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Using Needs Assessment as a Holistic Means for Improving Technology Infrastructure

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ELI Paper 3: 2007

June 2007

Abstract

This paper describes a four-step needs assessment process that institutions can use to determine the gaps between current and desired states of technology infrastructure, facilitating rapid decision making. The framework described focuses on aligning learning outcomes and technology tools and can help institutions compare the current state of technology infrastructure with a desired state to best meet identified learning outcomes.

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Introduction

As information technology increasingly becomes a critical component of higher education, decisions about infrastructure carry greater and greater weight. Institutional leaders must determine which technology to purchase and how best to support that technology. Many institutions struggle with choices about appropriate infrastructure: what students want, what faculty feel they need, and satisfaction with technology support. The rate at which technology changes only complicates these decisions. Assessment of student learning—as discussed in the first white paper in this series[1]—can be an important tool in making infrastructure decisions, but because such assessments take considerable time to develop and conduct, decision makers can become frustrated waiting for results. As a result, decisions about technology tend to revolve around cost-benefit analyses, including costs for staffing and support.

A focused needs assessment that asks the best questions can facilitate rapid and effective decision making. By explaining how a needs assessment determines the difference between the current and desired state of technology infrastructure, this paper describes how to improve decision making about infrastructure by considering student learning. This methodology uses a holistic view because the issues surrounding technology affect the entire institution and need to be viewed as a system rather than individually.

For this paper, *technology infrastructure* refers not only to hardware, software, networks, and facilities but also to the people, processes, and policies needed to help make the technology available. *Needs assessment* is defined as a type of evaluation that provides a formal process for identifying, documenting, and prioritizing gaps between current and desired results, based on the cost to meet the need versus the cost to ignore the need. The needs assessment incorporates data and opinions from different sources to enable decisions about what to change as well as what to continue.[2]

Conducting a Needs Assessment

An effective needs assessment involves four steps, which are outlined in Table 1 along with examples of specific procedures that can satisfy each step and an estimate of the time required to complete each step.

Table 1. Steps for Infrastructure Needs Assessment

Step	Suggested Procedures	Timeline to Develop and Implement Procedure
1. Identify learning outcomes	Needs assessment committee review of results from institutional assessment practices and accreditation reports, or committee selection of institutional-level outcomes	One week
2. Identify pedagogical strategies that best assist students with achieving these outcomes	Focus-groups or facilitated discussions with faculty and learning experts	Two weeks
3. Identify current and desired technologies that assist with identified pedagogies and outcomes	Surveys, interviews, or focus groups of faculty and students	Two to four weeks
4. Needs assessment of the infrastructure	Various, including focus groups or surveys	One to two months, depending on the number of people involved

Step One: Determine What Students Should Learn

The first step is to consider student learning rather than focus on technology. What do we want students to learn? What should students be able to know, think, or do by the end of their educational experience—that is, what are the outcomes? Consider whether these outcomes are at the institutional, college, program, or course level.

To focus the analysis and to provide timely data, determine the most important student learning outcomes for the chosen level of analysis. Focusing on the most important outcomes rather than including an unmanageable number of options provides the decision maker with less—but more important—data to analyze. This, in turn, will speed up the decision-making process. Outcomes might include the ability to:

- Demonstrate competence in effective writing and oral communication.
- Analyze diverse perspectives from a variety of cultures and respond appropriately to a variety of cross-cultural situations.
- Demonstrate the use of analytical and critical-thinking skills.
- Engage in a critical review of research, draw conclusions from research that lead to a solution to a problem, and show how the solution advances the knowledge of the field.
- Work effectively in teams.

Due to accreditation and accountability, most institutions already measure how well students are meeting learning outcomes. Therefore, one way to focus the needs assessment is to identify outcomes of interest through current assessment or accreditation activities. Focusing on what students are not learning well might be the best focus of a needs assessment. For example, if students aren't meeting the institutional expectations of effective writing and oral communication, this might be an area in which to try to find technologies to increase students' abilities.

Step Two: Identify Pedagogies That Support Student Learning

The second step is to determine which pedagogies will best increase the student learning outcomes identified in Step One. For example, the use of a pedagogy that teaches students how to critique each other's papers will help students learn teamwork and critical-thinking skills. A variety of resources address how best to improve student learning through appropriate pedagogies.[3] A discussion with campus teaching and learning experts may help quickly determine which pedagogies to focus on and how to shape a needs assessment project.

Step Three: Determine Current and Desired Technology

The next step is to consider which technologies best facilitate these pedagogies. Many technologies can be used for a variety of pedagogies, with varying degrees of effectiveness. For instance, a multimedia classroom with access to gaming technology might be effective for learning, but without the appropriate pedagogy, the technology may have no value. Asking faculty and students what they know about technologies for specific pedagogies and outcomes can help focus the needs assessment. Through surveys, interviews, or focus groups, institutions can ask faculty and students not only what they consider the best technologies but also what they currently use. For example, when considering a specific learning outcome, these two questions could be asked of a group of faculty:

- What technologies are you *using* that you believe best support your teaching, given the pedagogical techniques you employ that improve your stated student learning outcomes?
- What *better* technology uses for these pedagogical techniques could improve student learning of the identified desired outcomes?

Instead of discussing technology in terms of particular software or hardware, which changes rapidly, discuss technology in terms of teaching and learning.[4] In order to help faculty associate their uses of technology with specific pedagogy or teaching strategies that impact learning, NC State University's Learning in a Technology-Rich Environment (LITRE) Technology Practices Directory[5] project developed the taxonomy presented in Table 2.[6]

Table 2. Taxonomy of Tools/Technologies and Learning Activities

Activity	Tools/Technologies Supporting the Activity
Planning class activities or tasks/projects, setting goals	Electronic calendar for instructor to post exam dates, project management software for students to plan detailed steps in an assignment
Seeking information, representations, or physical artifacts	Search engines and library databases to help research ideas with keywords (information)
	Media libraries to access images, audio, or video; digital libraries to access scanned copies of letters/papers or other electronic artifacts (representations)
	Geiger counter to search for evidence of radiation, telescope to search for asteroids, infrared homing to seek light emitted by hot objects (physical artifacts)
Collecting/capturing information, representations, or physical artifacts	Survey software to capture response data, database software to capture and store client records, bookmarking tool to capture Web addresses, digital drop boxes for files, RSS aggregators to collect and store text-based news feeds and blog entries (information)
	Digital cameras to capture images, audio or video recorders to capture vocals and/or moving images, RSS aggregators to collect and store audio podcasts, Doppler radar to capture target velocity, magnetic resonance imaging (MRI) to capture representations of the body (representations)
	Scientific probeware (software for real-time data acquisition) to capture water molecules (physical artifacts)
Analyzing or manipulating information, representations, or physical artifacts	Spreadsheet software, mathematical modeling software, and statistics software to explore numerical data and look for trends; concept-mapping software to organize ideas and build relationships (information)
	Simulation software or interactive learning objects to alter variables (e.g., force per square inch on a new structure) and analyze resulting output; GIS software to add visual layers to maps and analyze interactions (representations)
	Microscope to enhance and study cells on a glass slide, remote-controlled robotic arm to examine hazardous substances (physical artifacts)
Integrating something new with existing information, representations, or physical artifacts; extending, building on	Reviewing tools to mark up or critique others' work/documents, Web 2.0 tools like furl.net or trailfire to add tags and comments/annotations to existing Web pages (information)
	Video coding software to mark and tag segments in a captured movie (representations)
	Surgical equipment to add a stent to an artery (physical artifacts)
Creating new information, representations, or physical artifacts	Word processors, blogging tools, Web page editors, and programming software, to create new papers, reflections, Web sites, and code (information)
	Video-editing software to produce a new movie, podcast software to create a new audio broadcast, animation software to create a new drawing, computer aided design (CAD) software to create a building layout (representations)
	Robotic equipment to create new textiles, 3D printer to create a tangible object, centrifuge to separate elements and create a new compound (physical artifacts)

Assessing, monitoring progress on student learning	Online quizzes and classroom student response systems (clickers) to gauge student progress, electronic gradebooks to monitor progress, reviewing tools to mark up or critique others' work/documents
One-way communicating	PowerPoint software or document cameras to support classroom presentations, screencast software to record and post a presentation online
Two-way communicating	E-mail, discussion boards, or chat software to communicate about course topics
Collaborating on tasks/projects	Wiki pages to co-construct ideas online, groupware and whiteboard software to meet remotely from different locations and work on a project

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ELI has developed an Applying Technology to Teaching and Learning tool to help institutions develop a process for selecting the best technologies for specific learning outcomes (see <http://www.educause.edu/11816>).

Step Four: Perform the Needs Assessment

Once the decision is made about the technologies most likely to support identified learning outcomes and pedagogies, the needs assessment evaluates the available technology resources and infrastructure compared to those needed to support those learning outcomes. Needs assessment methods include:

- Direct observation of technology usage
- Questionnaires or surveys completed by students, faculty, staff, or administrators
- Consultation with persons in key positions or who have specific knowledge of technology infrastructure
- Focus groups with students, staff, faculty, or administrators
- Review of relevant literature
- Usage records such as use of a learning management system or studies comparing different tools
- Direct performance assessment of students who use technology, including tests, essays, portfolios, homework, journals, presentations, projects, and capstone experience courses
- Student reflection on work, portfolios, and other activities

All of these evaluation methods are appropriate, especially surveys, focus groups, and interviews. Contacting those with expertise in developing surveys or focus groups (assessment professionals or faculty in education, sociology, or psychology, as well as those with qualitative or ethnographic research expertise) will facilitate obtaining better data. Many institutions have developed surveys about faculty use of technology, though these surveys typically do not focus on specific pedagogies or learning outcomes. A better tool is the ELI Student/Faculty Questionnaire,[7] which is designed to help explore student and faculty experiences and expectations with technology in teaching and learning.

Additional Considerations

By focusing on a few specific outcomes and technology tools that enable best pedagogical practices, we can save time and avoid simply creating a wish list. The needs assessment methodology does not have to be complex—it can be conducted quickly, with easily interpretable results.

When making decisions about technology and its infrastructure, the level of analysis tends to be at the institutional level; however, decisions can also be made at the division, college, or

program level. In addition, obtaining data that will provide a holistic picture of existing and desired technology infrastructure requires involving the appropriate people. Those individuals might be from the highest institutional level or from a smaller unit, such as a college or a set of academic programs. Consider the following questions to determine who should be involved:

- Who are the users of technology (students, faculty, others)?
- Who makes decisions about technology purchases?
- Who supports the technology once purchased?
- Who designs, implements, and supports the technology in virtual and real spaces?
- Who are the instructional designers and faculty development specialists who support teaching and learning with technology on your campus?
- What committees review or advise about technology issues?
- Are there groups outside the institution with whom you share technology?

Among the individuals and entities on campus who might be valuable to a needs assessment are those with assessment or evaluation backgrounds (faculty or staff), institutional research, planning, registration and admissions staff, and centers for faculty development.

Applying Data to the Assessment Framework

Table 3 outlines a needs assessment framework to support technology-rich environments. The framework compares the current state of technology infrastructure with a desired state to best meet identified learning outcomes. To this list institutions should add other unique infrastructure elements relevant to their situations.

Table 3. Technology Infrastructure Needs Assessment

Infrastructure	Describe the Current State of Each Item	Describe the Desired State of Each Item
Technology/equipment		
Software		
Hardware (including peripherals)		
Networks		
Other equipment (such as round tables, whiteboards)		
Digital artifacts (virtual slides, art objects)		
Support staff		
Technology/IT specialists, support personnel		
Instructional designers		
24 x 7 support for faculty or students, including help desks, Web sites, help lines		
IT security specialists		
Classroom management and course support		
Facilities and spaces (including walls, furniture, power, lighting, and wireless or other access to the Web or software)		
Formal: Classrooms and labs		
Informal: Outside classroom and labs (cybercafes, group work areas)		
Virtual spaces (online environments)		

Processes, including preparation (planning), installation (setup), operation (implementation), and termination (maintenance/cessation)		
Purchasing decisions and processes		
Processes for accessing specific technology in and outside class		
Processes for supporting student computing (including technical aspects and those related to student learning)		
Processes associated with security and privacy		
Processes for supporting faculty using technology (including technical aspects and improving teaching and learning)		
Academic policies that affect technology		
Policies about what can be posted online by faculty and students		
E-mail policies such as which accounts should be used and if e-mail is official business		
Policy specifying when students have access to the technology		
Licensing policies		

Use Table 3 (with institution-specific adjustments) to develop surveys, focus groups, or other means of gathering data to determine the gap between current and existing infrastructure. For example, consider classroom and lab spaces, many of which are designed to allow a one-to-many (faulty-to-students) presentation format. These types of classroom spaces invite a traditional lecture-style pedagogy rather than cooperative, active learning. The desired state of a technology-rich learning environment, however, might not be traditional classrooms but rather "...'places' where social interactions are encouraged and which are visible through the configuration of the space and how people conceive of the various interactions in it."[8] Faculty might determine that the infrastructure is not in place to support spaces that encourage "...lucid, problem-oriented, conversation-like presentations of learning matter."[9]

Once decision makers have determined the gap between current and desired states, steps can be taken to close the gap, including identifying priorities and costs. A small gap that is easy to fix might be of higher priority than a large problem. On the other hand, addressing a single large gap might fix several smaller problems. With a completed needs assessment, decision makers have data to begin to make decisions about where to make improvements, given the budget and other priorities.

Case Study: Fictitious University

To contextualize the steps necessary for an infrastructure needs assessment, the following hypothetical case study walks through the process for Fictitious University, which uses faculty focus groups to complete the steps. In Step One, the university identifies two learning outcomes that are the focus of the needs assessment: demonstrate competence in effective writing and oral communication, and demonstrate analytical skills.

In Step Two, for the first learning outcome, the university identifies three pedagogies that would best address the goals:

- Students critique each other's papers
- Instructors model written communication

- Experts in the field model oral communication skills

For the second outcome, demonstrating analytical skills, two pedagogies are deemed appropriate:

- Students critique each other's papers
- Instructors model techniques that analyze or manipulate information

Step Three collects information about current and desired technologies that would support the pedagogies identified in Step Two. Table 4 presents the results of the first three steps.

Table 4. Results from First Three Steps of Infrastructure Needs Assessment

Desired Learning Outcomes	Best Pedagogies	Current Technology	Desired Technology
Demonstrate competence in effective writing and oral communication	Students critique each other's papers	Web space that holds papers or enables student comments to be added	Web space that holds papers and allows anyone to edit the paper; technology that allows assessment of student work
	Instructors model written communication	E-mail, Word, Web pages with static examples and resources of best practices	Technology that allows modeling best written communication, whether text or mathematical equations, through interactive simulations on Web pages
	Experts in field model oral communication skills	Videotapes	Technology that allows students and faculty to watch presentations from anywhere in the world
Demonstrate the use of analytical skills	Students critique each other's papers	Web space that holds papers or enables student comments to be added	Web space that holds papers and allows anyone to edit the paper; technology that allows assessment of student work
	Instructors model techniques that analyze or manipulate information	Technology that allows students to analyze or manipulate information or change parameters, but not related to specific content areas (GIS or statistical software)	Technology that allows students to analyze or manipulate information in specific content areas

For Step Four, a random set of faculty, staff, and students from each college within the institution participate in a focus group. Each college's focus group discusses the following:

- **Question 1:** We now have the ability to communicate with students and provide examples of best practices for writing, speaking, and analytical thinking through posting materials on university Web spaces, which have typically been produced using course management systems or Web development tools. Are we providing the infrastructure necessary to continue to support these technologies so that students can best learn how to demonstrate written and oral communication and analytical skills? Look at the items in Table 3 and discuss what you see as current and desired states for each item to continue to support these technologies, pedagogies, and outcomes.

- **Question 2:** A group of faculty have listed the types of technology they would like to see at our institution. Looking at the items in Table 3, what would it take to buy or produce the desired technologies described in Step Three?

In this hypothetical case study, responses to Question 1 indicate a need for more hardware storage of information and more support for faculty to learn how best to use the technology already available on campus. For example, many faculty did not know how to use peer-review online groups in the course management system. Policies are needed to describe what types of material should be available to students online and establish disk space limits for analytical courses. The current state of the facilities is considered adequate for supporting the current technologies.

Results from Question 2 show that new technology and software could be purchased to support student learning of these two outcomes, depending on the limits of the university budget. The faculty in anthropology indicate that no simulation software could be purchased; it needs to be developed. Given adequate resources, these faculty are excited about the possibilities. In addition, to facilitate best pedagogical practices for oral communication, changes would be needed in the classroom facilities.

One solution might be to encourage more appropriate use of the existing technology rather than to purchase additional technologies. Another change that could be made for Fictitious University would be to improve the infrastructure that supports faculty teaching.

Conclusion

Needs assessment incorporates data and opinions from varied sources that facilitate decisions about what to change as well as what to continue. Needs assessment methodology, with the right framework, can allow institutions to determine appropriate infrastructure for supporting teaching and learning with technology. The needs assessment can take on a clear focus by concentrating on specific student learning outcomes. Using data obtained through surveys, focus groups, and other methods, the institution can determine the gap between current and desired states, and decision makers can then prioritize remedies to the gaps. These remedies will focus the institution's efforts at improving student learning.

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