INFORMATION LITERACY ASSESSMENT: MOVING BEYOND COMPUTER LITERACY

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Information literacy is a concept that has evolved as a result of recent efforts to move technology-based instruction and research to a level above the long-held concepts previously associated with "computer literacy"; the focus of information literacy education being the development of students' abilities to construct/collect and analyze information in a way that provides the basis for effective decision making. In this study, the authors assess the information literacy levels of some 600 college students with results of the study indicating that students' information literacy achievement levels were modest at best - only 40% of the students achieved a "passing" grade on the exam. Additional results show significant differences in achievement among the various groups of students with, for example, females scoring significantly higher than males on the exam.

For business educators computer literacy has long been a topic of interest and research. The 1990's began a concentration of study that has continued for almost twenty years as researchers studied the impact of technology on both students' education and employment (Hignite, 1990; Brock, 1992; Hignite & Echternacht, 1992; Amini, 1993; Epstein, 1993; Hignite & Echternacht, 1994; Davis, 1997). More recently, researchers have returned to this area of study as the concept of technological literacy has continued to evolve with current research being focused on the changing nature of computer literacy (Banta & Howard, 2004; O'Connor, 2007). Some researchers now contend that the very concept of computer literacy has become dated and that the emphasis of current educational and research efforts should be shifted toward a focus on "information literacy" (Brown, Murphy & Nanny, 2003; Bartholomew, 2004; Sharkey, 2006; Klusek & Bornstein, 2006; Andretta, 2008).

While computer literacy was often focused primarily on technology based definitions, concepts and skills, information literacy is much more oriented toward a higher-level set of concepts and abilities. Information literacy is concerned with a student's ability to collect, analyze and utilize information gathered via the use of information technology and to use that information to make effective decisions. The question then becomes not whether a student can simply manipulate technology to complete a given task, but whether

that student make good decisions from the information now at hand.

But how effectively do our current efforts convey these newly evolved information literacy concepts? Do students gain the necessary higher level skills associated with information literacy or are efforts still geared toward the more dated concepts associated with earlier computer literacy courses? Given the continued resources devoted to efforts designed to provide students with the appropriate technology knowledge, skills and abilities, and given the rapid evolution of such technology competency concepts, it would seem appropriate that a study focused on measuring student achievement in the area of information literacy would be highly appropriate.

The Study

The Information and Communications Technology (ICT) exam was recently designed to assess student mastery of newly evolved information literacy concepts. This exam is designed to go beyond a simple measure of a student's knowledge of facts, and is intended to assess a student's ability to collect, analyze and utilize information gathered via the use of information technology. As documented by the Education Testing Service (ETS), the goal of emerging technology literacy assessment efforts is to determine students "...ability to use digital technology, communication tools and networks appropriately to solve information problems in order to function in an information society. This includes the ability to use technology as a tool to research, organize, evaluate and communicate information, and the possession of a fundamental understanding of the ethical/legal issues surrounding the access and use of information" (Katz, 2008).

Utilizing the ICT as the assessment instrument, then, the primary product of this research is a basic assessment of current student information literacy performance. Additional statistical analyses are designed to reveal differences in student performance related to such factors as race and gender which could provide additional data that could significantly affect current and future efforts to provide relevant and effective information literacy instruction to students.

Methodology

Information Literacy assessment scores as well as additional demographic data were collected from approximately 600 first or second-semester college students enrolled in a required general education computer literacy course at a large Midwestern university (total student population of approximately 20,000). The majority of the sections of this course (some 30+ each semester) are taught within the University's College of Business.

In the form utilized in this study, the ICT exam required students to complete 15 tasks designed to make use of students' cognitive and/or critical thinking skills. These tasks, in turn, were designed to capture students' abilities to define, access, evaluate, manage, integrate, create and communicate information.

Performance on the exam was reported as a single composite score. With a maximum possible score of 300, the expected mean score reported for the exam

TABLE 1. CHARACTERISTICS OF COLLECTED SUBJECT DATA

Class	Classifications
RACE	Candidate race or ethnicity: Native American, Asian, Black, Mexican, Puerto Rican, Other Hispanic, White, Other.
GENDER	Male or Female
NEWTAKER	First time test taker, No or Yes
RESTART	Exam was restarted, No or Yes
TCODE1	How exam terminated in the first timed section: never visited, all questions complete, all questions visited, timed out, all items not visited, and exited with a pause, unknown exit
TCODE2	How exam terminated in the second timed section: never visited, all questions complete, all questions visited, timed out, all items not visited, and exited with a pause, unknown exit
TASKANS1	How many tasks were completed in timed section 1
TASKANS2	How many tasks were completed in timed section 2
ENGFIRST	Language learned first: English only, English and another, another language only
ENGBEST	Language best known: English only, English and another, another language only
CLASS	Candidate class or grade: 10^{th}, 11^{th}, 12^{th} College Freshman, College Sophomore, College Junior, College Senior, Graduate, Other
MAJGPA	GPA in Major: no grade, E/F, D, D+, C-, C, C+, B-, B, B+, A-, A, A+
TOTGPA	Overall GPA: no grade, E/F, D, D+, C-, C, C+, B-, B, B+, A-, A, A+
HSGPA	Overall High School GPA: no grade, E/F, D, D+, C-, C, C+, B-, B, B+, A-, A, A+
CITIZEN	Citizen: US, US Perm Res, another country, other
UGMAJOR	Undergraduate Major: Agriculture or Natural Resources, Architecture or Environmental Design, Arts: Visual or Performing, Biological Sciences, Business, Communications, Computer or Information Sciences, Education, Engineering, English Language and Literature, Foreign or Classical Languages, Health Services, Home Economics, Library Sciences, Mathematics, Military Sciences, Philosophy or Religion or Theology, Physical Sciences, Public Affairs and Services, Social Sciences and History, Technical and Vocational, Other, Undecided.
ENSTATUS	Enrollment status: not enroll, Native, Transfer
SATM	Highest SAT math: not taken, 200-240, 250-290, 300-340, 350-390, 400-440, 450-490, 500-540, 550-590, 600-640, 650-690, 700-740, 750-800
SATV	Highest SAT verbal: not taken, 200-240, 250-290, 300-340, 350-390, 400-440, 450-490, 500-540, 550-590, 600-640, 650-690, 700-740, 750-800
ACTC	Highest ACT composite: not taken, below 15, 16-20, 21-26, 27-31, 32-36
TCREDIT	Number of Transfer credits
CENROLL	Number of college classes enrolled in: zero, 1, 2, 3, 4, 5+
PARTTIME	Whether the student is part-time: full, part, not a student
WORK	Whither the student will work: no, on campus, off campus, both on and off campus
WORKHRS	How many hours the student will work: none, few, 10 or less, 11-20, 21-30, greater than 30
PRIMARYPLAN	If currently in High school, Primary plan for after graduation: not in hs, enter wf, enter cc, enter year, other, undecided

is approximately 150. As reported by ETS, the reliability measure for the ICT exam is .88 (Katz, 2008).

In addition to information literacy data, some 26 demographic questions/categories were used to capture test-taker attributes. A description of the data collected is contained in Table 1.

Using analysis of variance (ANOVA) statistical techniques, test scores on the various component parts of the exam were examined in light of the various groups/ classifications of students participating in the study.

Results

Scores for the 600+ students completing the ICT were not high. The mean score for the group was a modest 154.15, only slightly above the mean score of 150 established by the test developers (Katz, 2008). With regard to students who demonstrated mastery of the material, only slightly more than 40% of students exceeded this

level of achievement (a "cutoff" score of 164 is utilized by ETS used to determine information literacy proficiency).

It's important to note that with regard to the ANOVA analyses performed, we only included complete surveys with regards to the independent & dependent variables, therefore, while some 615 students participated in this study, in many instances our analysis relied on fewer student outcomes as some student exams were not fully completed. For the vast majority of attributes, there was no significant difference in performance between the various groups of students. However, there were four characteristics, race, gender, ACT score and major that did provide some interesting outcomes.

In the analysis of the first of these independent variables, race, there were 86 participants that described themselves as Non-Caucasians and 526 participants that described themselves as Caucasians. The mean reported score and the standard deviation of the reported scores are contained in **Table 2 below**. The ANOVA table for the Race variable is also given below. As indicated below by the significant results in the ANOVA table (p-value = 0.000), the mean reported score for the Non-Caucasian participants is significantly lower than the mean reported score of the Caucasian participants.

In the analysis of the second independent variable, gender, there were 344 participants that indicated that they were Female and 269 participants that indicated that they were Male. The mean reported score and the standard deviation of the reported scores can be found in **Table 3 below**. The ANOVA table for the Gender variable is also given below. As indicated below by the significant results in the ANOVA table (p-value = 0.046), the mean reported score for females is higher than the mean reported score for males.

TABLE 2. ANOVA RESULTS FOR RACE

Race	Mean	Sample Size	Standard Deviation
Non-Caucasian	135.58	86	40.150
Caucasian	157.08	526	32.346

Source	Type III SS	df	Mean Square	F	Sig
Race	34168.348	1	34168.348	30.369	0.000
Error	686316.415	610	1125.109		
Total (Corr)	720484.763	611			

TABLE 3. ANOVA RESULTS FOR GENDER

Gender	Mean	Sample Size	Standard Deviation
Female	156.45	344	31.684
Male	150.89	269	37.273

Source	Type III SS	df	Mean Square	F	Sig
Gender	4668.766	1	4668.766	3.980	0.046
Error	716659.129	611	1172.928		
Total (Corr)	721327.895	612			

TABLE 4. ANOVA RESULTS FOR ACT

ACT Category	Mean	Sample Size	Standard Deviation
16 - 20	139.15	88	27.535
21 - 26	152.23	325	32.079
27 - 31	173.01	128	32.199
32 - 36	179.71	17	31.794

Source	Type III SS	df	Mean Square	F	Sig
ACT Category	76159.345	3	25386.448	25.701	0.000
Error	547209.293	554	987.742		
Total (Corr)	623368.638	557			

In the analysis of the third independent variable, ACT Score (ACTC), there were 88 participants that indicated that they had an ACT score between 16 – 20, 325 participants indicated that they had an ACT score between 21 – 26, 128 participants indicated that they had an ACT score between 27 – 31 and 17 participants had an ACT score in the 32 – 36 range. Not all of the students in this study had taken the ACT test. The mean reported score and the standard deviation of the reported scores are found in Table 4 below. The ANOVA table for the ACT Category variable is also given below. As indicated below by the significant results in the ANOVA table (p-value = 0.000), at least one of the mean reported scores for the four ACT categories is different than the other mean reported scores of the other categories. Upon doing the proper statistical follow-ups (the Tukey Test), the mean reported score of the "16 - 20" ACT category was lower than the mean reported score of the "21 – 26" ACT category. In addition, the mean reported score of the "16 - 20" ACT category was lower than the mean reported score of the "27 – 31" ACT category. Furthermore, the mean reported score of the "16 - 20" ACT category was lower than the mean reported score of the "32 – 36" ACT category. The mean reported score of the "21 - 26" ACT category was lower than the mean reported score of the "27 – 31" ACT category. In addition, the mean reported score of the "21 - 26" ACT category was lower than the mean reported score of the "32 – 36" ACT category. Interesting enough, the mean reported score of the "27 - 31" ACT category was the same as the mean reported score of the "32 – 36" ACT category.

In the analysis of the fourth independent variable, undergraduate major (UGMAJOR), there were 471 participants that indicated that they were not Business majors while 142 participants indicated that they were business majors. The mean reported score and the standard deviation of the reported scores are contained in Table 5 below. The ANOVA table for the Business Student variable is also given below. As indicated below by the significant results in the ANOVA table (p-value = 0.518), there is insufficient evidence to conclude that there is a difference in the mean reported score for Non-Business major and the Business major. So we can conclude that there is no significant difference between the mean reported scores.

TABLE 5. ANOVA RESULTS FOR BUSINESS MAJORS

Business Student	Mean	Sample Size	Standard Deviation
No	153.65	471	35.575
Yes	155.77	142	29.723

Source	Type III SS	df	Mean Square	F	Sig
Biz Student	491.682	1	491.682	0.418	0.518
Error	719383.685	611	1177.387		
Total (Corr)	719875.367	612			

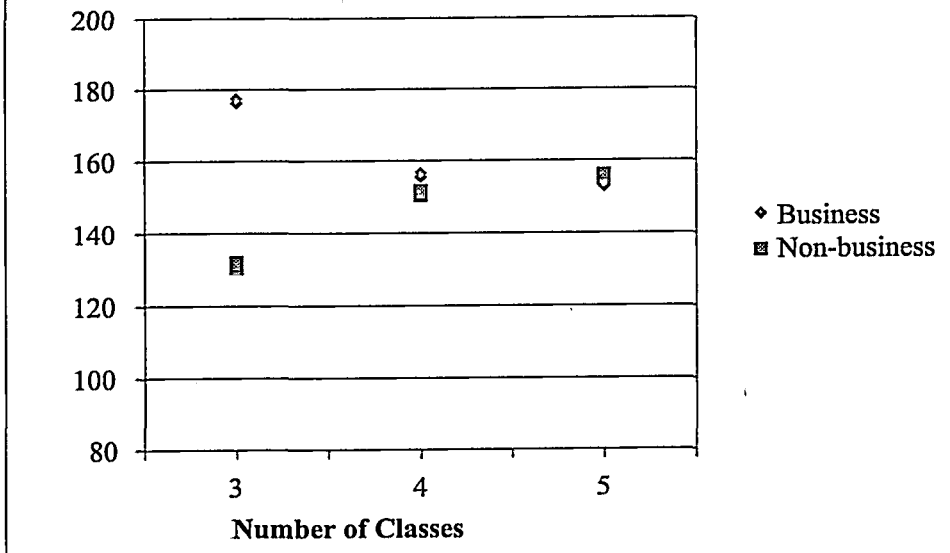
TABLE 6. ANOVA RESULTS FOR BUSINESS MAJOR AND COURSE LOAD

Biz & Current	Mean	Sample Size	Standard Deviation
Business & 3 or fewer classes	177.50	8	19.640
Business & 4 classes	156.75	20	23.185
Business & 5 or more classes	154.08	114	30.848
Non-Business & 3 or fewer classes	131.82	33	44.648
Non-Business & 4 classes	151.71	76	33.312
Non-Business & 5 or more classes	156.05	362	34.501

Source	Type III SS	df	Mean Square	F	Sig
Biz Student	10333.311	1	10333.311	8.997	0.003
Currently Enrolled	39.108	2	19.554	0.017	0.983
Business & Currently Enrolled	13797.523	2	6898.761	6.007	0.003
Error	697161.685	607	1148.537		
Total (Corr)	719875.367	612			

Although all possible two-way ANOVAs were performed, only one was of statistical interest. In the analysis below, there were 8 Business majors that were taking three or fewer classes, 20 Business majors were taking 4 classes and 114 Business majors were taking 5 or more classes. In addition, there were 33 Non-Business majors that were taking three or fewer classes, 76 Non-Business majors were taking 4 classes and 362 Non-Business majors were taking 5 or more classes. The mean reported score and the standard deviation of the reported scores are listed in Table 6 above. The two-way ANOVA table for the Business Student and the Current Enrollment variable is also reported in Table 6. As indicated below, there is significant interaction between the number of classes that they are currently enrolled in and whether or not the student is a Business major as indicated by the results in the ANOVA table for the interaction (p-value = 0.003) indicates the significant interac-

Figure 1. Interaction of Business Students and Enrollment



tion.

In order to see this interaction between whether or not a student is a business student and the student's current enrollment, we graphed the data above (Figure 1). It is obvious (and statistically different) that a Business student with three or fewer classes had a mean reported score that was much higher than a Non-Business student with three or fewer classes. Note that there was no significant difference between business students with four classes and non-business students with four classes. The same can be said for the students that have five or more classes.

Discussion

With regard to the basic assessment of information literacy performed here and the overall test scores reported, it is obvious that this early attempt at assessing information literacy competency has revealed some rather interesting insight into at least one university's current educational efforts. With students scoring just slight above the 50th percentile on the information literacy exam, certainly significant room for improvement in those scores exists.

With regard to the study's first significant finding related to the ANOVA analyses performed, it does appear that students who identified themselves as Caucasian did achieve higher scores than those students who indicated that they were non-Caucasian. The relationship between race and achievement on other types of assessments (ACT and SAT, for example) has

been explored by a number of authors/ researchers with some indication that achievement and race may be correlated (Sellers, 1992; Kronholz, 2004). Obviously there may be other interactions that might exist between race and other subject characteristics that should be explored in future research efforts. It is possible for example that because many of the students identified as non-Caucasian might be students from countries other than the United States, the effect of language comprehension upon exam scores could be significant.

The results of the study's second ANOVA analysis indicates females scored significantly higher on the assessment exam than did males. In recent years, a number of studies have focused on gender differences and academic performance. Contradictory findings have resulted with some studies indicating that gender and study topics may be associated resulting in differences in academic achievement (Demirbas & Demirkan, 2007), while others have found that gender has no apparent effect on academic achievement (Sulaiman & Mohezar, 2006). Again, suggestions for future research efforts would include additional investigation of the interaction between gender and other subject variables in an effort to more fully understand and explain this effect.

The study's third significant result indicated that students with higher ACT scores did have significantly higher ICT assessment scores as well. Both high ACT and SAT scores have been associated with positive college-level achievement by a number of researchers. Such high scores have also been associated with a student's choice of major, course load, and graduation rates (Stocking & Goldstein, 1992; Chenoweth, 1996; Stumph & Stanley, 2002; Thompson & Zamboanga, 2004). Certainly the results of the current study are in line with those previous findings.

The study's fourth analysis dealt with the difference between scores achieved by both business and non-business majors. Although the choice of an academic major has often been associated with such factors as satisfaction, motivation, persistence and achievement in college (Gearty & Milner, 1975; Suhre, Jansen, & Harskamp, 2007; Trautwein & Ludtke, 2007), it is clear from this analysis that no such difference exists between business and non-business majors. While in the past such differences may have been believed to exist, we may very well be seeing a "leveling" in terms of students' background, preparation and resulting success as a result of the immense diffusion of the use of technology among the greater student population.

In the study's final analysis, we looked at the interaction between undergraduate major and the number of courses a student was currently taking. The number of courses that a student is currently enrolled in is indicative of the level of active engagement in current semester coursework. And such engagement has been previously associated with achievement both in specific courses and in majors, in the specific areas of grades, retention, graduation rates by a number of researchers (Coffman, 2000; Onwuegbuzie, 2003; Yang, 2004; Hawkins, Hawkins & Grant, 2005). The results of this study indicated that business majors with a somewhat reduced load (3 courses instead of 4 or 5) did score higher on the assessment than other majors

with similar course loads. It is possible, for example, that the makeup of those course loads could be dissimilar, however, allowing business majors with a somewhat "lighter" schedule to devote more time to their individual classes thereby enhancing achievement/understanding in those areas. Clearly, this is an area of recommended focus/attention for any further research in the area.

Conclusions and Recommendations

While this study provided some very interesting outcomes as a result of the statistical analyses performed, with only some 40% of our subjects achieving a level of mastery on the ICT exam, clearly the focus of further studies should be the basic factors associated with that achievement. It is possible for example, that while the concept of information literacy has evolved, course content, coverage and curriculum have remained anchored in the "computer literacy" past. Our primary recommendation to those charged with offering such courses, then, is to make sure that there is a match between the goals of the course, and the methods utilized to achieve those goals. If we truly wish to convey to students the ability to gather and analyze information and then to make good decisions as a result of that analysis, clearly the course activities must go beyond the use and manipulation of hardware/software in order to complete some lower-level tasks. In this age of accountability and given the resources often committed, if such courses are to continue to provide value to students (and continue to exist), it would appear that significant future attention must be devoted to achieving greater success in such endeavors.

And while replication of this assessment is clearly recommended, and refinement of the ICT destined to occur, it is highly recommended that those charged with providing information literacy skills to college students take note of these results with an eye toward evaluation of their own current efforts.

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