EDUCAUSE Learning Initiative
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Technology and Learning:

Defining What You Want to Assess

By Joni E. Spurlin, University Director of Assessment and Associate Director of University Planning & Analysis, North Carolina State University

Edited by Diana Oblinger

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Abstract
Asking whether technology improves learning may seem straightforward, but the answer is not simple. The challenge begins with defining assessment and is compounded by the complexities of people, technology, and educational organizations. This paper clarifies technology assessment by exploring the definitions, methods, and realistic expectations it can address.

Introduction

Assessment is an increasingly common topic in higher education. Whether discussed as a measure of student learning, cost-effectiveness, administrative efficiency, or the value of technology, assessment is on the minds of many groups. Assessment has different meanings and measures, however, depending on its use.[1]

Adding technology to the mix can exacerbate the confusion about assessment. Although asking whether technology improves learning may seem like a straightforward question, the answer is not simple. Surveys conducted by higher education faculty have shown that students prefer courses taught using computers, and some research indicates that incorporating technology into a course results in greater learning.[2] Other studies have shown that technology-enriched courses positively affect students' personal and intellectual development.[3] Few have determined, however, whether technology has a positive effect on how well students learn.[4] The challenges begin with the definition of assessment but are compounded by the complexities of people, technology, and educational organizations.

The purpose of this paper is to clarify "technology assessment." In an environment where many want to know whether technology improves learning, it is essential to understand definitions and methods as well as to set realistic expectations for the questions that can be answered.

One Word, Many Definitions

Faculty, IT professionals, instructional designers, and others frequently mean different things when they refer to assessment. Some are discussing assessment of students' knowledge, some are focused on assessment for the sake of program improvement, and others intend to assess the resource needs associated with implementing technology effectively on campus. Some are concerned about the demands of regional accreditation, while others must meet administrative needs. Some want to know how well students are learning in face-to-face compared to online courses. Because all of these issues are lumped under the term *assessment*, the national conversation about assessment can be confusing.

Three explanations help clarify assessment:

- "Assessment is an ongoing process aimed at understanding and improving student learning. It involves making our expectations explicit and public; setting appropriate criteria and high standards for learning quality; systematically gathering, analyzing, and interpreting evidence to determine how well performance matches those expectations and standards; and using the resulting information to document, explain, and improve performance. When it is embedded effectively within larger institutional systems, assessment can help us to focus our collective attention, examine our assumptions, and create a shared academic culture dedicated to assuring and improving the quality of higher education."[5]
- "Assessment is the systematic collection, review, and use of information about educational programs undertaken for the purpose of improving student learning and development."[6]
- Assessment is a process that focuses on student learning, a process that involves reviewing and reflecting on student performance—what students can do—and focuses on curriculum and group performances in a planned, deliberate, and careful way.[7]

The key facets of assessment are

- a focus on student learning;
- the collection, analysis, and interpretation of information; and
- application for the purpose of improvement.

Assessment is a cyclical, five-part process (see Figure 1). This paper addresses the first two parts: developing the assessment question and defining methods. The other elements will be reviewed in subsequent papers.

Figure 1. The Assessment Cycle

- Develop/refine the assessment question, outcome, or objective.
- Define assessment methods that will gather evidence.
- Implement assessment methods, gather evidence, and analyze data.
- Interpret the results in terms of the assessment question, outcome, or objective.
- Make decisions based on results and interpretations.

Developing Assessment Questions

The first part of the assessment cycle defines what you want to know: assessment questions, outcomes, and objectives. Because poor questions result in weak answers, it is critical to understand the purpose of an assessment and develop well-focused questions.

Assessment and Evaluation

It is easy to confuse assessment and evaluation because they are not distinct categories but rather a continuum. The first step in developing assessment questions is determining where your question falls along the continuum. "[Evaluation is] a broader concept than assessment as it deals with all aspects of a program including resources, staffing, organization, operations, and efficiency."[8]

In general, evaluation consists of systematic investigation of the merit, worth, or significance of an object, a program, or a process.[9] There are many types of evaluation, including, but not limited to:

- Program evaluation
- Needs assessment
- Process evaluation
- Cost-benefit analysis

The difference between assessment and evaluation is important when discussing technology issues. To distinguish between assessment and evaluation, consider the questions' focus. Questions about technology often revolve around cost-benefit analyses, staffing, support, and infrastructure (types of and support for hardware and software). Many institutions have investigated infrastructure, what students want, what faculty feel they need, and satisfaction with technology support. These questions

are concerned with evaluation. In contrast, assessment focuses on the effect of technology on student learning. If environment, technology, curricular and cocurricular activities, instruction, and student variables are part of the question, and if the focus is student learning, then this is assessment.

Evaluation Questions

- How does technology influence faculty workload? Does technology improve use of class time? Does technology require more preparation time?
- Are students satisfied with technology support?
- Can future demand for technology be predicted? How many technology-enriched classrooms will be needed in the next five years?
- What barriers do faculty think inhibit their use of technology in the classroom?
- Which of the learning management systems available today is most cost-efficient?

Assessment Questions

- When is face-to-face instruction better than online? When is virtual better? How are they different?
- How does giving students feedback on their work via technology affect how well they think critically?
- How does technology meet different learning styles so that students are more engaged with the material?
- How can the use of technology improve learning in large-enrollment classes?
- How does access to Internet resources affect students' ability to conduct empirical inquiry?

Level of Analysis

To develop accurate assessment questions, you must identify the unit or level of analysis. Is assessment for an individual student, a course, a program, or an institution? Traditionally, assessment is about aggregate information—students as a group within courses, programs, or institutions.

Table 1 shows the interplay of the level of analysis with the assessment-evaluation spectrum. The columns represent steps on the continuum from assessment to evaluation; the rows identify the level of analysis; and each cell shows a sample question. Seeing common issues categorized may help in developing clear questions.

Table 1. Level of Analysis Versus Continuum of Assessment to Evaluation

Level of Analysis	Continuum of Assessment to Evaluation				
	General Assessment	Technology Assessment	Technology Evaluation	Staffing Evaluation	Operations and Efficiency Evaluation
Individual Student	How well is the student performing?	How does the student's proficiency with technology affect how well that student performs?	Does the student have access to technology needed for his or her major?	How effective is technology support for the student?	Is the student satisfied with access to technology overall?
Classroom or Specific Event	How well do students understand what I'm teaching in this class period?	By using a clicker system in my classroom, can I tell how well students understand this topic, right now?	What is the best technology to help me teach this topic?	How well is the support staff performing in support of the technology needed for this specific topic?	What other faculty teach this topic, and how can you share the technology?
Course or Specific Event	How well do students meet the outcomes and objectives for this course?	Does the use of simulation software increase students' understanding of the course objectives?	Which clicker system works with other technology (hardware/software) within this room?	How well is the support staff performing in support of this course?	Are there issues for operation of this course related to other courses?
Program	How well do students integrate their knowledge and abilities from different courses into a fuller understanding of their profession?	Are students required to bring laptops to college better able to meet the program outcomes related to problem solving?	What are the technology expectations and needs of students in this program?	How much will the use of online grading reduce the need for TAs within the program?	How does the number of students and faculty within this program influence the cost of technology for this program?
Division, College, or Institution	What do you know about the overall abilities of those who graduate from this institution?	In the educational environments that use technology, how well do students master fundamentals, intellectual discipline, creativity, problem solving, and responsibility?	How can you assure that faculty and students have access to the most effective technologies for supporting teaching and learning?	How does the infusion of technology across the curriculum impact the need for support staff?	Are you managing the technology within the university effectively and efficiently?

Assessment Purpose

The possible purposes of assessment are to improve the quality of education; to aid in decision making, or to meet external agencies' criteria (accountability). The specific purpose of an assessment shapes the questions asked. Are you assessing technology to improve student learning or to improve academic programs? What types of decisions do you need to make? Do you need documented assessment results for accountability purposes?

Assessment can refer to two very different activities—gathering information (measurement), and using information for improvement—though most assessment professionals agree that assessment is more than measurement. "The aims of assessment are typically broader than simply gathering direct evidence of student learning outcomes.... 'Assessment' also embraces the processes used by institutions and programs to apply what they learn to make improvements in teaching and learning."[10]

To make improvements, you must first decide what types of improvements are needed. For example, if students in large classes are not learning the material, appropriate assessment evidence can inform decisions about what technology to employ to improve that learning.

Accountability is often linked with assessment, particularly when the audience includes the public, state legislatures, or accrediting agencies,[11] each of whom asks for proof that students are achieving stated learning outcomes.[12] Assessment can provide the information called for in these circumstances.

Defining Interrelationships

Assessing the impact of technology on student learning is difficult. As much as we'd like to ask what impact technology has on student learning, this question cannot be answered because technology interacts with many variables—student preparation and motivation, how the student or instructor uses technology, and how well the environment supports learning. Assessment questions should move away from an emphasis on software and hardware, focusing instead on what students and faculty *do* with software and hardware.

Assessment programs should include an understanding of how the relationships among learners, learning principles, and learning technologies affect student learning. Instead of asking what impact technology has on student learning, ask how you can incorporate the best-known principles about teaching and learning, using technology as a tool for innovation. For example, a report published by the Association of American Colleges and Universities[13] articulates the principle of empowering students to become better problem solvers, to work well in teams, to better use and interpret data, and to increase their understanding of the world. How can technology facilitate this?

Technology can help establish effective learning environments by bringing real-world problems into the classroom; allowing learners to participate in complex learning; providing feedback on how to improve reasoning skills; building communities of instructors, administrators, and students; and expanding opportunities for the instructor's learning.[14] Assessment is important: "The tools of technology are creating new learning environments, which need to be assessed carefully, including how their use can facilitate learning, the types of assistance that teachers need in order to incorporate the tools into their classroom practices, the changes in classroom organization that are necessary for using technologies, and the cognitive, social, and learning consequences of using these new tools."[15]

Due to the complexity of these interrelationships, it helps to focus on measurable components. Think about learning, learning principles and practices, and learning technologies. Define the issues within each category. Consider the following questions as you identify the issues you want to measure:

Learners

- What are the learners' backgrounds?
- What knowledge, skills, and technology literacies do they already have?
- What are their demographics?
- What attitudes do they hold about technology?
- Do students' learning styles differ?

Learning Principles and Practices

- Where and when do you use technology? Internal/external to the classroom? Before/during/after class sessions? In virtual labs?
- How is technology used? To share notes, augment lectures? To simulate critical thinking? To link graphics to real-time data?
- What instructional practices are used in the course? Active learning? Group problem solving? Collaborative learning?

Learning Technologies

- How well does the technology work, in terms of functionality, support, and usability?
- What specific technologies or tools do you use, including software (simulation, communication, visual) and hardware (document camera, laptops, iPods, clickers)?

Focus on Student Learning

Identifying a specific technology and learning situation allows you to focus on student learning. For example, years ago, engineering professionals sketched ideas with pencil and paper. Today, CAD programs extend students' ability to accurately manipulate a creative reality of the problem. Consider this question: When using CAD technology for modeling in a laboratory setting, are students able to think more deeply about an issue or have a broader understanding? Because assessment focuses on student learning, however, you must clarify what you want to know about student learning.

CAD technology allows for nonlinear thinking—thinking in more than two dimensions—which lets an engineer creatively engage more ideas and variations without worrying about the technical skill of sketching.[16] Clarifying the student-learning portion, the question above can be modified as follows: When using CAD technology for modeling in a laboratory setting, how are the students' critical thinking and multidimensional problem-solving skills transformed?

Outcomes First, Technology Second

The way technology is used does not cause students to learn better, but there is a correlation, a connection. Assessing this connection is the most critical part of the assessment process and illustrates the difficulty of using traditional assessment techniques in the area of technology.

At the course or academic program level, faculty determine what they want students to learn (outcomes), often using Bloom's taxonomy[17] to clarify the level of learning (definition, synthesis, analysis, and so on). When you assess how well students learn at the course or academic program level, you don't typically ask about the connection between how the information was taught and how well the students learned—not, at least, in the first round of the assessment cycle. Initially, faculty develop outcomes and then measure how well students achieve them. If faculty find that students have met the outcomes, they don't ask how the material was taught. The results do not call for improvement, and so no further assessment is conducted. If students don't meet the outcomes, however, faculty begin to ask how the material was taught, when it was taught, and whether it should be taught differently. Therefore, by assessing the interrelationships among technology, learners, and pedagogy, you start with the second round of a traditional assessment cycle. You have not stopped to do the first round, which determines what students are learning, regardless of the learner characteristics or pedagogy.

The results from course and academic program assessments can make questions about technology more meaningful. Course or program assessment results help focus attention on areas (outcomes) where students have difficulty learning. Focusing on what students are not learning well can refine the assessment questions. For example, does the use of simulation help students better understand how to solve problems that, prior to the simulation, were difficult for them to understand?

Five Steps to Developing an Assessment Question

The assessment cycle starts with developing appropriate questions. To accurately assess technology's impact on student learning, carefully decide what you want to know.

- **Step 1:** Determine where along the continuum of assessment to evaluation your question resides. Is your question related to assessment of student learning or evaluation of resources?
- **Step 2:** Resolve the level of analysis. Is your inquiry about an individual student, a specific course, a program, a division, or an institution?
- **Step 3:** Establish the purpose of your inquiry. Is it for improvement, decision making, or accountability?
- **Step 4:** Characterize the interrelationships among learners, learning principles, and learning technology to further focus your question.
- **Step 5:** Define student learning. What do you want students to know, think, or do in relation to the other parts of your question? Use of course or program outcomes or prior assessment results can differentiate the learning related to your question.

Applying these steps results in improved questions that more fully address the impact technology has on student learning. Three examples illustrate the process.

Example 1

Does the help of an academic technology specialist create effective learning experiences for students?

- **Step 1:** The focus is on student learning, which makes this an assessment question.
- **Step 2:** The level of analysis is not clear in the question. Is it for a specific course? Is it an institution-level question? If so, the analysis would cross multiple courses. The level of analysis changes how the assessment would be conducted.
- **Step 3:** If the purpose is to improve a specific course, the question needs to include that purpose.
- **Step 4:** This question asks about the interrelationship between pedagogy and technology—whether the changes have an effect. Therefore, the question can be modified for the specific technologies and pedagogies used.
- **Step 5:** To make this an assessment question and not an evaluation question, it needs to reflect specifically what students are learning. Why was this course changed? One reason might be because students in the past did not learn the material to the instructor's satisfaction. Was it a depth-of-knowledge issue? Could students describe the basic knowledge but not apply that knowledge to other situations?

In this example, then, the five steps lead to a better question.

Improved question: For this course, did the change in pedagogy to a more interactive classroom, including the use of technology (changes based on the advice of an academic technology specialist),

enable students to use CAD modeling systems and specialized software applications to visualize, develop, and analyze the design of a product at the level appropriate for potential employers?

Example 2

How does the use of personal response systems (clickers) impact student learning?

Improved question: How does the level of involvement within a course, demonstrated by how much students respond during class through the use of personal response systems (clickers), impact how well students solve problems in large-enrollment science courses?

Example 3

Does the use of multimedia make learning easier and more efficient?

Improved question: How does incorporating visual and audio techniques align with students' learning styles and improve their ability to critically analyze music in the music program?

Defining Methods

Once a question has been established, the second component in the assessment cycle is to select the most appropriate assessment methods, either direct or indirect. Direct methods judge student work, projects, or portfolios developed from the learning experiences. Some consider this "authentic" assessment. Indirect methods use opinions of students or others to indicate student abilities. In many cases, there is no ideal assessment method, but matching the method to the question is more important than having a perfect, well-controlled method: "Far better an approximate answer to the right question…than an exact answer to the wrong question."[18]

Direct Assessment Methods

- Course-based performance, including tests, essays, portfolios, homework, journals, presentations, projects, and capstone experienced-based courses
- National test scores, at entry, midpoint, and graduation
- Certification exams and professional licensure
- Case studies
- Thesis or dissertation work
- Qualifying exams for graduate work
- Longitudinal or cross-sectional comparisons (knowledge, time to do task, problem-solving skills)

Indirect Assessment Methods

- Surveys completed by incoming, enrolled, withdrawn, and graduating students, as well as by alumni and employers
- Surveys and inventories related to behavior or attitude changes (pre- and post-educational experience)
- Focus group meetings of students, staff, faculty, employers, or community agencies
- Student development transcripts (record of out-of-class experiences)
- Tracking of course-taking patterns
- Student reflection on work, portfolios, and other activities

Additional Information

For more information about how faculty, administrators, and institutions from around the world are assessing and evaluating technology and student learning, see NC State University's Web site, Assessing the Impact of Technology-Rich Spaces on Student Learning (http://www2.acs.ncsu.edu/UPA/assmt/litre/index.html), which provides links to a wealth of resources designed to facilitate understanding of the role of assessment and evaluation in technology and student learning:

- The online searchable bibliography contains citations for publications relevant to assessing the impact of technology on student learning. While the focus is on work published since 2000 that has been conducted in higher education, some applicable K–12 research is also included.
- The Frequently Asked Questions page addresses issues that faculty regularly ask.
- The Resources page is designed to connect to a number of different resources associated with assessing the impact of technology on student learning, including NC State projects, other projects around the country, and other Web sites of interest.

As you contemplate which assessment methods to use, consider how well the method matches your question. Although most methods can be used at any level, the difference is the complexity of the tool. A student survey for a course can be very focused, while a survey distributed to all students within an academic program addresses broader questions, covering a wider range of topics. A test developed for a specific course, testing a specific concept, is easier to develop than an exam that assesses all senior students' ability on the same outcome.

Consider possible assessment methods for Example 1 above. Conducting a survey about students' satisfaction with the redesigned course is not an appropriate method because measuring satisfaction—which does not reflect how well students are learning—is evaluation. It might be important to understand their satisfaction, but this is not what the question addresses. A more appropriate method for Example 1 would be direct assessment of the project developed in this course. A rubric could be developed to measure each student's ability to visualize, develop, and analyze the design of a product at a level appropriate for potential employers. One or more faculty would judge the project based on that rubric.

Conclusion

The first critical step in technology assessment is developing the question. A clear question takes into account the intentions behind assessment, the unit of analysis, and the interaction of technology with other variables. Using the five steps discussed above will improve the quality of your question. Once you define the question, you can select an appropriate method—direct or indirect—for measurement.

Assessment, which focuses on student learning, is not a solitary activity but a cycle that can lead to improvement. The ultimate goal of assessment is the informed, purposeful improvement of the quality of student learning. Although assessment is not easy, the goal makes it well worth the effort.

Endnotes

1. For a history of the development of assessment, see Ewell, P. (2002). An emerging scholarship: A brief history of assessment. In T. W. Banta and associates (Eds.), *Building a Scholarship of Assessment*. San Francisco: Jossey-Bass.
2. Twigg, C. A. (2004). *Improving learning and reducing costs: Lessons learned from round II of the Pew grant program in course redesign.* Troy, NY: Center for Academic Transformation.
3. Hu, S., & Kuh, G. D. (2001, November 24). Computing experience and good practices in undergraduate education: Does the degree of campus "wiredness" matter? *Education Policy Analysis Archives, 9*(49). Retrieved June 24, 2006, from http://epaa.asu.edu/epaa/v9n49.html; Kuh, G. D., & Vesper, N. (2001). Do computers enhance or detract from student

learning? *Research in Higher Education*, *42*, 87–102; and Kuh, G. D., & Hu, S. (2001). The relationships between computer and information technology use, student learning, and other college experiences. *Journal of College Student Development,* 42, 217–232.

4. Nelson Laird, T. F., & Kuh, G. D. (2005). Student experiences with information technology and their relationship to other aspects of student engagement. *Research in Higher Education, 46*(2), 211–233.
5. Angelo, T. (1995). Reassessing (and redefining) assessment. *AAHE Bulletin, 48*(3), 7–9.
6. Palomba, C. A., & Banta, T. W. (1999). *Assessment essentials: Planning, implementing, and improving assessment in higher education.* San Francisco: Jossey-Bass.
7. Ewell (2002), op. cit.; Ewell, P., & Reis, P. (2000). Assessing student learning outcomes: A supplement to measuring up 2000. National Center for Public Policy and Higher Education. Retrieved June 24, 2006, from http://measuringup2000.highereducation.org/assessA.html; and Ewell, P. (2004). *Assessment that matters: Creating authentic academic cultures of evidence.* Retrieved June 24, 2006, from http://www.usna.edu/CTL/DeptPosters/PostersPPT/Ewell.pps
8. *Supporting assessment in undergraduate mathematics (SAUM)*, Retrieved June 24, 2006, from http://www.maa.org/saum/faq.html#diffeval
9. Scriven, M. (1998). Minimalist theory of evaluation: The least theory that practice requires. *American Journal of Evaluation, 19,* 57–70; Shadish, W. R., Cook, T. D., & Leviton, L. C. (1991). *Foundations of program evaluation: Theories of practice.* Newbury Park, CA: Sage Publications.
10. Council for Higher Education Accreditation (CHEA) Institute for Research and Study of Accreditation and Quality Assurance. (2003). *Statement of mutual responsibilities for student learning outcomes: Accreditation, institutions, and programs.* Retrieved June 24, 2006, from http://www.chea.org/pdf/StmntStudentLearningOutcomes9-03.pdf
11. *Accountability* is defined as the process of improving performance, assuring quality, providing the public with evidence of what students are learning, and sustaining confidence in the institution.
12. Eaton, J. S. (2001). Regional accreditation reform: Who is served? *Change Magazine, 33*(2), 38–45.
13. Association of American Colleges and Universities. *Greater expectations: A new vision for learning as a nation goes to college.* Retrieved June 24, 2006, from http://www.greaterexpectations.org/
14. Carmean, C. (2004). Learner-centered principles. EDUCAUSE National Learning Infrastructure Initiative. Retrieved June 24, 2006, from http://www.educause.edu/LearnerCentered/940; Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (2002). *How people learn: Brain, mind, experience, and school (expanded edition).* Washington, DC: The National Academies Press.
15. Bransford, op. cit., p. 247.
16. Rohrback, R., Spurlin, J., Mayberry, K., & Rajala, S. (2004). Engineering computing as an essential component of inquiry-guided learning. In V. S. Lee (Ed.), *Teaching and learning through inquiry: A guidebook for institutions and instructors.* Sterling, VA: Stylus Publishing.
17. Examples of how to use Bloom's Taxonomy for developing outcomes can be found at http://www.nwlink.com/~donclark/hrd/bloom.html and http://faculty.washington.edu/krumme/guides/bloom1.html
18. Tukey, J. (1962). *Annals of math statistics, 33,* 1–67.

The EDUCAUSE Learning Initiative (ELI) is a community of higher education institutions and organizations committed to advancing learning through IT innovation. To achieve this mission, ELI focuses on learners, learning principles and practices, and learning technologies. We believe that using IT to improve learning requires a solid understanding of learners and how they learn. It also requires effective practices enabled by learning technologies. We encourage institutions to use this report to broaden awareness and improve effective teaching and learning practice.