Using Informatics and Technology Practices for Academic Performance Review

Kim MOORNING
Computer Information Systems, The City University of New York
Brooklyn, NY 11225, United States of America

ABSTRACT

Informatics and digital technologies serve a variety of infrastructural functions in the modern academic institution. Emerging technologies are viable solutions for collecting student performance data across the campus and addressing the growing concern of an equitable education even where budget restraints exist. Free or low-cost communication, collaborative and web tools allow for data collection across the campus making academic processes more comprehensive and expansive. Colleges can maintain dynamic information about student performance in preparation for their career success.

The digital age warrants an advancement on the traditional assessment process by catalyzing the power of technology in aggregating and appropriating micro-data to fuel effective decision making. When integrated seamlessly in the academic environment, digital assessment makes it possible to obtain a more accurate measure of excellence in education. The purpose of this research is to describe the implementation and evaluation of how digital assessment augments the educational experience and builds a culture of institution-wide performance excellence. It reviews a "digital academic professional portfolio engagement and review system" (DAPPERS) that collects curricular and co-curricular student data in a dynamic digital network.

Keywords: Academic Information System, Digital Assessment, Digital Academic Profiles, Education Informatics

1. THE INTRODUCTION

Rapid increases in the use of technology and digital communications has led to strategic advantages for business, professions, education, and society. Schools and state agencies have recognized the need to proactively capitalize on the use of technology to guide educational decision making and better manage critical academic data [1]. The Association of American Colleges and Universities (2009) believes that valid assessment data are needed to guide planning, teaching, and improvement. Well-planned data collection methods establish new assessments metrics and lead institutions in achieving expected goals [2]. Researchers and educators have found that digital tools which make our lives inherently efficient also helps to appropriate information in ways that improve the quality of education [3].

2. EDUCATION INFORMATICS

Delandshere (2002) pointed out years of arguments regarding the need for new forms of educational assessment due to "an almost unanimous recognition of the limitations of current measurement theory and practice." Those who perform educational metrics work from old methodologies and perspectives. In fact, the history of grading point average (GPA) in American colleges dates back to the 1700s when Yale University formulated it, then finalized a numerical system in the 1800s [4]. Excluded from traditional grading systems are specific notions of learning, knowing, and inquiry, and the conditions necessary to foster productive learning experiences. According to Dr. Samuel Meisels, a renowned Harvard scholar on assessment, "most standardized tests are not designed to evaluate the individualized growth and development taking place in your classroom" [5]. Dr. Meisels advocates for "purposeful collections" of student's work that "illustrate their efforts, progress, and achievements."

Most colleges and universities have an abundance of data but need the capacity to turn data into meaningful information. When considered in conjunction with interoperability standards, academic data can be dispersed in mini-systems throughout the functional units of an institution to create a more extensive process than usual for performing program assessment. At any given college, there are dozens of databases, not counting the research databases and course management systems holding a wealth of assessment metrics.

Tremendous pressure is placed on academic institutions to provide an education leading to gainful employment, given the soaring price of tuition. To connect data to educational outcomes is to use an assessment plan that evaluates variables in curricular, co-curricular, extra-curricular, and non-curricular activities throughout a student's college life. Such collections provide rich documentation of the student's experiences throughout the year and lead to the development of new activities based on the student's progress and interests. A comprehensive performance assessment system is an excellent method for displaying a student's true potential and ability [5].

3. AUTHENTIC ASSESSMENT

ACT, Inc. conducts tests for more than 2 million (or 64 percent) of high school graduates and has become the most popular tool used to predict college performance. In their 2012 report of the nearly 80% of high school students who pre-selected a college major, 64% of them chose a major that did not fit with their academic strengths and interests [6]. Similarly, about 90% of low-income, first-generation students do not graduate within six years because they are likely unfamiliar with the "hidden curriculum" that determines students' success in their major [7]. Jon Erickson, ACT, Inc. president of education believes that choosing a college major reflective of students' interests gives them a better chance of succeeding and could also contribute to their satisfaction in school and on the job.

The Association of American Colleges and Universities (AACU) is using their Liberal Education and America's Promise (LEAP) initiative and the Valid Assessment of Learning in Undergraduate Education (VALUE) project to explore an alternative approach for assessing learning. VALUE assumes that "well-planned e-portfolios can inform programs and institutions about their [students] progress to achieve expected goals." AACU seeks to report aggregate findings to internal and external audiences on a "broad range of outcomes associated with the global and complex world in which we live" [8].

The ubiquity of electronic communications makes the collection of student data intuitive. For many institutions, finding the resources for normalizing and warehousing data and the expertise to set up a robust assessment system can be challenging. The lack of technology skills by academicians is another challenge. Pechone & Chung (2006) warns that it is insufficient to measure student achievement with only course grades. Student learning must be tied to goals and objectives in a systematic process. Authentic assessment requires cross-program collaboration and communication to effect institutional change. This imperative, if done appropriately, will advance institutional review far beyond the goal of conforming to accreditation [9]. It will help to validate what students have learned and measure the academic intensity of degree programs.

Digital assessment is a more rapid and reliable process for creating measurable relationships and continuous improvement (Diamond & Gardiner, 2000; Marsh, 2012). Several academic institutions have adopted the outcome based educational model to move away from the GPA driven model. This research presents a digital academic professional portfolio engagement and review system" (DAPPERS) as an outcome-based model. It includes additional factors in a continuous cycle of collection, organization, and interpretation of data to determine whether degree programs produce the types of graduates, colleges state in their mission, goals, and objectives.

4. ELECTRONIC PORTFOLIO FRAMEWORK

The use of electronic portfolios in higher education institutions has been steadily increasing due to campus saturation with digital technologies. E-portfolios are purposeful aggregations of digital artifacts that articulate student experiences, achievements and learning. They may be the most significant technological innovation on college campuses for evaluating performance and exposing enormous possibilities for re-thinking curricula, instruction, and assessment. By 2004 approximately 70% of higher educational institutions were implementing or using some form of e-portfolio [10]. Didactical implications for using e-portfolios are to diversify student-centered learning and create higher quality outcomes.

The states of Vermont and Kentucky began to investigate the possibility of using portfolio assessments instead of standardized tests to judge educational achievement. Zayed University researchers developed an e-portfolio assessment system for an information technology degree program. Zayed required students to create an e-portfolio and showcase significant course work as digital artifacts [11]. The research proved that in time, e-portfolios would become an essential source of information for evaluating the effectiveness of student outcomes. Other educational institutions see the broad impact of performing portfolio-based assessment.

The "Urban Universities Portfolio Project" was the first to explore institution-wide e-portfolios for assessment and accreditation [13]. Subsequently, the Western Association of Schools and Colleges also encouraged institutions to use e-portfolios for accreditation. As the phrase "portfolio thinking" emerged, it became the mindset institutions adopt in its assessments practices to create a culture of analysis, interpretation, and reflection [14].

Early research from the Coalition of Essential Schools and the Annenberg Institute for School Reform identify assessment and technology as two core factors in the successful implementation and use of e-portfolios [12]. As the concept of portfolio assessment expands, technology makes way for the transformative process of digital assessment.

5. DIGITAL ACADEMIC SYSTEM

ACT set new benchmarks with its "interest-major fit" score predicting student outcomes. Encouraging the use of behavioral assessments to help identify noncognitive impediments to success, they review factors of: motivation and skills, social engagement, and self-regulation. ACT research and elsewhere suggests when students' interests match interests of professionals in their career, they will be more likely to remain in their major, persist in college, and timely complete a degree in [15].

In exploring the efficacy of this digital academic information system (DAIS), the goal is to put in the hands of academicians a digital mechanism for reflecting more accurate measures of excellence and revolutionizing the grade reporting process. DAIS proves to be a paradigm shift and disruptive innovation that changes the dynamics of educational review. In a four-phase process, DAIS 1) establishes non-traditional measurable outcomes of student learning, 2) ensures that students have adequate opportunities to achieve these outcomes, 3) gathers, analyzes and interprets learning artifacts to determine how well it matches program goals, and 4) uses the resulting algorithms for performance reporting.

This DAIS model is dubbed "Digital Academic Professional Portfolio Engagement and Review System" (DAPPERS^{tm}) produces digital academic profiles (DAPS) that reflect all the student's accomplishments as they matriculate through college. DAPs provide greater depth of student progress by capturing engagement data across several points. The concept of "points" is expanded to include summative and formative review from entry to collegiate activities to coursework, and ultimately graduation. DAPs are essential for critical feedback and performance assessment to support strategic interventions in academic and career guidance. The portfolios detail student grades, course objectives, student activities, career interests, and unique qualities.

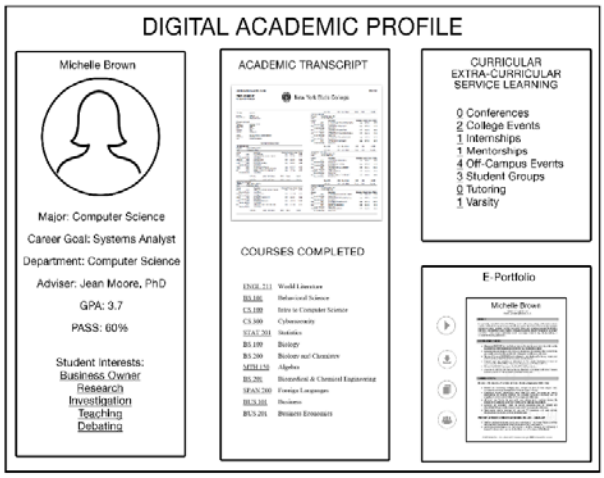
As a fluid, measurable methodology, the ongoing digital assessment evaluates academic data at several points in time from multiple data sources to disclose success factors. DAPs will contain a new Performance Assessment Symmetry Score (PASS) a multi-factor analysis of student's performance throughout their college life.

While portfolios are aggregations of artifacts representing accomplishments, profiles represent the subject's character, interest, and performance. Digital profiles allow for multimedia representations of content. They are the heart of social media and used to showcase an individuals' characteristics. The Pew Research Center report "Social Media Use in 2018" show that "88% of 18- to 29-year-olds indicate that they use any form of social media" which require the creation and use a digital profile. Online career centers require prospective employees to highlight key components of their career experiences, skills, and goals in a digital profile to match their qualifications with job openings. The new reality is that a well-designed digital profile

demonstrates professionalism and is an asset to building an individual's brand.

Figure 1 shows the DAP (patent pending) concept and prototype which is more robust record of student's performance. A student has the option of granting DAP[tm] open access to employers or restricting access in full or in part with a personal identification number (PIN). The full transcript and resume may be downloaded. Numeric values next to activities link to information describing the events. Links under the student interests display the student's rationale. Links next to courses codes connect to course objectives. The department name connects to the department mission statement. The name of the major connects to the program goals and objectives.

Figure 1



DAP[tm] Prototype

DAPPERS merges the concepts of e-portfolios and digital profiles to represent students' broad performance. It is an assessment product that looks at formal and informal student learning and behaviors to reveal greater academic insights. The DAP includes the traditional transcript data as well as digital artifacts highlighting special accomplishments, and participation data. Other sections of the report contain information about performance in co-curricular, extracurricular and service learning activities (sports, events, conferences, student groups, etc.). A student section allows for an explanation of career interests and goals. The digital aspect of DAP makes it interactive and shareable in full or in part, and interactive.

This multi-campus effort supports academic advising, early alert, first-year retention, and institutional data analysis. All college constituents, faculty, staff, and administrators must align their functional areas to support assessment initiatives. Each department must share in the commitment to helping students succeed. DAPPERS uses a web-based interface for capturing performance data across the institution. Users have the options of entering data or running performance reports online and remotely. Faculty, registrars, admission officers, advisers, and students all have access to student DAPs. Career counselors are only part of the network for helping students succeed in the workforce. Colleges that create campus-wide retention programs have a clear strategy for identifying at-risk students and early intervention.

6. THEORETICAL FRAMEWORK

This disruptive paradigm is expected to influence educational policy and significantly challenge institutional assumptions about assessment and student learning. To support colleges and universities and design a systematic process for improving outcomes, this research adopts more than one theoretical framework to broaden discussions within the research community. To uncritically apply alternative explanations from varying points of view, it uses a participatory epistemology, heuristic evaluation, and disruptive innovation principles. Table 1 summarizes the theoretical implications by impact, method, and analysis.

Table 1 – Theoretical Implications

THEORY	**Participatory Epistemology**	**Heuristic Evaluation**	**Disruptive Innovation**
IMPACT	Learners	Software	Assessment
METHOD	Evaluate subjects in academic activities.	Evaluate the design and usability of DAPPERS.	Evaluate institutional DAPPERS practices.
ANALYSIS	Quantify and qualify student performance.	Correlate usability with institutional outcomes.	Perform a cost benefit analysis.
	COGNITIVE	**INTUITIVE**	**PRACTICAL**

7. SYSTEM DESIGN & DATA ANALYSIS

The user will be able to collects a matrix of performance data at varying functional levels for review and tracking, in much of the same way e-portfolio information is collected. Colleges capture a vibrant picture of student development and progress in and out of classrooms. The institution will have a record of learning and performance from admission through graduation. Data about courses and programs are incorporated as base information. Career and personal interest data are entered by students. Grades and course performance scores are entered by faculty members. Co-curricular, extra-curricular and non-curricular student data is entered by the specified unit (ex: athletics, sorority, fraternity, mentor, internship, etc.) This data creates key performance indicators not captured by classroom assessments.

To strategically incorporating stakeholder objectives, DAPPERS aligns student performance with industry skills (communication, quantitative reasoning and problem-solving etc.), and program outcomes with the accreditation standards the institution is guided by. The system analyzes whether a program is achieving the required levels and if not, where improvement is needed. Recommendations from these program reviews can become part of a program's strategic planning efforts.

Listed below are the data items (objectives, measures, activities, and scores):

1. Performance Objectives (PO) are the knowledge, skills and abilities students are expected to accomplish.
    a. Agency performance objectives (APO) are specific POs as determined by accreditation and industry standards;

   b. Program objectives (PPO) are POs as determined by the degree program; and
   c. Course objectives (CPO) are POs as determined by each course.
2. Performance Measures (PM) are graded course assignments used to assess learning.
   a. Exams – interim tests that contain (multiple/choice, true/false, fill-in the blanks, matching questions, etc.);
   b. Written reports – research reports and essays that are not a part of an exam; and
   c. Projects – presentations, case studies, and comprehensive assignments; and
   d. Term grades – total student grade for each course.
3. Performance-Based Activities (PA) represent student participation in activities outside of the classroom that support learning.
   a. Campus events – that are discipline-specific, college-specific, industry-specific, general activities;
   b. Off-campus events – that are discipline-specific, college-specific, industry-specific;
   c. Varsity – participation in sports as an athlete; and
   d. Service learning – internships, externships, college work study.
4. Performance Scores (PS) are calculated ratios and scores from the performance measures and performance-based activities in student e-portfolio artifacts.
   a. Student Performance Score (SPS) – is an individual score from each PM.
   b. Course Performance Score (CPS) – collection of scores from all students within a course.
   c. Aggregate Performance Score (APS) – collection of scores from all students within a program; and
5. Performance Assessment Symmetry Score (PASS) – the calculated symmetry score between student learning, student performance, and degree program outcomes. This score represents an interest-major fit and student success factor.

Table 2 shows the data points, purposes, data analysis metrics, and type of variables. The Metric column indicates the codes: C-Causal. D-Descriptive, E-Exploratory, I-Inferential, M-Mechanistic, and P-Predictive. The Type column indicates the variable codes: D-Dependent, I-Independent, Me-Mediator, and Mo-Moderator.

Table 2 – DAPPERS DATA ANALYSIS

Data	Definition	Metric	Type
Program Objectives	knowledge and skills to be acquired by end of the program	D	Mo
Course Objectives	knowledge and skills to be acquired by end of the course	D	Mo
Agency Objectives	accreditation and industry standards	I, P	Mo
Student Outcomes	Performance scores (grades, participation in activities)	D, E, I	D
Program Outcomes	Program metrics (graduation rates, retention, enrollments)	D, E, l	D
DAIS Use	Measured system use	C, D	I
DAIS Competency	Capacity at which DAIS is used effectively	M	I
Assessment Competency	Ability of DAIS user to correlate objectives to outcomes	M	I
Program Assessment	the evaluation of program goals, objectives and outcomes	D	I
Subject Dissonance	incompatibility between major and student performance	I, P	Me
Program Dissonance	incompatibility between program and agency objectives	I, P	Me
Agency Symmetry	ratio between the agency standards and program objectives	I, P	D
Program Symmetry	ratio between program and course objectives	I, P	D
Student Symmetry	ratio between course objectives and student interests	I, P	D
Performance Assessment Symmetry Score (PASS)	Overall symmetry score between program objectives and student outcomes	I, P	

The data analysis includes a review of student, faculty and agency perceptions of DAPs, student symmetry scores in DAPs, outcomes assessment and the usefulness of the DAPPERS. The performance matrix and associated symmetry scores will be analyzed to determine how well the system captures performance variables, correlate them to improvements in assessment methods and to create a sustainable digital process for program review. The overall system analysis will include: 1) user statistics, 2) symmetry reports, 3) academic outcomes, and a 4) cost-benefit analysis.

8. DISCUSSIONS AND CONCLUSIONS

The underlying aim is to study the effectiveness of digital assessment in measuring programs goals and student performance and providing evidence of symmetry in digital academic profiles. It is expected that DAPPERS will enhances program review, increases symmetry between student outcomes and student choice of major, and increases symmetry between program objectives and external standards. This results of this in-process study of the digital assessment prototype is limited to institutions who make full use of e-portfolios. The results may not be generalizable for institutions who do not follow a "portfolio thinking" approach. Agency data includes the collection of accreditation associations standards and industry skillsets for fit factor analysis. At present no colleges are using DAPs to represent student performance. Negative perceptions about digital assessment and e-portfolios may affect system outcomes. Insufficient data points will affect symmetry and yield false positives. Colleges must conduct their own cost benefit

analysis, feasibility studies (technical, economic, and operational).

Discomfort with entering data into an assessment information system may also hinder an institution's potential for program symmetry. Attempts to minimize the impact of these limitations and acknowledge the potential limitations is unique for each institution. Future research should evaluate collaborations between academic institutions and external stakeholders, and the impact businesses and industry have on college curriculum.

9. REFERENCES

[1] J. Marsh, "**Interventions Promoting Educators' Use of Data: Research Insights and Gaps**," *Teachers College Record*, vol. 114, no. 110303, 2012.

[2] Association of American Colleges and Universities, "**VALUE: Valid assessment of learning in undergraduate education**," 2009. [Online]. [Accessed 1 May 2013].

[3] C. Hu, "**Students, computers and learning: Where is the connection?**," *Education Information Technologies*, vol. 22, no. 6, p. 2665–2670, 2017.

[4] W. A. Durm, "**An A is Not an A is Not A: The History of Grading**," *The Educational Forum*, vol. 57, Spring 1993.

[5] S. J. Meisels, "**Using Work Sampling in authentic performance assessments**," *Educational Leadership*, vol. 54, pp. 60-65, 1997.

[6] ACT, Inc., "**A Profile of 2012 ACT-Tested High School Graduates: College Choice Report Part 1 - Preferences and Prospects**," ACT, Inc., Iowa City, 2013.

[7] Education Advisory Board, "**90% of low-income, first-gen students don't graduate on time. But colleges can change that**," 16 March 2016. [Online]. Available: https://www.eab.com/daily-briefing/2016/03/16/90-percent-of-low-income-first-gen-students-dont-graduate-on-time-but-colleges-can-change-that.

[8] D. Humphreys, "**Assessing Learning Outcomes: Lessons from AAC&U's VALUE Project**," *Peer Review: Emerging Trends and Key Debates in Undergraduate Education*, vol. 11, no. 1, 2009.

[9] N. Buzzetto-More, "**The E-Portfolio Paradigm: Informing, Educating, Assessing and Managing with E-Portfolios**," Santa Rosa: Informing Science Press, 2010.

[10] G. Lorenzo and J. C. Ittelson, "**An Overview of EPortfolios**," Educause Learning Initiative, Washington, 2005.

[11] A. Tubaishat, A. Lansari and A. A. Al-Rawi, "**E-portfolio Assessment System for an Outcome-Based Information Technology Curriculum**," *Journal of Information Technology Education*, vol. 8, pp. 43-54, 2009.

[12] D. Niguidula, "**Picturing performance with digital portfolios**," *Educational Leadership*, vol. 55, no. 3, pp. 26-29, 1997.

[13] B. Cambridge, "**Electronic portfolios: Emerging practices in student, faculty, and institutional learning**," Washington: Stylus Publishing, 2001.

[14] B. Holland, Ed."**Metropolitan Universities: An International Form,**" *Urban Universities Portfolio Project*, vol. 13, no. 3, 2002.

[15] ACT, Inc., "**ACT College Choice Report: Class of 2015**," ACT, Inc., Iowa City, 2016.

[16] A. Porter, M. Chester and M. Schlesinger, "**Framework for an Effective Assessment and Accountability Program: The Philadelphia Example**," *Teachers College Press*, vol. 106, no. 6, pp. 1358-1400, June 2004.

[17] The Hechinger Report, "**3.9 Million Students Dropped Out of College With Debt in 2015 and 2016**," U.S. News, Washington, 2017.

[18] E. Waterman, "**Beyond the Administrative Core: Creating Web-based Student Services for Online Learners**," Regis University, Denver, 2002.

[19] L. McNeil, **"Sameness, bureaucracy, and the myth of educational equity: The TAAS system of testing in Texas public schools**," *Hispanic Journal of Behavioral Sciences*, vol. 22, no. 4, pp. 508-523, 2000.

[20] S. Battenfield, "**Is a Digital Portfolio Really Worth It?**," in *iMet13*, Sacramento, 2012.

[21] A. Jafari, "**The "Sticky" ePortfolio System: Tackling Challenges and Identifying Attribute**," *Educause*, vol. 39, no. 4, pp. 38-49, July/August 2004.

[22] D. M. Leonard and J. Norris, "**What Every Campus Leader Needs to Know**," Strategic Initiatives, Inc., Herndon, 2008.

[23] H. Topi, J. S. Valacich, R. T. Wright, K. M. Kaiser, J. F. Nunamaker, J. C. Sipior and G. de Vreede, "**Curriculum Guidelines for Undergraduate Degree Programs in Information Systems**," *Association for Computing Machinery and Association for Information Systems*, 2010.

[24] R. M. Diamond and L. F. Gardiner, "**Curriculum review," The National Academy for Academic Leadership**, Rutgers University, Rutgers, 2000.

[25] H. Barrett, "**Balancing the two faces of e-portfolios," in *Innovations in Education (2nd Edition)***, British Columbia Ministry of Education, 2011.

[26] D. Goodhue and R. Thompson, "**Task-technology fit and individual performance**," *MIS Quarterly*, vol. 19, no. 2, pp. 213-238, 1995.

[27] E. Stringer and W. J. Genat, "**Action research in health**," New Jersey: Pearson Education, 2004.

[28] L. M. McNeil, "**Contradictions of school reform: Educational costs of standardized testing**," New York: Routledge, 2000.

[29] L. A. Shepard and M. L. Smith, "**Flunking grades: Research and policies on retention**," Philadelphia: Falmer Press, 1989.

[30] M. Smith, "**Put to the test: The effects of external testing on teachers**," *Educational Research*, vol. 20, no. 5, pp. 8-11, 1991.

[31] R. L. Pechone and R. Chung, "**Evidence in Teacher Education**," *Journal of Teacher Education*, vol. 57, no. 1, pp. 22-36, 2006.

[32] L. L. Knefelkamp, "**Assessment as Transformation**," in *Speech to the American Association for Higher Education*

Fourth National Conference on Assessment in Higher Education, Atlanta, 1989.

[33] G. Delandshere, "**Assessment as Inquiry**," *Teachers College Record*, vol. 104, no. 7, pp. 1461-1484, 2002.

[34] J. L. Herman and L. Winters, "**Portfolio Research: A Slim Collection**," *Reporting What Students Are Learning*, vol. 52, no. 2, pp. 48-55, October 1994.

[35] H. Barrett, "**Researching and Evaluating Digital Storytelling as a Deep Learning Tool**," in *Society for Information Technology and Teacher Education*, 2006.

[36] J. S. Wholey, H. Hatry and K. Newcomer, "**Handbook of Practical Program Evaluation**," San Francisco: Jossey-Bass, 2010.

[37] D. Norris and J. Leonard, "**What Every Campus Leader Needs to Know About Analytics**," Strategic Initiatives, Inc., Herndon, 2008.