

Association for Information Systems AIS Electronic Library (AISeL)

AMCIS 2009 Proceedings

Americas Conference on Information Systems
(AMCIS)

2009

Information and Communication Technology Assessment Benchmark

L. Troboy
Arkansas Tech University

Alice Batch
Arkansas Tech University

Linda Bean
Arkansas Tech University

Follow this and additional works at: <http://aisel.aisnet.org/amcis2009>

Recommended Citation

Troboy, L.; Batch, Alice; and Bean, Linda, "Information and Communication Technology Assessment Benchmark" (2009). *AMCIS 2009 Proceedings*. 257.
<http://aisel.aisnet.org/amcis2009/257>

This material is brought to you by the Americas Conference on Information Systems (AMCIS) at AIS Electronic Library (AISeL). It has been accepted for inclusion in AMCIS 2009 Proceedings by an authorized administrator of AIS Electronic Library (AISeL). For more information, please contact elibrary@aisnet.org.

Information and Communication Technology Assessment Benchmark

ABSTRACT

This paper reports on an initial effort to assess student learning with respect to effective use of information and communication technology. A business school in a small public university administered the iSkills assessment from the Educational Testing Service (ETS) in 2008. This online web service simulates websites, web searches, databases, and office productivity software to present realistic scenarios. iSkills evaluates seven skill areas (define, access, evaluate, manage, integrate, create, and communicate). Upper division student median performance on the Advanced Level test was generally above the median level of the reference group with strengths in the Define and Integrate proficiencies and weaknesses in the Manage and Create proficiencies. Lower division student median performance on the Advanced Level test was generally below the median with strengths in the Access and the Integrate proficiencies and weaknesses in the Manage, Define, and Communicate proficiencies. Lower division student median performance on the Core Level test was generally below the median with strengths in the Access and Integrate proficiencies and weaknesses in the Evaluate and Communicate proficiencies. While the upper division students performed adequately, there remains room for improvement. The lower division student performance will provide a benchmark to measure the impact of planned curriculum changes.

Keywords

Assessment, information technology, communication technology, iSkills, IT competency, IT literacy, computer skills, curriculum, education.

INTRODUCTION

To succeed in today's information-driven academic environment, students need to know how to find, use, manage, evaluate and convey information efficiently and effectively. Organizations of all sorts have a consistent need for individuals at every level that can effectively use information and communication technology. Institutions of higher learning spend significant financial resources and faculty spend significant time and energy in an effort to encourage students to develop these skills and abilities. The relevant portion of the Mission Statement of our business school states that

“... School of Business faculty and students will use current technology to develop communication, critical thinking and problem-solving skills.”

The relevant learning goal objectives established to measure achievement of this mission are:

- Develop students' ability to use technology to support managerial decisions.
- Develop students' written, presentation, and interpersonal communication skills.

All of the stakeholders in this process, including taxpayers, accrediting agencies, parents, and students themselves, would like some assurance of learning with respect to these skills and abilities. Therefore, we need effective ways to demonstrate that students are being prepared for a successful career.

BACKGROUND/LITERATURE

Technology proficiency has been on the radar of educators for about two decades. This section outlines what some schools are doing to address the need for assessment of student's technology skills. A 2002 report commissioned by the U.S. Department of Education found that technology proficiency is rapidly evolving and is likely to continue to change (Crawford and Toyama, 2002). The authors of the report contend that it will be important for schools to be willing to address these changes and to adjust the assessment approaches to meet the changing needs. This report outlines the issues and questions that need to be addressed as direct measures of technology proficiency are developed. This study was targeting teacher and student assessment at the elementary and secondary school level; however, many of the assessment tools studied could easily transfer to higher education.

In a study by Johnson, Bartholomew and Miller (2006), objective and subjective computer competency evaluations were given to business management students at Utah Valley State College during their freshman, junior and senior years. They found that the students' skill level and confidence decreased by graduation. Other researchers did not find support for the accuracy of subjective, self-report ratings (Merritt, Smith and Renzo, 2005).

Johnson et al. (2006) formulated a change management plan that would help move their students from the novice into the intermediate and advanced application of spreadsheets, which was the most deficient area identified by the employers of their graduates. They looked for ways to improve the computer literacy/proficiency of business majors by building on the skills learned in the foundation class in other business courses across the curriculum. They expected to improve retention of knowledge and skills in this area by increasing the use of these technologies in other business classes. They began by looking at the need to improve the computer literacy of faculty. They looked at 20 different approaches being used by business schools to achieve cross-functional integration of specific competencies in the curriculum (Hamilton, McFarland, and Mirchandani 2000).

Johnson et al. (2006) decided that the Just-In-Time integration method would work best at their institution. This Just-In-Time technique brings in skilled technology faculty or other training resources to teach hands-on skills just as needed at strategic places throughout the curriculum. The authors of this study volunteered their support to work with the other business management faculty to prepare and grade assignments and to help review spreadsheet concepts with students. They concluded that the faculty members would have to require students to complete assignments that involved using computer applications and applied the concepts and skills they learned in previous computer and business classes. Up to this point, except for word processing, the business faculty was not requiring the use of the basic computer tools in their courses.

Perez, Murray, and Myers (2007) also used self-reports to assess students' skills and knowledge. They evaluated a variety of assessment instruments and did not find one that was comprehensive enough to evaluate their students' progress on all of their learning goals. They created an instrument with items to measure computer hardware, system software, application software, networking, the Internet, and information literacy. Each item asks the student to rate their level of agreement with a statement about themselves (such as "I am skilled at ...", "I know how to ...", "I enjoy ...", etc.). Perez et al. then compared ratings on each item at the beginning and at the end of an introductory course. This approach, however, may measure student confidence rather than actual competence.

Merritt, Smith and Renzo (2005) had students self-report their level of computer literacy. A total of 55 students participated in the study. The authors found that self-reported computer literacy was not reliable. Some students over-reported while others under-reported their skills, which resulted in misplacement of the students in the proper level of computer course. Based on their findings, they recommend that people who are questioning the computer skills of prospective employees should test them instead of relying on the candidates' self assessment.

Robbins and Zhou (2007) compared the results of two simulation-based assessment tools that are used as a testing tool for credit-by-exam (Computer Skills Placement/CSP and Prentice Hall's Train and Assess IT/TAIT). They acknowledged that the iSkills test was much more involved and measures how well students can apply their computer knowledge to real-life scenarios that require them to use cognitive skills as well as critical and logical thinking skills. They were exploring the possibility of a pilot study on utilizing the iSkills assessment to compare with their current studies. However, they see difficulty in comparing and analyzing the three approaches because of their differences.

ISKILLS ASSESSMENT

As part of the National Higher Education ICT Initiative, ETS and a group of colleges and universities collaborated to create the iSkills assessment, a comprehensive test of information and communication technology proficiency specifically designed for the higher education environment. ETS also provides the SAT, PRAXIS, GRE, and Major Field Test assessment tools (ETS, 2008a).

ETS defines ICT literacy proficiency as the 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.

The Advanced Assessment iSkills Test from ETS provides a measure of students' technology skills (ETS, 2008b). iSkills is a web-based test that uses scenarios and simulated environments rather than multiple-choice or true/false questions. The test takes 75 minutes to complete, consists of 14 short (3-5 minute) tasks and 1 longer (15 minute) task. There is sufficient information available to support the validity and reliability of the test.

The test measures seven information and communication technology proficiencies: define, access, manage, integrate, evaluate, create, and communicate. The test also measures higher-order problem solving, critical thinking, evaluation, and communication skills in the context of identifying, selecting and using information and information technology to respond to real-world situations. The test simulates websites, web search, databases, office productivity software (including word processing, spreadsheet, database, presentation, email).

METHODOLOGY

The iSkills assessment was administered to students in an AACSB-accredited school of business of a small public university in a rural part of the central southern U.S. This assessment was part of a larger project to assess progress toward achieving learning goal objectives. The student population for the entire university is just under 7,500 while the school of business has about 654 students.

Faculty in the business school received an internal assessment grant to administer the iSkills test. The price per test ranged from \$22 to \$33 depending upon the number purchased. For 51-250 tests the cost was \$25 per test. During the 2008 academic year, the advanced iSkills assessment from ETS was administered in class to students enrolled in a senior-level management information systems course, a senior-level management elective course (e-commerce), and a junior-level advanced accounting course (accounting information systems). The iSkills assessment was also given to students enrolled in two sections of a freshman level Introduction to Business course. One section of this introduction course took the advanced iSkills assessment while the other section took the core level.

Prior to administering the assessment, staff installed the required browser plug-in and certified each of the computers in the classroom lab as ready and able to run the assessment web service. One of the authors proctored the assessment in the MIS and Introduction to Business courses and trained staff to assist the accounting course professor, who proctored the assessment in the AIS course. Two staff members were available to provide assistance during the beginning and throughout most of the testing period.

Students were promised confidentiality of their individual score. They were informed that the aggregate information would be used in assessment reports and research publications. To improve motivation, students in the MIS course were offered bonus points for successful completion of the assessment. Successful completion meant answering all questions and participating in all tasks with reasonable effort and attention. Students in the Introduction to Business course participated as part of the required activities of that course. Although students were not required to participate, most students chose to complete the assessment.

Under the guidance of the proctor, students created an account at the iSkills test administration website. Students were first presented with extensive demographic questions, including items such as the student's id number, email address, ACT scores, college GPA, whether English is their first language, gender, and ethnic background. If time for the proctored portion of the exam is short, students may be directed to register and complete the demographics on their own. Students were then presented with a set of scenarios and asked to accomplish a series of tasks. Once ETS completes the analysis of the responses (about 2 weeks), they send each student an email notice directing them to an individual results report. At this point, the institutional analyses and data set are also available to the faculty administrator.

There were a few minor technical glitches. In several cases the browser plug-in had to be re-installed. In one case, a damaged student network profile would not allow the web service to run. This student completed the test while logged in with the

instructor’s network account (under her watchful eye). Out of the upper level participants, 18 were excluded because they were not school of business majors. Of the remaining participants, two were excluded by the ETS analysis. ETS excludes the responses of any students who completed less than four of the tasks or spent less than ten minutes in either the first or the second section of the test.

ANALYSIS AND FINDINGS

Because this study was essentially exploratory in nature and intended as a means of assessing student competence with respect to information and communication technology skills, the analysis focuses on descriptive statistics and comparisons to national norms. Data was collected from upper division students to evaluate competency and from lower division students as a benchmark to use in evaluating the impact of a planned curriculum change. Future studies will look for statistically significant differences in the students before and after the intervention.

ETS evaluates and analyzes the students’ responses and returns several reports. For each student, the company issues an Individual Score Report which describes the individual’s overall score, percentile ranking, strengths, and weaknesses. For the institution, ETS prepares an Aggregate Task Performance Feedback Report and an Institutional Skill Area Report. The Aggregate Task Performance Feedback Report consolidates the results of all individual student reports at the specified institution and provides the numbers and percentages of students who receive the highest score on specific components of each of the seven skill areas. These results are then compared to the reference group’s highest scoring response percentage. In this study, the reference group was juniors and seniors at a four-year college who participated in the same assessment. The Institutional Skill Area Report provides the university with the aggregate results from test takers and compares student scores with that same reference group. The performance in each ICT literacy skill area is reported and includes two graphical representations of skill area performance relative to the reference group using score distribution and median point analysis.

Figure 1 below contains the main portion of the Institutional Skill Area Report for the upper division students (juniors and seniors) on the Advanced Level Test. The ETS analysis identified a total of 103 upper division business student responses in the final institutional analysis. Overall, the students did relatively well, but there is room for improvement. The median performance for upper division students was generally at or above the 50th percentile on most proficiencies for the selected reference group of four-year universities who took the test.

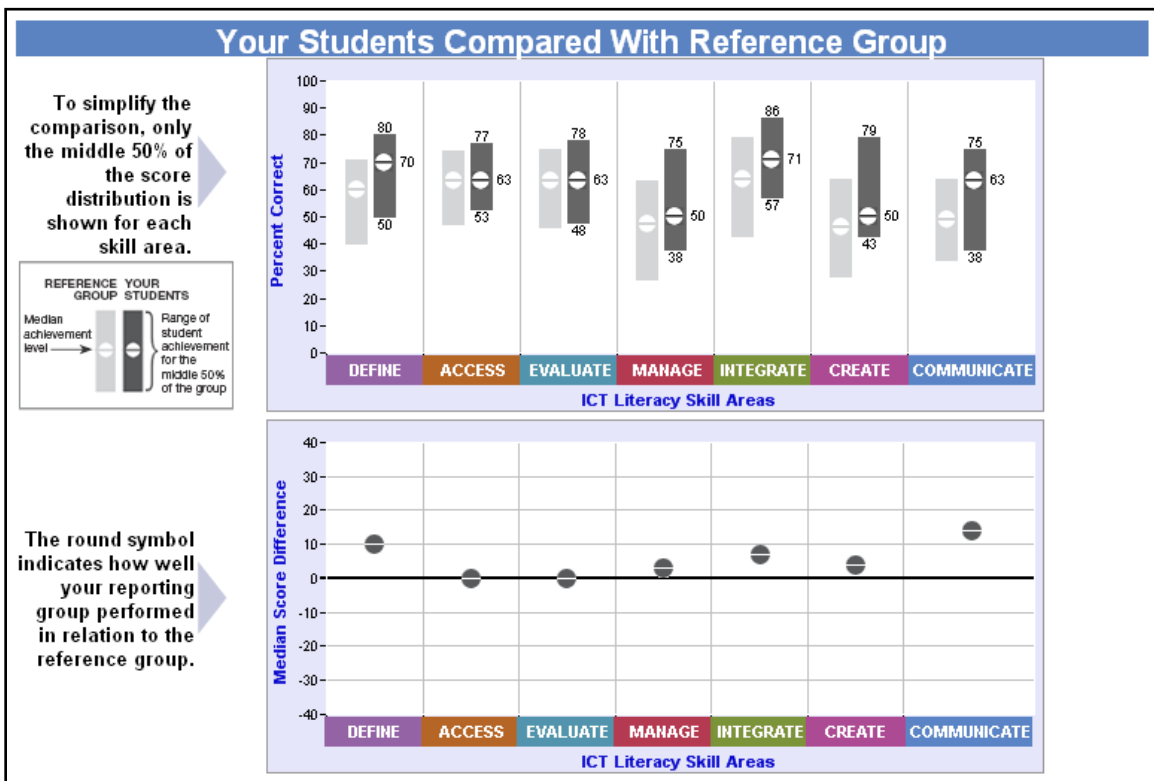


Figure 1 Institutional Skill Area Report for Upper Level Students - Advanced Level Test

The upper division students were strongest in figuring out what they needed before conducting electronic searches and in interpreting and analyzing information once they have it. The highest percentile scores and median scores were in the Define and the Integrate proficiencies.

The Integrate proficiency had a median percent correct score of 71 with a range of 57 - 86. ETS defines this skill as “The ability to interpret and represent digital information. This includes the ability to use ICT tools to synthesize, summarize, compare and contrast information from multiple digital sources” (ETS, 2008c).

The Define proficiency had a median percent correct score of 70 with a range of 50 – 80. ETS defines this skill as “The ability to understand and articulate the scope of an information problem in order to facilitate the electronic search for information” (ETS, 2008c).

These students were weakest in generating and managing information. There was also a small indication of weakness in the Communicate proficiency. The lowest two median scores were in the Manage and Create proficiencies. The lowest percent correct scores in this sample were Manage, Create, and Communicate proficiencies (38, 43, and 38, respectively). These three proficiencies also had the widest range in the reported scores, which implies a wider variation in students’ skills in these three areas.

The Manage median percent correct score was 50 with a range of 75- 38. ETS defines the Manage skill as “The ability to apply an existing organizational or classification scheme for digital information. This ability focuses on reorganizing existing digital information from a single source using preexisting organizational formats. It includes the ability to identify preexisting organizational schemes, select appropriate schemes for the current usage and apply the schemes.” (ETS, 2008c).

The Create median percent correct score was 50 with a range of 79 – 43. ETS defines the Create skill as “The ability to generate information by adapting, applying, designing or inventing information in ICT environments” (ETS, 2008c).

The Communicate proficiency had a relatively high median percent correct score of 63 and the high end of the score range was 75. However, the low end of the score range was 38, which is one of the lower values. ETS defines the Communicate skill as “The ability to communicate information properly in its context of use for ICT environments. This includes the ability to gear electronic information for a particular audience and communicate knowledge in the appropriate venue” (ETS, 2008c).

ETS will not generate a subgroup report for less than 50 iSkills responses. In addition, the results reported above do not include the entire sample size (see comment on capturing data about the student’s major in the Limitations section below). While there were enough Management/Marketing majors to generate a separate report, there were not enough Accounting or Economics/Finance majors to generate separate reports. However, the Association to Advance Collegiate Schools of Business (AACSB) assurance of learning standards requires the school to report findings for each major. To meet this requirement, the average reported score and average percentile rank were calculated for each major for both upper division and lower division students. The results are listed in Table 1.

Majors	n	Upper Division Avg. of Reported Percent Correct Score	Upper Division Avg. of Percentile Rank	n	Lower Division Avg. of Reported Percent Correct Score	Lower Division Average of Percentile Rank
Accounting	47	567.4	63.0	16	558.8	56.1
Business Education	2	567.5	77.0			
Economics/Finance	14	565.7	59.0	7	522.9	28.9
Management/ Marketing	52	563.5	58.7	20	545.8	43.9
Undeclared/Other				16	543.6	42.1
Grand Total	115	565.4	60.6	59	545.3	44.3

Table 1 Upper and Lower Division Advanced Level iSkills Assessment

Although there was not much difference on the average reported correct score across majors for the upper division students, the percentile rankings do show some small differences. The business education majors had the highest average percentile ranking, but there were only two students in this sample. The upper division management/marketing students had the lowest

average percentile ranking. There is more variation in the averages for the lower division students with economics/finance majors ranking the lowest and accounting ranking the highest.

The Advanced Level iSkills assessment was administered to lower division students enrolled in a freshman Introduction to Business course. These students clearly scored lower in each major, as expected. The median performance for lower division students was below the 50th percentile on most proficiencies for the selected reference group. Figure 2 below illustrates this result. Since the upper division students scored higher than the lower division students, one explanation for this finding is that the curriculum in general is effective in improving students’ information and communication technology skills.

The lower division students who took the Advanced Level iSkills assessment scored highest on the Access and the Integrate skill proficiencies. These students performed adequately at collecting, retrieving, interpreting, and presenting information in a digital environment. The median percent correct score for the Access proficiency was 63 with a range of 43 – 70. ETS defines the Access skill as the ability to “collect and/or retrieve information in digital environments” (ETS, 2008c). The median percent correct score for the Integrate proficiency was 64 with a range of 50 – 79 (highest score for this sample).

The lowest median percent correct scores for this group were the Manage and Create skill proficiencies. These students were weakest at figuring out how construct and adapt information in digital environments and how to organize information for later retrieval. The median percent correct score for the Manage proficiency was 25 with a score range of 25 to 50 (25 was the lowest percentile score in the entire sample). The median percent correct score for the Create proficiency was 43 with a range of 29 – 64. The median percent correct score for the Communicate proficiency was also 50 but with a score range of 31 – 63.

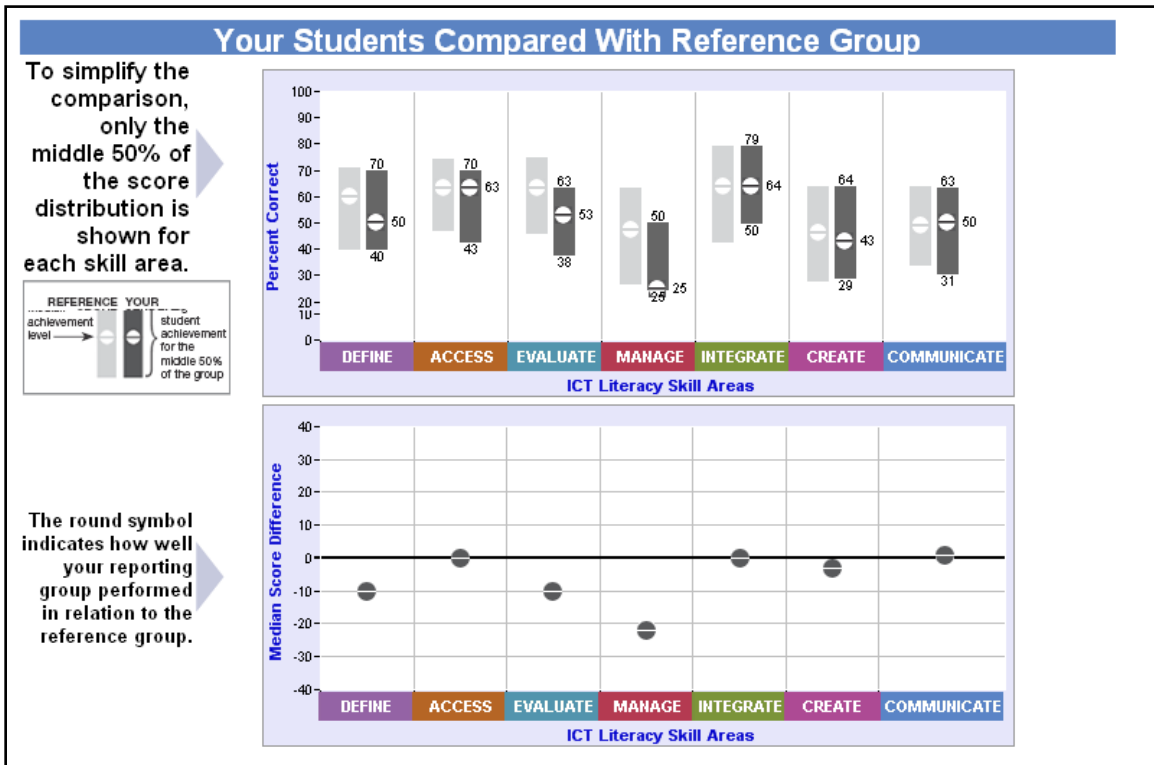


Figure 2 Institutional Skill Area Report for Lower Division Students - Advanced Level Test

Because the Advanced Level assessment is intended for rising juniors, the researchers also gave the Core Level assessment to another section of the Introduction to Business course. The Core Level test is designed for high school seniors or college freshmen. Figure 3 below illustrates the results. The student participants in this sample also scored mostly below the median score for the reference group and had lower scores in general. One explanation for this finding is that the students entering this school of business are much less prepared in the area of information and communication technology. Keeping in mind that this study has a cross-sectional rather than longitudinal design, this explanation also suggests that the upper division students may have been successful enough in developing their skills to achieve scores generally above the median on the Advanced Level assessment. They may also have been better prepared for these skills than the current group of freshman.

Just like the lower division students taking the Advanced Level assessment, the lower division students taking the Core Level assessment also scored highest in the Access and Integrate skill proficiencies. These students performed adequately on retrieving and interpreting information. The median percent correct score for the Access proficiency was 69 with a score range of 52 – 75. The median percent correct score for the Integrate proficiency was 64 with a range of 50 – 86 (also highest percentile score for this sample). The Integrate proficiency scores also had one of the widest ranges.

The lower division students taking the Core Level assessment were weakest in the Evaluate and Communicate skill proficiencies. These participants were not as able to take into consideration the quality of the information with which they were working, nor were they able to present that information to others effectively. The median percent correct score for the Evaluate proficiency was 53 with a score range of 31 - 69. ETS defines the Evaluate skill as the ability to “judge whether information satisfies an information problem by determining authority, bias, timeliness, relevance, and other aspects of materials” (ETS, 2008c). The median percent correct score for the Communicate proficiency was 40 with a score range of 25 – 55 (one of the lowest percentile scores in the entire study).

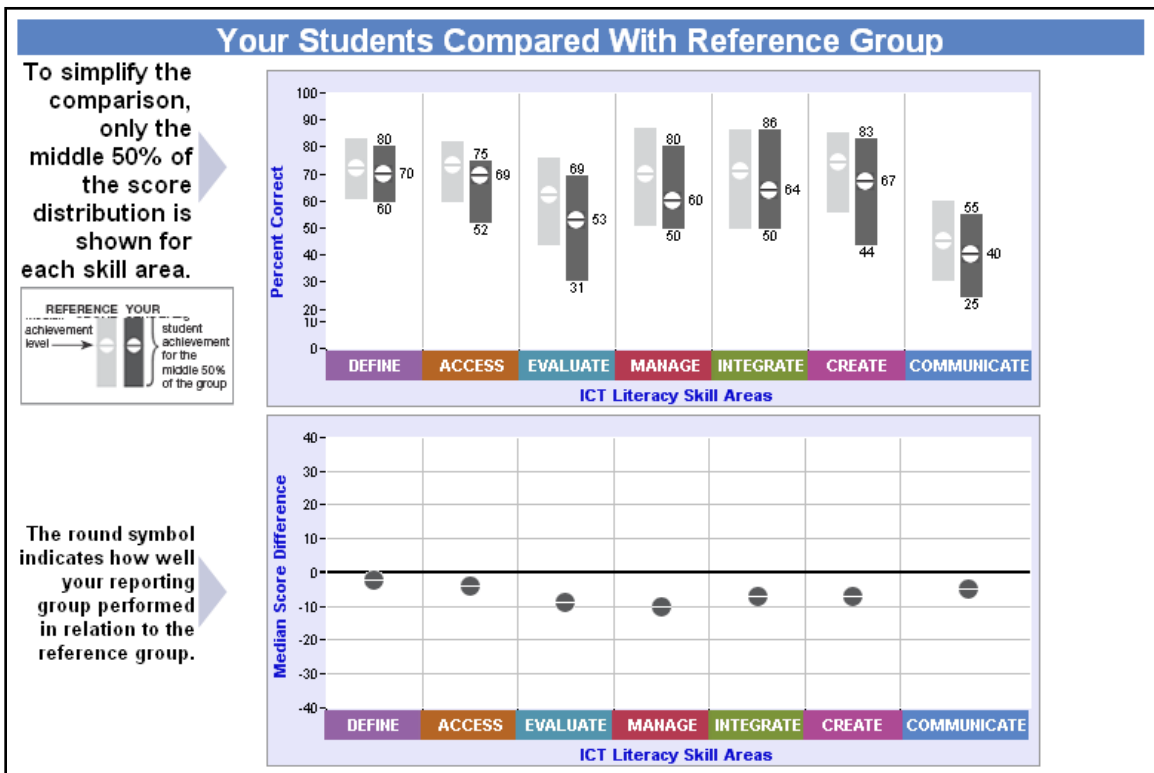


Figure 3 Institutional Skill Area Report for Lower Division Students - Core Level Test

To report assessment data by major, as required for AACSB accreditation, average scores and average percentile rankings were also calculated for this sample. Table 2 below shows the results. For the lower division students taking the Core Level iSkills assessment, the management/marketing majors had the lowest average reported percent correct score and economics/finance majors had the highest average reported percent correct score. For the average of percentile rankings, the management/marketing majors had the lowest average and the economics/finance majors had the highest average. However, there were only three economics/finance majors participating in this part of the assessment.

Majors	n	Lower Division Avg. of Reported Percent Correct Score	Lower Division Average of Percentile Rank
Accounting	11	150.9	47.8
Economics/Finance	3	195.0	89.7
Management/Marketing	29	136.9	35.3
Other/Undeclared	14	158.9	56.5
Grand Total	57	148.1	45.8

Table 2 Lower Division Core Level iSkills Assessment

Limitations

There are several limitations of the data and analysis provided by ETS. This assessment instrument does not directly measure knowledge of and competence in using specific software packages. iSkills simulates generic application environments and focuses instead on the student's ability to acquire, manipulate, store, and use information and communicate findings to others.

ETS will not generate a subgroup report for less than 50 iSkills responses. The results reported above are for the entire sample size. While there were enough Management/Marketing majors to generate a separate report, there were not enough Accounting and Economics/Finance majors to generate separate reports. However, the Association to Advance Collegiate Schools of Business (AACSB) assurance of learning standards requires the school to report findings for each major.

To address this problem, the authors are planning to collect enough additional data in the Spring 2009 term to allow generation of the report for the major subgroups. In the meantime, an average score and an average percentile ranking were calculated for each major taking the advanced level assessment, as shown in Table 1.

While the ETS includes individual scores and demographic data in an institutional spreadsheet download feature, they do not provide percentile rankings for each student. That data must be collected manually from each student's individual report. In addition, the analysis shown in Figure 2 is provided in graphic form on a webpage but the original reference group data is not provided should the researcher wish to compare to other assessment data or generate box plots in some other statistical analysis software.

ETS does not provide sub scores for the seven literacy skill areas (define, access, evaluate, manage, integrate, create, and communicate). The authors would like to have compared this data to other data collected in the school assessment of critical thinking and communication learning objectives. ETS also does not provide individual sub scores for the MIS portion of the Business Major Field Test. While the MIS subsection does not measure the same knowledge and skills as the iSkills assessment, it would have been helpful in crafting curriculum changes to compare each student's scores on both measures

ETS provides a web-based Institutional Skill Area Report and a more detailed Aggregate Task Performance Feedback Report that can be tailored to select inclusion of student scores based on demographic data, including major. ETS regards the undergraduate major as the student's degree program (i.e. 'business', 'engineering', etc.) and does not differentiate discipline within degree program ('accounting', 'management', 'marketing', etc.). In the spring data collection, some students reported their major incorrectly. For example, some accounting students selected 'Other' rather than 'business' as their major and some health information management students (a degree program outside of the school of business) selected 'Other' rather than 'health services' as their major. When selecting which majors to include in a report, it was not possible to include those accounting students without selecting the 'other' option, which also included several health information management students. The ETS system does not allow the account administrator (one of the authors of this paper) to correct these demographic data errors in the ETS database. Therefore, the reports shown in Figure 1 and Figure 2 are not completely accurate. However, the data could be corrected in the spreadsheet downloaded from the ETS website. This is why the sample size for the reports in Figure 1 and Figure 2 to not tally exactly with the sample size reported in Table 1.

The authors attempted to correct this problem in the Fall 2008 data collection in two ways. First, the proctor stressed to the student participants the need to make an accurate selection of business as the undergraduate major. Second, an additional

question was added to the demographic area asking the students to indicate their primary and secondary major within business. However, the reports do not allow use of these added demographic questions in selecting the sample for a report. ETS does allow selection based on particular sessions, but each section contained a mix of majors. Therefore, the ETS reports remain problematic with respect to selection based on undergraduate major. In the future, the authors will attempt to manually segregate assessment sessions by major.

RECOMMENDATIONS

While the students did well, there remains room for improvement. There are several approaches to ‘closing the loop’ and improving student learning in this area. Three major areas are the initial learning process, retention of learning, and application of learning in upper-division courses and in the workplace. The school could make changes in the lower level courses to improve initial learning and could provide more reinforcement in upper division courses to improve retention and to improve students’ ability to apply these skills to real world problems (Hollister and Koppel, 2008).

As a result of this study, several changes have been recommended. First, a curriculum change has been proposed which would require students to take a business-focused introductory package course within the department in place of one being taught as a generic course in another department. This change will allow a stronger focus on business problem solving as well as go more into depth in the spreadsheet and database applications rather than just teaching the tool or skill. This change will also allow a sophomore-level application packages course to focus more on problem solving and less on teaching specific package skills.

Second, a reduced emphasis on group work, an increased emphasis on individual work, and increased effort in the prevention of academic dishonesty are recommended in the lower division courses with respect to software applications. Students are less likely to acquire individual skills if they work heavily in groups, have excessive help, or cheat in completing assignments.

Once a solid foundation of individual skills are in place, the upper-division courses can continue the ‘business problem solving’ approach and add more group work to simulate real workplace conditions. We are re-examining the upper-division core and elective courses with respect to when and how these skills can be reinforced and extended in order to improve retention.

FUTURE RESEARCH

The authors plan to continue collecting data in order to reach a level of at least 50 students in each major for validity and comparison across the majors. Work is also being done to collect test data on other majors at the University. The iSkills test was administered to an upper division Engineering course in 2008. Another possible assessment measure in the future would be to include Microsoft Certification in the School of Business curriculum. The students who were tested at the Lower Division in 2008 will be tested again in their senior year to see how well the School is meeting its learning goal objectives.

CONCLUSION

The iSkills assessment of information technology and communication skills has provided a useful guide in making changes to our curriculum that will hopefully improve assurance of learning in our business degree program. This assessment has also provided a valuable benchmark with external validity to measure the impact of planned curriculum changes.

REFERENCES

1. Bartholomew, K. W. (2004) Computer literacy: is the emperor still exposed after all these years? *Journal of Computing Sciences in Colleges*, 20, 1, 323-331.
2. Case, T., MacKinnon, R., and Dyer, J. (2004) Computer Literacy and the Introductory Student: An Analysis of Perceived and Actual Knowledge of Computers and Computer Applications, *Proceedings of the Seventh Annual Conference of the Southern Association for Information Systems*, 278-284.
3. Crawford, Valerie M and Toyama, Yukie (2002) *Assessing the Educational Technology Proficiency of Students and Educators*, Prepared for the U.S. Department of Education Planning and Evaluation Service. [Online] Retrieved February 16, 2009, from the World Wide Web http://ctl.sri.com/publications/downloads/Task2_FinalReport3.pdf.
4. Dyer, J., MacKinnon, R., and Case, T. (2004) What Intro Students Know About Computer Concepts, *Proceedings of the Tenth Annual Americas Conference on Information Systems*, New York, 2917-2924.
5. Educational Testing Service (ETS) (2003) Succeeding in the 21st Century: What Higher Education Must Do to Address the Gap in Information and Communication Technology Proficiencies, http://www.ets.org/Media/Tests/InformationandCommunicationTechnology_Literacy/ICTwhitepaperfinal.pdf.
6. Educational Testing Service (ETS) (2008a) iSkills Overview. Retrieved September 5, 2008, from <http://www.ets.org>, menu item iSkills.
7. Educational Testing Service (ETS) (2008b) ETS.Org Home Page. Retrieved September 5, 2008, from <http://www.ets.org>.
8. Educational Testing Service (ETS) (2008c) ICT Proficiencies: Measure Both Cognitive and Technical Skills. Retrieved September 5, 2008, from http://www.ets.org/Media/Tests/ICT_Literacy/pdf/ICT_Seven_Proficiencies.pdf.
9. Hamilton, D., McFarland, D. and Mirchandani, D. (2000) A decision model for integration across the business curriculum in the 21st. century, *Journal of Management Education*, 24(1), 102-127.
10. Hardy, C., Heeler, P., and Brooks, D. (2006) Are high school graduates technologically ready for post-secondary education? *Journal of Computing Sciences in Colleges*, 21, 4, 52-60.
11. Hollister, K. K., and Koppel, N. B. (2008) Curricular Changes in Response to Assurance of Learning Results in Information Technology, *Journal of American Academy of Business, Cambridge*, 13, 1, 287-293.
12. Johnson, D. W., Bartholomew, K. W. and Miller, D. (2006) Improving Computer Literacy of Business Management Majors: A Case Study, *Journal of Information Technology Education*, (5), 77-94.
13. Merritt, K., Smith, K. D., and Renzo Jr., J. C. (2005) An Investigation of Self-Reported Computer Literacy: Is it Reliable? *Issues in Information Systems*, 4, 289-295.
14. Murray, M., Hooper, J. and Perez, J. (2007) A Project-Based Approach To Student Competency With Productivity Software, *Proceedings of the AIS SIG-ED IAIM 2007 Conference*, December 7-9, Montreal, Quebec, Canada, 1-14.
15. Perez, J. and Murray, M. (2006) Journey to the Center of the Core: Computers and the Internet in the Core Curriculum, *Journal of Issues in Informing Science and Information Technology*, 3, 489 – 497.
16. Perez, J, Murray, M., and Myers, Martha (2007) An Information Technology Literacy Self-Assessment Instrument: Development and Pilot Results, *Proceedings of the Americas Conference on Information Systems*, August 9-12, Keystone, CO, USA, Paper 229.
17. Robbins, R. and Zhou, Z. (2007) a Comparison of Two Computer Literacy Testing Approaches, *Issues in Information Systems*, 8, 1, 185-191.
18. Stephens, P. and Shotick, J. (2001) Computer Literacy and Incoming Business Students: Assessment, Design and Definition of a Skill Set, *Issues in Information Systems*, 2, 460 – 466.
19. Wallace, P. and Clariana, R. (2005) Perception verses reality – Determining business students’ computer literacy skills and need for instruction in information concepts and technology, *Journal of Information Technology Education*, 4, 141-151. Available at <http://jite.org/documents/Vol4/v4p141-151Wallace59.pdf>.
20. Whitaker, B. and Coste, T.G. (2002) Developing an effective IT integration and support system, *Journal of Information Technology Education*, 1, 1, 53-63. Available at <http://jite.org/documents/Vol1/v1n1p053-064.pdf>.

APPENDIX A

DEFINITIONS OF ICT LITERACY SKILL AREAS IN THE ETS ISKILLS TEST

The list is from the Content tab on the iSkills page, which can be reached from <http://www.ets.org>.

Define: Understand and articulate the scope of an information problem in order to facilitate the electronic search for information, such as by

- Distinguishing a clear, concise, and topical research question from poorly framed questions, such as ones that are overly broad or do not otherwise fulfill the information need
- Asking questions of a "professor" that help disambiguate a vague research assignment
- Conducting effective preliminary information searches to help frame a research statement

Access: Collect and/or retrieve information in digital environments. Information sources might be web pages, databases, discussion groups, e-mail, or online descriptions of print media. Tasks include

- Generating and combining search terms (keywords) to satisfy the requirements of a particular research task
- Efficiently browsing one or more resources to locate pertinent information
- Deciding what types of resources might yield the most useful information for a particular need

Evaluate: Judge whether information satisfies an information problem by determining authority, bias, timeliness, relevance, and other aspects of materials. Tasks include

- Judging the relative usefulness of provided web pages and online journal articles
- Evaluating whether a database contains appropriately current and pertinent information
- Deciding the extent to which a collection of resources sufficiently covers a research area

Manage: Organize information to help you or others find it later, such as by

- Categorizing e-mails into appropriate folders based on a critical view of the e-mails' contents
- Arranging personnel information into an organizational chart
- Sorting files, e-mail's, or database returns to clarify clusters of related information

Integrate: Interpret and represent information, such as by using digital tools to synthesize, summarize, compare, and contrast information from multiple sources while

- Comparing advertisements, e-mails, or websites from competing vendors by summarizing information into a table
- Summarizing and synthesizing information from a variety of types of sources according to specific criteria in order to compare information and make a decision
- Re-representing results from an academic or sports tournament into a spreadsheet to clarify standings and decide the need for playoffs

Create: Adapt, apply, design, or construct information in digital environments, such as by

- Editing and formatting a document according to a set of editorial specifications
- Creating a presentation slide to support a position on a controversial topic
- Creating a data display to clarify the relationship between academic and economic variables

Communicate: Disseminate information tailored to a particular audience in an effective digital format, such as by

- Formatting a document to make it more useful to a particular group
- Transforming an e-mail into a succinct presentation to meet an audience's needs
- Selecting and organizing slides for distinct presentations to different audiences
- Designing a flyer to advertise to a distinct group of users

APPENDIX B

ETS ISKILLS AGGREGATE TASK PERFORMANCE FEEDBACK REPORT ADVANCED LEVEL VERSION

Upper Level includes Junior and Senior students and the Lower Level includes Freshmen and Sophomore students.

This report shows the number and percentage of our students reporting group who achieved the highest score for each of the components of the tasks and skills areas. The percentage of students from the reference group achieving the highest score of each of the components is also presented. The reference group consisted of 1,164 examinees from 4-year colleges.

What students were asked to do	Feedback on highest-scoring response	# of students with highest-scoring response		% of students with highest-scoring response		% in reference group with highest-scoring response
		Upper Level	Lower Level	Upper Level	Lower Level	Reference
Define Skill Area						
Answer three questions to clarify a research project	Selected the best initial question to help clarify the project	66 of 103	33 of 59	64%	56%	58%
	Selected the best database variable to provide useful information for the project	49 of 103	17 of 59	48%	29%	43%
	Chose the best research question	64 of 103	33 of 59	62%	59%	50%
Choose a research topic according to specific criteria and explain your choice	Chose a research topic that fulfilled all of the criteria given	46 of 103	15 of 59	44%	25%	33%
	Correctly reported the criteria fulfilled by the research topic selected	14 of 103	4 of 49	14%	7%	9%
Access Skill Area						
Install a video player in order to download a video file	Installed the Video player and played the video file successfully	90 of 103	54 of 59	87%	92%	87%
	Selected no unnecessary links when installing the video player	56 of 103	34 of 59	54%	58%	52%
	Saved the video file to the proper folder on the hard drive	65 of 103	31 of 59	63%	53%	51%
Locate a Web page and two database abstracts for a research project	Used search terms that were precise and useful in Web searches	25 of 103	16 of 59	24%	27%	26%
	Used search terms that were precise and useful in database searches	44 of 103	18 of 59	43%	31%	38%
	Used proper search delimiters in database searches	35 of 103	19 of 59	34%	32%	37%
Search a store's database in response to a customer's inquiry	Chose the correct store database on your first search	88 of 103	46 of 59	85%	78%	86%
	Selected the most appropriate category for searching	26 of 103	18 of 59	25%	31%	29%
	Chose the best search expression for the category selected	69 of 103	37 of 59	67%	63%	54%
	Selected all of the appropriate items for the customer	46 of 103	15 of 59	45%	25%	31%
	Did not select any inappropriate items for the customer	45 of 103	15 of 59	44%	25%	31%

Evaluate Skill Area		Upper	Lower	Upper	Lower	Ref.
Judge the probable usefulness of sites returned in a Web search for a particular research topic	Selected the best site for the research topic	47 of 103	16 of 59	46%	27%	51%
	Judged sites correctly with regard to authority	64 of 103	27 of 59	62%	46%	54%
	Judged sites correctly with regard to bias	25 of 103	6 of 59	24%	10%	28%
	Judged sites correctly with regard to currency	85 of 103	43 of 59	83%	73%	81%
Judge the usefulness of Web pages and article abstracts	Visited only promising Web pages	17 of 103	7 of 59	17%	12%	17%
	Selected the best Web page to visit the first time it was returned in a Web search	44 of 103	14 of 59	43%	24%	41%
	Bookmarked the best Web page for the assign.	48 of 103	17 of 59	47%	29%	42%
	Selected the two best abstracts from the article database	25 of 103	8 of 59	24%	14%	16%
Manage Skill Area						
Organize files into folders on a hard drive	Moved all files into proper folders	21 of 103	7 of 59	20%	12%	20%
	Deleted all unnecessary folders	32 of 103	9 of 59	31%	15%	23%
Place e-mails into correct folders and identify those requiring later action	Moved e-mails into proper folders	34 of 103	12 of 59	33%	20%	24%
	Properly handled e-mails requiring later action	50 of 103	10 of 59	49%	17%	33%
Integrate Skill Area						
Combine several electronic suggestions in order to plan a scientific experiment	Organized the experiment correctly	46 of 103	24 of 59	45%	41%	32%
	Distinguished the steps and results of the experiment correctly	57 of 103	28 of 59	55%	47%	38%
	Correctly identified the conclusion in the experiment plan	57 of 103	33 of 59	55%	56%	43%
	Accurately cited the source of the experiment	62 of 103	32 of 59	60%	54%	57%
Compare several reviews in order to choose the best product	Created table rows that represented your needs effectively	23 of 103	14 of 59	22%	24%	27%
	Filled in table cells accurately	50 of 103	20 of 59	49%	34%	41%
	Ranked products correctly	90 of 103	49 of 59	87%	83%	81%
Create Skill Area						
Choose material to create a Web page	Selected the necessary and desirable content	63 of 103	41 of 59	61%	69%	56%
	Organized the Web page logically and effectively	67 of 103	33 of 59	65%	56%	48%
	Observed ethical or legal considerations	85 of 103	42 of 59	83%	71%	77%
Create a data display	Selected the necessary content for the data display	34 of 103	9 of 59	33%	15%	27%
	Organized the layout of the data display logically and effectively	32 of 103	7 of 59	31%	12%	22%
	Created the data display very efficiently	27 of 103	6 of 59	26%	10%	19%
	Drew a correct conclusion based on the data display	51 of 103	27 of 59	50%	46%	37%

Communicate Skill Area		Upper	Lower	Upper	Lower	Ref.
Make a slide arguing a position on telecommuting based on information presented in an e-mail	Included all key points necessary for effective communication	34 of 103	12 of 59	33%	20%	26%
	Included no points irrelevant to the audience's needs	26 of 103	10 of 59	25%	17%	20%
	Chose the most effective title for the presentation slide	38 of 103	24 of 59	37%	41%	44%
Select the best way to advertise an event to the users of an electronic mailing list	Correctly analyzed the key details of all the ads	27 of 103	9 of 59	26%	15%	16%
	Correctly applied the mailing list policy to the ads	42 of 103	21 of 59	41%	36%	33%
	Chose appropriate ad content for the audience	66 of 103	35 of 59	64%	59%	57%
	Chose an ad with language and tone suitable for the audience	66 of 103	34 of 59	64%	58%	54%
	Selected the best ad for the mailing list	55 of 103	29 of 59	53%	49%	43%

Important notice: Statistics computed for small numbers of students (e.g., 50 or fewer) may not generalize to other, similar groups of students. The smaller the number of students included in the statistics, the less likely that another group of students would have performed similarly. Students who completed fewer than 4 tasks, or spent less than 10 minutes, in either of the two sections of the test are excluded from this report.

APPENDIX C

ETS ISKILLS AGGREGATE TASK PERFORMANCE FEEDBACK REPORT CORE LEVEL VERSION

Includes Mostly Freshmen and Sophomore students

This report shows the number and percentage of our students reporting group who achieved the highest score for each of the components of the tasks and skills areas. The percentage of students from the reference group achieving the highest score of each of the components is also presented. The reference group consisted of 1,164 examinees from 4-year colleges.

What students were asked to do	Feedback on highest-scoring response	# of students with highest-scoring response	% of students with highest-scoring response	% in reference group with highest-scoring response
Define Skill Area				
Answer three questions to clarify a research project	Selected the best initial question to help clarify the project	35 of 56	63%	82%
	Selected the best database variable to provide useful information for the project	33 of 56	59%	70%
	Chose the best research question	30 of 56	54%	61%
Choose a research topic according to specific criteria and explain your choice	Chose a research topic that fulfilled all of the criteria given	30 of 56	54%	45%
	Correctly reported the criteria fulfilled by the research topic selected	17 of 56	30%	31%
Access Skill Area				
Search a store’s database in response to a customer’s inquiry	Chose the correct store database on your first search	51 of 56	91%	95%
	Chose the best search expression for the category selected	50 of 56	89%	88%
	Selected all of the appropriate Items for the customer	31 of 56	55%	61%
	Did not select any inappropriate items for the customer	17 of 56	30%	32%
Locate two Web pages for a research project	Used search terms that were precise and useful in Web searches	32 of 56	57%	57%
	Received a high percentage of relevant returns in one or two searches	4 of 56	7%	10%
Evaluate Skill Area				
Evaluate a database in order to determine its usefulness for a project about opposing viewpoints	Evaluated the database correctly and selected sources with authority and objectivity	22 of 56	39%	62%
	Selected current sources from the database	22 of 56	39%	48%
	Selected relevant sources from the database	20 of 56	36%	45%
	Correctly determined whether the database was useful for your project and selected the best articles	13 of 56	23%	33%
	Correctly evaluated the usefulness of the database without needing explicit criteria	40 of 56	71%	81%

Evaluate Skill Area Continued				
Judge the usefulness of Web pages for a research project	You selected the best Web page to visit the first time it was returned in a Web search	15 of 56	27%	19%
	Chose the best Web pages as most useful for the research project	5 of 56	9%	7%
	Judged Web pages correctly with regard to relevance	6 of 56	11%	12%
	Judged Web Pages correctly with regard to authority	8 of 56	14%	21%
	Judged Web pages correctly with regard to point of view	32 of 56	57%	57%
	Judged Web pages correctly with regard to currency	22 of 56	39%	47%
Judge the probable usefulness of sites returned in a Web search for a particular research topic	Selected the best sites for the research topic	25 of 56	45%	58%
	Judged sites correctly with regard to authority	30 of 56	54%	69%
	Judged sites correctly with regard to bias	27 of 56	48%	63%
	Judged sites correctly with regard to currency	28 of 56	50%	71%
Manage Skill Area				
Fill in an organizational chart to reflect the structure of a new business	Represented all required elements in the organizational chart	36 of 56	64%	76%
	Represented all elements in the right relationships	33 of 56	59%	71%
	Appropriately deleted unused cells	38 of 56	68%	70%
Organize files into folders on a hard drive	You moved all files into proper folders	9 of 56	16%	20%
	You deleted all unnecessary folders	11 of 56	20%	35%
Integrate Skill Area				
Fill out a spreadsheet in order to determine the season records of teams in a volleyball league	Selected proper headings for spreadsheet rows and columns	39 of 56	70%	67%
	Represented information in spreadsheet cells accurately	39 of 56	70%	69%
	Accurately interpreted the information presented	35 of 56	63%	69%
Complete a table comparing potential checking accounts according to specific criteria	Selected correct column headings for the table	19 of 56	34%	37%
	Accurately represented information in the table	23 of 56	41%	53%
	Ranked the checking accounts correctly	33 of 56	59%	60%
Create Skill Area				
Create a data display	Selected the necessary content for the data display	36 of 56	64%	66%
	Organized the layout of the data display logically and effectively	42 of 56	75%	80%
	Created the data display very efficiently	41 of 56	73%	79%
	Drew a correct conclusion based on the data display	46 of 56	82%	85%
Create a slide for a group presentation	Choose the best layout to create the slide	23 of 56	41%	59%
	Chose the best title for the slide	33 of 56	59%	71%
	Chose the best text for the slide	4 of 56	7%	7%
	Chose the best image for the slide	29 of 56	52%	70%
	Formatted the finished slide effectively	17 of 56	30%	35%

Communicate Skill Area				
Select and organize slides for two distinct presentations to different audiences	Selected the best slides and titles for the first presentation	5 of 56	11%	10%
	Sequenced the slides correctly for the first presentation	18 of 56	32%	30%
	Selected the best slides and titles for the second presentation	6 of 56	11%	22%
	Sequenced the slides correctly for the second presentation	16 of 56	29%	38%
	Made a correct decision regarding the delivery mode for the two presentations	29 of 56	52%	42%
	Indicated an awareness of the different needs of the two audiences	3 of 56	5%	2%
Select the best way to advertise products to users of an electronic mailing list	Correctly analyzed the key details of all the advertisements	30 of 56	54%	49%
	Correctly applied the mailing list policy to the advertisements	12 of 56	21%	23%
	Chose an advertisement with language and tone suitable for the audience	37 of 56	66%	74%
	Selected the best advertisement for the mailing list	33 of 56	59%	70%

Important notice: Statistics computed for small numbers of students (e.g., 50 or fewer) may not generalize to other, similar groups of students. The smaller the number of students included in the statistics, the less likely that another group of students would have performed similarly. Students who completed fewer than 4 tasks, or spent less than 10 minutes, in either of the two sections of the test are excluded from this report.