PENNSYLVANIA IN-COMING STUDENTS ARE NOT COMPUTER LITERATE AS A WHOLE: SO, WHAT ARE YOU GOING TO DO ABOUT IT?

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ABSTRACT

Assessment of computer literacy of in-coming students should be an important precursor to college entry and should be assessed as an indicator of successful outcomes for colleges and universities. Unfortunately, neither is done on a recurring basis at this time. However, this situation should change soon. In the interim, this paper presents a solution via the use of a Computer-based Training (CBT) tool for assessment and training, and a description of several institutional changes including creating a new course and revising current course offerings.

INTRODUCTION

Universities and, for that matter, businesses require some level of computer literacy for in-coming students and for new hires. There are several questions raised by this statement, such as what is the definition of computer literacy and what level of literacy is required, how does one establish computer literacy, and what does one do if a student does not meet a requirement for computer literacy. These questions are particularly vexing since many k-12 school districts provide computer training in a variety of software. Probably more troubling is the fact that no formal outcomes assessment of computer education is done at the k-12 or college levels of education in the United States. That is, there is no on-going evaluation of k-12 computer training, and no on-going evaluation of computer training in colleges or universities. Not at any level, do we assess what is a major investment of public, private, and individual funds.

The evidence is mounting that in-coming students are not, as a whole, computer literate. For instance, Case, MacKinnon, and Dyer (2004) assessed the degree of computer knowledge attained by in-coming college students. They concluded that despite the increasing number of students who have had at least one high-school course that there is a wide variation in computer literacy. They concluded that the introductory level computing course at their university cannot be removed from the curriculum. An interesting phenomenon related to the study of computer literacy is that often times, students, and for that matter faculty and administrators, overestimate the computer competency of in-coming students. Baugh (2004) reports a directive that in-coming students be evaluated for computer literacy because faculty and administrators thought that in-coming students did not need an introductory course in computing. Baugh reports that 44% of in-coming students were not literate with spreadsheet software, and that 68% were not literate with database software. Finally, Eddins (2003) reports a study of the computer performance skills of in-coming students by means of a Computer-based Training (CBT) tool that simulates application software. This study found that students in an introductory computer literacy course performed significantly higher (about 80% of tasks completed correctly) than students who did not take an introductory computer literacy score (about 60% of tasks completed correctly).

One might expect that the traditional testing agencies would provide an assessment of computer literacy for consumption by colleges and universities since so much is expended in computer training in k-12 and colleges. Neither the SAT, ACT, nor does ETS report a computer literacy scale that indicates computer proficiency on the part of in-coming students or graduates from colleges. However, there may be developments on several fronts that will cause this state of affairs to change. The first front comes from the commercial sector and suggests that the private industry is seeing a potential for profit. The International Computer Driving License (ICDL) represents an intriguing possibility of assessment of computer literacy, particularly for employers to evaluate the skills of newly graduated students (Csapo 2002). The ICDL has a certification program that is very comprehensive (icdlus.com 2005). It covers seven areas of computer literacy: basic concepts, computer use and file management, word processing, spreadsheets, databases, presentations, and information and communication. It can be completed within two years. However, they report that individuals have completed the ICDL in an hour and a half. While the ICDL would possibly provide a valuable adjunct to college or university training as

an outcomes assessment indicator, it is probably too comprehensive to assess computer literacy of in-coming students.

On a second front, certification organizations are beginning to recognize the need to specify computer training and assessment on the part of colleges and universities. The Association to Advance Collegiate Schools of Business (AACSB) recently revised its statement of curricular content for schools of business to require "learning experiences in such general knowledge and skills areas as: communications abilities, ethical understanding and reasoning abilities, analytic skills, use of information technology, multicultural and diversity understanding, and reflective thinking skills" (AACSB 2004). The AACSB stresses information technology in several delivery areas, such as that college faculty should describe models of educational delivery that use technology, that explaining global and technological advances in business require innovation, that the judgment of educational delivery should consider the totality of the students education including technology-based experiences, and that relevance and currency of faculty and programs can be measured by the discussion of technology and information systems in modern business practices (AACSB 2004).

On an third front, the Association of Computing Machinery (ACM), Association of Information Systems (AIS), and Association of Information Technology Professionals (AITP) provide a model curriculum that can be used by colleges to develop an Information Systems (IS) undergraduate curriculum (Gorgone et al 2002). While the curriculum directive, also known as the IS 2002 Undergraduate Curriculum, is geared primarily to IS programs, it includes a description of a prerequisite course for entry into an undergraduate level IS program of study that could/should be adopted by business programs in colleges and universities. The course, IS 2002.P0 – Personal Productivity with IS Technology, has as its focus a requirement that in-coming students have problem solving skills exhibited by the ability to apply information technologies to problem situations involving individuals or teams. The scope statement for the prerequisite lists application software that should be mastered by in-coming students which includes spreadsheets, databases, presentation graphics, and Web authoring software. The IS 2002 Undergraduate Curriculum, possibly conceding that the course may be remedial in nature, authorizes the college or university to employ non-traditional delivery techniques such as self-directed learning, computer-based training (CBT), or a traditional, lecture based course.

Given that definitions and levels of computer literacy will be standardized within a few years, the question begs to be asked: what will schools or departments of business do in the interim to guarantee that in-coming students can benefit from courses that have computer literacy as a basic prerequisite? This paper reports on the experience of the Information Competency (IT Comp) program at York College of Pennsylvania (YCP) to answer this question. Previous to the IT Comp initiative, the Business Administration Department had a three pronged approach to computer literacy training. First, all in-coming students in the business department were required to take IFS105-Personal Productivity Computing. As a testament to the popularity of the course, between 30% to 40% of the students in this course typically were not business majors. This course is roughly analogous to IS 2002.P0 – Personal Productivity with IS Technology (Gorgone et al 2002). The emphasis of the course is on the knowledge of computing concepts and the attainment of performance skills using applications software such as word processing, spreadsheets, windows, and presentation programs. Second, all business majors were required to take IFS305-Management Information Systems (MIS). This was a traditional MIS style of course in that it served as an introduction to the application of computing to managerial problems. The focus of the traditional MIS course is on the support that computing provides to management in problem solving and not on the hands-on use of computer application software. Finally, the faculty of other business department courses required that students use application software in their courses as they felt appropriate. That is, faculty who felt that certain software packages were appropriate for their course were encouraged to incorporate the software into their course on an ad hoc basis.

The following discussion describes the features of CBT. Next is a summarization of revisions to computer instruction due to the variation of computer literacy of in-coming students. After that, examples of CBT techniques are provided. Finally, institutional experience with the techniques is presented.

DISCUSSION

This report is an illustrative case study that describes the experience of a medium size college in south central Pennsylvania while it wrestled with the

issue of prerequisite computer knowledge on the part of in-coming students. Most instructors know the problem of non-qualified students who attend their courses. Frustration can mount on the part of the student who struggles to "catch-up" and on the part of the instructor who must spend additional time bringing the student up to speed. All the while, the other students become bored while the instructor spends precious in-class time discussing prerequisite knowledge. Lack of computer literacy causes similar problems, while bringing additional concerns to the discussion. One additional concern is that the term "computer literacy" is not understood well by many instructors or administrators, nor is the term agreed upon by the computing professions. Another concern is that computer literacy is basically a "moving target." As technology evolves, some students will bring more experience to the table because they come from advanced high schools that can afford new technology. On the other hand, instructors can be overwhelmed learning those new technologies without the appropriate support from computing staffs and resources. It is hoped that this case study will help alleviate some of these problems by reporting on techniques used to identify under qualified students, give students the resources to teach themselves, and provide an example of automating the whole process by means of CBT.

Automating remedial instruction

Within the last few years, CBT have become affordable, internet based, and realistic. Traditionally, CBT provide multi-media functionality to the learner that includes text, sound, video, and animation. CBT also may simulate the behavior of application software, provide testing for subjects who perform specific operations using a simulated interface, give feedback on subjects' mistakes, and provide instruction to students on how to perform required operations (Janicki and Steinberg 2003).

In addition, CBT should provide technical and reporting functions. CBT should have a secure, password guarded administrative interface that can be used to look up student profiles and make changes to the profiles. The administrative interface also should present a range of reporting tools that can be used to determine students' progress in learning and their performance on tests. The reporting tools should be able to output to a browser and export the data to a file system. Finally, the administrative interface should permit the selection of skills to be learned and tasks to be performed on practice exams or graded exams.

There are many examples of CBT on the market that satisfy the features discussed above. In addition, many of the traditional book publishers provide CBT. The Business Administration Department at YCP examined CBT from traditional publishers such as Thompson Course Technology, McGraw-Hill, and Prentice-Hall. We choose the CBT from Course Technology because it met the objectives of the department. However, all of the publishers have very competent CBT which should be examined with objectives appropriate to your institution in mind.

Course's CBT is named SAM XP/TOM. SAM XP is an acronym for Skills Assessment Manager for Windows XP. It is a client-server application that has two primary components. The server is operated by the publisher and has an administrative interface that functions over the internet by means of a standard internet browser. Because the server is operated by the publisher, costs to the college of administration are kept down. The second component is the client. The client software simulates Microsoft Office and is the interface that the learner uses while taking either practice tests or graded tests. It can be installed in a college's labs, or students can install it on their own machines, either at home or in their dorms. It requires Windows XP and about 550 megabytes of hard disk space. Given the massive hard disks that are available these days, the disk space requirement is minimal. Finally, SAM XP simulates the software being learned, so that the labs or the students' computers do not require the installation of Microsoft Office. See http://samcentral.course.com/ for additional information.

Course's TOM is a CBT that instructs the learner in using Microsoft Office. It is an acronym for Training Online Manager. It runs over the Internet and comes on a CD. Since TOM simulates MS Office, it does not requires the installation of MS Office on your labs' computers or on students' computers. However, it requires either an internet link or a diskette drive should instructors or students wish to track their progress while learning. TOM provides true multimedia instruction. Students can read about operations or concepts that they need to learn, view and hear narration from a movie clip of the operation being performed, or practice the operation themselves before they take any tests.

Creating and revising courses

In addition to "automating" the remedial instruction, faculty at YCP also made several changes to their business curricula as follows.

- Create a new test course named IFS100-IT Competency Exam
- Revise IFS105-Personal Productivity Computing
- Revise IFS305-Management Information Systems
- Change prerequisites to appropriate courses

The exam course, IFS100, was created to document the verification of computer literacy on the part of in-coming students in the business department. It has four component tests which test Word, Excel, PowerPoint, and Windows. The student must make a 70% or better on each component. Students are given two chances to pass the exam. If a student cannot pass all four tests within their first semester at YCP, then the student must take IFS105.

The introductory computer course, IFS105, was revised since it is now considered a remedial course. First, it is no longer required by the curricula of any of the business majors. Second, it is a pass/fail course for business majors who are required to take it. Third, it will be automated in a fashion similar to IFS100 beginning this coming fall. See Table 1.

The MIS course, IFS305, was revised to include hands-on computing exercises. It is required by all business department majors. This course had no hands-on component before our revisions because students received in-class and lab instruction in IFS105. Also, this course is often taught without a hands-on component because its primary objective is a discussion of how a business' computing resources should be aligned to assist managers in solving business related problems. Because our research suggests that many students need more hands-on experience with computing (Eddins 2003) and because we dropped IFS105 from all business curricula, we began including a hands-on component in the fall of 2004. The hands-on component includes projects that combine written exercises and the use of at least two software applications, Excel and Access. In addition, several faculty members include a component on authoring internet content.

Table 1
Revisions to IFS105 – Personal Productivity Computing

Course characteristic	Before course revision	After course revision
Requirement	All business department majors must take.	Not required for any business department majors.
Credits	Three.	No credit given for business majors.
Delivery of instruction	In-class instruction of concepts (50%) and lab practice (50%) which was attended by fully qualified faculty.	In-class instruction of concepts (50%), in-class instruction of application concepts (20%), lab practice (20%), and lab testing (10%) by fully qualified faculty.
Enrollment per semester	(138 F'04 + 174 Sp'05) / 2 = 156 students	85 students so far in F'05

Finally, non-computing courses were examined within the business department to determine whether faculty felt that computer literacy was necessary. To date, one non-computing course was identified as requiring computer literacy, QBA260-Business Statistics I. This is a standard course in teaching the process of using quantitative techniques for preparing, analyzing, and interpreting business data. The faculty of QBA260 regularly employed spreadsheet and statistical software as illustrative of the process. Therefore, catalog descriptions of the course were updated to publish the use of software and to state that computer literacy is a prerequisite for entry into the course. Attainment of computer literacy for the course prerequisite is now defined as passing IFS100 or taking and passing IFS105.

SAM XP/TOM's student interface

SAM XP has an intuitive student testing interface, especially if the student is familiar with the software that is being simulated. For instance, Figure 1 illustrates the SAM XP testing interface with Word being the targeted test environment. The upper three quarters of the interface simulates the application software quite convincingly, while the lower part of

the interface presents the test task and the test navigation widgets. The example shows Word in the upper pane or the simulation area. The lower pane presents the task and asks the student to "Apply a 0.5" Left indent to the paragraph that begins the "Christmas Group Exhibition attracts…" There are four navigation widgets in the lower pane. The first widget allows the student to view the tasks remaining on the exam. The second and third widgets on the lower pane give the student the ability to navigate to the previous task or skip the current task. The last widget on the lower pane on Figure 1 gives the student the choice to end the exam.

The next example of the testing interface shows a spreadsheet task. Figure 2 presents a simulation of Excel in the upper pane and the test task in the lower pane. The test task requires the student to enter a formula that uses the max function to find the highest value in a range. The test pane looks identical to the test pane in the previous example. In addition to the navigation widgets explained above, the reader should note that Figure 2 tells the student that there are 3 attempts remaining on this task.

TOM is the training module of SAM XP. TOM is more involved than the testing interface because it gives the student multiple learning modalities and options. For instance, Figure 3 shows the Getting Started screen that begins a TOM session. This screen teaches the student how to navigate TOM, what the learning modes are that are supported by TOM, and gives feedback to students on tracking progress. The learning modalities are Prepare, Observe, Practice, and Apply. Prepare gives a conceptual backgrounder on the task to be learned. Observe permits the student to watch and hear a presenter as the task is performed. To the student, it appears as if the narrator has taken control of the computer, and is doing the task. In effect, the student watches as the task is executed, and hears a voice describe the actions. Practice gives the student the opportunity to carry out the task that she just viewed, while TOM gives guidance. The last modality is Apply. Apply tests the student's learning of a task without any feedback via an interface similar to the SAM XP testing interface. Finally, students or their instructors may wish to track progress through TOM. Icons on the interface give feedback on whether an Apply type of training task has been completed.

TOM provides training based upon the student's desire for certification, or based upon one of several popular textbooks. Figure 4 shows TOM's menu of training tasks based upon the Shelly Cashman Series of lab based tutorials. The tutorials in the figure are on Word and are arranged as projects that increase in complexity as the student proceeds. As can be seen in Figure 4, Project 1 and Changing the Default Font Size menu options have been selected. The Modify Fonts menu option has been checked because training has been completed on this task.

SAM XP's administrator interface

The SAM XP administrator interface is comprehensive and provides features for managing people, and designing, and administering tests. See Figure 5. The first form in the administrative interface is for managing sections. Sections are analogous to specific classes or courses. Section forms allow the administrator to manage course details, students and instructors, and to give students permission to auto-enroll into a section.

SAM XP is similar to many network applications, and, therefore, has menu options to manage groups and users. See Figure 6 for the Groups interface. Of course, the Users menu option is used to enter students, instructors, or administrators into the system. The Groups menu option gives the administrator the ability to manage groups or roles and assign users to the groups. Groups are a common technique for managing users in a networked application. The idea behind the concept of groups is to create a group or a role by giving it a name and assigning permissions to the group to do specific functions. Then, the administrator can add users to a group thereby assigning to the user the permissions of the group. Consequently, administrators can easily assign permissions to a user and take permissions away from a user with just a few mouse clicks. Also, the administrator can change an entire group's permissions, and, by so doing, change the permissions of all members of the group. Finally, as can be seen in Figure 6, the Administrators group has permission to do all administrative tasks. That is, administrators can add exams, users, groups, and sections. In addition, the administrator can do periodic tasks such as schedule exams, and perform database maintenance. Also, administrators have access to several types of reports.

Finally, SAM XP has several other interesting administrative options that serve instructional purposes as well. The Reports menu gives the administrator or instructor access to a variety of useful reports. Examples of SAM reports include task frequency analyses, individual student performance, and exam results by student, exam or section. One also can obtain TOM training progress

reports. Figure 7 depicts the SAM Frequency Analysis Performance report. Using this report, the instructor can assess which tasks or activities that students understand, and which tasks that may need further instruction. For instance, Figure 7 shows that most students can use Excel to insert a cell; however, students may need additional instruction in merging or splitting cells. One of the last menu items available to administrators or instructors in Figure 6 is the Student menu option. This option switches to the student interface. This is an extremely valuable option because it can be used by the instructor to see SAM XP as the student sees it, or, in the case of in-class lectures, to illustrate to students how SAM XP works.

Experience with IT competency to date

We have been using SAM XP/TOM for about a year at York College of Pennsylvania. As seen in Table 1, student enrollment in IFS105 has fallen from around 156 students per semester to 85 students for this coming fall. Student passing rate for IFS100, which uses SAM XP/TOM, is a little over 50%. See Table 2 for a summary of student pass/fail counts and percentages for those students who took the test the first time and those who took the test the second time.

Table 2
IFS100 Summary of Fall 04 and Spring 05

	1st Time	2nd Time	Total	Percent
Passed	50	15	65	52.0%
Failed	47	13	60	48.0%
Total	97	28	125	
Passed %	40.0%	12.0%		

As seen in Table 2, 125 tests were given. Due to the labor involved in administering the tests, the college hired a part-time administrator to manage IFS100. The IFS100 administrator enters students into SAM XP, creates and schedules tests, and reports test statistics to the Business Administration Department. It is felt that this resource is absolutely necessary due to the workload involved.

Also seen in Table 2 is the passing rate of students who take IFS100. In particular, the faculty were very satisfied that 40% of the in-coming students were able to pass the exam on the first attempt. Overall, 52% of students are able to pass the exam by the second exam. This suggests that almost half of the in-coming students will need remediation.

The faculty feel that IFS100 and SAM XP/TOM have been very successful at the college to date. However, what is not apparent from Tables 1 and 2 is the motivation, or lack thereof, for students to take this newly established program seriously. The department had approximately 150 in-coming students during fall 2004 and spring 2005. Since 65 students passed the exam, 85 students or 57% (85/150) either failed the exam on the second try or simply did not take it. We have attempted to solve this problem by being proactive with presentations during Exporientation (a program for in-coming students which occurs during the first weekend before the semester) and by sending letters and email to in-coming students warning them that they may have scheduling problems for the up-coming semester.

CONCLUSIONS

Computer-based training provides a cost effective solution to the computer literacy problem. However, business faculty should be aware that a significant proportion of in-coming students will require remediation. The approach presented in this paper gives students the opportunity to take a CBT exam up to two times and prove computer literacy for only a few dollars (around $25). Students, who do not pass the test the first time, can train themselves using the CBT. Students who do not pass or do not take the test are required to take an instructor-lead course. Since the course is considered remedial, business students get no credit for the instructor-lead course.

It is expected that schools of business can anticipate that a major proportion of in-coming students will not be computer literate. It would be favorable if testing services such as SAT or ACT tested for computer literacy. At this time, none do. Even more optimal would be that high-schools test for computer literacy and provided remediation. Until this occurs, one can expect to have a significant proportion of in-coming students who are not computer literate; therefore, one should consider a computer literacy testing and remediation program.

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APPENDIX

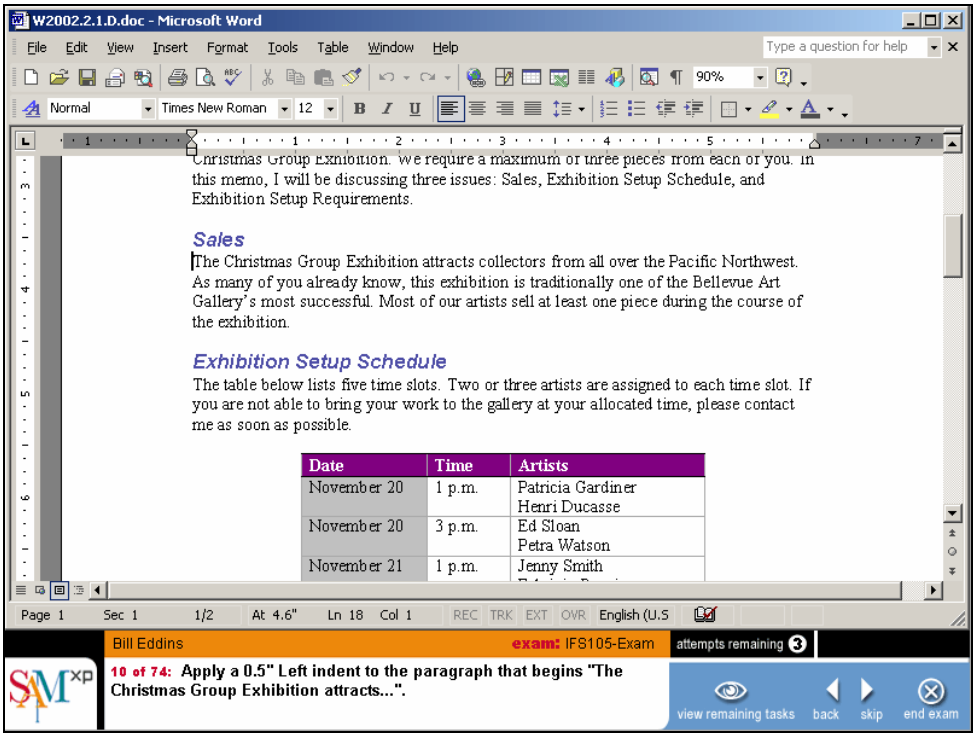

Figure 1 - SAM XP Testing Interface

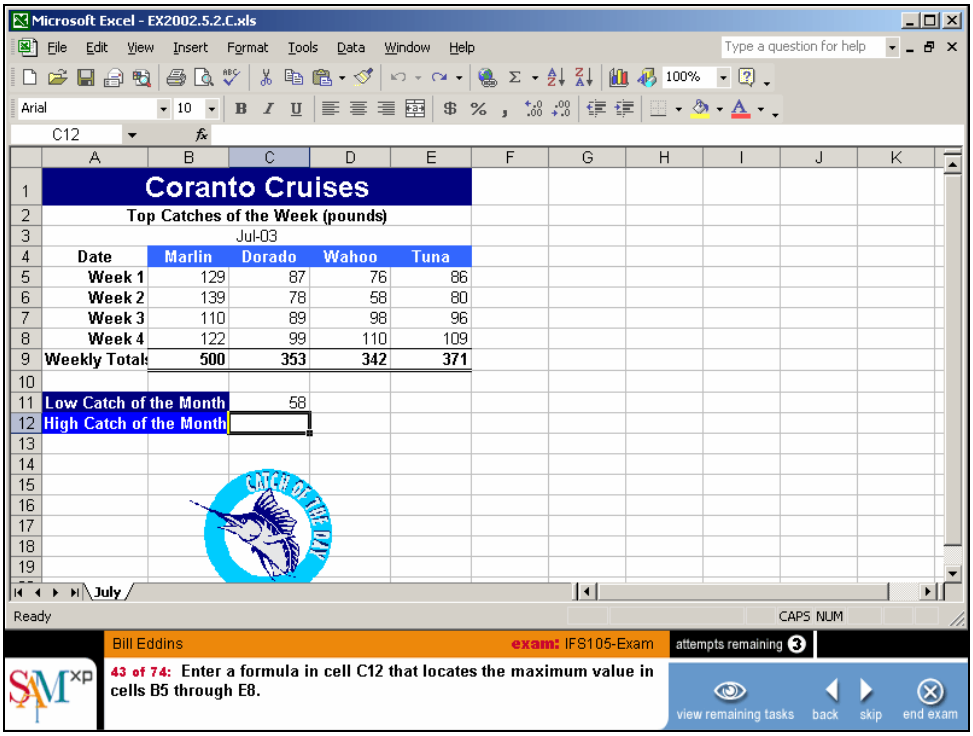

Figure 2 - SAM XP shows Excel Task

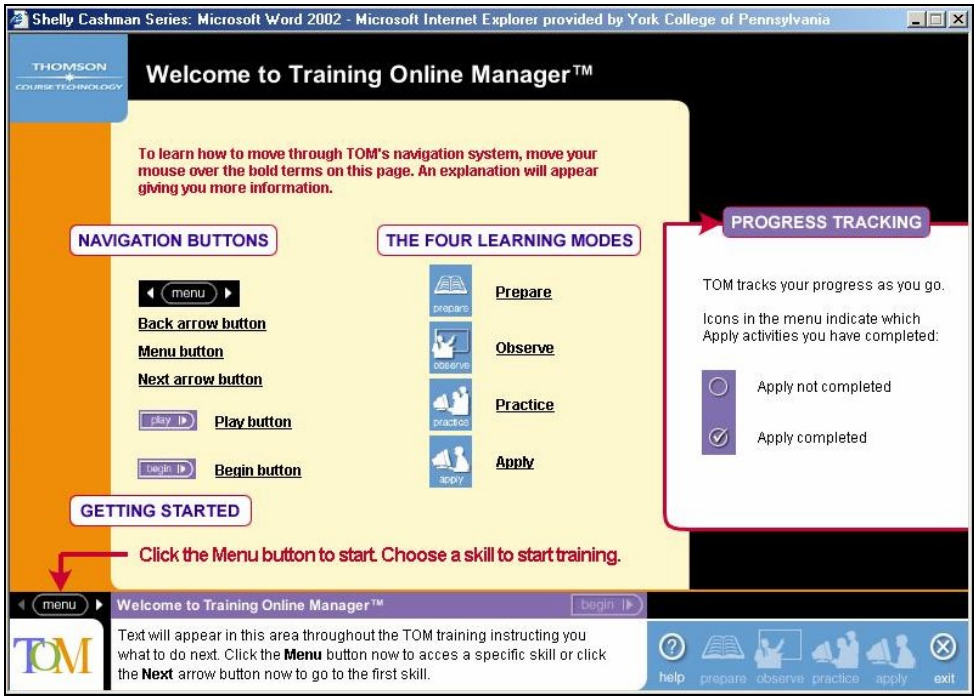

Figure 3 – TOM's Learning Modalities

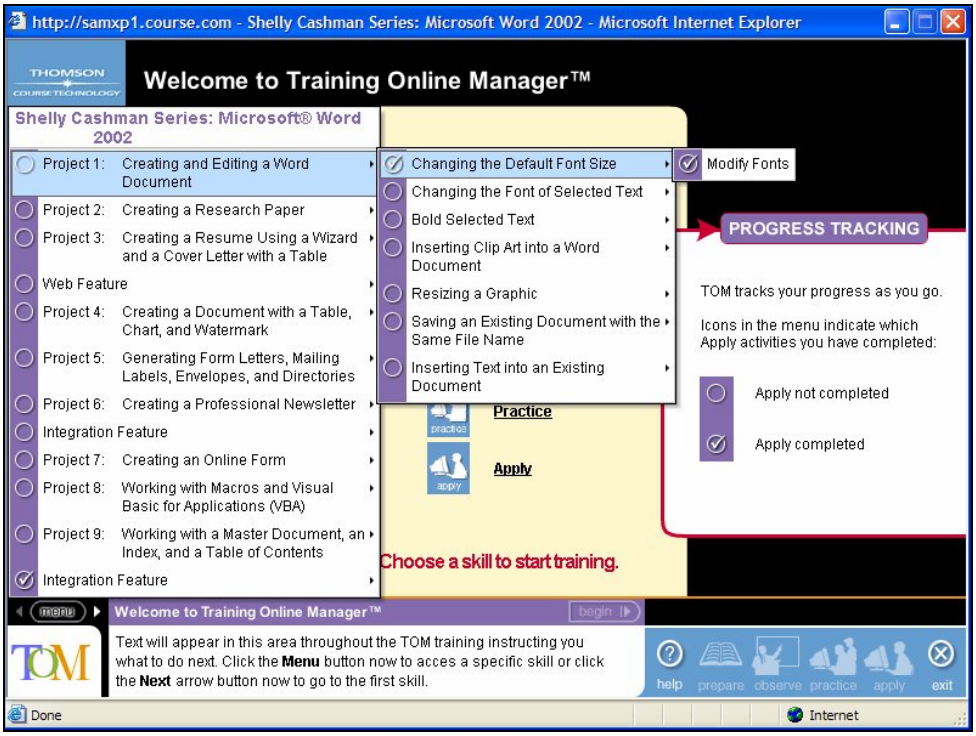

Figure 4 - TOM's Training Menu

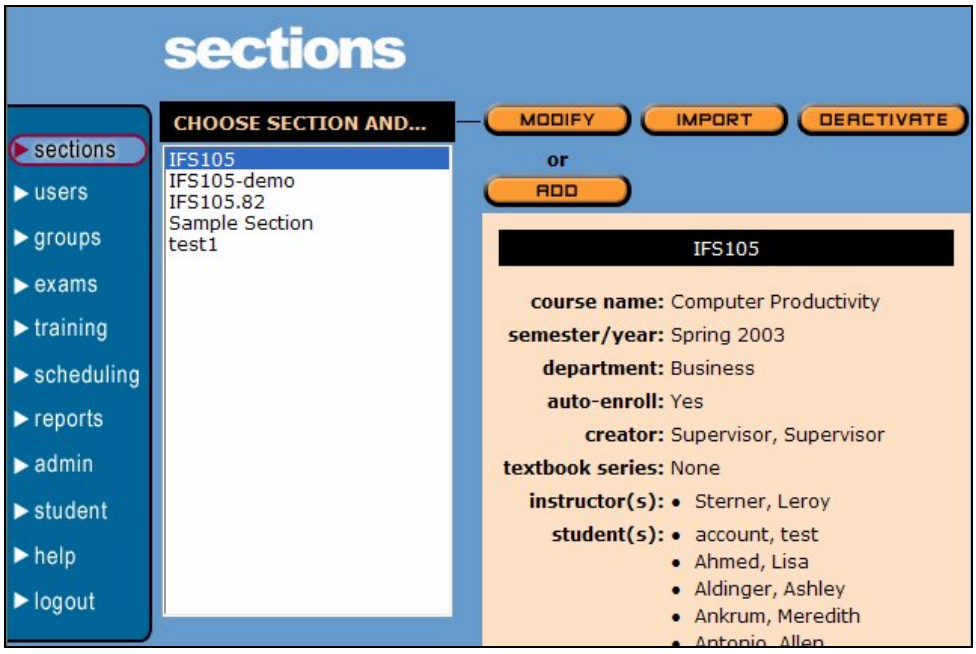

Figure 5 - SAM XP's Administrator's Interface

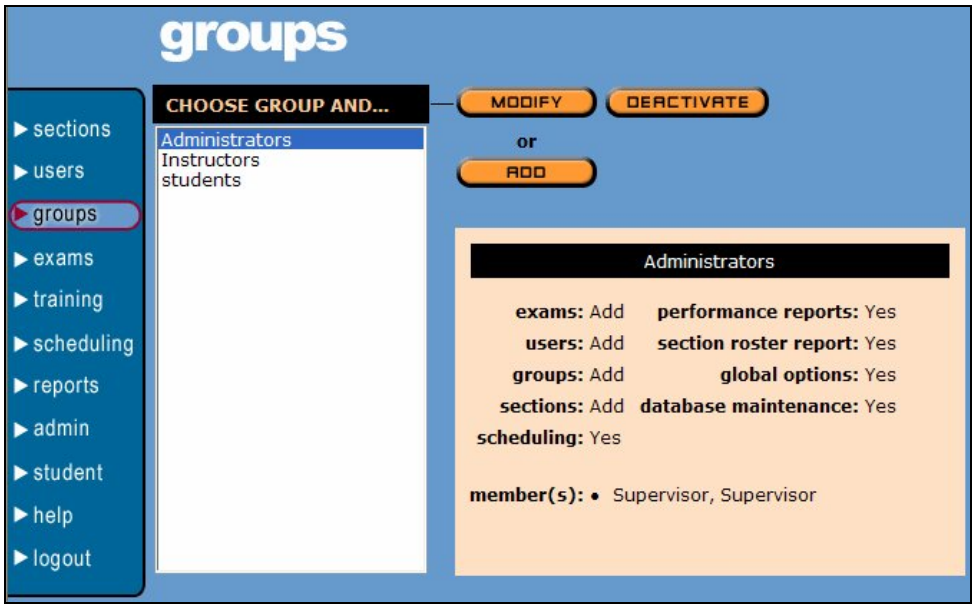

Figure 6 - SAM XP's Groups Option

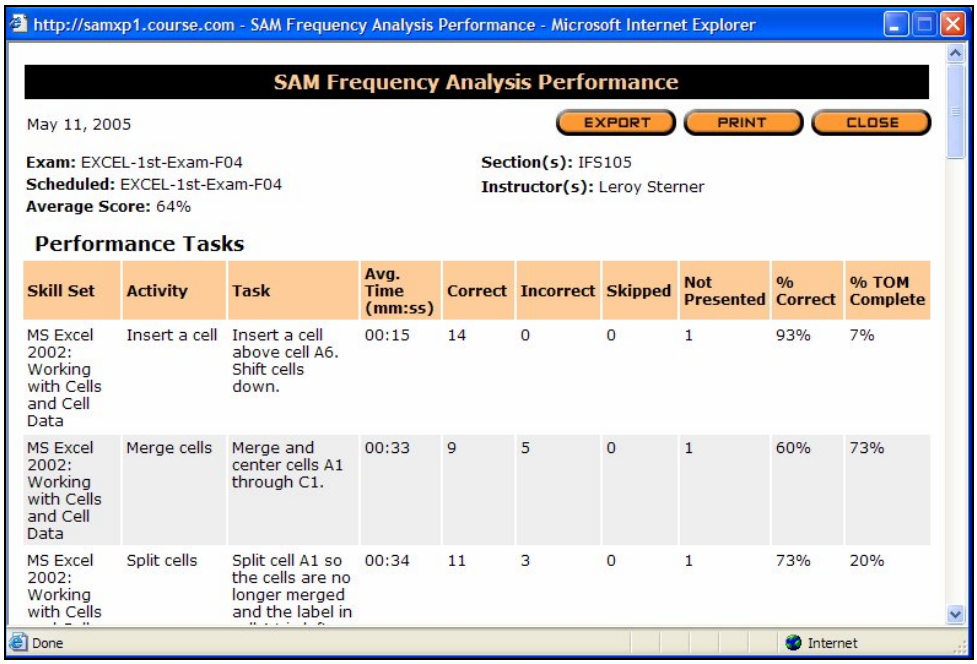

Figure 7 – SAM XP's Frequency Analysis Report