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ABSTRACT

This paper describes the approach of the University of Texas at Arlington (UTA) to ensuring that all students have basic competence in computer use. It describes the development and implementation of the UTA computer proficiency examination. UTA students currently have two options. They may take the computer proficiency course designated in their major department or they may take the UTA Computer Proficiency Examination. The test is a performance-based, or authentic, assessment that is a modified combination of product-oriented and portfolio assessment. Rather than measuring a student's ability to memorize keystrokes and pulldown menus, it is a measure of a student's ability to use the tools available in order to perform meaningful, real-life tasks, although in a proctored environment that makes it an abbreviated version of a portfolio. The five test components are: word processing, spreadsheets, Internet research and evaluation, e-mail, and online library use. A student who fails a component may take it again 6 weeks later. A small student survey (n=22) has indicated that students generally felt prepared for the test and found that it tested content they expected. (SLD)

Computer Proficiency Testing in Higher Education: Impetus and Implementation

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Introduction

Virtually every organization, in both the private and public sectors, has experienced a rapid increase in the use of technology over the past 10 years. In keeping with these changes, it has been necessary to adapt curriculum at every level to ensure that students have the skills necessary to compete in the new knowledge economy.

While we know that students need to be prepared to use technology, identifying the skills that qualify as general proficiency is a difficult task. Technology is becoming increasingly specialized. Nearly every discipline has a software program unique to their work. On most campuses, the Engineering Department uses AutoCAD, the Music department uses music notation and sequencing software (MIDI), the Psychology Department uses SPSS, and some departments use nothing beyond e-mail and word processing.

However, all students need to be knowledgeable consumers of information and be able to use the tools that are necessary for performance in any environment. This paper will focus on the incorporation of these needs into higher education graduation requirements, how a computer proficiency requirement can be implemented, and the development of a computer proficiency exam.

Changing Environments, University Responses

The sweep of digital technologies and the transformation to a knowledge-based economy have created a robust demand for workers highly skilled in the use of information technology. The demand for workers who can create, apply and use information technology goes beyond the IT industry, cutting across manufacturing and services, transportation, health care, education and government.

In order to meet the new demands resulting from the rapid rise in technology use over the past decade, institutions of higher education have endeavored to identify what basic competencies students need when they graduate. Computer proficiency at the University of Texas at Arlington was officially defined in 1997. UTA, upon the 1997 recommendation of the Southern Association of Colleges and Schools (SACS) Reaffirmation Committee, adopted a computer proficiency requirement for all undergraduate students. The1997 SACS Reaffirmation Committee Report categorically stated that basic computer use must be appropriate to the discipline and that it be clearly and explicitly demonstrated (SACS Criteria for Accreditation, Section 4.2.2).

UTA concurred that computer proficiency is essential both within the university and in the changing job market. The requirement would meet two objectives. First, it would ensure that professors could assume that students in their courses were proficient by the end of their freshman year. Second, that the university would be graduating students who had the necessary skills to succeed in their careers.

A computer proficiency requirement allows Instructors to focus on the content of their courses, rather than training students in the use of technology. Instructors increasingly require that students use technology in their coursework. Many Instructors require that students use e-mail to communicate, participate in discussion boards, access on-line databases, use PowerPoint for presentations, and use basic productivity tools such as word processing. A National Center for Educational Statistics study of the use telecommunications faculty by postsecondary instructional faculty and staff in Fall 1998 found that 69 percent of full-time and 46 percent of part-time faculty used e-mail to communicate with students and about one-third of both full- and part-time faculty used course specific web sites (NCES, 2002).

Furthermore, a degree from an institution of higher education has traditionally indicated to employers that students had a basic skill level in core areas. A college degree, regardless of the discipline, communicates to employers that graduates have received a certain level of education that will aid them in their careers. Math and English proficiency have long been requirements for a university education because they are basic to success in those employment areas that require a college degree. Over the past decade, computer proficiency has emerged as an additional area that is consistently valued by employers.

The job market has seen a dramatic increase in the demand for employees capable of incorporating technology and information management skills in their jobs. Although the technology skills of students currently graduating from high schools and universities surpass the skills of students graduating just ten years ago, employers are not yet able, or not yet willing, to assume that candidates know how to use technology and manage information. (Improving the Responsiveness Between Industry and Higher Education. 1999. http://www.itaa.org/workforce/studies/response.htm.) Requiring computer proficiency for graduation, like requiring Math and English proficiency, provides employers with critical information about the skills of college graduates.

However, specifying demonstration of computer proficiency is complicated by the fact that base skill levels differ drastically. Many traditional students have been using computers since elementary school. Non-traditional students, particularly those who were not exposed to computers in school or the workplace before coming to campus, require more extensive training. Thus, requiring all students to take a course aimed at basic proficiency would likely prove frustrating for students who were already at the minimum skill level. However, requiring a more advanced computer course would not be logical for many majors.

The implementation of the computer proficiency requirement at UTA addressed these varying levels through the development of a Computer Proficiency Test that would allow advanced students to demonstrate proficiency without taking a course. Currently, students have two options for fulfilling the computer proficiency requirement:

1.) The student may opt to take the course designated within their major department as that which satisfies the computer proficiency requirement.

2.) The student may opt to take the Computer Proficiency Exam developed by Assessment Services at the University of Texas at Arlington.

As the first option indicates, UTA decided that the decision as to what course would satisfy the computer proficiency requirement ought to be left with the department. This was done for two reasons. It was decided that each discipline had specific knowledge about the unique computer requirements of their field. For some departments, these requirements were quite stringent and thus the course required to meet the computer proficiency requirement was part of the students' core curriculum. In this case, the student would never be a candidate for the Computer Proficiency Test. Other departments determined that the computer proficiency level demanded by their discipline was more broadly based – there were no specific software programs that were essential for success. Thus students could satisfy the requirement with a general course. Those students who already had the skills to be taught in that course would be candidates for the Computer Proficiency Test.

The second objective was met by leaving the decision in the department was that departments became focused on assessing the computer skills needed for students they were

graduating. It was anticipated that this would have a positive affect on the use of technology on campus.

Whether or not increased technology use is the result of the computer proficiency requirement, or some other intervening variable, is unclear. However, a survey of department chairs (N=25) conducted in Fall 2002 indicates that many do believe that technology use in the classroom has increased since the requirement was implemented. When asked, do you believe that the level of technology use in the classroom has increased since the computer proficiency requirement implementation in 1999? 29 percent responded "definitely yes," 42 percent responded "probably yes," 21 percent responded "unsure," 8 percent responded "probably no" and no respondents indicated that they thought, "definitely no," the level of technology had not increased.

UTA Computer Proficiency Test Development

Because the decision of what course would satisfy the computer proficiency requirement was left with the department, in some cases the designated course was part of the student's core curriculum. These students would not qualify to take the test. Thus, during the initial development of the Computer Proficiency Test, it was difficult to estimate how many students it would be necessary to test. If the number of students were expected to be extremely high, such as the volume of students who take Math Placement Exams, then the volume of students expected to take the test would have to play some role in deciding how the test was developed and administered.

Certainly, a multiple-choice test would be a more efficient means to test a high volume of students. However, concerns regarding the construct validity of such a test immediately surfaced. It seemed unlikely that a multiple-choice test could accurately measure computer proficiency. For example, if the ability to copy and paste text were determined to be an indicator of proficiency, a multiple-choice test might ask the student to choose from a list of items that were representative of the steps necessary to complete the task. However, there are, at minimum, three different ways to accomplish this task; all of them valid. This was significant concern and, when balanced with the possibility that there may be a high number of students taking the test, it was decided that the measurement instrument itself was of primary importance.

Therefore, the test developed at UTA is a performance-based, or authentic, assessment. Grounded in William Spady's philosophy of Outcomes Based Education (OBE), authentic assessment is a performance opportunity for students requiring them to demonstrate outcomes that result in either solutions to meaningful real-life problems or significant purposeful products. Thus, an outcome is a culminating demonstration of the entire range of learning experiences and capabilities, including higher order thinking skills (Grandgenett, 1999).

Authentic assessment avoids the artificial division of knowledge into discrete items in favor of measuring behavior as a whole (Yen, 1993, in Hoepfl, 2003). The increased use of authentic assessment is grounded in broader reform efforts aimed at overall curriculum change. According to Marie Hoepfl, these reform efforts stem from three sources: a backlash against the pressure for accountability through standardized testing, the expansion of cognitive science, and concern from the business community that schools are not adequately preparing youth for today's workplace (Hoepfl, 2003, p.49).

In order to develop an authentic assessment of computer proficiency, UTA began with the identification of five competency areas with associated learning outcomes, general indicators, and performance measurements (see Appendix I). Once the competencies were identified, they were further broken down into specific tasks that, when combined, would produce a cohesive product or outcome.

The Computer Proficiency Test is a modified combination of product-oriented and portfolio assessment. A product-oriented assessment requires students to produce tangible products, e.g. a visual display. A portfolio assessment is a collection of samples of student work (Grandgenett, 1999). Rather than measuring a student's ability to memorize keystrokes and pull-down menus, the test was designed to measure a students' ability to use the tools available in order to perform meaningful, real-life tasks. Because the Computer Proficiency Test requires that the student perform a task in a proctored environment, it is, of course, an abbreviated version of a portfolio.

The test is divided into five components, each measuring one of the five competency areas: Word Processing, Spreadsheets, Internet Research and Evaluation, E-mail, and On-line Library Usage. Beyond knowing how to use these tools, students are required to analyze their utility. Additionally, there are several built-in components that are designed to expose students to

more advanced uses of the technology without requiring that they are proficient in these more advanced tasks.

Word Processing
- The student is asked to modify a document, according to the instructions, using a word processing program.
- Desktop management is also incorporated in this component.

Spreadsheets
- The student is asked to create a basic spreadsheet and graph.
- In addition the test exposes them to more powerful uses, such as using pre-built calculators to answer questions.

Internet Research and Evaluation
- The student is asked to:
  - search for information on a given topic,
  - choose a web site,
  - evaluate the web sites using an internet evaluation form, prepare a bibliography for the sites,
  - use the UTA web page and gather information.

E-mail
- The student is asked to use their UTA e-mail account, via remote access, and send an e-mail with and attachment from a disk, to the Test Administrator.

On-line Library Usage
- use the library web site to research a topic related to their field of study
- print full-text articles,
- determine if a book of their choice is currently available in the library,
- and e-mail database search records to the test administrator.

Consistent with the philosophy of OBE, students are well prepared for the test. Assessment Services provides a tutorial for each component. The tutorials consist of a series of screen captures taken at each step of the tasks which students are required to perform, accompanied by a text box describing the action. The tutorials are available as hard copies or on CD-ROM.

Test Administration

Large-scale administration of an authentic assessment presents unique challenges. Hoepfl points to Roeber's division of these challenges into two categories: practical and technical. Technical challenges include invalidity, fairness, reliability, generalizability, and comparability. Practical challenges include multiple purposes, cost, and time (Hoepfl, 2003, p. 54). In the case

of computer proficiency, UTA considered an authentic assessment more likely to meet the standards of construct and content validity because of the direct relationship between the objective and the measurement being used (see Appendix I). However, the issues of reliability, generalizability, and comparability proved more difficult.

While the student is given a comprehensive task, such as the creation of a document, that task is broken down for grading purposes. The use of a point system for grading, addressed below, was used in order to increase the reliability of the test and remove subjectivity. In order to address issues of generalizability, or the ability of the assessment to assess the broader skill set, the test incorporates higher order thinking skills and problem solving (see Appendix I). Data is currently being collected in order to measure the comparability, or consistency, of the test.

The practical concerns of purpose, cost and time have not proved overwhelming at UTA; primarily because of the single purpose of the test, a staff position dedicated to the test and a reasonably low demand. The Computer Proficiency Test is currently offered twice a month. The exam is administered in a proctored computer-testing center. Students are allocated four hours to complete the exam. Many students complete the exam in two hours, however there has been no correlation between the time taken to complete the exam and passage rate.

The exam is graded using a point system. Each component is broken down into tasks. For example, one portion of the Word Processing test might include:

Word Processing

- Open the Word document titled "test" (1 point)
- Change the font size from 10 pt. to 12 pt. (1 point)
- Change the font from Times New Roman to Arial (1 point)
- Indent the paragraphs (1 point)
- Full justify the test. (1 point)

A student who successfully modifies the document will have performed each of these tasks. Other skills are incorporated into each component in order to increase generalizability and measure higher order thinking skills. For example, the disk containing the "test.doc" file will also contain a spreadsheet file, a PowerPoint file, and an HTML file titled test, thus requiring the students to demonstrate their ability to distinguish between file types. The word processing test, as part of a measure of their knowledge of how to make a bulleted list, requires that they list advantages and disadvantages of using Internet sources for research. Additionally, they are

required to save their results in a folder with their name on the disk in order to demonstrate file management skills.

Each component is graded separately, with 80% passing. A student who fails one component of the test is not required to re-take the entire exam – only the portion they failed. Grading the test is time consuming. An experienced grader will spend, on average, 30 minutes grading one exam.

Since fall 1999, 83 Computer Proficiency Tests have been administered:

2000	5
2001	18
2002	50
2003 (3 months)	8 (7 registered for April)

Each component of the test is graded separately. The majority of students pass the Word Processing, Internet, E-mail, and Library components on the first try. Students who fail Word Processing tend to fail the entire exam. Approximately 10 percent of examinees failed the Spreadsheet component on their first try. A student who fails a component of the test may re-take that component six weeks later. A student may re-take a slightly modified version of a component once. Those students who fail a component twice are advised to register for a full course.

Other Higher Education Models

Other institutions of higher education have faced similar mandates. A Google search for "computer proficiency requirement," limited to institutions of higher education, reveals 417 hits. Certainly, this is a less than scientific method. However, a cursory examination of these results indicates that many colleges and universities have implemented a computer proficiency requirement, with several offering the option to take a test as a means of fulfilling the requirement. It also appears that many departments have instituted their own computer proficiency requirements.

Of those institutions of higher education that appear to have instituted a requirement, The University of Missouri-Columbia, Centenary College, and Southeastern Oklahoma State University, University of the Sciences in Philadelphia, Belmont University, and Northeastern State University, all require computer proficiency, which can be satisfied through course completion or an exam. A more comprehensive and methodological search would likely find many more. The exam at Southeastern, like the UTA exam, includes an authentic assessment of word processing and Internet research skills. In addition, their exam incorporates software, hardware, and ethics.

Virginia Commonwealth University uses a somewhat different model. Their web page indicates that VCU Students may be required to take a computer proficiency test in order to graduate, or as an entrance requirement to one of VCU's graduate programs. They list four groups that are required to take the exam: those graduating from the College of Humanities and Sciences, all incoming Freshmen, incoming MBA Students, and incoming Pharm. D. Students. The exam is part of a more comprehensive system, SmartForce:

> "SmartForce also offers Tutorials (or smartcourses) to all faculty, staff and students who are interested in learning how to use various software programs and products including Microsoft, Macromedia, Lotus, Java, etc. Students can also take the tutorials in preparation for the Assessments. (http://www.vcu.edu/cte/smartforce/)"

UTA was particularly interested in the passage rate of students at VCU. Information on their web page indicates that:

- Students whose scores ranged from 80-100 were classified as **Highly Competent.**
- Students whose scores ranged from 60-79 were classified as **Competent**.
- Students whose scores fell below 60 were classified as **Less than Competent**.

	n = # who completed SmartForce assessment	**Highly Competent**	**Competent**	**Less than Competent**
General Knowledge and Operating Systems	194	121-**62%**	73-**38%**	0
Word Processing	197	108-**55%**	89-**45%**	0
Using the Web	166	69-**42%**	97-**58%**	0
Using E-mail	186	82-**44%**	104-**56%**	0

(http://www.vcu.edu/cte/smartforce/faqs.html#faring)

In considering a system of training and assessment similar to that used by VCU, UTA determined that the nature of the exams, which are multiple-choice, would not meet the University's needs. There is a trade-off between authentic assessment and volume of students that can be accommodated. However, if the volume of students taking the exam were higher, or demand for tutorials on campus greater, it would certainly be considered.

In 1999 The Virginia Foundation for Independent Colleges (VFIC) developed the Tek.Xam. The test was originally requested by the area business community in Virginia as a certification of technology proficiency in the hopes that it could be used similar to a Microsoft Certification. It was certified by several East coast corporations when UTA offered the Tek.Xam in Spring 2000, however no students registered for the exam. Since that time, it appears that the Tek.Xam is now marketed as an exam available to institutions of higher education to test computer proficiency of students. More information is available at http://www.tekxam.com/index.htm. The Tek.Xam includes General Computing Concepts, Presentations, Spreadsheets, Web Design, and Word Processing. A more specific outline of the test can be found at http://www.tekxam.com/StudyGuide/Guide.html.

Expanded Computer Proficiency Testing

A modified version of the Computer Proficiency Test was prepared for the Department of Human Resources at UTA. The test was intended to test current employees as part of their Employee Development Plan. Three levels were established and two components, Microsoft PowerPoint and Microsoft Access, were added.

Level I – Basic Word Processing, E-mail, and UTA web site use.

Level II – Word Processing II, Spreadsheets, E-mail, Advanced Internet.

Level III – Advanced Word Processing, Spreadsheets, E-mail, Advanced Internet, Access, PowerPoint. If employee has taken Level II they will only be required to take the Advanced Word Processing, PowerPoint and Access Portions of the test.

The structure of this exam could serve as a model for more department-specific exams. An exam can be developed for any number of components, including the original five. For instance, a statistical software component could be added to meet the needs of the Psychology department. However, this model ought to be approached with some caution for two reasons.

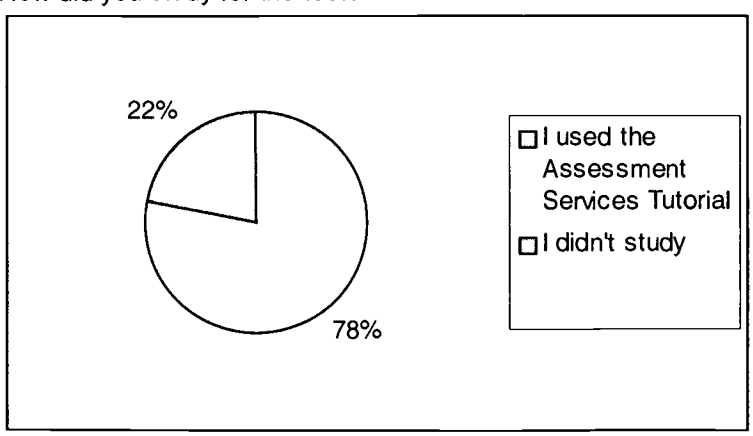
One, it may lead campus assessment offices down a slippery slope towards the development of any number of specific computer proficiency exams. Second, many of these software packages ought to be taught within their discipline – a fact well recognized by Department Chairs. In the 2002 UTA Faculty Survey, 21 percent of Department Chairs indicated "definitely yes" when asked if they thought the standard of computer proficiency should differ by discipline, with 45 percent indicating "probably yes." Seventeen percent indicated they were "not sure" and 17 percent indicated "probably no." No one indicated "definitely no."

However, some departments at UTA have indicated that they would like to use the Computer Proficiency Test as a benchmark exam that would allow them to assume that students in their courses had a minimum level of proficiency so that they could move on to more advanced task. This is probably reflective of some overlap with general skills. The Fall 2002 survey asked: The Computer Proficiency Exam includes five components: word processing, spreadsheets, Internet research productivity, email, and use of on-line catalogs of the library. How consistent are these components with what is included in your department-designated computer proficiency course? Fifty-six percent of respondents indicated "very consistent," 32 percent indicated "somewhat consistent," and no one indicated "not at all consistent."

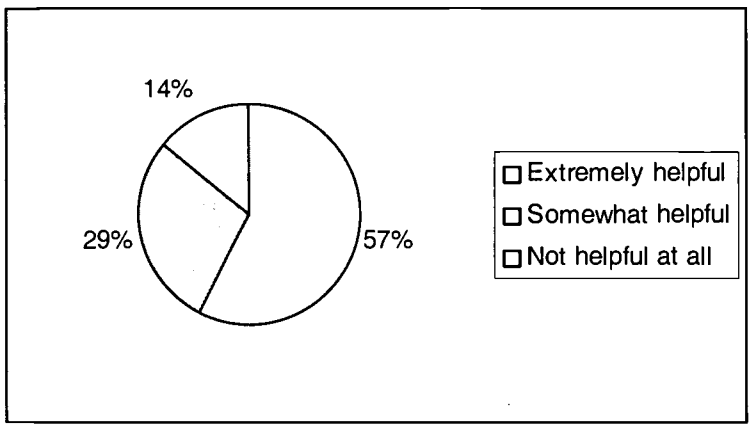
Student Survey

A student survey was administered during the Fall 2002 and Spring 2003 semesters (N=22). Our first concern was with how well students felt they were prepared for the test and whether it contained the content they expected to be tested over.

How did you study for the test?

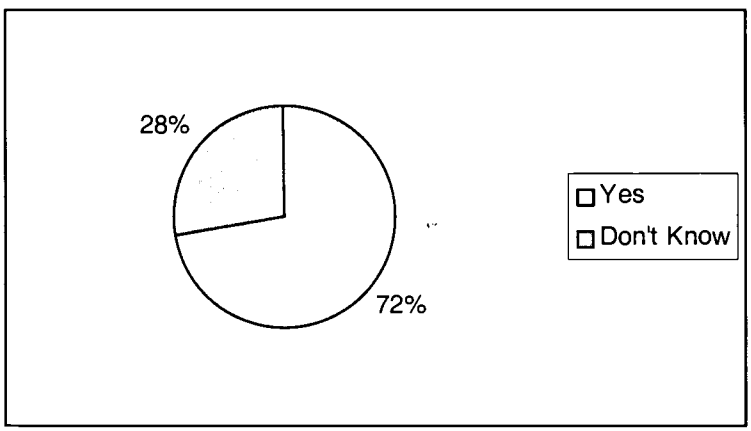


If you used the Assessment Services tutorial, was it helpful?

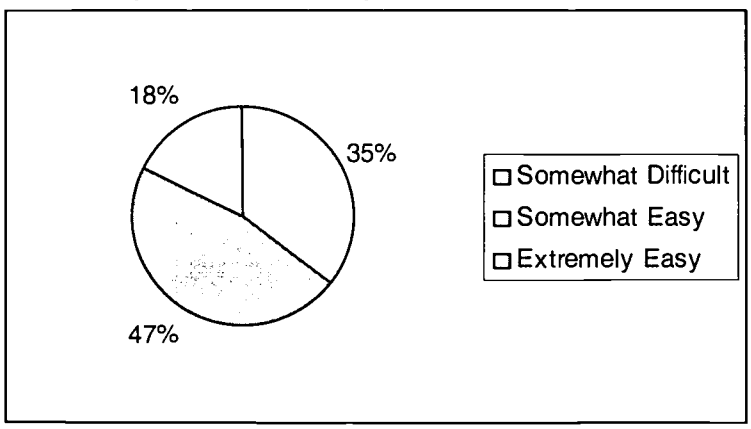


Our next concern was how students felt about the difficult of the test and the test format.

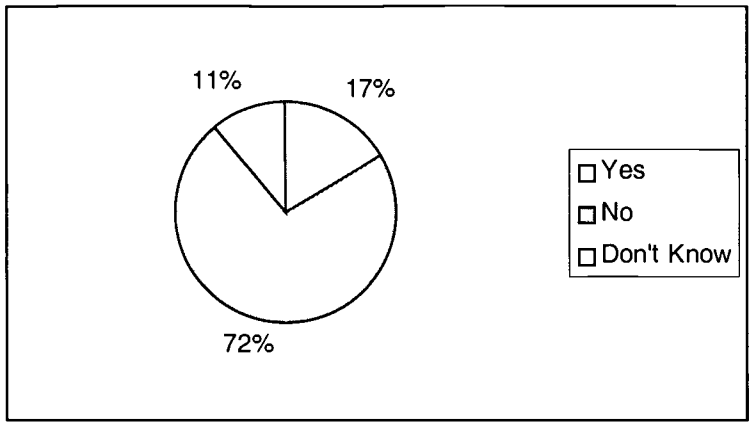
Did you feel that the test measured your proficiency level?



How would you rate the difficulty of the test?



Would you rather take a multiple choice test than the test you took today?



Conclusion

When UTA first began development of the Computer Proficiency Test in 1999, there were virtually no models available and it was difficult to obtain information about computer proficiency requirements in higher education. In the four years since then, as evidenced by the cursory examination previously referred to, there has been an increase in the number of colleges and universities requiring that students demonstrate computer proficiency prior to graduation. It is somewhat reassuring that many universities, apparently operating independent of one another, have developed similar programs. However, there still remains a lack of cohesive literature in the area of computer proficiency and its assessment. Further research is needed regarding how such policies are implemented, their effectiveness, and the reliability of measurement of this unique skill set.

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Appendix I
University of Texas at Arlington
Student Computer Proficiency Outcomes

Learning Outcomes	General Indicators	Performance Criteria	Performance Measurement
Word Processing	Student can create, modify, save, and print documents.	1. Create file 2. Cut and paste text 3. Copy text 4. Save file as/to 5. Create a table 6. Underline text 7. Bold face text 8. Italicize text 9. Justify text 10. Change font size 11. Change font face 12. Double space the document 13. Change margins 14. Create a bulleted list 15. Spell checks the document.	Given a document, the student will successfully alter the document to administrator specifications, spell check the document, save the document to a floppy disk, and print the document.
Desktop/file management	Student can use peripherals, multi-task, and identify operating systems and software.	1. Use the keyboard and mouse. 2. Minimize windows 3. Create file folders 4. Copy and paste from one folder to another folder, desktop, and disk. 5. Differentiate between software programs. (identify file type by "tag" (.ppt, .doc, etc.)	The student will use desktop and file management skills to complete other measurement tasks.
Spreadsheets	Student uses spreadsheets to manage and interpret information. Student understands the capabilities of	1. enter data 2. format cells 3. create chart 4. modify chart 5. sort data 6. use wizards 7. use pre-formatted worksheets to	Given a list of data, the student will enter the data, modify the spreadsheet to administrator specifications, and create a chart to administrator specifications. Given a series of questions the student will use a pre-formatted

	spreadsheet programs.	determine relationships between numbers	worksheet to determine the answers.
On-line Library Usage	Student successfully performs catalog and database searches for citations on a given topic.	1. Identify appropriate database for subject matter 2. Log on to the database from an off-site location 3. Limit searches	Given a subject, the student will identify resources in the library, where they are located, and identify them as available or not available. Given a research topic, the student is able to identify, print, and send by e-mail, 2 Full Text sources of information using appropriate an academic database.
Internet Search Productivity	Student successfully performs an Internet search for information on given topic and is able to create a bibliography.	1. Determine appropriate search engine 2. narrow search 3. use URLs 4. evaluate quality of site 5. copy and paste from Internet into a word processing program 6. create a bibliography for web pages using a reputable style guide 7. Use the UTA web page to find information regarding their activities on campus.	Given a research topic, students will identify 5 relevant URLs, evaluate the web pages, and create a bibliography using the proper format for their chosen style. Given a question, the student is able to use the UTA web page to find information.
E-mail	Student is able to communicate via e-mail.	1. Create e-mail 2. Attach file 3. Carbon copy a message	The student is able to log in to their UTA e-mail account, create a message with an attached file, and send the message to two recipients.

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