A COMPREHENSIVE REVIEW OF COMPETENCY ASSESSMENT FOR COMPUTER INFORMATION SYSTEMS INSTRUCTION

by

John Whitney

A Research Paper

Submitted in Partial Fulfillment of the
Requirements for the
Master of Science Degree
With a Major in
Vocational Technical Adult Education

Approved: 2 Semester Credits

_____

Investigation Advisor

The Graduate School
University of Wisconsin-Stout
August, 2002

The Graduate School
University of Wisconsin-Stout
Menomonie, WI 54751

ABSTRACT

Whitney John F
(Writer) (Last Name) (First) (Initial)

A Comprehensive Review of Competency Assessment for Computer Information Systems Instruction
(Title)

MS in VTAE Dr. Ed Biggerstaff August, 2002 57
(Graduate Major) (Research Advisor) (Month, Year) (No. of Pages)

American Psychological Association (APA) Publication Manual
(Name of Style Manual Used in this Study)

The purpose of this study was to explore the issues that affect student assessment in the Computer Information Systems (CIS) degree program at a technical college, review alternatives, and to formulate recommendations that could be used to meet the varying needs of all parties involved in the educational process. This study includes a comprehensive review and critical analysis of literature associated with assessment strategies, computer industry certifications, and potential resistance to implementation of alternative assessment methodologies. The goal is that the recommendations may serve to improve the CIS degree program at Fox Valley Technical College.

ACKNOWLEDGEMENTS

First, I would like to thank Dr. Ed Biggerstaff, for his guidance, support, and patience during the writing of this paper. His proactive approach to this project streamlined the entire effort (not to mention his continual reminder "that the end is in sight").

The University of Wisconsin-Stout deserves a "thank you" for bringing the Master's program to those of us who are geographically challenged and creating a program that combines the traditional graduate program with the advantages of the modern information age.

A special thanks to Peg for her support and efforts to make my life during this process a little more bearable.

Finally, a particular note of appreciation to my parents who, while no longer with us, managed to inspire their children to pursue further education. I'm sure they've been watching my progress and no doubt will be reading this via some Internet connection from above.

TABLE OF CONTENTS

CHAPTER ONE

Introduction

As grade inflation has taken hold in the educational system, prospective employers frequently state that they are paying less attention to the grades of the graduates when hiring new employees (Nagel, 1998). Students in the Fox Valley Technical College (FVTC) Computer Information Systems (CIS) degree program are among those affected by this trend. Vocational education institutions like FVTC are focused on training students with specific skill sets to gain employment (*Fox Valley Technical College – Mission, vision, purposes, values and strategic directions*, n.d.). The traditional grading system may no longer be effective in assessing a student's progress and abilities with respect to finding employment within the Information Technology (IT) industry.

A new development has emerged in the IT industry; many businesses have begun to require certifications for specific technologies. This entails further testing beyond traditional schooling to authenticate the abilities of the graduate. Novell Corporation (n.d.) claims that 80% of the IT managers now require employment candidates to become Certified Novell Engineers (CNE) when hiring computer network specialists.

Cisco Corporation has begun to collaborate with traditional educational institutions so that it can control the quality and content of students wishing to learn Cisco

networking concepts. It promises an "innovative educational program – [a] new model for learning and accountability" with its Cisco Academy, and now boasts 9,457 academies across the United States (Cisco Corporation, n.d., ¶ 1). Microsoft Corporation is moving in a similar direction with its Academic Alliance program (Microsoft Academic Alliance, n.d.).

For the purposes of certification, the assessment mechanism is essentially pass/fail. A passing score must be attained on a test or series of tests or the certification will not be granted. The traditional A, B, C, D, F grading method seems to have little meaning with respect to CIS. In the binary world of computers, there is no gray; things are either right or wrong. Computer software either produces the correct result, or it does not. A computer/network either functions or it is useless.

By contrast, in a technical education setting it is not unusual for students to approach earning a course grade as learning the rules and winning a game (McKowen, 1979). Mastery of a subject takes a backseat to the sorting, ranking, and labeling of the grading process. The notion of learning to be proficient in an occupation fades as the testing/assessment process moves into the foreground during coursework.

It might follow logically that a pass/fail grading method would be the better assessment choice in determining the proficiency level required, but this also could prove

lacking. The work being performed will never exist in a vacuum and will need to integrate with other systems and solve a particular business problem. "As IT programming projects expand to affect all areas of the company, [knowledge workers] increasingly need strong communication and project-management skills to get the job done" according to Feldman (1998, ¶ 1). This area is not addressed by any of the certification tests, but is certainly relevant to the assessment process.

Although the CIS occupation has existed for over 40 years, it is still a very young field when compared with other technical areas. It is also a rapidly changing and evolving area with techniques becoming obsolete within a period of years. A competency assessment method has to be as flexible as the subject it is assessing or it risks becoming obsolete as rapidly as the subject for which it was developed.

Beyond the technical aspects of measuring competency in CIS, difficulties also arise due to the varied expectations of those involved in education. Prospective employers would like grades to be a predictor of success in industry; instructors may be tempted to use grading as a motivational tool; students might view grades with a sense of entitlement or as a reward for effort, rather than an assessment of success; and, administrators may look to grades to promote the success of the institution (Kamber & Biggs, 2002).

Pressures to overrate students abound. For example, financial aid packages are frequently tied to grades. To help students with their finances, a caring instructor may be pressed to find ways to overrate hard workers who may not have the ability to succeed in their chosen field. New instructors quickly realize that keeping enrollment high is important to the administration and the ongoing health of the school, and therefore important to themselves. "Low-grading departments pay an enormous price in enrollment," according to Sabot, a Williams College professor who studies collegiate grade patterns (as cited in Toch, 1994, p.20).

Students, faculty members, and administrators have a vested interest in ignoring, excusing, or compromising with grade inflation, rather than fighting it (Kamber & Biggs, 2002). At a minimum, this creates an assessment environment that is far from objective for the instructor.

To sidestep the assessment difficulties, some have suggested that entrance requirements should be imposed to prevent students who are unlikely to succeed from even entering a program (CIS Department Meeting Minutes, 1999). However, are entrance requirements valid in a community college? Don't students have the right to experiment with their future and succeed or fail based on their own abilities and efforts? It is a stated tenet of FVTC that its programs are open to all students who feel they can

benefit from them (*Fox Valley Technical College – Admission policy*, n.d.).

Finally, alternative assessment methods have been developed in many fields of study, but they have not always been embraced. Change is difficult in an educational institution and resistance to change is strong. Even though competency assessment is a popular topic for in-service education days for faculty (Miltich, 2001-2002), the institution itself rarely has the grading mechanism in place to record or distribute alternative measurements of competency.

Resistance to change is a natural human trait. Proposing or trying to implement changes of any sort is risky in any environment and public education is no exception. Any analysis of alternative assessment methods would be incomplete without a realistic review of the pros and cons of those methods with respect to the various stakeholders, or the presenter of the proposal could easily become a casualty of innovation rather than the solution provider (de Jager, 2001).

Statement of the Problem

The traditional assessment method used in the Computer Programming courses at Fox Valley Technical College must change to reflect new competency measurements accepted by business and industry, as well as the changing requirements of the various stakeholders involved in the educational process.

Purpose of the Study

The purpose of the study is to identify appropriate alternative assessment methods that may be adapted for the CIS Programmer/Analyst degree at Fox Valley Technical College. The study will be conducted through a comprehensive review and critical analysis of research and literature.

Research Questions

There are research questions this study will attempt to answer. They are:

1. Who are the stakeholders in the CIS Degree program at Fox Valley Technical College?
2. What are the requirements of the stakeholders with respect to assessment?
3. What are alternative methods of assessment that might be appropriate for the CIS Degree?
4. How should FVTC adapt to the trend of industry certifications?
5. What are potential reasons for resistance to changing assessment methodologies?

Justification of the Study

The study can be justified on several levels:

1. Student assessment is a key component of the educational process.
2. Technical College students are focused on gaining or improving their employment possibilities. An approach to assessment must be mindful of this fact.

3. The traditional assessment model needs to be revisited in light of the certification requirements now becoming part of the hiring process.

Limitations of the Study

The study is subject to the following limitations:

1. This study will not include the implementation of its recommendations or a follow-up study of the results.

2. This will be limited to existing literature on the subject of assessment.

Definition of Terms

For clarity of understanding, the following terms need to be defined:

1. **CIS Programmer/Analyst degree program** – The associate degree program offered by FVTC that offers concentrations in computer and Web programming.

2. **Competencies** – major skills, knowledge, attitudes or abilities needed to perform a task effectively and efficiently (WIDS, n.d.).

3. **Competency Based Instruction (CBI)** – A system in which achievement is measured by the demonstration of explicitly stated skills (Stump, 1999).

4. **Core abilities** – the broadest outcomes, skills, or purposes that are addressed throughout an entire course or program (WIDS, n.d.).

5. **Information Technology (IT) Industry** – Organizations concerned with the furtherance of computer science and technology, design, development, installation,

and implementation of information systems and applications (Hicks, n.d.).

CHAPTER TWO

Review of Literature

Introduction

In examining the literature on assessment methodologies, the review took a problem analysis approach. First, an identification of the factions impacted by the assessment method was considered and the requirements of those groups were examined. Next, a survey of alternative assessment techniques was made, along with a review of the emerging trend of computer industry certification. Finally, an investigation of the potential resistance to change in making modifications to the assessment method was conducted.

Identification of Technical College Stakeholders

The first step in identifying the interested groups in the assessment process is to decide upon a working definition of a stakeholder. Typically, colleges concentrate on students, faculty, and accrediting agencies. However, in an era of increasing accountability, a more effective definition might simply be all those individuals or groups either who affect or who are affected by a college's actions and policies (Burrows, 1999).

Using the "affect" definition with respect to assessment, the list of stakeholders can expand to include employers who will potentially hire graduates, parents who wish success for their children attending the school, financial aid providers, alumni whose own reputation is

tied to the ongoing success of the school, the administration of the school, and other institutions who compete for the same students. Inclusion of all of these groups is important because they either will be directly affected by any change to the assessment process, or will have the power to prevent any change from taking place (Smith & DeMicheill, 1996).

Burrows (1999) suggested further classifying stakeholders by the following parameters:

Internal/External: This is the most common classification when identifying stakeholders, but in an educational setting, the distinction is not always clear. Students, for example, are clearly internal stakeholders being directly affected by the policies of the school. At the same time, students can also be seen as external when viewed in light of consumer behavior when choosing among competing institutions.

Passive/Active: Active stakeholders are those with whom transactions are currently being conducted, or whose laws and rules the institution must follow. Passive stakeholders are those who are affected by past or future actions, but do not have a current influence. Stakeholders can move between passive and active over time.

Cooperation/Threat: A third view of stakeholders classifies them as high or low cooperation, and high or low threat. For example, a competing education provider is a high threat stakeholder. If they can be engaged in

articulation agreements or educational consortiums, they can also be high cooperation. On the other hand, a new competitor may wish only to capture market share and have no interest in cooperation.

Stakes/Influence: Another view of stakeholders is by the type of stake held in the institution: ownership, economic dependence, or social. "Owners" are those with an institutional stake in maintaining the long-term health of the school. Economic dependents are the employees of the school. Social stakeholders are concerned with issues that relate to the school as a social entity.

Influence can be broken into three categories that refer to the methods that stakeholders may use to influence the institution: formal, economic, and political. Formal influence refers to contractual and regulatory relationships. Economic influence derives from the stakeholder's ability to contribute or generate needed resources. Political influence refers to the stakeholder's ability to affect decisions through their status or negotiations.

Using this four-dimension framework, the requirements of the affected parties can be further defined. Burrows also advised that the classification of those groups needs to be an ongoing, iterative process.

Requirements of Assessment by Stakeholder

Much of the literature written on assessment focuses on the construction and efficiency of assessment

instruments while spending little time on the purpose of assessment itself. The literature reviewed in this section was chosen to examine the requirements of the stakeholders identified in the previous section, i.e. students, faculty, parents, financial sponsors, employers, alumni, competing institutions, accrediting agencies, and the college administration.

Students

The purposes of assessment for students are numerous. Its main functions are diagnosis, evaluation, and grading, but the reasons for each vary. One common use of assessment is the selection of candidates for enrollment, degree program options, advanced standing, or occupations. Students need input from assessment to make reasonable choices in their educational path. Feedback to the student throughout a particular course is another critical purpose. Rowntree (1987) described assessment as a feedback mechanism that is the "lifeblood of learning." Effective feedback allows students to identify their strengths and weaknesses, to build upon what they do best, and to know where improvement is needed. Students also need to know that their accomplishments will be worth something when viewed by outside parties, and require some assessment mechanism for that purpose.

Assessment will not end once the student graduates and finds employment. Virtually all employers use some form of assessment on the job and the student should become

accustomed to the process (Archer North & Associates, n.d.).

Faculty

Instructors' requirements for assessment mirror many of the same needs as students. They need tools to evaluate an individual student's progress, as well as that of an entire class. This feedback can be used to shape and adjust the subsequent instruction to be the most effective. They also need data about the efficacy of the curriculum itself. Rowntree (1987) described assessment as a useful tool for directing students as well, and as a method to claim an appropriate portion of a student's time when balanced against other course work.

Wolfe and Blumenstyk (2001) argued that the faculty may also have a largely unspoken interest in keeping assessment simple and possibly improperly easy. Students rarely (if ever) complain about assessment being too easy, but making it difficult will, if nothing else, indirectly result in more work for the instructors who will be faced with more demands on their time from struggling students. This potential also must be considered when reviewing assessment strategies.

Parents and Financial Sponsors

Most students at a college or university level have reached the age of majority and are no longer legally responsible to their parents. Colleges may not have an official responsibility to include parents in the results

of assessment, but in reality, most parents remain stakeholders, at least indirectly. Parents typically retain an interest in how their children are performing, and are frequently involved in the financing of the education. Parents will, in all likelihood, be party to the results provided from much of the assessment and will use it to evaluate the success of their children's education. Other financial sponsors also have an interest in the results of the education they are in part financing, and have a responsibility to ensure that the most worthwhile and deserving students are receiving their aid (Rowntree, 1987).

Employers

Potential employers are the recipients of published information about the students usually in the form of grades or personal references. The purpose of this is to aid in selecting the proper employees and to avoid misemploying a student. In addition, if employers are using the training to upgrade existing employees, they will want direct feedback on the success of that employee before continuing to finance or possibly advance that employee within the organization. It is sometimes argued that schools should not aid employers in selecting employees but should instead invent their own assessment examinations (Rowntree, 1987). In fact, that process is already underway in the IT industry with the large software, hardware, and network providers creating their own certifications and

credentials (Business Week Online, 2000). Schools are now facing pressures to adjust their training to fit the industry certifications.

Alumni

When surveyed, alumni are excited to be solicited for input on curriculum issues. Alumni have a stake in the ongoing perception and quality of the degree they have earned from the institution (Smith & DeMicheill, 1996).

Competing Institutions

Bailey, Badway, and Gumport (2001) have identified multiple sources of new competition for the community college. Online universities such as the University of Phoenix (which has grown from under 10,000 undergraduate students in 1990 to over 45,000 in 2000) have begun to enter the territories traditionally served by the community college. "For-profit" training, particularly in technical education, has established a strong foothold, offering faster paced training and more relaxed requirements. "A 2001 report by the Education Commission of the States (ECS) suggests explosive growth in the sector by pointing out a 78 percent growth in the number of for-profit two-year degree granting institutions between 1989 and 1999" (Bailey, Badway, & Gumport, 2001, p. 6). These competing institutions do not receive funding from government sources, are not subject to the same standards of accountability, and therefore have more latitude in their assessment options.

Accrediting Agencies

The North Central Association of Colleges and Schools accredits FVTC. In its proposed criteria for accreditation to be effective September 2004, the association will seek the following evidence regarding assessment (North Central Association, 2002, ¶ 6):

- Institution uses data collected for purposes of accountability (graduate rates, passage rates on licensing exams; placement rates; transfer rates, etc.)
- Assessment programs measure student learning at multiple levels, course, program, and institutional
- Assessment strategies include direct and indirect measures of learning
- Results of assessment measures testify to achievement of learning goals and are available to constituencies

College Administration

The function of the administration is to balance the needs of all of the stakeholders and ensure the ongoing health of the institution. At FVTC, it is a strategic direction to "enhance the effectiveness of instructional programs, college services, and student academic performance through an all-inclusive assessment process" (*Fox Valley Technical College - Mission, vision, purposes, values and strategic directions*, n.d., ¶ 12).

Alternative Assessment Methodologies

Traditional objective testing, although convenient, has met with growing dissatisfaction. The ease with which objective tests can be administered and graded has made them the incontrovertible leader in testing popularity. The difficulty lies in the assumption that there is a single correct answer or method, or that complex tasks can be broken down into simple sequences that can be reduced to multiple-choice, true/false, or short answer questions. "Teaching to the test" and rote memorization of facts tend to occur when emphasis is placed on this style of testing (Shank, 1994).

The term "alternative assessment" is a broad term that encompasses many forms of assessment, all of which are based on the concept of requiring a student to generate rather than simply choose a response. The goal is to make the assessment process an integral part of the learning process. Improvements in assessment will yield improvements in learning. Rather than narrowing the focus to routine and discrete skills, the emphasis shifts to complex thinking and problem solving. According to Herman, Aschbacher, and Winters (1992), the common characteristics in alternative assessment are: creation or production of something by students; utilization of higher-level thinking and problem-solving skills; invocation of real-world applications; and, new assessment roles for teachers.

The emphasis of assessment shifts to examining the processes, as well as the products of learning. Students are challenged to move beyond "one right answer" thinking and explore possibilities. Effective teachers have always been attuned to observing students during the learning process and making adjustments to the instructional process as needed. Alternative assessment seeks to accomplish this as well by simulating as much as possible the real-world environment where the skill will ultimately be used (Herman, Aschbacher, & Winters, 1992).

The skills required in the CIS industry to solve real-world problems are complex and non-linear. The educational process in mastering those skills cannot be either. "Learning does not best proceed in discrete hierarchies. Because learning is not linear and can take many directions at once at an uneven pace, conceptual learning is not something that can be delayed until all of the 'basic facts' have been mastered" (Herman, Aschbacher, & Winters, 1992, p.15).

Competency-Based Assessment

Competency or performance-based assessment is a very common method used for employee performance appraisals in business and industry as found in a study by Locher and Teel (cited in Archer North & Associates, n.d.). Employees are evaluated based on job performance of specific tasks that are tied to management objectives. It is a logical extension to use a similar approach in training students

since this type of assessment is likely to be part of any future job after completing their education.

Curricula developed for use in the Wisconsin Technical College System is required to be developed using the WIDS model. A DACUM (Developing a Curriculum) committee made up of local professionals in an occupation is convened and together they define their jobs in terms of the duties and tasks required of them. The process proceeds to discussion of the general skills and knowledge that a successful individual working their field must possess. This becomes the basis for subsequent curricula development that takes the output from the DACUM and breaks it down further into competencies. Each competency is then refined into learning objectives that describe the lower level, supporting knowledge, skills, and attitudes needed to master the competency. (Wisconsin Technical College System Foundation, 2002).

The difficulty comes when assigning letter grades to the competencies and for the course itself. Some schools have begun to reorganize grading around the competencies themselves rather than grouping competencies into courses. For example, the New Hampshire Department of Education has designed and piloted a Competency-Based Assessment and recording system described as follows:

> Teams of teachers work collaboratively to ensure that there are learning opportunities for these skills across the curriculum. No one teacher or class is

> expected to be responsible for teaching or assessing all the competencies. Teachers or advisors, sometimes working in teams, are taught to assess collections of student work against the written performance standard for each competency. Students become acquainted with the performance standards and are coached in collecting evidence of proficiency during their regular learning experiences. Each student is responsible for collecting their own work examples and then presenting the evidence to their teacher/advisor or designated assessor. The work is evaluated as Proficient (P), Not Yet Proficient (NYP), or Surpasses Proficiency (SP). In some rare cases, when no opportunity to attain or demonstrate a competency has occurred, an evaluation of No Basis for Evaluation (NBE) may be given. A student who is Not Yet Proficient continues to work toward proficiency in that particular competency. An assessment of Not Yet Proficient does not mean that a student is not able to reach proficiency. Because proficiency may be demonstrated in any way, all students are able to reach proficiency in their own way and in their own time. (*New Hampshire's competency-based assessment system,* n.d., n.p.)

Specifying the criteria for scoring is focused on four common elements: dimensions or traits that form the basis for judging the student response; definitions and examples

to clarify each dimension; a scale of values for rating each dimension; and, standards of excellence for the performance levels with models or examples of each. The California Assessment Program (CAP) has developed a competence-based rubric that ranks the performance of the student by from 1 through 6 based on the proficiency demonstrated for each competency (Herman, Aschbacher, & Winters, 1992, p.56):

DEMONSTRATED COMPETENCE

Exemplary Response . . . Rating = 6

Gives a complete response with a clear, coherent, unambiguous, and elegant explanation; includes a clear and simplified diagram; communicates effectively to the identified audience; shows understanding of the open-ended problem's mathematical ideas and processes; identifies all the important elements of the problem; may include examples and counterexamples; presents strong supporting arguments.

Competent Response . . . Rating = 5

Gives a fairly complete response with reasonably clear explanations; may include an appropriate diagram; communicates effectively to the identified audience, shows understanding of the problem's mathematical ideas and processes, identifies the most important elements of the problems; presents solid supporting arguments.

SATISFACTORY RESPONSE

Minor Flaws But Satisfactory . . . Rating = 4

Completes the problem satisfactorily, but the explanation may be muddled; argumentation may be incomplete; diagram may be inappropriate or unclear; understands the underlying mathematical ideas; uses mathematical ideas effectively.

Serious Flaws But Nearly Satisfactory . . . Rating = 3

Begins the problem appropriately but may fail to complete or may omit significant parts of the problem; may fail to show full understanding of mathematical ideas and processes; may make major computational errors; may misuse or fail to use mathematical terms; response may reflect an inappropriate strategy for solving the problem.

INADEQUATE RESPONSE

Begins, But Fails to Complete Problem . . . Rating = 2

Explanation is not understandable; diagram may be unclear; shows no understanding of the problem situation; may make major computational errors.

Unable to Begin Effectively . . . Rating = 1

Words do not reflect the problem; drawings misrepresent the problem situation; copies parts of the problem but without attempting a solution; fails to indicate which information is appropriate to problem.

No Attempt . . . Rating = 0

This type of rating tool shows what is required to attain each level, basic examples of what fits the category, and can be easily adapted to any performance based task.

Portfolio-Based Assessment

Another style of alternative assessment is portfolio-based assessment. Portfolios are collections of students' work. The portfolio itself is simply a receptacle for work, but if coupled with a defined assessment purpose, criteria for selection for inclusion in the portfolio, and, criteria for assessing the work, it can be used a basis for assessment (Herman, Aschbacher, & Winters, 1992).

The work included can be individual or group efforts as appropriate, span multiple courses or areas of study, and involve the student more directly with the assessment process (Pearson Education Inc., 2002). In addition to being used in the assessment process by the instructor(s), a portfolio involves the student in the educational process and encourages self-assessment as well. A portfolio can also be useful in finding employment by giving a potential employer real examples of what could be expected from a candidate. This use greatly enhances the value of a well-constructed portfolio and keeps the focus of the entire educational process on future employment.

Bellevue Community College (2001, October) has drafted a proposal for portfolio-based assessment in their IT degree that encompasses four program areas: Web authoring,

network support, programming, and database administration. Those program areas are mapped against nine criteria: problem solving/trouble shooting, research organization and presentation, communication and team skills, benefits and limitations of IT, computers and information systems, basic programming skills, operating system installation and configuration, and basic and advanced office applications. The weighting for each program by criteria is specified as high, medium, or low with descriptions and examples of the specific skills to be evaluated. This cross-program area approach mimics the inter-disciplinary skill set required by the different occupations and sets the stage for portfolio work selection and assessment that corresponds to the chosen profession.

Goal-Based Scenarios (GBS)

Goal-based scenarios refer to an entire strategy of learning where students take an active role in structuring their own education. The assessment process is tightly woven within the scenario and relies heavily on self-evaluation. GBS attempts to simulate natural rather than structured learning and include curiosity as a key element. This allows the student to investigate and learn things as needed rather than when prescribed by curriculum planners. In a more traditional approach, it is not uncommon for something to have to be re-learned because it was included too early in the educational process. Shank (1994) contrasts this pre-requisite driven style of learning with

an example of an undergraduate who will likely be doing quantitative research at some point in his schooling but is required to take mathematics at too early of a point in the degree process. The math department is probably not aware of his requirements and must teach a standardized type of mathematics to all students. When the time for the actual research arises, the student will likely have to re-learn the required techniques. If the required mathematics could have sought out by the student as needed to accomplish the larger task of obtaining the degree, there would have been a more direct link to the ultimate goal. Assessment itself would fall naturally within the flow of education because the mastering of the appropriate mathematics would now be a requirement of the student's own objectives.

"Goal-based scenarios have become a mainstay of Anderson Consulting's 900 million dollar effort to train its employees" according to Kantor, Waddington, and Osgood (2000, p.211). Anderson has attempted to recreate authentic consulting situations in the classroom to develop the learners' develop and test their problem solving skills. Actual case studies are used with students working in teams, but the outcome is not constrained to follow the actual outcome of the original situation. Participants are immersed in the details of the case and learn by being involved in the solution rather than merely studying it. Faculty members function as coaches rather than instructors and role-playing is used to simulate clients.

Assessment is not based on conventional knowledge tests that "would only render a measure of decontextualized knowledge and not provide an accurate indicator of participant problem solving abilities" (Kantor, Waddington, & Osgood, 2000, p. 219). The goal of Anderson's GBS approach is to enhance the learner's job performance and develop their own self-assessment abilities for use in the future. Students are asked to rate their proficiencies on specific proficiencies before and after taking the course using the following scale:

5 = Expert

4 = Perform independently

3 = Perform with minimal guidance

2 = Perform with extensive guidance

1 = Little/No ability

Students are encouraged to create their own learning without direct instruction from faculty who instead probe and challenge students about the expected skills to be learned. Learners are debriefed after various activities with feedback provided by the coaches. The learner is faced with a certain amount of ambiguity about how to approach the tasks as well as difficulty managing the workload, but this also simulates a real-world environment that is the ultimate goal of GBS.

Experiential Education

Byrne and Wolfe (1980) talk of the importance of field-testing competence by using a student internship. Two

processes are defined in the process for the student: social comparison and clarification of power. Interns experience an actual working relationship in their field of study and can determine what only they can answer for themselves, “Do I belong here?”. The intern also begins to experience not only “if” they belong in a job, but “where”. This type of self-assessment is difficult to attain except through an actual experience that is guided by a faculty member in their area of study.

In addition, employers can use the internship as an opportunity to assess the student directly and determine whether they would want to hire them as an employee. However, internships are not always successful experiences for the employer and require that they treat the intern as an employee with clear goals, supervision, and realistic expectations. Interns must possess a basic knowledge of business functions in addition to their technical IT knowledge (Swanson, 2001).

Rating and Consistency

One of the fundamental difficulties of performance-based assessment techniques is that there is not usually a simple answer that can be objectively scored. There is a strong reliance on human judgment that can result in conflicting perceptions or interpretations. To be effective, assessments must be fair, consistent, and valid, particularly when the results influence important decisions about students and their occupational choices. The raters

must fully understand and have reached a consensus as to the meaning of the criteria and how they are to be applied. The same rater should rate the same performance consistently on separate occasions, and different raters should agree when rating a particular performance. Instructors must learn to apply the ratings through training in proper scoring procedures. Formal scoring manuals are helpful in both the training of the instructors and for the students who will be assessed. According to Herman, Aschbacher, and Winters (1992), a good scoring guide will contain: fully explicated scoring criteria; examples or models illustrating each score point; an abbreviated, one-page, version of the criteria; and, a sample form for recording scores.

An ideal assessment environment might include multiple instructors each scoring the students performance and an average rating calculated from the multiple scores. This serves to minimize variations in judgments.

Computer Industry Professional Certifications

The computer industry, although relatively new, is beginning to join the ranks of other professions in the ways that individuals enter the field. Entrants to the fields of law, accounting, engineering, and medicine typically begin their careers by enrolling and completing an accredited degree program. After graduation, these fields require some sort of apprenticeship or residency in an approved work environment in addition to the successful

completion of an accepted exam that proves that he or she has attained a minimal level of proficiency (McConell & Tripp, 1999).

Ford and Gibbs (1996, n.p.) observed that professions follow a development path that is fairly similar regardless of their specific discipline:

- Initial professional education
- Accreditation
- Skills development
- Certification
- Licensing
- Professional development
- Professional societies
- Code of ethics

The IT industry is well on its way following this path. Professional education at accredited institutions is the norm. Although no formal apprenticeship program exists, many companies do offer internships to promising students near the end of their degree program. Certification requirements are becoming more prevalent in business and industry, but licensing -- a formalized version of certification -- has not been implemented. Ongoing professional development is certainly a requirement of anyone employed in the IT industry, and most professional societies such as Association of Information Technology Professionals have codes of ethics (AITP, 2002).

According to Business Week Online (2000, June 2), the most useful certifications to be considered in employment are A+ (certification of basic hardware and operating system of a personal computer), MCSE + Internet (qualifies IT professionals to enhance, deploy, and manage sophisticated intranet and Internet solutions), MCSE (versed in Microsoft Windows NT Server and the Microsoft BackOffice server products), MCDBA (certified database administrator), MCP+ Site Building (qualified to plan build, maintain, and manage Web sites), and CCNA (certified to install, configure, and operate simple-routed LAN, routed WAN, and switched LAN networks). All but two of the major certifications are created and administered by the Microsoft Corporation.

Microsoft has taken the lead in the certification arena. Since the introduction of the Microsoft Certified Professional (MCP) in 1992, over 200,000 individuals now hold that credential (Jeansonne, 1999). The exams used in the various MCP certifications are crafted to test real-world skills, test the application of those skills in problem solving, and are designed to be more than a simple recitation of facts (*How MCP exams are developed*, 2002).

A rigorous methodology is followed in the development of the Microsoft exams (*How MCP exams are developed*, 2002):

Phase 1: Job Analysis. Identify the knowledge, skills, and abilities required of people who are currently functioning in that position.

Phase 2: Objective Domain Definition. The results of the job analysis are used to create an "objective domain" which forms the basis of both training materials and exams.

Phase 3: Blueprint Survey. IT professionals who currently perform the job being examined then review the objective domain, and they are asked to prioritize and weigh each objective.

Phase 4: Item Development. An initial pool of items is then created that correspond to each of the blueprinted objectives. These items are reviewed to ensure that they are technically accurate, clear, unambiguous, relevant, unbiased, not misleading or tricky, and test for useful knowledge not trivial facts.

Phase 5: Alpha Review and Item Revision. A panel of technical experts reviews each item in the pool for accuracy and a consensus is reached.

Phase 6: Beta Exam. The reviewed items are then used in "beta" (sample) tests with actual test takers for statistical analysis.

Phase 7: Item Selection and Cut-Score Setting. The items are analyzed and rated based on difficulty and relevance. The "cut-score", or level of proficiency required to pass the exam is determined.

Phase 8: Live Exam. The exams are then distributed to designated independent testing centers worldwide.

The Microsoft exams take advantage of several different testing techniques. Select-and-Place exam items

test the candidate's ability to synthesize information and assemble a solution to a problem or scenario. Case study based exam items give a particular situation to which the candidate must devise a solution. Simulations recreate the actual software to test a candidate's understanding of the various functions under specific circumstances. Computer Adaptive Testing (CAT) modifies the testing experience on the fly to respond to the test takers answers. If proficiency is shown in a particular area, the computer probes further with more difficult question to ascertain a more specific level of proficiency. The goal is to use a computer to simulate an oral exam where the test giver adjusts the questioning to abilities of the test taker (*How MCP exams are developed*, 2002).

CompTIA's A+ certification is also adaptive and was designed using the Job Task Analysis method (*CompTIA A+ certification test overview, 2002*). Cisco Corporation plans to begin incorporating CAT in its future tests (Blacharski, 2001).

Microsoft offers official curricula that correspond to the different certifications offered, but it must be taught by certified trainers. There are two ways that a student can receive this training. Certified Technical Education Centers (CTEC) are privately run companies that offer the training. Authorized Academic Training Programs (AATP) are nonprofit schools, colleges, and universities that offer the official curriculum in a traditional academic setting,

typically for credit towards a degree program. AATPs offer the same material at a slower pace and lower cost than CTECs. Many AATPs also offer internship programs with local businesses and focus on the certifications most requested by their advisory boards. One drawback however, is the need to continuously recertify instructors to maintain the AATP status (Jeansonne, 1999).

The Association of Information Technology Professionals (AITP) (original called Data Processing Management Association (DPMA) when it was formed in 1962) offered a Certificate Data Processing (CDP) credential that was intended to be a broad-based business technology exam. In recent years, the organization has reformed and revised its certification to create the Certified Computer Professional (CCP) to stay current with other certification trends (Goldman, 2001) and focus the content of the exam more on specific topics.

The most recent certification survey shows that a combination of experience and certification yields the best salary. Companies are increasingly footing the bill for their employees to become certified, and AATPs account for 9% of preparation techniques used. There is no requirement that candidates use any official training and many of the applicants use other books and materials to prepare for the tests. (McCarthy & Schaffhauser, 2001).

Potential Resistance to Change in Assessment

There is a natural resistance to change in any environment, and proposing new assessment strategies is likely to meet with some degree of conflict before it can be adopted (de Jager, 2001). This section will examine possible resistance and review techniques to manage it.

Wright, Palmer, and Kavanaugh (1995) identify the following factors that influence the level of acceptance by stakeholders of innovations in education: Relative advantage, compatibility, complexity, trialability, observability, and perceived risk.

Relative advantage refers to the extent that an innovation improves upon what is already in use. In education, measurement of improvement can be difficult because the effects of change tend to be long-term and may require years for the effects to be fully observed. This can make it difficult for the stakeholders to see immediate improvements and "buy into" proposed changes.

Lack of compatibility can be an obstacle to educational innovations. New systems of assessment are likely to be at odds with the previous experiences of the stakeholders and their expectations and beliefs.

The complexity of an innovation may require extensive education of those directly involved before they will be willing to accept it. As a result, it may be quite difficult to implement any complex assessment methodology.

Wright, Palmer, and Kavanaugh use the term "trialability" to gauge the extent to which a new approach can be tested on a trail basis before its adoption as a standard. In some cases, a short-term test can be used before attempting to obtain commitment from all stakeholders.

"Observability" refers to the visibility of the innovation. If it can be readily viewed, it will be more acceptable. Changes that are difficult to observe will be met with resistance in most cases.

The final factor identified is risk. The more risk increases for particular stakeholders, the less likely they will be to welcome the change. Perceived risks and the fear of being blamed for failure will impede the adoption of a new idea in most situations.

A proposed change in assessment will require careful marketing to the affected parties. The marketing strategy must be mindful of all of the factors identified by Wright, Palmer, and Kavanaugh.

Norton, Spencer, and Harrington (1983) outline six possible strategies for changing to a competence-based assessment strategy:

The decree approach. In this strategy, a person or persons in a position of authority make a unilateral decision. The inherent hazards are faculty antagonism and resistance.

Replacement approach. Individual staff members not desiring to participate are allowed to remove themselves from the institution or accept other responsibilities.

Structural-reorganization approach. Development groups or task forces are formed, bypassing the departmental structure. The risks with this approach are that inter-departmental stresses develop.

Group-decision approach. This involves obtaining group agreement to carry out decisions and solutions made by others.

Data-discussion approach. Program developers furnish the faculty with information as the development process continues, and the faculty makes decisions as the processing continues. One difficulty is avoiding overwhelming the faculty with decisions but at the same time giving enough relevant information for them to act.

Group-problem-solving approach. Problems are identified and solved through group effort. This is considered the most desirable option, but the others may be used as conditions warrant.

Summary of the Literature Review

The review of literature confirmed the complexity of choosing an assessment approach. Many groups have stakes in the outcome of the assessment strategy and need to be consulted and included in its selection.

Technical colleges are especially focused on providing appropriate training for the employment of its students and

are also indirectly responsible to the employers of those students to provide relevant assessment that will assist in the employment process. This may involve curricula from other sources and industry certifications. A common theme found throughout the literature suggests that simulating the actual work experience in as many ways possible is ideal in both the learning and assessment process.

CHAPTER THREE

Summary, Analysis, and Recommendations

Introduction

Human nature seems to dictate that we quantify and compare our abilities. Whatever assessment method is chosen for an educational program, it naturally moves to the forefront of the learning process and its selection must be carefully made.

In the computer industry, rapid change is a driving force. This requires frequent upgrades and modifications to the curricula of a degree program for IT occupations. The assessment approach is affected as well, and needs to be updated to meet changing requirements.

Summary

Assessment affects different stakeholders in different ways. Students are in need of feedback and validation from the assessment process. This feedback is necessary for degree and career choices, as well directing study efforts. The type and style of assessment also affects the workload for students.

Faculty members have needs similar to students with respect to feedback and directing their instructional efforts, and student assessment aids in evaluating the quality of the curriculum itself. However, the methodology chosen has a direct bearing on instructor and student workload. The style and difficulty of the grading process

could adversely affect enrollment that could in turn influence the choice of an assessment methodology.

Competing institutions might have an interest in offering alternative assessment methods to draw students away from the school. Competitors may also be involved in collaborative efforts with articulation agreements or consortiums and may have their own specific grading requirements to allow credit transfer.

The business community expects the assessment process to aid them in selecting new employees. Individual references are another form of assessment. Employers also use technical colleges to re-train and upgrade the skills of employees and require some form of measurement of the success of those programs.

Financial aid sponsors need validation that their funds are being used for effective education and that they are being allocated to the most deserving students. This can also include parents who may be funding their child's education and who have an interest in the success of appropriateness of the chosen institution and degree program.

The alumni continue to maintain an interest in the assessment process and its effects. The school's reputation and, by extension, their own are affected by changing perceptions of the degree program.

Accrediting agencies have standards that must be met to continue the accreditation of the institution. Any

change in the assessment process needs to be reviewed in light of these requirements.

The school's administration is affected by the needs of all of the stakeholders and must balance those requirements. They have to make decisions that will ensure the ongoing health of the institution with an eye towards marketing, quality, student retention, and financial viability.

Alternative assessment methods usually focus on examining the processes as well as the products of learning. Building the assessment process into the learning method itself and directing it towards competencies can open many possibilities to create an effective education. The Wisconsin Technical College system already bases curriculum development on competencies that should easily lend themselves to performance-based assessment techniques.

Portfolio-based assessment requires students to collect samples of their work that meet certain criteria, usually under the guidance of an instructor. The selection and emphasis can vary depending on the area of study. The portfolio can span several subject areas and be evaluated by multiple instructors. This can minimize instructor bias that might otherwise affect the grading process. It can also be used in obtaining future employment. This adds an element of student involvement that goes beyond merely satisfying an instructor, and can inspire students to put their best foot forward during the learning process.

Goal-based scenarios simulate the work environment in the classroom. Students typically work in teams to solve real-world style problems. Ideally, this approach sidesteps the traditional prerequisite driven curriculum and allows the students to pursue topics as needed to accomplish their ultimate goal. This lessens the emphasis on grading because mastering a subject area is required to complete the final project.

There is also a current and powerful trend in the IT industry towards certification. This affects the style and content of the course offerings at technical schools and, in some cases, provides a viable partnership in curriculum development and assessment strategies.

Any change to the assessment methodology must take into account all of the stakeholders and their concerns. It must also be devised in such a way to gain the "buy-in" of all parties.

Analysis

Clearly, the mission of a technical college is to train students for future employment and to enhance and upgrade the skills of existing employees. Simulating real-world situations as closely as possible fits well with the emphasis of a technical college on employment. Alternative assessment strategies typically move away from the traditional A – F grading system and concentrate on measuring specific competencies. These competencies have already been defined by industry experts through the DACUM

process and distributed throughout the various curriculum of the CIS program. However, some of the methods reviewed (such as portfolio-based and goal-based scenarios) go beyond the bundling of competencies into specific courses, and may actually conflict with the traditional prerequisite/course approach. Adopting this style of training may be even more disruptive than moving away from the A – F grading system. Students might need to move through courses in an order that suits their individual goals. Some courses might have to be unbundled into smaller subject areas that address particular competencies and may not fit neatly into the traditional semester scheduling.

The crossing of technical areas is a valuable simulation of the environment likely to be encountered by a future professional in the IT industry. For example, an effective computer programmer must specialize in a computer language and platform, but must at least have a working knowledge of database and network concepts. On the other hand, a database analyst must have extensive knowledge of the database software, but still have working knowledge of the programming platform and network in use. A good CIS degree program will mirror this environment and allow students to not only emphasize their area of specialization, but also draw from other related areas.

Group projects also replicate the team approach common in business and industry. Students specializing in particular areas can work in teams to accomplish a larger

project that may span multiple courses and longer periods of time. Assessment of a group project can be troublesome because a truly functioning team will compensate for weaker individuals who may not always be apparent to the instructor. A key component in a group setting is to have team members rate each other using a 360-appraisal technique commonly used in a business setting. Co-worker ratings are as important as ratings from a manager (or an instructor) and give the individual valuable feedback on how well they interact with others.

Incorporating assessment directly into the learning method instills it with more significance than merely following up a learning activity or course with some sort of grading process. Even in the simplest learning endeavor we learn by doing, making mistakes, and then repeating the task until we have mastered it. The assessment is directly embedded in the activity and there is minimal value in qualitatively grading it during the learning process. Once the activity is mastered, we can move on to the next skill required to complete the ultimate goal.

Learning how to learn and seek solutions is probably the most valuable skill that can be taught in any CIS curriculum. No two situations will ever be alike, and a continuous survey of new technology required in problem solving is required. In the computer field, it is unrealistic to believe that any degree program will cover all of the skills necessary to perform effectively on the

job. Self-direction, self-assessment, and self-motivation are essential traits of the successful IT professional. All components of the educational process should work towards developing those skills along side technical knowledge.

The certification exams offered by CIS industry leaders are current and sophisticated assessment tools. The corporations that develop these exams can respond more quickly and thoroughly to the rapid changes in the computer technology than a traditional technical college. They have the resources available to build powerful and timely examination tools that could never be matched by a small college.

On the other hand, certifications tend to be narrow in their scope and less broad-based than is typical in a CIS degree program. There is also a risk that the curricula of the school would begin to skew towards a particular vendor that may not be desirable for the local business community served by the college. However, specialization is a powerful trend, as experienced by AITP and their former CDP designation that dropped in popularity as the IT industry became more highly focused. Relying heavily on certification curricula developed by outside parties would also require a commitment from the school's administration to continuously retrain and recertify the faculty.

If the popularity and value of industry certifications continues to grow, it should actually provide some degree of freedom in the college environment to use alternative

teaching and assessment approaches. The burden of grading students will shift to the certification procedure and allow more variety in the instructional process. The college will need to monitor carefully the success of its graduates in becoming certified to verify that the institution itself is meeting the requirements of its students.

Adopting any change or innovation in education is difficult. The needs of the many stakeholders vary, but all have had their own personal experiences with education that is likely to color their interpretations of any proposed changes.

Change will always result in some degree of risk, and unless a clear benefit can be seen, that change will likely be resisted. Overworked faculty can hardly be expected to embrace new approaches to assessment that will require more of their time. Nor are students likely to be eager for such change when it might mean having to shoulder more responsibility and additional work in their own education.

Memorizing answers for traditional multiple-choice tests is easier for students than finding their way through a relatively unstructured learning experience, even if that experience would be more relevant to their ultimate goal of successful employment. For instructors, creating and grading objective tests is a relatively simple task when compared to assessing portfolios or coordinating internships and goal-based scenarios. Administrators are

also unlikely to press for new innovations when the result might be rebellion from the faculty and the student body.

However, there is support for changes. Instructors in the technical college system are required to have thousands of hours of experience in their profession before they can join the faculty. Most new instructors are open to creating a learning environment that replicates what they have experienced professionally. In addition, the threat from competing institutions and new educational technologies may inspire even the most reluctant stakeholders to risk some degree of change lest the institution fall prey to its competition. Weinberg, a respected management consultant on change makes the case that things only change when necessary to remain the same. "The biggest and longest lasting changes usually originate in attempts to preserve the very thing that ultimately changes most" (Weinberg, 1985, p. 132).

Recommendations

Further study of the trends in the region served by Fox Valley Technical College with respect to industry certification requirements by employers should be made. A first step might be to encourage instructors to seek certification themselves so that they can assist their students in doing the same. It might be prudent for the administration to encourage instructors to seek certification appropriate to their areas of expertise through either tuition reimbursement or salary schedule

adjustments. The current pay scale is based solely on traditional educational credits, and has not been modified to reflect this new trend in the CIS industry.

Collaborating with software companies such as Cisco and Microsoft is an excellent way to expand and supplement existing curriculum as long as the goals of the school are not supplanted by the goals of the software company. Deciding which partnerships are best requires involvement from the advisory board and local business. It is probably not necessary to target specific industry certifications, but the curricula should indirectly support the students for whom that will be a viable strategy after graduation.

Wholesale change of the assessment methods used in the CIS degree program and supporting courses is probably not realistic or even advisable. But where possible, it would be useful to begin to move away from the traditional grading system and implement scoring scale by competency similar to that used by Bellevue Community College or the New Hampshire Department of Education cited in the review of literature. Competencies already established in the curriculum could be graded as “surpasses proficiency” (SP), “proficient” (P), or “not yet proficient” (NYP), within a course, and then if needed translated to A, B, or Incomplete for transcript or articulation purposes. If these changes are successful at an individual course level, the next step might be to re-package competencies across

existing courses and allow students to proceed through the curriculum in ways tailored to their individual goals.

The portfolio-based approach might be especially useful in the computer and Web programming majors. Students could be given requirements that must be met prior to graduation and build portfolios of their work as they continue through the program. An ideal assessment of the portfolio would involve a panel of instructors who would advise the student on what would be most useful for demonstrating their qualifications to a prospective employer. Using more than one instructor would result in varied and unbiased feedback of the type that would be most useful in preparation for the job application process.

Where possible, computer adaptive testing should be substituted for the traditional objective testing. This use of technology would offer the speed and ease of grading, but not sacrifice the individualized evaluation that is more desirable. It would also remove the temptation to "teach to the test" and return the focus to the competencies required by the profession.

In any case, at least some attempt to incorporate alternative assessment techniques should begin. As resistance occurs, Weinberg (1985) recommends finding a neutral way to identify and address that resistance. The most important goal is to keep the resistance becoming "frozen in place". The temptation is always to "resist the resistance", but that in itself leads to even more

opposition. It is better to avoid causing polarization among the stakeholders and instead work slowly towards new ideas. Because, in education as in all things, “the more it stays the same, the less it changes” (Saint Hubbens, Tufnel & Smalls, 1992).

BIBLIOGRAPHY

AITP. (n.d.). *Association of information technology professionals code of ethics*. Retrieved June 25, 2002 from: http://www.aitp.org/

Archer North & Associates. (n.d.). *Appraisal methods*. Retrieved June 28, 2002 from: http://www.performance-appraisal.com/methods.htm

Bailey, T., Badway, N., & Gumport, P. (2001). *For-profit higher education and community colleges* (Deliverable # 0400). Retrieved June 30, 2002 from: http://www.stanford.edu/group/ncpi/documents/pdfs/forprofitandcc.pdf

Bellevue Community College. (2001, October). *PLA faculty handbook*. Bellevue, WA: Bellevue Community College. Retrieved June 29, 2002 from: http://www.skillsgapconsortium.org/cats/PLAHandbookFaculty.pdf

Blacharski, D. (2001, February 5). *Computerized adaptive testing*. Retrieved June 25, 2002 from: http://www.itworld.com/nl/cert_news/02052001/

Burrows, J. (1999, Summer). Going beyond labels: A framework for profiling institutional stakeholders. *Contemporary Education, 70*(4), 5-10. Retrieved June 19, 2002 from: HWWilsonWeb (200001043300).

Business Week Online (2000, June 2). *Before you put that high-priced geek on your payroll*. Retrieved June 25, 2002 from: http://www.businessweek.com/smallbiz/0006/te000602.htm

Byrne, E. T., & Wolfe, D. E. (1980). *Developing experiential learning programs for professional education.* San Francisco: Jossey-Bass, Inc.

CIS Department Meeting Minutes. (1999, November). Fox Valley Technical College.

Cisco Corporation. (n.d.). *Career certifications*. Retrieved June 16, 2002 from: www.cisco.com/warp/public/10/wwtraining/certprog/

Cisco Corporation. (n.d.). *Cisco networking academy program fast facts*. Retrieved June 16, 2002 from: www.cisco.com/warp/public/779/edu/academy/overview/fast_facts.html

CompTIA A+ certification test overview. (n.d.). Retrieved June 25, 2002 from: http://www.comptia.org/certification/aplus/

de Jager, P. (2001, May/June). Resistance to change: A new view of an old problem. *Futurist, 35*(3), 24-27. Retrieved June 17, 2002 from: EBSCOhost Academic Search Elite (4339215).

Duderstadt, J. (July 30, 2001). *Leading higher education in an era of rapid change*. Paper presented at the meeting of the State Higher Education Executive Officers 48th Annual Meeting. Retrieved June 16, 2002 from: http://milproj.ummu.umich.edu/publications/SHEEO/download/SHEEO.pdf

Feldman, M. (1998). Programmers. *InfoWorld, 20*(14), 101. Retrieved June 16, 2002 from: EBSCOhost Academic Search Elite (470172).

Ford, G., & Gibbs, N. (1996, January). *A mature profession of software engineering*. Retrieved June 25, 2002 from: http://www.sei.cmu.edu/publications/documents/96.reports/96.tr.004.html

Fox Valley Technical College - Admission policy. (n.d.). Retrieved June 16, 2002 from: http://www.fvtc.edu

Fox Valley Technical College – Mission, vision, purposes, values and strategic directions. (n.d.). Retrieved June 16, 2002 from: http://www.fvtc.edu

Goldman, A. (2001, May 4). *ISP association directory: Association of information technology professionals*. Retrieved June 26, 2002 from: http://www.isp-planet.com/business/associations/aitp.html

Herman, J. L., Aschbacher, P. R., & Winters, L. (1992). *A practical guide to alternative assessment.* Alexandria, VA: ASCD Publications.

Hicks, J. (n.d.). *Industry channels: Information technology*. Retrieved June 15, 2002 from: www.imdiversity.com/Article_Detail.asp?Article_ID=5781

Horsley, D., & Kaser, J. (1999, Fall). How to keep a change initiative on track. *Journal of Staff Development, 20*(4), 40-45. Retrieved June 19, 2002 from: HWWilsonWeb (199902503300).

How MCP exams are developed. (2001, December 20). Retrieved June 24, 2002 from: www.microsoft.com/traincert/mcpexams/policies/examdev.asp

Jeansonne, W. (1999). *Microsoft certification careers.* Foster City, CA: IDG Books Worldwide, Inc.

Kamber, R., & Biggs, M. (2002). Grade conflation: A question of credibility. *Chronicle of Higher Education, 48*(31), B14. Retrieved June 16, 2002 from: EBSCOhost Academic Search Elite (6664746).

Kantor, R. J., & Waddington, T., & Osgood, R. E. (2000, December). Fostering the suspension of disbelief: The role of authencity in goal-based scenarios. *Interactive Learning Environments, 8*(3), 211-227.

McCarthy, K., & Schaffhauser, D. (2001). *2001 salary surveys*. Retrieved June 24, 2002 from: http://www.mcpmag.com/salarysurveys/

McConell, S., & Tripp, L. (1999, November/December). Professional certification: Fact or fiction? [Electronic version]. *IEEE Software Magazine*. Retrieved June 25, 2002 from: http://computer.org/certification/FactorFiction.htm

McKowen, C. (1979). *Get your A out of college. Mastering the hidden rules of the game.* Los Altos, CA: William Kaufmann, Inc.

Merrow, J. (2001). *Choosing excellence.* Lanham, MD: Scarecrow Press, Inc.

Microsoft Academic Alliance. (n.d.). *MSDN Academic Alliance*. Retrieved June 16, 2002 from: http://www.msdnaa.net

Miltich, M. (2001-2002, Winter). All the fish in the river: An essay on assessment. *Thought & Action The NEA Higher Education Journal, 17*(2), 85-91.

Muse, T., & Teal, M. (1993). Alternative admission policies for adult learners. *Community College Review, 21*(3), 44-52. Retrieved June 16, 2002 from: EBSCOhost Academic Search Elite (9410121134).

Nagel, B. (1998, September/October). A proposal for dealing with grade inflation: The relative performance index. *Journal of Education for Business, 74*(1), 40-43. Retrieved June 16, 2002 from: EBSCOhost Academic Search Elite (1260903).

New Hampshire's competency-based assessment system. (n.d.). Retrieved June 28, 2002 from: http://www.ed.state.nh.us/Guidance/nhcompetency.htm

Ngeow, K., & Kong, Y. (2001, October). Learning to learn: Preparing teachers and students for problem-based learning. *ERIC Clearinghouse on Reading, English and Communication, EDO-CS-01-04*. Retrieved June 16, 2002 from ERIC (ED 457 524).

North Central Association. (2002, March). *Proposed new criteria for accreditation*. Retrieved June 30, 2002 from: http://www.ncacihe.org/restructuring/newcriteria

Norton, R. E., Spencer, C. J., & Harrington, L. G. (1983). Planning for change to CBAE. *Resource person's guide to implementing competency-based administrator education* (pp. 30-31). Columbus, OH: American Association for Vocational Instructional Materials.

Novell Corporation. (n.d.). *Professional certifications*. Retrieved June 16, 2002 from: http://www.novell.com/education/certinfo/

Pearson Education, Inc. (2002). *Portfolio-based assessment*. Retrieved June 29, 2002 from: www.phschool.com/professional_development/assessment/portfolio_based_assess.cfm

Rowntree, D. (1987). *Assessing students: How shall we know them?* New York: Nichols Publishing Company.

Shank, R. C. (1994). *Engines for educators*. Retrieved June 28, 2002 from: http://www.ils.northwestern.edu/e-for-e/nodes/I-M-NODE-4121-pg.html#NODE-42

Smith, S., & DeMicheill, R. (1996, July/August). Survey of stakeholders: A tool for assessing the importance of proposed curriculum changes. *Journal of Education for Business, 71,* 325-328. Retrieved June 19, 2000 from: HWWilsonWeb (199602626000).

Saint Hubbins, D., Tufnel, N., & Smalls, D. (1992). The majesty of rock. [Recorded by Spinal Tap]. On *Break like the wind* [CD]. Universal City, CA: MCA Records. Retrieved July 12, 2002 from: http://www.spinalpap.com/words/BLTW_02_majesty_of_rock.asp

Stump, D. (1999, October 28). *CBI glossary*. Retrieved June 23, 2002 from: http://physnet2.pa.msu.edu/cbi/cbihome/reference/glossary.html

Swanson, S. (2001, June 11). Internships that work. *Information Week, 841,* 117.

Testing innovations. (2001, October 1). Retrieved June 25, 2002 from: http://www.microsoft.com/traincert/mcpexams/policies/innovations.asp

Toch, T. (1994, June 13). Rethinking failure. *U.S. News & World Report, 116(23),* 20.

Weinberg, G. (1985). *The secrets of consulting. A guide to giving & getting advice successfully.* New York: Dorset House Publishing.

Wisconsin Instructional Design System. (WIDS). (Version 6.0.20). (n.d.). [Computer Software]. Waunakee, WI: Wisconsin Technical College System Foundation, Inc.

Wisconsin Technical College System Foundation. (2002). *A practitioner's design model*. Retrieved June 28, 2002 from: http://www.wids.org/

Wolfe, A., & Blumenstyk, G. (2001, March 2). Professors are unconvincing in shielding their interests. *Chronicle of Higher Education, 47*(25), B20. Retrieved June 20, 2002 from: Academic Search Elite (4145544).

Wright, R., Palmer, J., & Kavanaugh, D. (1995, Summer). The importance of promoting stakeholder acceptance of educational innovations. *Education, 115*(4), 628-632. Retrieved June 19, 2002 from: EBSCOhost Academic Search Elite (9510054555).