invited to participate during the 2009-2010 academic year. Twenty of these students took the advanced *iSkills*TM exam during the fall semester. When the time came for them to retake the exam, ETS had changed the *iSkills*TM to the *iCritical Thinking*TM exam and transferred the exam to Certiport for administration. Since Certiport required a signed license agreement before any testing could be conducted, the University needed time to review the agreement. After 8 months of deliberation Certiport and the University agreed on the terms for testing to begin again. Unfortunately, the first set of 20 students had already graduated and the researchers had to wait for the new group of incoming MSLS graduate students who enrolled in the face to face program for the 2010-2011 academic year. Thirteen of these students agreed to participate and took the *iCritical Thinking*TM exam during the fall semester. When ETS notified the researchers that the exam was transferring back to ETS for administration at the end of March, 2011 (K. Costantino,

personal communication, February 4, 2011), the researchers halted any further testing due to the complications this presented with student schedules and computer readiness.

Procedures

The principal researcher applied for a faculty professional development grant through the Pennsylvania State System of Higher Education to secure funding for the exams. Once notified of the award, the laptop computers were reexamined for the appropriate specification in order to run the *iSkills*TM advanced test even though they were used for the core exam with undergraduate students during the previous academic year. Paperwork was prepared and submitted to the university Institutional Review Board (IRB) so the study could commence at the beginning of the 2009-2010 academic year. IRB approval was obtained and students were asked to participate during one of the evening class sessions and given an informed consent. Some professors also offered extra credit points to students for their participation. Sessions were scheduled and published so students could select times convenient to them. The principal investigator administered the exam in the department's computer lab. Students were also asked to share their individual score reports since institutional data only included the overall score in addition to the background information students were asked to provide at the beginning of the exam.

Once *iSkills*TM became *iCritical Thinking*TM and the cutover was made to Certiport in the 2010-2011 academic year, new software, the IQsystem, had to be installed to administer the new exam. New netbook computers also replaced the older laptops from the prior year, so each had to be examined for the appropriate settings and configurations before downloading the IQsystem software. It was also necessary for the principal investigator to have admin privileges on the netbooks in order to run the updates that occurred between each testing session. Once all the computers were operational, a testing schedule was created and circulated among the students so

they could select convenient times according to their schedules. Students were also instructed to register with Certiport in order to create their profile and usernames and passwords before actually taking the exam. Extra credit in two classes was again offered for participation. Thirteen students participated in this phase of the study and institutional data were accessed in the Certiport administrator's module. This time, though, in addition to the overall score, percentage breakdowns for each participant were calculated according to the skill set categories for accessing, communicating, creating, defining, evaluating, integrating, and managing information. This information was entered into SPSS for statistical analysis. ETS scores were entered according to the comparison tables given by Certiport (J. Barlow, personal communication, July, 2010) in order to use one score scale when completing the statistical analysis. Other variables used in SPSS were gender, undergraduate GPA, graduate GPA, years of work experience, undergraduate major, and whether English was the student's native tongue.

Further testing was curtailed when ETS announced that it would reclaim the exam from Certiport at the beginning of April, 2011 (K. Costantino, personal communication, February 4, 2011). Since this would involve another platform, new software configurations, and a new learning curve for students, time did not permit extending the study any further. The researchers decided to interview students who received a score below the 260 cut score and then hold a group session with all students to explore their impressions of the exam. Individual students were interviewed first and asked the following questions:

- What portions of the exam did you find difficult?
- What parts of the exam were easy?
- What did you think about the exam?

- How would you describe the exam as a measure of your knowledge for information and computer literacy?
- How would you improve the exam?

Eight of the thirteen students attended the focus group session. The researchers asked them the same questions that were used during the individual interviews. Afterward, interview transcripts and focus group notes were analyzed for recurring themes and patterns.

Data Analysis

Statistical Analysis

Participants' background information

There were a total of 33 students in this investigation. As noted earlier, 20 of the students took the advanced iSkills™ exam and 13 students took the *iCritical Thinking*™ exam. Among the 33 participants, 18 (54.5%) were female and 15 (45.5%) were male. There were only 2 students (6.1%) who had a native tongue other than English. There were no significant statistical differences between these factors and reported scores.

Background information collected as part of each exam revealed that students varied in years of work experience and undergraduate majors. The participants' working experience ranged from none (n=3, 9.1%) to more than 10 years (n=5, 15.2%). At least 20 students (60.6%) had 5 or less years of work experience. Although the participants' undergraduate majors varied from arts to business, the majority (72%) held undergraduate degrees in library science (n=9, 28%), social sciences or history (n=6, 19%), education (n=4, 12.5%), or English language and literature (n=4, 12.5%). This coincides with ongoing admissions data collected by the chair as students are admitted into the program. English, history, education, and the undergraduate K-12

library science degree are the leading fields for those enrolled in the graduate LIS program. While there were no significant statistical differences between years of work experience and undergraduate degrees, Table 1 demonstrates a tendency for exam scores to decline with an increase of work years. This suggests that students with more work experience were older and were removed from an academic setting for a longer period of time.

Table 1

Work Experience and Reported Scores

		Reported Score	
Work Experience	<i>n</i>	<i>M (SD)</i>	95% CI
None	3	250.00 (105.830)	[-12.90, 512.90]
Less than 2 years	8	292.50 (43.342)	[256.26, 328.74]
More than 2 years	9	318.89 (53.020)	[278.13, 359.64]
More than 5 years; Less than 10 years	8	300.00 (60.474)	[249.44, 350.56]
More than 10 years	5	234.00 (132.023)	[70.07, 397.93]

Note. CI=confidence interval.

Students also self-reported undergraduate and graduate grade point averages (GPA). Twenty-two students (69%) reported that they achieved a GPA equivalent of an A at their undergraduate institution while 8 students (25%) reported achieving a B. Only 2 students (6%) indicated receiving a GPA equivalent of a C. The majority of participants (n=30, 91%) have a graduate GPA of 3.5 or higher. As shown in Table 2, the mean ($M=3.7414$) and leptokurdic distribution of the graduate GPAs are high and tightly distributed around the mean which is similar to the median. This occurs because graduate admissions requirements generally require

an undergraduate GPA of 3.0 or better. However, there were no statistically significant differences found between the undergraduate or graduate GPA with the reported exam score.

Table 2

Graduate GPA Descriptive Statistics:

Statistic	
N	33
Mean	3.7414
Median	3.8000
Mode	4.00
Std. Deviation	.25595

Test score results

Overall, the students performed well on the exam. Test scores ranged from 80 to 410 with an average score of 288.79 ($M=288.79$, $SD=75.447$, $Mode=320, 340$). Twenty-one students scored above the mean but more ($n=24$, 73%) scored above the Certiport cut score of 260. This left 9 students (27%) scoring below the cut score that indicates an intermediate foundational level of information and computer skills. As noted in Table 3, a one sample t test revealed statistically significant differences between the reported scores and the cut score.

Table 3

Comparison of Reported Scores to Cut Score

Cut Score=260			
	Mean Difference	t(32)	95%
Reported Score	28.788	2.192*	[2.04, 55.54]

Notes: CI=confidence interval

* $p < .05$, two-tailed

One advantage of the *iCritical Thinking*TM score reports furnished by Certiport was that the report provided a breakdown of the overall score into the main skills categories, that is, access, communicate, create, define, evaluate, integrate, and manage. The older *iSkills*TM score reports furnished a verbal commentary on skills students mastered instead of a percentage of correct answers. Consequently, reports for 11 of the 13 students who took the *iCritical Thinking*TM exam were generated and analyzed. The two missing reports were never found in the Certiport administrator’s module by the researchers and no explanation as to why they were missing was offered by Certiport. A correlation analysis was conducted on the skills categories and the overall reported score. Table 4 shows that strong, positive correlations to the reported score were found to be statistically significant with all skills categories except evaluate.

Table 4

Correlations of Skills Categories with Overall Reported Score

	Categories							
	RS	Access	Communicate	Create	Define	Evaluate	Integrate	Manage
RS								
P. Correlation	1	.821**	.626*	.773**	.760**	.058	.919**	.952**

Notes: RS=Reported Score; P=Pearson
 *p<.05, two-tailed. **p<.01, two-tailed

Interview and Focus Group Session

While the graduate students who scored below the cut score of 260 were interviewed individually, some consistent themes emerged when their transcript underwent content analysis. A summary of the themes for each student is presented in the following table. Pseudonyms were used to protect student identity and the meaning of the categories is subsequently explained.

Table 5

Themes from Student Interviews

Themes	Tom	Lynn	Robert	Jim
Time	X	X	X	X
Location	X	X	X	
English				X
Tech. Problems				
Font Size		X		
Software	X	X	X	
Netbooks		X		
Purpose	X	X	X	X
Critical Thinking				
Measure	X	X	X	
Definition		X		
Improvement				
Time	X	X	X	X

If the group session revealed similar themes and patterns, it is indicated in the category summary. Any new categories that emerged from the group session are designated as such and are presented after the individual interview themes.

Time

All four of the students felt that either more time should be allowed for the exam or that time should not be a consideration. Tom indicated that "I think ... for a lot of the questions...I just needed more time." Robert indicated that

...it's sort of panicky to have to try an answer those questions especially with the ... time frame that you have to answer it...it makes you a little more nervous and you might not be able to answer the questions as clearly as you would be able to if you had as much time as you would need to take it.

Jim, a nonnative English speaker, stated "...English is not my native language, you know, so it took me a long time ... to figure out what the question said, and then, you know, answer." Lynn felt that the test was assessing how quickly one could answer questions instead of how critically. She suggested a change in the exam name when she stated "Quick Thinking could be the name." Likewise, students in the group session could not see the relationship between critical thinking and having the test timed. They felt that answering the questions within the designated time did not necessarily indicate critical thinking.

Location

Three of the four students believed that the department computer lab was not the best place to take the exam since the lab serves as a gathering place for the graduate students during the day. Lynn explained that

The lab is a very difficult to concentrate when you are being timed for an exam. It can be quiet and it can be noisy, but regardless it can be difficult to concentrate on something when you have only a certain amount of time allotted for when there are other people around.

Tom stated that he was "easily distracted" in the lab and Robert emphasized that he needed "silence to concentrate."

English

The background information gathered during the registration process records whether English was the student's first, or native, language. A total of three students indicated ability in another language and Jim was the only one who scored below the designated cut score for the exam. He indicated that it took him "a long time ... to figure out what the question said..."

Technical Problems

Technical problems fell into three subcategories: font size, software, and netbooks. Lynn was the only one who indicated that she had difficulties with the size of the text used by the exam and with completing it on the netbooks. She explained that

It was very hard to read on the small computers, and the font. I could not, I kept trying to get the font to enlarge and with my glasses on the small computer and the tiny font it was, I still couldn't see it very well.

Robert did not necessarily have issues with using the netbooks, but mentioned that he never took a standardized test on a computer before and "would've preferred a paper test." The more consistent difficulty, though, involved the software, or interface, used for the exam. Tom stated that he found "the software difficult to use" and that "it takes me awhile ... to learn how to use new software...and do a good job." Robert remarked that "It's just how it's presented and how it's laid out doesn't always click right away and make me think about the correct answer." Lynn stated that "I think that the software was difficult to work with a lot of times, like getting used to in the beginning ... I think that the software could have been a little bit more straightforward or easier to use."

The other students in the group session echoed these concerns. They felt that the netbooks were cumbersome to use and that the system software or platform was rather "clunky."

The students indicated they spent a good bit of time trying to figure out the built in applications, such as the spreadsheet, email, or presentation slides. Overall, the applications within the exam were not a good replication of actual application programs commonly used by students.

Purpose

This category refers to the clarity, or purpose, behind the question. Students could not associate skills to the questions being asked. Jim reflected that he thought the exam should "concentrate on different skills" instead of using "diagrams ... that need lot of time." Tom stated that he "had difficulty in distinguishing between what was just part of the scenario and what was sort-of at the core of the problem." He kept thinking about and looking for "the purpose of the question." Lynn maintained that

...there were portions of the exam where I don't think that the question was very clear.

Like with the power points, they would tell you what they were expecting and then they would give you slides, but I think it was very subjective. Like you could kind-of arrange them in different ways.

She continued

But I kept thinking, what are they looking for as an answer, you know is there a specific right or wrong? So it was a little more subjective like somebody could say "Oh well this is right" and then somebody could say that the other way was right, so.

Robert was perplexed by some questions because he knew of others and himself that are obviously good at those things, but when you put it in a question form that gives you an amount of time to answer these questions it's a lot different. So I don't think that it [the test] shows that people can't think that way, it's just providing the information in a different way I think...

The group session students also commented that they questioned the purpose of the exam questions or tasks. They kept wondering how the question, especially a multiple choice question, proved critical thinking. Overall, they felt limited by the choice of answers and that not enough options were presented. The exam items requesting the use of spreadsheets were referenced considerably by the students in the group. They felt the exam question did not make sense the way they were presented and that there were many different ways to find a solution. Instead of actually testing knowledge and skills like in other tests, such as the GRE[®], they felt that they were just "jumping through hoops" that the *iCritical Thinking*[™] exam required.

Critical Thinking

Lynn particularly struggled with a definition of critical thinking. She summarized her thoughts by saying "thinking quickly is not necessarily thinking critically ... it just didn't seem to be a critical thinking exam." She further explained

I don't think if it took someone two hours to complete the exam and they had every question correct, I don't see how that couldn't be critical thinking. I mean, they are still using the interface, they are still learning it, but you know every question correctly that's critical thinking in two hours, that should be taken into consideration.

Robert had doubts as to the effectiveness of the exam as a measuring tool. He stressed that he knew individuals that did not pass the exam but that he considers them

very knowledgeable about information and ... very computer literate ... So, I think as a measuring tool, I wouldn't put a whole lot of merit on it because I think critical thinking is a difficult thing to measure or grade on a numeric scale ... but, as a concrete measuring tool, I don't think that it's [the exam] is very useful ... I don't think you can really measure critical thinking just in a specific time frame.

Tom struggled with the real life scenarios and the practical examples used in the exam questions as a measure of critical thinking. He felt that critical thinking was a "strength for me which wasn't tested at all." He preferred "less practical and more abstract" questions that would employ the use of "logic ... problem solving ... and mathematics." He felt that an "analytical essay" would have been a more accurate measure of his abilities.

Improvement

When asked how they would improve the exam, all agreed that more time was needed. Jim stated that "time was not sufficient" and Tom indicated that "more time would be an improvement." Lynn emphatically indicated that "the time was definitely not; they did not give you enough time for it." Robert recommended one of two changes: either "more time or no time."

While the group session supported the need for more time, the students also felt that clearer instructions would give them a better idea of what to expect. The authenticity of the questions was another concern. Instead of "making up applications [spreadsheet, email, and presentation programs]" authentic questions or situations should be used. Actually using regular spreadsheet, email, and presentation programs and software would better demonstrate abilities in these areas. Students also commented that the exam was dated and required updating.

Additional Comments

Some students in the group session offered some additional thoughts about the exam. They felt it was more a measure of computer literacy rather than critical thinking and that it would be more valuable in measuring a specific skill set as prescribed by an employer in an actual work situation. Others commented that the exam items were not aimed at the college level and could probably be answered by middle or high school students instead.

Conclusions

Practical outcomes of this study focus on the testing environment. The netbooks proved to be inappropriate delivery method due to the exam interface. A desktop computer seems that it would display the exam in a more user-friendly, readable format than the netbooks can. Also, while the department computer lab is a graduate student study and work area, it apparently has taken on an atmosphere similar to a student lounge. A quieter location is needed so students can concentrate as best possible.

The value of the exam for graduate students is questionable. Approximately three-fourths of the students in this study passed the exam on the first attempt. The remaining students expressed valid concerns about the importance of time placed on the exam. It is unclear as to how critical thinking is measured in a timed response situation. Students expected abstract questions similar to the Graduate Record Exam[®] (GRE) and felt that the real life scenarios described in the *iCritical Thinking*[™] questions did not call for critical thinking as did those from the GRE. They did not understand the purpose of the *iCritical Thinking*[™] questions and how they could measure critical thinking skills. It could be necessary to offer an alternative method for measuring information and computer literacy for students who are more deliberate in their approach to standardized testing. Perhaps authentic assessment opportunities emphasized by Gilchrist (2009) would offer graduate students more meaningful ways to demonstrate their skills. Also, the correlation findings with regards to the evaluate category tasks in some ways echo those of Snow and Katz (2009) when they attempted to validate exam scores with more naturalistic exercises involving the evaluate tasks. They noted that students were able to select their own information and computer technology (ICT) within a computer lab to perform the naturalistic, authentic exercises created from actual assignments and interviews of students.

Since the students were not bound by the exam web browsers and software, they were able to apply information and computer technology skills beyond a predetermined, less authentic setting. Embedding such opportunities within the curriculum could generate value-added assessment data for enhancing the curriculum and programs of study.

Further Research

Obviously, the number of participants and the problems created by the change in vendors and the exam itself served as limitations to this study. However, since the time limit on the exam was a major issue for the students, it would be interesting to see if the students who scored below the desired cut score could achieve it if given more time when retaking the exam. It would also be interesting to compare results using the ETS platform since this proved less problematic in previous research conducted by the principal investigator. Furthermore, given the changes in personal computing options that have emerged since ETS first created the exam, computer skills may need to be assessed differently and separately from information literacy skills. Building a series of tasks using materials found in an actual school or work environment may shed more light on an individual student's initial skill level with regard to emerging computer technologies found in libraries. Once this level is established, course assignments integrating naturalistic and authentic scenarios can then demonstrate a student's skill level for defining, accessing, evaluating, managing, integrating, creating, and communicating information more effectively.

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