National Institute for Learning Outcomes Assessment

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Technology Solutions
to Support Assessment

Jennifer M. Harrison and Sherri N. Braxton

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NILOA Mission

The National Institute for Learning Outcomes Assessment's (NILOA) primary objective is to discover and disseminate the ways that academic programs and institutions can productively use assessment data internally to inform and strengthen undergraduate education, and externally to communicate with policy makers, families, and other stakeholders.

About the Authors

Dr. Jennifer M. Harrison has worked in higher education for almost 30 years and is currently UMBC's Associate Director for Assessment in the Faculty Development Center. She has expertise in accreditation, institutional effectiveness, student learning assessment, critical pedagogy, curriculum development, educational technology, and online and face-to-face active learning. She currently specializes in interdisciplinary educational development. An experienced speaker, she has created hundreds of workshops, programs, and presentations for a range of higher education audiences, including national, regional, and local conferences. At UMBC, she consults with faculty and staff to strengthen learning assessment practices and offers programs and workshops to support faculty development. She was a key contributor to UMBC's successful re-accreditation efforts and continues to work with faculty, staff, and leaders to support authentic assessment.

Before joining UMBC, she served the labor movement for 15 years at the National Labor College, crafting interdisciplinary writing, research, and critical thinking curricula; leading faculty development, prior learning assessment, and educational technology processes; cultivating strategic, institutional effectiveness, and learning assessment plans, and successfully contributing to re-accreditation as Associate Professor of Writing and Director of Assessment. After earning tenure, she chaired the admissions committee, brokering a FIPSE grant into a redesigned student-success oriented matriculation process designed to integrate with prior learning assessment and improve graduation rates; redesigned the capstone program; crafted key policy documents; and contributed to continuous improvement initiatives by founding and chairing the Assessment Committee.

Dr. Harrison holds an interdisciplinary Ph.D. in Language, Literacy, and Culture from UMBC, a master's degree in English Language and Literature from University of Maryland, College Park, and a bachelor's degree in English with a minor in art from Washington College. Her current research focuses on authentic assessment, including inclusive curriculum mapping and design; graduate, co-curricular, and interdisciplinary assessment; assessment technologies; and the benefits of contextualizing learning analytics with direct learning evidence.

Dr. Sherri N. Braxton is the Senior Director of Instructional Technology at UMBC where she is responsible for leading the Division of Information Technology's (DoIT) strategy for end-user support of instructional technologies including online, hybrid, and traditional, "face-to-face" technologies. With over 20 years of experience in traditional classroom instruction and adult education strategies grounded in instructional design models, she also possesses over 17 years of experience using learning technologies in higher education settings, including the design and facilitation of online and hybrid courses. Dr. Braxton is a dynamic presenter known for her ability to engage audiences and capture their attention, even for highly complex topics. She collaborates with her staff to devise learning opportunities delivered in multiple modes that meet the varied and shifting needs of both UMBC faculty and students. Dr. Braxton is also the DoIT representative on the University System of Maryland (USM) Academic Transformation Advisory Council, a group spearheaded by the William E. Kirwan Center for Academic Innovation. Dr. Braxton has crafted a national presence through her participation in educational technology associations like EDUCAUSE, the Online Learning Consortium (OLC), and the IMS Global Learning Consortium; in addition to presenting at national, regional, and local conferences, she serves as a proposal reviewer, constituent group leader, leadership institute faculty, and both task force leader and working group participant.

Dr. Braxton earned a Doctor of Science in Computer Science with Minors in Educational Leadership and Management Science from the George Washington University. She also holds a Master of Science in Computer Science with a Math Minor from North Carolina State University and a Bachelor of Science degree in Mathematics with a minor in Computer Science from Wake Forest University.

Abstract

In this paper, we explore how assessment technologies can support college and university assessment processes at multiple levels. Our goal is to help you think through your institutional assessment culture and processes, so you can identify tools that support your institution's approach to assessment. Multiple software systems can offer institutions rich and nuanced information about students—most schools have learning management systems (LMS) and student information systems (SIS), often supported by analytics programs that integrate the data. Faculty rely on the LMS and other tools like student response systems (i.e., "clickers"), Scantron, and e-portfolios to assess students' work at the program- and course-levels. At program- and institution-levels, many schools have adopted Assessment Management Systems (AMS) to streamline assessment processes and enrich their evidence about student learning. Yet "meaningful implementation remains elusive"—while 29% of provosts would like tools that can "aggregate assessment results to represent overall institutional performance," 51% of provosts do not find their AMS fully supportive of assessment efforts (Jankowski, Timmer, Kinzie, & Kuh, 2018, p. 4, 15, 23). How can institutions select useful assessment technologies and integrate them with existing tools, so faculty and administrators can easily extract and use the data to improve student learning? What elements should we consider when selecting technologies? Do any systems exist that address the requirements of authentic assessment in one solution?

To explore these questions, we discuss how technologies can address assessment challenges. Next, we classify the functional criteria in a taxonomy. We then sketch a process to help you reflect on your assessment technology needs, giving attention to your institution's assessment culture, data, technology users, and audiences. Finally, we present evaluation criteria for judging the appropriateness of technologies.

Technology Solutions to Support Assessment

Jennifer M. Harrison and Sherri N. Braxton

Introduction

In seeking any technology solution, a critical first step is to identify and articulate the problems to be solved. Student learning and success data present a particular challenge—how do institutions gather, integrate, apply, and share these data? How do institutions determine who has access? How do institutions use these data to close the loop and document continuous improvement efforts? Colleges and universities must prove that they are achieving their mission and institution- and program-level learning outcomes to many different audiences. As a result, many institutions juggle technologies to capture and use data to demonstrate success in meeting these goals. These multiple data sources are further complicated by various audiences and users, often siloed, who seek answers to a range of questions—even questions not yet articulated. How can institutions find ways to present assessment data to their various stakeholders in formats that resonate effectively? How can institutions integrate these data to gain insights into institution-level, general education, program-level, and course-level outcomes? How can institutions more effectively use student learning outcomes data to improve student learning?

The nexus of student learning outcomes data and student success data is at the core of this discussion. How do institutions integrate these data systematically, so leaders can more effectively use the results? Many institutions, for example, carefully analyze grades, particularly Drop, Fail, and Withdrawal (DFW) rates, and fund redesigns for courses with recurring patterns of unsuccessful students. Since grades represent a composite of learning outcomes, however, these efforts do not allow us to see specifically where students are struggling to learn. In this essay, we recommend seeking tools that will allow institutions to drill down into DFW, retention, and graduation rates, so student learning outcomes evidence informs and contextualizes learning analytics. The Council of Regional Accrediting Commissions (C-RAC) shares this concern about the national tendency to narrowly define "student outcomes" in terms of graduation, employment, and student loan repayment rates. The Council has called these "inadequate measures of student achievement," claiming that "student outcomes must be assessed above and beyond these indirect measures through direct measures of what students learn" (CRAC, 2016, par. 1). Further, educational leaders seeking stronger quality assurance for U.S. higher education recommend integrating outcome and other data as part of accreditation reform that includes cross-institutional benchmarking (Brown, Kurzweil, & Pritchett, 2017). As one developer commented, "It's all connected. A new paradigm is required to drive and measure holistic student success" (LoMonaco & Milton, 2017). We need tools that integrate multiple

> *We need tools that integrate multiple measures of student success—especially direct evidence of student learning—to strengthen the institutional analytics movement.*

measures of student success—especially direct evidence of student learning—to strengthen the institutional analytics movement (Figure 1).
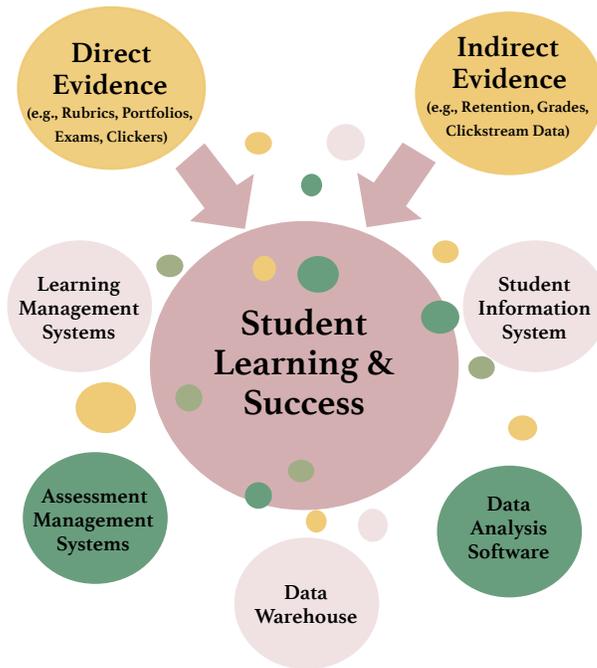

Figure 1. Bridging Learning Outcomes & Analytics: Contextualizing Learning Evidence to Improve Student Learning.

While numerous assessment management software solutions are available, unfortunately, at this point, no single tool meets all the needs of authentic assessment practices.

In this paper, we explore technology solutions that make it possible for institutions to integrate direct and indirect evidence, so we can more effectively analyze student learning, identify and implement evidence-based interventions, and measure their effectiveness. To bridge student success and outcomes data, we need software that enables institutions to aggregate outcomes data by rolling up direct measures to both the program- and the institution-levels.

Assessment technologies continue to emerge, and those already in place often evolve in response to institutional needs. While numerous assessment management software solutions are available (NILOA, Assessment Related Technologies, nd), unfortunately, at this point, no single tool meets all the needs of authentic assessment practices. In fact, some of the tools on the market today do not demonstrate core understanding of how to integrate learning data and why and how people would want to use it. We need a way to sort, clarify, and evaluate what these tools can do to improve assessment practices on campuses—a taxonomy. As the Next Generation Digital Learning Environment (NGDLE) develops, and new tools are created and refined, we anticipate that innovative technologies will emerge to address the needs of authentic assessment (Brown, 2017). But we also realize that technology will not fix everything. The disaggregation of mammoth-sized tools offering broad functionality—some of which

is never used—into smaller, discrete "capabilities" that you can select for customized "plug-and-play" solutions should emerge as part of the NGDLE revolution. As you review the capabilities and selection criteria for Assessment Management Systems (AMS) outlined in this paper, we will demonstrate why the promise of NGDLE would be an attractive solution for this technology space. In the interim, to help you manage your assessment data—and make it possible to use that data— we offer a framework to identify technologies to help your institution use assessment evidence to improve student learning and success. Our goal is to help you use your institutional assessment plan to identify tools that can streamline assessment data collection and use. While we won't answer all of your questions about assessment technologies, we think it is important to raise these shared challenges, so institutions can integrate a range of data sources, get reliable answers, and push past barriers to closing the loop.

We begin with an examination of how institutions are currently managing assessment processes with technology. Then we discuss how technology tools can address assessment challenges. We devise a taxonomy to classify the array of assessment-focused technologies available to institutions. Next, we sketch a planning process and discuss how to identify stakeholders at the planning stages of technology adoption. Finally, we develop evaluation criteria for assessing technologies and present a rubric you can customize to your institution's needs.

What is the Current State of AMS?

1a. Addressing the Challenges of Siloed Data

Institutions that look beyond mandates about learning evidence from the federal government, accreditors, and state regulatory bodies seek triangulated learning data for evidence-based decision-making focused on student success. Higher education institutions are data rich; information about their students' experiences across campus are stored in numerous systems, and often these systems do not share data. Therefore, institutions must implement strategies to connect the dots; that is, they must find a way to combine and "relate" the data for each student to create an overall picture of students' experiences as they progress through their education at the institution. "Assessment and analytics, supported by information technology, can change institutional culture and drive the transformation in student retention, graduation, and success." (Hrabowski, Suess, & Fritz, 2011). Our goal is to explore how assessment technologies can contribute to this transformation.

To address the challenges of siloed data, institutions must first define their goals for tracking, measuring, and improving student success. All campus stakeholders involved in student success initiatives should discuss their questions, share insights about the type of data they need to answer those questions, and offer strategies for using that data to create actionable analytics. Technology is best suited to manipulate these large data sets, so choosing the correct technology solutions is critical and

To address the challenges of siloed data, institutions must first define their goals for tracking, measuring, and improving student success.

often requires information technology expertise. Since implementing technologies that integrate and aggregate data from numerous sources is a key challenge, information technology staff become a vital means to enable integration of the broad array of individual stakeholder perspectives and data requirements (Suess & Childers, 2016; Jankowski, Timmer, Kinzie, & Kuh, 2018).

1b. How Are Institutions Currently Managing Assessment Data?

Progress in using technology to manage student learning outcomes has been uneven across the country. Institutions have struggled to build or purchase software that facilitates centralized collection and storage of learning assessment data. College leaders at some institutions point to inadequate technology (~20 percent) or technology use/implementation (~20 percent) as barriers to enabling their institution to improve student outcomes (Straumsheim, 2016). Yet only 37 percent named investment in technology as a top priority to improve outcomes, and most were uncertain about what kind of technology they needed (Straumsheim, 2016). Their uncertainty seems warranted, since some of the technology solutions available do not meet the needs of the authentic, faculty-situated assessment culture modeled by NILOA and assessment scholars.

Nonetheless, assessment leaders continue to call for "quality metrics" that "provide assessment reporting that is a credible indicator of educational value to external stakeholders" (Wehlburg & Eubanks, 2016, p. 1-2). In fact, in Fall 2016 the Association for the Assessment of Learning in Higher Education (AALHE) proposed a transformation in assessment data practices intended to "generate better quality assessment data" by linking "learning outcomes to grades and graduation at the campus or institutional level" and creating connections to institutional research data (Wehlburg & Eubanks, 2016, p. 1-2). Many institutions, including UMBC, are exploring or implementing approaches to integrate direct evidence of student learning with institutional effectiveness measures like retention and graduation rates.

Below, we offer snapshots of how some institutions are grappling with technology to manage assessment data:

- Capella University has piloted "an electronic faculty dashboard that translates data into real-time, visually represented, action-worthy analytics" and uses a "fully-embedded assessment model" to align and capture assessment results (Jankowski, 2011, p. 2-3).

- Colorado State University-Global Campus relies on a course design document to map outcomes from assignment to course to program within its learning management system (LMS) (DiGiacomo, 2017, p. 29). They embed rubrics in the LMS, link them to grading and student feedback, and extract the data every six months. Institutional research analyzes the data, provides fall and spring reports to chairs and faculty, and archives data and action items in the AMS (DiGiacomo, 2017, p. 30-31).

Many institutions are exploring or implementing approaches to integrate direct evidence of student learning with institutional effectiveness measures like retention and graduation rates.

- Fort Lewis College set up a process designed to use Canvas, an LMS, to collect, store, manage, and communicate the results of their secondary evaluation process using VALUE rubrics. Since they were not able to make it work in Canvas, they used Excel to compile the data, created corresponding files in Canvas with a manual process to upload essays, and exported the results back to Excel (Snyder & Stanley, 2017).

- Prince George's Community College uses All-in-One, an in-house system that integrates formative and summative assessments into reports readily available on their website (Richman & Ariovich, 2013; PGCC, 2013-14).

- St. Olaf collects general education direct measure data using a Qualtrics survey and a data collection schedule (St Olaf College, 2011-12).

- University of Arizona uses Civitas Learning for predictive analytics, integrating information from the SIS, LMS, and tutoring support systems to pre-empt achievement gaps with interventions. Additionally, they use Illume Impact (part of Civitas) to find out which interventions are effective (Suess & Childers, 2016).

- University of South Carolina, University Housing relies on real-time dashboards created with Excel to improve evidence-based decision making. They collect interaction forms and card swipe data, compile and connect them in Excel Power-Pivot, and present the results in a dashboard of outcomes, demographics, and other information with "slicers" to allow users to sort the data in multiple ways (Reinhardt, Sturm, & Pease, 2017).

- University of Texas at Dallas uses an in-house web-based tool that includes a repository of assessment plans and results along with online rubrics and reports. The system collects outcomes, measures, and evidence and uses heatmaps to show student learning in each school (Shenoy, 2017).

- Texas Women's University (TWU) uses an in-house AMS and Peregrine Enterprise software to facilitate their secondary-evaluation assessment process. TWU's institutional research data management system pulls a stratified random sample of students; core faculty upload artifacts and assessment results; and paper or emailed reports are circulated for discussion. As the institution prepared for new accreditation requirements requiring outcome alignment, however, they have discovered that Peregrine cannot meet this need (Flanagan, Doty, & Kernek, 2017).

At UMBC, our indirect measure capacities are highly refined with a sophisticated data analytics suite, including Civitas, Blackboard Analytics, Blackboard Predict, Pyramid, and Predictive Analytics Reporting (PAR) Framework Student Success Matrix (SSMX). Our direct

Technology is vital to making assessment achievable and useful—especially for large, complex institutions seeking to bring direct measure data to scale alongside student success data.

measure data is less technologically systematized, though the reporting process is well established. Academic Program Review and program assessment processes are centralized in Blackboard, our LMS; General Education is supported by customized software linked to our portal. Leaders encourage programs to develop authentic assessment for their disciplines, including divisions like Student Affairs and Undergraduate Academic Affairs that connect curricular and co-curricular learning data. Instructional technology and faculty development staff work with departments to implement diverse tools and identify ways to bridge the evidence with our data warehouse. For example, some programs have invested in Tk20 or Acrobatiq; others rely on Excel spreadsheet templates (see Harrison & Williams, 2017, Summer), Scantron, Qualtrics, or tools in our LMS. Since Blackboard Outcomes is designed for a secondary evaluation process, it does not fit our assessment culture. However, EAC Visual Data (2016-18), a Blackboard Learn integration, allows us limited capacity to align direct evidence to outcomes and extract aggregated data. EAC adapts our LMS, but fails to facilitate the vertical data rollup that we need. Instead leaders integrate data via narrative aggregation (synthesizing assessment data into cohesive narratives of student learning) at Council of Deans meetings, Data Days, and other collaborations at the college/division and institutional levels.

Many questions remain, as institutions struggle to find solutions that enable them to capture direct evidence of learning, link these data to outcomes at multiple levels, triangulate them with indirect measures, and apply the results to improving student learning. We know it is possible to take direct measures to scale, since the Multi-State Collaborative to Advance Quality Student Learning (MSC) and the VALUE rubric project has successfully demonstrated "proofs of concept at scale" by assessing 14,0000 artifacts with four VALUE rubrics (Sullivan & McConnell, 2017, p. 20; AAC&U 2017; AAC&U 2016; VALUE/MSC 2014-2015).

Other educators are also working to address these challenges, for example, EDUCAUSE outlined the NGDLE as a solution to the mismatch between technology and teaching and learning needs. Some argue that we need "an LMS that understands learning," so it can serve as a hub that coordinates other systems. (Baker, 2017, p. 32). Future technologies could help institutions use a range of tools and still "get the data, context, and results back," while allowing for freedom and flexibility and making it easier "to integrate new features into learning activities" (Baker, 2017, p. 34). Others call for a "student success management system" (Straumsheim, 2017). Some schools have made great progress in this direction, like Georgia State University and National University, and offer good examples (Dimeo, 2017; Fain, 2017). However, many institutions are struggling to streamline assessment processes with technology. As assessment and technology leaders, our job is to continue to push for better solutions.

Using Technology to Solve Assessment Challenges

2a. How Can Technology Tools Solve Assessment Challenges?

Technology is vital to making assessment achievable and useful—especially for large, complex institutions seeking to bring direct

Many institutions are struggling to streamline assessment processes with technology. As assessment and technology leaders, our job is to continue to push for better solutions.

measure data to scale alongside student success data. Since assessment has multiple levels (assignment, course, program, college, institution, co-curricular, plus external accrediting body standards and state or licensure regulations) with intersecting relationships, institutions need tools to stipulate these relationships through horizontal and vertical alignment from institution-level outcomes to direct measures of student learning. For the data to be useful, we need to be able to aggregate data in multiple ways. We need tools to align our outcomes and aggregate the data in response to questions about student learning.

Unfortunately, use of assessment data continues to be a challenge across the country (Kuh, Jankowski, Ikenberry, & Kinzie, 2014; Kuh, Ikenberry, Jankowski, Cain, Hutchins, & Kinzie, 2015; Ewell, 2009; Banta, & Blaich, 2011; Hutchings, 2010 and 2016). Until we identify tools to make it easier to close the loop and help faculty to move beyond closing the loop into double-loop analysis (i.e., assessing closing-the-loop applications, see Harrison & Williams, 2017), higher education leaders may continue to lament this problem. We need assessment tools that make it easier for faculty to get answers to their hypotheses about student learning, test them with empirical evidence, and identify ways to improve learning.

Most AMSs share the ability to manage, maintain, and report assessment data; however, these tools can vary widely in features offered, so you will need to unpack how each feature works to ensure you have found the proper technology to support your assessment needs.

2b. Taxonomy of Assessment Technologies

Assessment technologies can serve a number of functions. Understanding the goals and desired outcomes for student learning evidence will help you choose more suitable technologies. RiCharde (2009, 2012) outlined the general tasks assessment software can perform, noting that assessment tools can support either one or some combination of the capabilities required by higher education administrators. Assessment tools,

1) manage, organize, and report the voluminous documents for discipline-specific or regional accreditation;

2) organize coursework into some type of curriculum map for reporting on the relationship between a curriculum and learning outcomes;

3) act as a repository for and provide connections between strategic planning goals, learning outcomes, data generated from the measure of learning outcomes, and targets for program improvement (p. 3).

A multi-featured software solution intended to address these needs is called an Assessment Management System (AMS), which Oakleaf, Belanger, and Graham (2013) defined as a system

that enables institutions to collect, manage, and report data related to student learning outcomes assessment; [it can] help educators...list their outcomes, record and maintain data on each outcome, facilitate connections to similar outcomes throughout an institution, and generate reports. [It can] allow higher education institutions to link outcomes vertically (within units) and horizontally (across divisions, colleges, departments, programs, and libraries) (p. 2).

Most AMSs share the ability to manage, maintain, and report assessment data; however, these tools can vary widely in features offered, so you will need to unpack how each feature works to ensure you have found the proper technology to support your assessment needs. In addition to RiCharde's (2009) general task assessment for these tools, Oakleaf, Belanger, and Graham (2013) identified eight categories of characteristics to use as selection criteria when reviewing these tools prior to acquisition: assessment ability, outcomes alignment, repository capacity, data management, system integration, support services, reporting, and action taking support.

While these strategies for describing the tools are beneficial, they need to be simplified to clarify the functionality for faculty, staff, and administrators engaged in assessment. To that end, we integrate RiCharde's (2009) and Oakleaf, Belanger, and Graham's (2013) work with our own insights to propose the following taxonomy of assessment technologies to define these criteria. Some AMSs may fit into more than one category based on the functionality/capabilities provided by the tools. A useful and authentic process likely requires assessment technologies to help with the following:

- **Collecting:** supports creation and delivery of assessments (diagnostic, summative, and formative), building and applying rubrics, tests, course-level grading, student evaluations, and linking standards to outcomes.

- **Connecting:** supports linking/aligning of outcomes both horizontally and vertically, creating and generating curriculum maps, integrating budget and financial information, tracking and managing strategic planning information, and linking data from both student information and learning management systems. Connecting data has become more complex, as institutions diversify their assessment approaches (Jankowski, Timmer, Kinzie, & Kuh, 2018, p. 9).

- **Organizing:** supports data management and collecting/tracking program-, course-, and co-curricular assessment; integrates new and existing evidence/data sources; offers reports and/or customizable dashboards.

- **Archiving:** stores assessment evidence/data; serves as a long-term repository for student submissions/assignments and other artifacts.

- **Analyzing:** supports statistical examination of evidence/data, enables manipulation of data/evidence for detailed investigation.

- **Communicating:** supports assessment report generation and documentation of progress toward institution-level priorities, goals, missions, and outcomes. Additionally, NILOA's Provost Survey suggests communication about assessment is key to future assessment efforts, since provosts want to be able to

A useful and authentic assessment process likely requires assessment technologies to help with tasks such as collecting, connecting, organizing, archiving, analyzing, communicating, and closing the loop.

communicate a "nuanced, complicated picture of student learning" (Jankowski, Timmer, Kinzie, & Kuh, 2018, p. 23).

- **Closing the Loop:** supports decision-making and action-taking, assessment plan development, status reporting, and reporting of assessment evidence/data and results to stakeholders; makes it easier to engage double-loop analysis, or measuring the impact of closing-the-loop interventions.

Table 1 uses this taxonomy to categorize a subset of the technologies described in NILOA's Assessment Related Technologies list.

Taxonomy/ Tool	Collecting	Connecting	Organizing	Archiving	Analyzing	Communicating	Closing the Loop
Acrobatiq	*	*	*	*	*	*	
AEFIS	*	x	*	*	x	x	x
Blackboard Learn	x			x	*		
Civitas Learning		*	*		x	*	*
ExamSoft	*		*		*		
Explorance	*	*	*		*	*	*
Learning Objects	*	*	x	x	*	*	*
PASS-PORT	*	*	*	*	*	x	x
PeopleSoft Campus		*			*	*	*
Portfolium	x	*	*	x	*	*	*
Taskstream Watermark Livetext Tk20	x	*	x	x	*	x	x

*The tools above may not provide all of the capabilities as defined in a specific taxonomy capability; but they offer at least one aspect of the functionality outlined in the taxonomy. X = provides all capabilities of category. * = provides at least one of the capabilities of the category. (Developed from earlier versions presented and refined with participant feedback. See Bishop, Braxton-Lieber, & Harrison [2017, April] and Harrison & Braxton [2018, January] for original versions.)*

Table 1: Taxonomy of Assessment Technologies.

A Process for Planning Assessment Technology Choices

Next, we suggest a process for thinking through your institution's assessment culture to help you prepare to choose suitable assessment technologies informed by the taxonomy. First, we encourage you to clarify your institution's common ground by defining (or reviewing) how student learning outcomes align from the mission to the students' demonstration of learning. Next, we suggest beginning at the end—

determine what types of evidence you need, inventory technologies already in place, and identify audiences who will use the technology or resulting data. Once you have synthesized these steps, you'll want to seek expert advice on your campus to identify potential solutions. Finally, you'll need to form a collaborative team to evaluate and pilot these solutions.

3a.   Clarify Common Ground: How Do Your Institution's Outcomes Align at Each Level?

Assessment technologies can help your institution to organize and connect your outcomes and results, but first you need to clarify common ground at each outcome level. According to the 2017 NILOA Provost Survey, while 82% of institutions have common learning outcomes at the institution-level, and 50% of institutions vertically align program- to institution-level outcomes, only 35% of doctoral institutions have aligned outcomes (Jankowski, Timmer, Kinzie, & Kuh, 2018, p. 7). (In 2013 the results were 84%, 49%, and 27%, respectively, Kuh, et. al., 2014). Without the common ground of vertically aligned outcomes, institutions will continue to struggle with assessment technology, since any assessment technology chosen will only be effective with a clear schema for the data. Assessment technology will not solve problems for your institution unless it is built from your institution's framework and culture (Levy, 2017). After all, "the process of selecting a tool must be driven by your institution's philosophy on why you do assessment" (Shenoy, 2017, p. 13). You don't want to let "the technology drive the work"; instead you should select or develop tools that can support your assessment needs (Blasi, 2015). NILOA's 2017 Provost Survey confirms this authentic connection: provosts said they were "unsure how to implement software solutions in a manner that would fit with institutional culture" (Jankowski, Timmer, Kinzie, & Kuh, 2018, p. 4).

Common ground begins with your school's mission, which is typically operationalized in institutional learning outcomes. An institutional assessment plan usually clarifies how each unit contributes to the mission and outcomes. What does your institution's assessment plan look like? If your plan has a diagram, reflect on the flow of information and how technology might streamline and make data easier to use. An AMS should help you to collect, aggregate, and analyze data in a way that imitates your assessment plan.

How will you map direct evidence of student learning at the assignment-level to outcomes at the course-, program-, and institution-levels, so you can meaningfully aggregate relevant data to answer questions at each level? An AMS or LMS may offer "tagging" features to help you create a clear path from student artifacts to the mission. Then, when faculty create new tests, rubrics, or other direct measures, they can "tag" each criterion with an outcome. Ideally the system would allow you to "tag" just once to link an assignment criterion to a course-level outcome, since the technology would be programmed with all of the vertical and horizontal (i.e., across programs or to disciplinary accrediting standards) relationships. In this way, direct evidence could roll up automatically to each level, and users could extract results about any outcome at any

Without the common ground of vertically aligned outcomes, institutions will continue to struggle with assessment technology, since any assessment technology chosen will only be effective with a clear schema for the data.

level, depending on their questions about student learning. Before you can achieve these connections in the technology, you need to define connections from course-level learning outcomes to your institution's mission. Help faculty create alignments from assignment to course, course to program, program to institution, so you can aggregate data at each level.
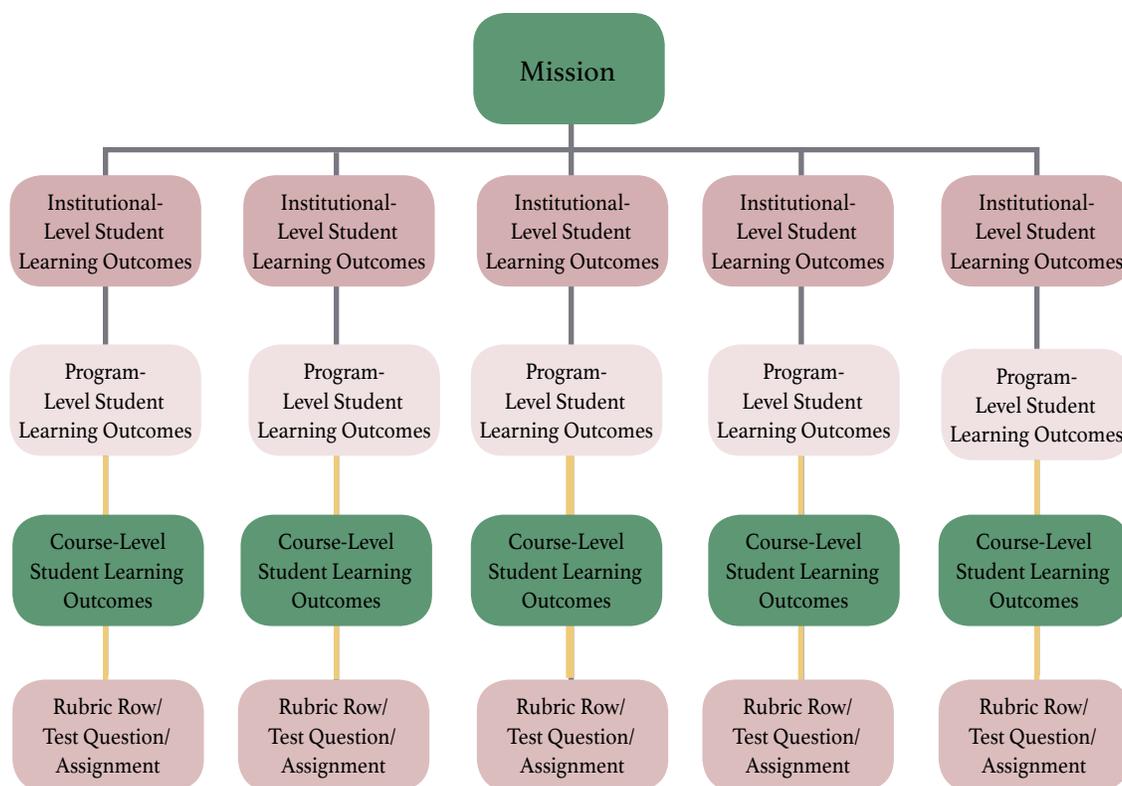

Figure 2: Vertical Alignment of Student Learning Outcomes.

This diagram (Figure 2) helps faculty to analyze vertical alignment from the student demonstration of learning to course, program, and institutional learning outcomes. The student demonstration of learning could come in many forms, including projects, papers, presentations, reflections, and other signature assignments—typically assessed with rubrics aligned to the course outcomes. Or faculty may use tests, quizzes, clicker questions, or exams mapped to the course outcomes.

3b. Use Backward Design: What Direct Evidence Do You Need to Understand Student Learning and Success?

Backward design has proven to be useful in crafting courses—it helps faculty to think through what students need to be able to learn and do by the end of the course and then map a way to help them get there (Wiggins & McTighe, 1998). Likewise, backward design can help you to imagine the data you need to understand student learning at your institution, so you can identify technologies that can help you reach your goals for collecting, analyzing, comparing, and using evidence of student learning across the curriculum.

Begin at the end—visualize the data you will need to demonstrate student learning at your school, how you need to organize and communicate about it, and how you plan to use the data to close the loop. Questions to consider include the following:

- What data do you need for continuous improvement of student learning outcomes?

- How will you need to aggregate evidence at the program- and institution-levels?

- What reports does your institution need to submit to external reviewers (i.e., accreditation reports, state reports, disciplinary accreditor reports)?

- What reports does your institutional assessment process require from colleges, programs, courses, general education, and co-curricular offerings?

- How does your institution share learning results with students and prospective students, parents, faculty, the Board, the public, donors and other audiences?

- How can your institution present data to faculty and staff, so it encourages thoughtful application, promotes curiosity about student learning and how to improve it, and allows everyone to participate in the conversation?

3c.   Take Inventory: What Processes and Technology Tools are Already in Place at Your Institution?

Your institution may already be using a host of technologies, giving you access to on-campus experts who have already tested some of the tools available.

- Look at your LMS and related tool integrations which may have tools you can adapt to your needs.

- Review the processes already in place where learning data are being collected (i.e., General Education, Academic Program Review). How is it being collected? Where is it archived? Who can access it and how is it used? Who are the experts on campus who can help you figure this out?

- Consider the tools your institution uses to collect evidence of learning outcomes, learner analytics, and student success data. Will the assessment technology tool(s) you are considering integrate well with it?

3d. Identify the Audiences for Assessment Data: Who Needs to Know About Student Learning? What Action Research Questions Will They Ask?

As you review the evidence you need, ways you need to share it, and tools already in place, it will become clear that assessment evidence has many potential audiences. Who needs to use the data to improve student learning? What kinds of questions will they be able to answer with learning data? Using assessment data, or closing the loop, has been

Using assessment data, or closing the loop, has been a challenge at many institutions, likely because the data are not easily accessible and useable by those who need it the most.

a challenge at many institutions, likely because the data are not easily accessible and useable by those who need it the most. According to *Inside Higher Education's* 2017 Survey of Faculty Attitudes on Technology, faculty often do not have access to the data: only 30 percent of faculty (23% of tenured faculty) claim they "regularly receive data from my college ... that allow me to improve my teaching" (Lederman & McKenzie, 2017). Since improving student learning is the primary reason for student learning assessment processes, clearly institutions need better tools to make it easier for faculty to apply assessment data.

Include a range of audiences as you brainstorm about assessment technologies, so you can more effectively imagine their needs. For example,

- You are a learning resources center leader or teacher who wants to explore student learning in multiple sections of a course where faculty use a common rubric and assignment. You set up your rubric in your LMS; all faculty are using it to give feedback and assess learning and grades, and each teacher can access a report to view the aggregated data from the individual course-level assignment. But you can't figure out how to aggregate the data across courses. What technology tools would make this possible? How could you compare data across semesters and years?

- You are a program or department leader who wants to explore the impact an intervention has had on student learning in a gateway course across time and in the next course in the sequence. You need data on both direct and indirect measures. How can you extract the relevant rubrics and institutional data and triangulate them?

- You are a faculty member who uses a rubric in your institution's LMS to assess and grade student learning in a core introductory undergraduate course. You want to compare student learning across a series of assignments in one course both collectively for learning assessment analysis and individually to help students see their growth. You are also interested in writing about the assignment you have developed and its potential to scaffold student learning for the course and the program. Does the assignment help students to build the skills they need to be successful in later courses? How can you organize the data to answer your questions and help students to see their own progress?

- You are the provost and you want to know how well students are learning in relation to the institutional learning outcomes across the campus for the current term. At least 73% of programs in each college have created direct measures of student learning in your LMS that align to program and institutional outcomes. You access your Learning Outcomes Dashboard and can easily see that:

Include a range of audiences as you brainstorm about assessment technologies, so you can more effectively imagine their needs.

- 98% of this term's courses include direct measures and data on student learning (via rubrics, tests, etc.).

- 77% of students demonstrated competence or above in the communication outcomes, 23% did not demonstrate competence; similar details are available for all of your institutional outcomes.

- You can see how well students are achieving program-level outcomes and how each of these data intersect with retention data.

What tools contribute to the dashboard data you need to identify learning challenges at the institution-level?

- You are the chair of your department's assessment committee. This semester's capstone review revealed gaps in student learning in information literacy, even though your department has instituted interventions that have proven effective in the past. Your committee discusses ways to address the gap and needs additional information. You consult with your colleagues and use your LMS to access rubric results for research papers from 100-, 200-, and 300-level courses in your program where your curriculum map indicates information literacy instruction takes place. Your committee meets to review the papers and finds that the students are achieving information literacy learning in the 100- and 200-level courses, but students struggle with the complications in information literacy introduced by the 300-level interventions. You work with your department, the faculty for the 300-level class, and library specialists to create additional scaffolding to help students overcome this obstacle and plan to re-measure next year.

- You are the chair of your college's assessment committee, and your committee has instituted a shared rubric that measures two program outcomes aligned to two institutional outcomes (critical reasoning and scientific and quantitative reasoning) in student discussion postings and responses. Each of the 100-level General Education courses in your college will use the rubric to give feedback and capture direct learning data at the beginning, middle, and end of the semester. You want to be able to capture the rubric data and compare student learning across courses and within courses.

- A member of your institution's board of directors has contacted you with questions about student learning in your program. She is interested in funding an intervention to help students struggling with the transition from undergraduate- to graduate-level presentations—but first she wants to see data about student learning, particularly bachelor's capstone data compared to master's core course learning data.

If your assessment technologies and processes cannot help your colleagues to answer questions, then they are not empowered to pursue the deep thinking necessary to make evidence-based decisions.

Each of these examples involves different types of audiences with engaging questions that can help to improve student learning and build assessment continuity. Unfortunately, however, if your assessment technologies and processes cannot help your colleagues to answer questions, then they are not empowered to pursue the deep thinking necessary to make evidence-based decisions. As Blasi (2015) has suggested, sometimes users are not aware of their needs, so you need to work with them to brainstorm their questions.

As you plan to implement assessment technologies, consider how these solutions will contribute to key questions for a range of audiences:

- How will you collect, archive, and report on learning results in useful ways to assessment practitioners at each level (course, program, college, institution, etc.) and in co-curricular learning opportunities?

- How will you present learning data to external audiences through your website and other communications (i.e., NILOA's Transparency Framework)?

- Can you use learning data to strengthen your communications to potential students and parents?

- How will you track (and share) follow-up measures to find out if closing-the-loop interactions have improved student learning? Can you identify tools that help your institution build double-loop analysis (Harrison & Williams, 2017)?

- How can you use assessment technologies in ways that inspire creativity and innovation, so you and your colleagues can ask new questions?

Once you have completed these planning steps, you will gain additional clarity about what kinds of support you need from assessment technologies.

3e. Synthesize and Seek Expert Advice

As you engaged in the steps above, you probably discovered expertise in assessment technologies on your campus. Who on your campus handles instructional technology and learning analytics? An IT professional's insights about current and anticipated technological innovations can help you to identify tools that are already in place and delineate gaps you need help filling.

Your institution's instructional technology professionals are key resources for identifying, adopting, and implementing a model for student success that enables your institution to collect, connect, integrate, aggregate, and use data to create actionable analytics (Suess & Childers, 2016). This problem is not trivial. First, institutional stakeholders must determine the evidence needed from assessment activities to measure and track student learning outcomes at each level of the institution. They can help

Your institution's instructional technology professionals are key resources for identifying, adopting, and implementing a model for student success that enables your institution to collect, connect, integrate, aggregate, and use data to create actionable analytics.

you to identify technology tools that provide the capabilities you need and determine if they will provide the return on investment required. While testing those tools, you will need to continue to work with the IT staff to ensure data yielded from those tools can be integrated into the existing student success technology framework. Reflecting on the assessment data that stakeholders across your institution need and how that data will need to be manipulated to provide actionable analytics is critical to this process.

While working with your campus experts, consider a range of questions from multiple perspectives, for example:

- What do you want to know about student learning? What learning data do you need to answer specific questions about student success and learning?

- At what point in the learning process is the tool needed (i.e., diagnostic, formative, summative)? How will these types of data relate to each other?

- Who needs the data? How will they use the data?

- What data do you already have collected? Where does it currently live? Who can access it?

- Will the tool improve the current process or enable new applications?

- What form does that information need to take for it to be easy to use at various levels and for varying purposes?

- Will the tools make data entry or integration easier for end users?

- Will the tools facilitate manipulation of the data to answer questions posed?

- Can you extract results that will enable conversations about the outcomes?

- Will the tools help you to assist faculty and administrators to think about the data, talk about the data, and use it to make meaningful changes to student learning?

- Can you easily connect various data points across systems?

3f. Form a Collaborative Team to Evaluate Technologies

Now that you know who needs to be involved in the process and the questions they might ask, plan to form a team to help you evaluate the technologies. As part of this process, you must first identify the requirements for the tools and outline the gaps in the capabilities of your current toolset. Next, conduct a market survey of the available tools that possess the required features you've outlined in the requirements analysis. Contact the creators of the tools, and ask those companies to provide demonstrations—ask specific questions about interoperability and accessibility. If possible, have them identify organizations that are

Plan to form a team to help you evaluate the assessment technologies. As part of this process, you must first identify the requirements for the tools and outline the gaps in the capabilities of your current toolset.

current users of the tools under consideration, and collect reference data and lessons learned within those organizations related to the use of the tools. Work with the vendor to pilot the tools in your own environment to evaluate its performance within your existing ecosystem.

In the next section, we offer ideas for evaluating assessment technologies to help you focus your search on tools that will be useful for you and your colleagues.

Assessment technologies can potentially help faculty and staff use assessment data more effectively, but only when constructed around a clear assessment process.

Evaluating Assessment Technology Tools

The rubric below (Table 2) begins to capture criteria for choosing assessment technology tools. To make our rubric more effective, we've assessed and refined it by analyzing criteria for effective assessment and education technologies developed by other sources. By triangulating criteria from multiple points of view, we aim to create a flexible tool for you to adapt to your institution. Luckily, the assessment process is ongoing, so we are optimistic that the evaluation tools we offer here will continue to develop as assessment and technology professionals collaborate to build tools that meet our needs and flatten the learning curve, so more faculty, staff, and leaders can easily use assessment data.

Criteria	Questions to Consider
Usability	Is the software intuitive and easy to use? (Will users need extensive training?) Does it work well with software we already have (and are using)? Does it require additional steps/staff to enter and extract data? Does it make assessment feel like an add-on? Or does it make assessment work part of the teaching and learning process? Does data export in a usable format? Is it IMS Global Learning Tools Interoperable (LTI)? Can students track their learning over time?
Functionality	Does the software reflect best practices in assessment? Can it manage multiple levels of assessment? Does it help users create and align outcomes? Does it walk users through curriculum mapping and rubric development? Does it offer easy-to-use reports and dashboards customizable to audience needs?
Cost	How much is the annual software license? Are updates included? If not, how much will they cost? How much will it cost for technical support and training? What hardware/cloud costs are needed to support it? What hidden costs might emerge?
Audiences	Who will need to use this software? Who enters the data? Who can access the data? How will they learn to use it? What questions can they answer with this tool? Is the tool accessible to all of your audiences?
Flexibility	Is the software flexible enough to meet your needs? How will the system grow with your institution? How will the system adapt to anticipated (and unforeseen) changes in assessment demands?

(This resource was developed from earlier versions presented and refined with participant feedback. See Bishop, Braxton-Lieber, & Harrison, 2017, and Harrison & Braxton, 2018, for original versions.)

Table 2. An Adaptable Rubric to Assess Technologies.

Conclusion

Assessment technologies can potentially help faculty and staff use assessment data more effectively, but only when constructed around a clear assessment process. While we need better tools to make it easier to collect, integrate, and share learning evidence, current Assessment Management Systems offer ways to streamline these processes. As you plan for your institution's next steps in using assessment technologies, our taxonomy, planning process, and evaluation rubric will help you to think through the multiple layers involved in managing learning assessment evidence.

While we need better tools to make it easier to collect, integrate, and share learning evidence, current Assessment Management Systems offer ways to streamline these processes.

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Acknowledgements

About NILOA

- The National Institute for Learning Outcomes Assessment (NILOA) was established in December 2008.
- NILOA is co-located at the University of Illinois and Indiana University.
- The NILOA website contains free assessment resources and can be found at http://www.learningoutcomesassessment.org.
- The NILOA research team has scanned institutional websites, surveyed chief academic officers, and commissioned a series of occasional papers.
- NILOA's Founding Director, George Kuh, founded the National Survey for Student Engagement (NSSE).
- The other co-principal investigator for NILOA, Stanley Ikenberry, was president of the University of Illinois from 1979 to 1995 and of the American Council of Education from 1996 to 2001.

NILOA Staff

NATIONAL INSTITUTE FOR LEARNING OUTCOMES ASSESSMENT

Natasha Jankowski, *Director*

Gianina Baker, *Assistant Director*

Katie Schultz, *Project Manager*

Erick Montenegro, *Communications Coordinator and Research Analyst*

George Kuh, *Founding Director, Senior Scholar, and Co-Principal Investigator*

Peter Ewell, *Senior Scholar*

Pat Hutchings*, Senior Scholar*

Jillian Kinzie, *Senior Scholar*

Paul Lingenfelter, *Senior Scholar*

David Marshall*, Senior Scholar*

Stanley Ikenberry, *Emeritus*

Verna F. Orr*, Research Analyst*

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National Institute for Learning Outcomes Assessment

For more information, please contact:

National Institute for Learning Outcomes Assessment (NILOA)
University of Illinois Urbana-Champaign
51 Gerty Dr.
Room 196, MC-672
Champaign, IL 61820

learningoutcomesassessment.org
niloa@education.illinois.edu
Phone: 217.244.2155