

AC 2009-22: SUSTAINABLE ASSESSMENT AND BEYOND

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Sustainable Assessment and Beyond

Abstract

This paper provides an overview of two web-based tools for program-level and course-level assessment of student learning outcomes at the Georgia Institute of Technology. An institutional level perspective for annual program assessment is discussed using a tool called the “Online Assessment Tracking System (OATS).” A second perspective, at the academic unit or department level, is provided using a web-based tool entitled “Course Level Assessment System (CLASS)” for conducting ongoing direct course assessment of student learning outcomes. Five integrative courses in the mechanical engineering curriculum are selected to assess twelve learning outcomes. These web-based outcomes assessment programs are sustainable and provide measures of change over time. Results are fed back to provide a mechanism for continuous improvement of the educational process. The tools also integrate online technology to develop and maintain the systems. At both the institute and academic unit/department level, the assessment process is subject to review and approval. Administrators and faculty instructors are able to use the information to fine tune their assessments in the future. In addition, the annual reviews ensure that the programs will be ready at any time for accreditation visits, such as ABET or Regional Accreditation Boards, for example. The topics presented regarding web-based assessment tools are particularly pertinent to others who work in higher education. This paper offers creative web-based solutions to a problem that is common to colleges and universities.

Background and Motivation

Educational institutions are expected to have a program of continuous improvement to demonstrate how well they are accomplishing their teaching, learning, and research missions. Assessment methods and tools allow schools to accomplish this goal and to continually renew their commitment toward building better learning environments.

Instructors constantly assess student learning through comparison to standards required for a competent understanding of the course material. Assessment is more than assigning individual grades in a course. Assessment is more holistic. The goal is to assess the learning that is being achieved by our students as a whole, rather than a single student. The question addressed is whether learning is effective through a curriculum that produces graduates who are able to achieve learning outcomes and objectives desired by the educational institution. Strengths are identified to build on and improve the overall program. Weaknesses are also identified so that they may be corrected and also improved upon. If the learning community, to include students, faculty, and constituents, are able to continuously improve the teaching and learning experience for their students, the assessment process should be considered a success.

In addition, there are requirements for educational institutions to be in compliance with a number of accreditation bodies.¹ This will include a regional accreditation board, such as the Southern Association of Colleges and Schools (SACS) for schools in the southeast. For engineering and

engineering technology programs, periodic accreditation visits are conducted by the Accreditation Board for Engineering and Engineering Technology (ABET). Public universities, such as Georgia Tech, may have additional periodic Board of Regents Academic Program reviews. And finally, most universities require some sort of a mandated university assessment process, usually on an annual basis. Each of these accreditation bodies are examining the school's educational outcomes and objectives and determining whether a satisfactory assessment plan is in place to monitor their achievement.

Overview of Web-Based Tools to complement an Outcomes-Based Assessment Program

This paper will provide an overview of two web-based tools for program-level and course-level assessment of student learning outcomes at the Georgia Institute of Technology. These tools are an attempt to improve and provide a more efficient means for the design, development, and implementation of an outcomes-based assessment program for engineering education.² There are already some web-based methods described in the literature. Reference [3] describes tools to enhance assessment automation. Web-based portfolios are also being used in the assessment of learning outcomes for on-campus and distance learning programs.⁴

Two perspectives for the implementation of web-based tools for assessment will be described in this paper. From an institutional-level perspective, web-based program assessment at the Georgia Institute of Technology is performed using a tool called the "Online Assessment Tracking System (OATS)." The "Online Assessment Tracking System" is used for annual program assessment. Individuals at the academic unit, or department level, provide input. The system also serves as a repository for previous annual assessments.

As a second perspective, at the academic unit-level, or department level, is provided using a web-based tool entitled "Course Level Assessment System (CLASS)." This system is currently used in the Woodruff School of Mechanical Engineering at the Georgia Institute of Technology. The "Course Level Assessment System" is used for annual direct course assessment of student learning outcomes. Faculty members of selected courses provide input. The system also serves as a repository for previous annual assessments.

Online Assessment Tracking System (OATS)

At Georgia Tech, program assessment information is collected by the Institute annually using a web-based tool. Figure 1 shows the design of the main menu for this program. Note that current annual assessment may be viewed or edited. A record of previous annual assessments is also maintained.

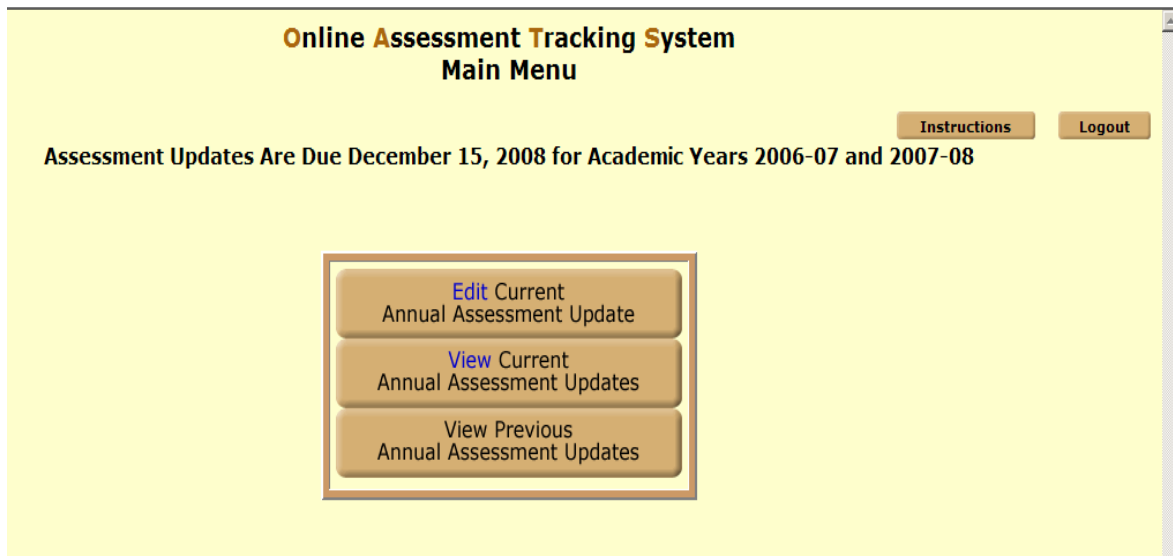


Figure 1. Online Assessment Tracking System (OATS) Main Menu

For each degree program, the OATS system allows learning objectives and outcomes to be documented. The methods for assessing these objectives and outcomes are defined. Results from the assessment are collected. Impacts on the program are recorded and actions to take based on this assessment feedback are formulated. Figure 2 is an example of how the status of this assessment data is kept. Figure 3 is a screen capture of a typical entry for the assessment of a learning outcome. The annual online assessments are sent through the Deans of the various Colleges at Georgia Tech for review and then go to the Provost's Office and the Georgia Tech Office of Assessment for final review and approval.

College, Unit: Degree Program(s)	Outcomes/Objectives	Methods	Results	Actions/Impacts	Status
View Assessment Update for: 10628 notes College of Engineering, School of Mechanical Engineering: Bachelor of Science in Mechanical Engineering	11 15 Dec 2008	52 16 Dec 2008	52 16 Dec 2008	11 16 Dec 2008	Ready for OOA Review
View Assessment Update for: 10889 notes College of Engineering, School of Mechanical Engineering: Bachelor of Science in Nuclear & Radiolgl Engr	11 05 Dec 2008	40 05 Dec 2008	61 05 Dec 2008	11 05 Dec 2008	Ready for OOA Review

Figure 2. Status of Degree Program Assessment

<ul style="list-style-type: none"> 11. Tools for Practice <ul style="list-style-type: none"> Direct Assessment in Integrative C <ul style="list-style-type: none"> ★ Results of Direct Assessment ★ + Result Survey of Graduating Students <ul style="list-style-type: none"> ★ Results of Survey of Graduat ★ + Result Co-operative Employer Evaluation <ul style="list-style-type: none"> ★ Results of Co-operative Empl ★ + Result Alumni Survey <ul style="list-style-type: none"> ★ Results of Alumni Survey ★ + Result + Method Action for Tools for Practice 12. + Outcome/Objective 	<p>Outcome/ Objective: 11 <i>Tools for Practice</i></p> <p>Students will have an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.</p> <hr/> <p>Method: 1 <i>Direct Assessment in Integrative Courses</i></p> <p>Five integrative courses have been selected for evaluation by the instructor. Criteria have been established for evaluating this outcome and rubrics have been set up to allow standardized evaluation. At least one section of each of these courses is selected each term for this assessment method. The selected sections are rotated among the participating faculty.</p> <hr/> <p>Result: 1 <i>Results of Direct Assessment in Integrative Courses</i></p> <p>The average over the five courses was that 93% of the students had achieved an understanding of the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. This result is considered to be excellent.</p> <hr/> <p>Method: 2 <i>Survey of Graduating Students</i></p> <p>An exit survey is conducted of undergraduate students upon completion of their</p>
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Figure 3. Typical OATS entry for the assessment of a learning outcome

Course-Level Assessment System (CLASS)

In the School of Mechanical Engineering at Georgia Tech, direct assessment of student learning outcomes is accomplished using a Course-Level Assessment System (CLASS) web-based tool. Five integrative courses in the mechanical engineering curriculum are selected to assess twelve outcomes. Figure 4 shows the entry screen for this web-based program. Figure 5 shows the integrative courses that are currently selected for assessment. Note that administrators of this web-based system are able to add or edit learning outcomes, methods of assessment, and narrative assessment questions. The assignment of faculty instructors for conducting assessments may also be updated as necessary.

The faculty input screens for assessment information are shown in Figures 6, 7, 8 and 9. The achievement of learning outcomes is assessed using a performance criteria rubric. A typical rubric defined for a specific course is given in Figure 6. Figure 7 shows the selection of methods of assessment for a designated outcome in a particular course. Faculty members teaching the selected courses input ways they are assessing student learning outcomes. Narrative assessment input is shown in Figure 8. Figure 9 shows how faculty instructors are able to record the achievement of specific outcomes for students in the course. This part of the assessment is based on performance expectations for the various learning outcomes.

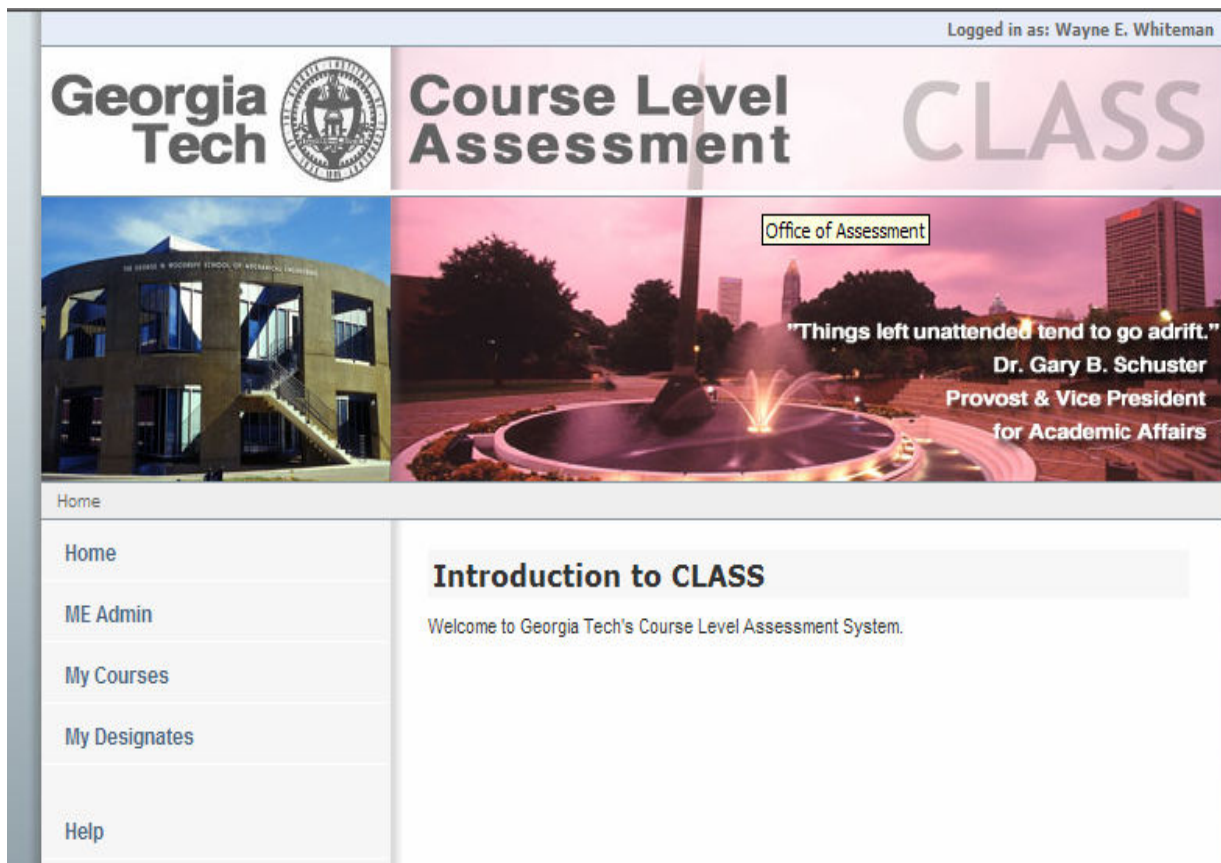


Figure 4. Course-Level Assessment System (CLASS)

Program Administrator

1. [Add/Edit Program Outcomes](#)
2. [Add/Edit Methods](#)
3. [Add/Edit Narrative Questions](#)
4. [Add Assignment](#)
5. [Add/Edit Outcome Scale](#)
6. [Notify Users](#)

Existing Assessment Assignments

1. Fall 2008 - ME 2110
Creative Decisions& Dsgn ([Mayor, James Rhett](#)) ([Outcomes](#) | [Delete?](#))
2. Fall 2008 - ME 4053
ME Systems Lab ([Rogers, Peter](#)) ([Outcomes](#) | [Delete?](#))
3. Fall 2008 - ME 4182
Capstone Design ([Lipkin, Harvey](#)) ([Outcomes](#) | [Delete?](#))

Assessment Assignments Submitted for Review

1. Fall 2008 - ME 3340
Fluid Mechanics ([Aidun, Cyrus K](#)) ([Review](#) | [Delete?](#))

Closed Assessment Assignments

1. Summer 2008 - ME 4189
Structural Vibrations ([Whiteman, Wayne E](#)) ([View](#) | [Delete?](#))
2. Fall 2008 - ME 2015

Figure 5. Course-Level Assessment System (CLASS) administrative functions

Domain Analysis.

5. An ability to identify, formulate, and solve engineering problems

Novice: Student is able to formulate physical models for very elementary discrete systems, develop a mathematical model (DEOM/Transfer Function), and solve for the system response.

Apprentice: Student is able to formulate physical models for basic discrete systems, develop a mathematical model (DEOM/Transfer Function), and solve for the system response. Student recognizes and is able to solve elementary engineering problems of a dynamic nature with 1 degree of freedom using frequency domain analysis.

Proficient: Student has a superior grasp in being able to formulate physical models for advanced discrete systems, develop a mathematical model (DEOM/Transfer Function), and solve for the system response. Student recognizes and is able to solve basic engineering problems of a dynamic nature with 1 or more degrees of freedom using frequency domain analysis.

Exceptional: Student is able to formulate physical models for advanced discrete systems, develop a mathematical model (DEOM/Transfer Function), and solve for the system response. Student recognizes and is able to solve advanced engineering problems of a dynamic nature with 1 or more degrees of freedom using frequency domain analysis.

11. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Novice: Student is able to apply basic MATLAB operations (or a similar mathematical software package) to solve elementary System Dynamics and Control problems.

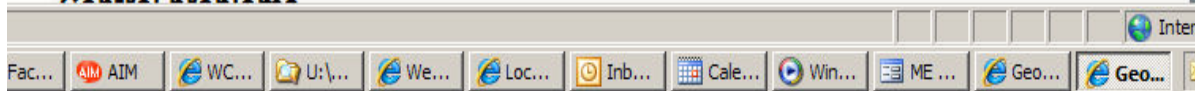


Figure 6. Typical Performance Criteria Rubric

Save

Next: Scales Form →

Outcome 1: An ability to apply knowledge of mathematics, science and engineering

What assessment methods did you use in your course to achieve this program outcome?

(check all that apply):

- Exams/Quizzes
- Graded Homework
- Written Project(s)
- Oral Presentation(s)
- Class Participation
- External Evaluators
- In-class worksheets
- Interaction during office hours
- Feedback from student assistant graders
- Personal interactions with students in and out of the classroom
- Peer Evaluation
- Other (please explain in narrative sections)

Outcome 5: An ability to identify, formulate, and solve engineering problems

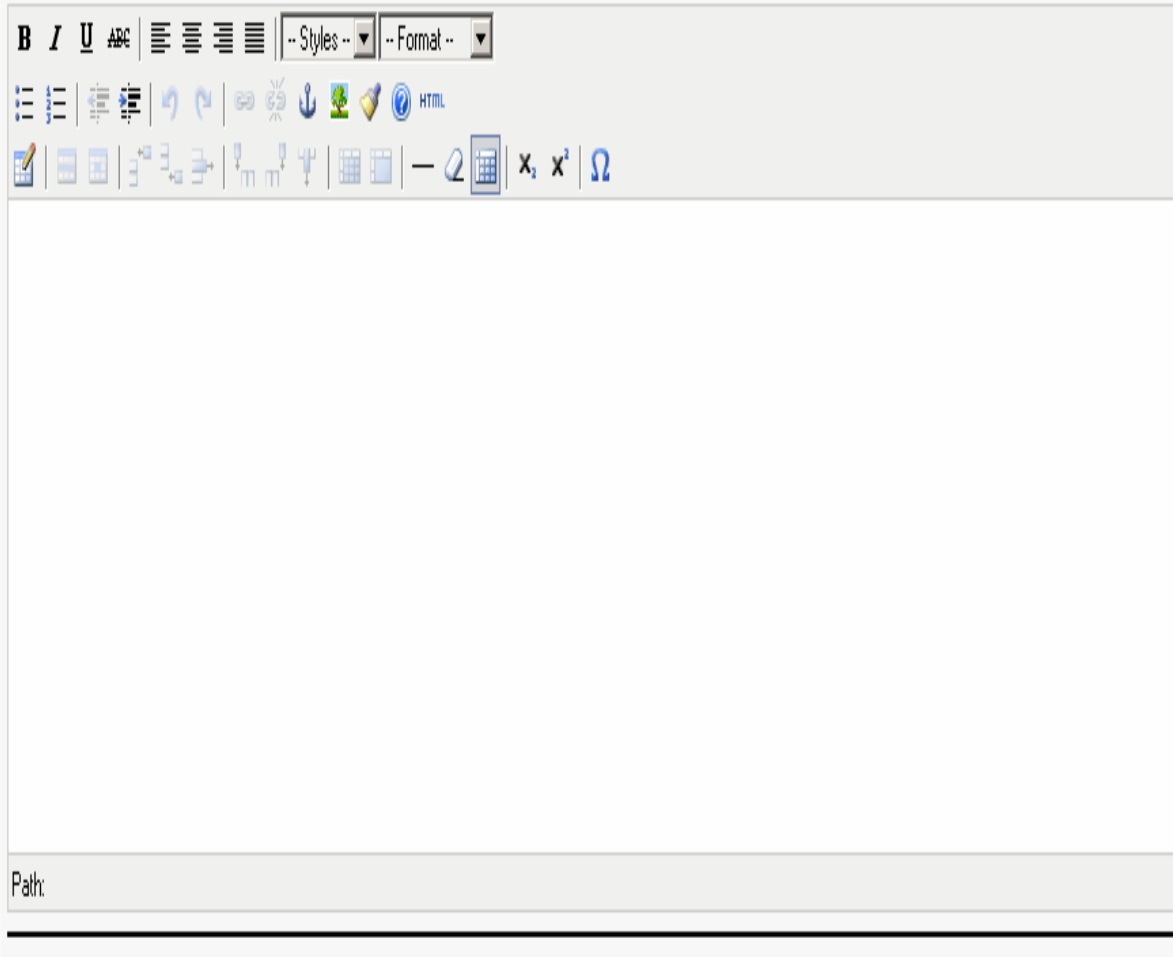
What assessment methods did you use in your course to achieve this program outcome?

(check all that apply):

- Exams/Quizzes
- Graded Homework

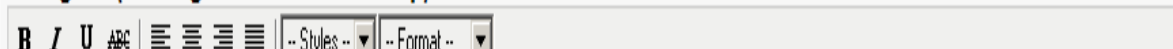
Figure 7. Methods for course outcome assessment

5. Do you have any recommended changes for the course? Include proposed changes to the course in the specified area, such as textbooks, topics covered, assessment methods, etc. Recommendations should be based on assessment results.



The screenshot shows a rich text editor interface. At the top, there is a toolbar with various icons for text formatting (bold, italic, underline, text color, background color), alignment (left, center, right, justified), bulleted and numbered lists, indentation, undo, redo, link, unlink, insert image, insert table, and insert code. Below the toolbar is a large, empty text input area. At the bottom left of the input area, the word "Path:" is visible.

6. If changes, based on previous assessments, were recently made to the course, what were the effects of those changes? (Closing the assessment loop)



The screenshot shows a rich text editor interface, similar to the one above, but with a smaller text input area. The toolbar is visible at the top, and the text input area is mostly empty.

Figure 8. Narrative input for course outcome assessment

Spring 2009 - ME 3015 (Whiteman, Wayne E)

Outcome 1: An ability to apply knowledge of mathematics, science and engineering

Outcome 5: An ability to identify, formulate, and solve engineering problems

Outcome 11: An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Outcome 12: The ability to: apply principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations) to model, analyze, design, and realize physical systems, components, or processes; and work professionally in both thermal and mechanical systems areas (Program Criteria-ASME)

← Previous: Scales Form

Next: Narrative Form →

For your students listed below, please indicate whether they have achieved this program outcome.

Records 1 to 10 of 20

Student Name	Outcome 1	Outcome 5	Outcome 11	Outcome 12
1. Adams, Christopher James	Proficient			
2. Bessette, Nathan Hale				
3. Chen, Xue		N/A		
4. Creasy, Jeffrey Michael		Novice		
5. Fontaine, Douglas Latimer		Apprentice		
6. Gamble, Scott Louis		Proficient		
7. Gantt, Jeffery Clinton		Exceptional		

Figure 9. Learning outcome assessment for a specific course.

Sustainability

An outcomes-based assessment program must be sustainable and provide measures of change over time. Results must be fed back to provide a mechanism for continuous improvement of the educational process.^{5,6} The web-based tools described in the previous section are an effective means for capturing and implementing this continuous improvement process. The tools also integrate online technology to develop and maintain the systems.

As previously described, student learning outcomes are reviewed on an annual basis. Methods are recorded for assessing these outcomes along with the assessment results. These methods and results include direct course assessment of student learning, design projects, coop and internship employer feedback, undergraduate research papers, student portfolios, student exit surveys, alumni surveys, advisory board feedback, and national rankings, as examples.

Sustainability of the process allows assessment to be ongoing and not episodic. Assessment is most effective when it looks at performance over time. As depicted in the OATS and CLASS web-based tools, both quantitative and qualitative information is recorded. The web interface is designed to be user-friendly. The web-based system allows the data to be more efficiently managed. The web-based tools can be easily modified to accommodate future changes.

At both the institute and academic unit/department level, the assessment process is subject to review and approval. Administrators and faculty instructors are able to use the information to fine tune their assessments in the future on a sustainable basis. In addition, the annual reviews ensure that the programs will be ready at any time for accreditation visits.

Applicability to other Educational Institutions

The topics presented in this paper regarding web-based assessment tools are particularly pertinent to others who work in higher education and who are struggling with these same issues. This paper offers creative web-based solutions to a problem that is common to colleges and universities. Leveraging information technology solutions, such as these types of online assessment tools, is an innovation that needs more exploration.

Interested readers should identify other program-level and course-level assessment tools they are currently using, or have seen used at other educational institutions. They may want to consider a web-based system, like OATS or CLASS discussed in this paper, to be possibly adopted at their home institution.

Conclusions

Web-based assessment tools are an efficient means for the design, development, and implementation of an outcomes-based assessment program. This paper describes two of these tools used at the Georgia Institute of Technology. These web-based programs are a sustainable means of providing measures of change over time. This allows a systematic mechanism for continuous improvement of the educational process. These web-based tools are also fully applicable and may be adopted by other educational institutions that are interested in leveraging information technology solutions to assessment processes.

References

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