John Cays and Burcak Ozludil
College of Architecture and Design
New Jersey Institute of Technology
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The 'Kepler System': 10 Years of Digital Outcome Assessment in Architecture, Art and Design Schools

'Knowledge will forever govern ignorance, and people who mean to be their own governors must arm themselves with the power knowledge gives. A popular government without popular information, or the means of acquiring it, is but a prologue to a farce or a tragedy or perhaps both.'

James Madison[1]

10 years ago, in 2005, the New Jersey Institute of Technology's College of Architecture and Design became the first school in the world to build a curricular management system that would digitally collect a full body of academic work intended for internal and external quality monitoring: *Kepler: A Transparent Course Work Review System.*[2] *Kepler* was built using Microsoft's SharePoint software to address the increasing complexity of work produced in architecture, art and design schools, by continuously sharing every project by every student in every class with all members of the college community. This paper will outline important aspects of the system, its adoption by students, faculty and administration as well as the external users.

1   The "Tool": What is *Kepler?*

Kepler is a digital collection tool, an internal self-assessment and an external accreditation tool as well as an individual portfolio building tool for students. Most importantly, it is a highly visual communication system that attempts to provide a comprehensive, qualitative and rolling

evidence based view of the College to be shared with students, faculty members and administrators.

While the social dimension of the *Kepler* system provides the *raison d'être* for the entire project, its technical aspects are integral to a full discussion of its development. Rather than spending years building and testing a custom digital data collection and display software interface package, the technical backbone was formed in house using basic, out-of-the-box SharePoint software. This means that any academic institution with access to this enterprise level software package can build its own version of the system. In the decade since the first iteration of *Kepler,* six cohorts of students have graduated each cohort leaving a comprehensive record of academic work.

The main feature that distinguishes the *Kepler* system from other classroom management systems, such as Moodle, WebCT and Blackboard, is its ability to collect, organize, display and share large quantities of high quality visual information, including media rich files commonly produced in design courses, through a web based interface.

Server and IT support

After the primary decision was made to use the SharePoint software package, servers were sized that would store all academic work for roughly 1000 students. Non-professional general education courses taken outside the CoAD were not included. For the purpose of calculation, work was to be collected over five years and stored for one more year from 10 design studios with multiple sections, 8 building systems courses, 4 history courses, 2 graphic communications courses, 1 programming and project development course, 1 professional practice course and around 50 elective courses.

During initial set up, the total onetime cost in the spring of 2006 for the hardware to support the program for 1000 users was approximately $100.00 per user. Because of the compelling nature of this academic initiative, interest was high among alumni donors to provide funding to underwrite the *Kepler* project. In addition to the hardware costs, numerous personnel hours were spent researching and developing *Kepler*. Originally, these were donated after hours by an extraordinarily dedicated project team to determine what was possible or, more importantly, probable to achieve within executable cost, schedule and social parameters. Once the decision was made to go ahead, a conservative estimate of time given by the core development team both on and off the clock during the first year through the beta-test phase totaled approximately 2,500 to 3,000 hours and has, since then, required at least the same yearly effort from the team for the maintenance, management and improvement of the system.

Current Developments

By 2010 *Kepler* had migrated from a single server housed in the College of Architecture and Design to an enterprise level server in NJIT's central computing services. This second iteration allowed all course provisioning to be coordinated with other enterprise level University systems. NJIT runs all record collection and management using Banner. Instead of manually building and indexing approximately 80 course sites each semester, many with multiple sections, populate the sites with tens of thousands of student folders and troubleshoot password protocols for students and instructors, as we initially had to do, Banner now automatically provisions all of this information at the beginning of each academic semester.

As Microsoft updates SharePoint, Kepler continues to evolve and more features are added to improve the user experience. We are currently evaluating a newer version of SharePoint

(SharePoint 2013) for our next update. Taking advantage of all features will require modifying our current central server and technical support structure but will eliminate nuisance issues like password problems while improving overall uploading, indexing, searching and viewing functionality. This will mark *Kepler's* third iteration at NJIT.

2 Users and workings of Kepler

Measures such as grades or student evaluations only provide *quantitative* information and are relatively opaque. They do not, however, provide sufficient *qualitative* evidence to fully assess teaching/learning efficacy. This holds particularly true in the fields of art and design. Without a body of detailed visual evidence, in the form of actual student work, it is difficult to conduct any fair internal assessment of current curricular or pedagogical success; it is also impossible to conduct the type of longitudinal assessment for meaningful strategic and tactical planning. Bereft of a persistent body of evidence, the entire academic community is subject to erroneous perceptions based on interpolation and extrapolation of an inadequate sample.

2.1 Internal users and assessment

Internally, the ultimate aim of *Kepler* is to develop greater cohesion and clarity between all members of the academic community through an open system of sharing stated curricular objectives and work results. Through sharing student work in a comprehensive and persistent format, fact based perceptions inform discussions between students, faculty members and administrators alike. Rather than rely on anecdotal evidence, a thorough review of the work of multiple students can provide reliable backup evidence for the relative merits or deficiencies of a given assignment, single course or entire program.

If the academic community as a whole continually asks the important question "What kind of school do we want to be?" it is essential to regularly and accurately assess the present state of academic affairs. **Who** uses *Kepler* has, from the start, provided the guiding principles for **how** the technical components of *Kepler* work and **what *Kepler*** does.

1. Encourage students to properly format their own work, to post to an open and standard forum and to provide a portfolio to share with peers, instructors and potential employers.
Today's students have mediated the world through some sort of technological interface since early childhood. These students are willing and able to leverage advanced digital media to produce copious amounts of work easily but require constant guidance in the editorial process. Since they receive grades based on what an instructor can view on the screen, posting to *Kepler* provides a clear opportunity for students to ask themselves what documents, information and production quality are necessary to effectively describe a project and what material is superfluous to an effective presentation.[3]

2. Give the faculty an instrument to collect and evaluate student work, share course outcomes and improve teaching efficacy through peer dialogue.
The faculty can use *Kepler* to review student work and discuss the state of the curriculum using actual examples of student work to inform the discussion. In addition to grades, nominations for student merit awards and scholarships can be informed through close qualitative comparisons of student work. Student grade appeals are less capricious and can be seen in a more complete context. *Kepler* provides important qualitative context for quantitative student course evaluation

scores. Soon after the system was introduced, *Kepler* began to inform the evolution of the curriculum through presenting persistent evidence of the past and current state of student work.

3. Provide the administration with persistent empirical data to assess the current state of all design programs.

In addition to providing a basis for internal qualitative assessment and producing longitudinal studies, *Kepler* aids in communicating the salient features of specific courses and programs. After reviewing work in each class, the Dean's office populates the school's website and accreditation sites with work selected from the vast data pool produced each semester.

Courses Site Structure

Each semester the "Courses Site" is provisioned based on data from Banner system. Once a course site is built, the uploading function is fairly intuitive by both faculty and students. Ambitious or interested instructors can readily customize/personalize their course sites and can individually manage permissions in order, for instance, to control student upload due dates and deadlines. This can all be done remotely providing the faculty more freedom and greater control in the management of their classes over the course of a semester. Each course is built as an individual web accessible site. Any student or faculty member can upload documents from anywhere in the world they have access to a computer with internet connection.

Inside each site is a left hand column controlled by the course instructor that includes a list of course documents and assignment galleries. In addition to the technical and social management of Kepler by the team, some additional work is required from each faculty member at the beginning of each semester. Documents such as syllabi and assignment descriptions are to be

posted in each course site and if the faculty member is not able to build their own assignment galleries they must make sure the team has a list of assignments so the gallery can be built and populated with student folders. This is consistent with the academic policies at most institutions and *Kepler* creates a standard collection format and a way for the administration to verify that this contractual obligation has been satisfied each semester.

Each assignment gallery contains a set of named folders. One folder in each assignment set is assigned to a student and the student is required to post all work, labeled correctly with at least the student's last and first name, for the assignment in that folder. The College *Kepler* policy requires all students to post their work for evaluation by faculty in order to receive a grade. Several metadata fields are also provided but not required for more detailed indexing should either the student or instructor desire it. The nature and specific requirements of student postings is set by the instructor. While a maximum 2000 x 2000 pixel JPEG is the preferred file type since it allows the greatest search and viewing utility as well as excellent file size to resolution ratio, Share Point accepts all file type uploads.

With enough time and money most design programs can develop a digital collection and review system that is as good as or better than *Kepler*. If, however, the social aspect of implementation is not addressed, the system will not take root. It must be viewed as a collaborative effort with the faculty and it must be relatively easy to use.

2.2   External users and assessment

The effect of continuous internal evaluation and transparent outcomes assessment create the preconditions for an open and healthy dialogue among the faculty. This type of internal assessment is consistent with the requirements specified by many architecture and design

external assessment or accrediting bodies. External accrediting bodies mandate regular reporting. It should essentially provide representative snapshots of a continuous internal assessment. Because of the limitations of design schools in collecting, storing and presenting copious amounts of student work, current accreditation methods are based on scant information. Many design programs calibrate the granularity of internal evidence review and self-assessment to coincide with the typical 5 to 10 years between accreditation visits. This situation produces two negative consequences. First, there is accountability between visits. Second, and more importantly, because the visits are spaced so far apart, the internal assessment procedures are often ad-hoc and skewed to building a case for re-accreditation rather than providing the basis for rational continuous decision making. Leveraging the fact that our internal assessment procedures were closely aligned with those of our accrediting bodies (NAAB, CIDA and NASAD) NJIT's College of Architecture and Design developed parallel *Kepler* websites tailored to present evidentiary examples of student work in all courses that comprise the undergraduate and graduate design programs.[4]

Between 2006 and 2016, NJIT successfully hosted two National Architecture Accrediting Board accreditations, one for Council of Interior Design Accreditation and one for National Association of Schools of Art and Design.[4] During all accrediting team visits, a full body of evidence was presented digitally at the College and one full collection pool of evidence was sent asynchronously to the NAAB team a week prior to their visit in the 2014 spring semester.

Accreditation Site Structure

As opposed to the crowd-sourced nature of "Courses Site" automatically provisioned each semester and populated by faculty and students, the accreditation sites are curated by a selected

group of faculty members, administrators and graduate students. The first step is identifying the requirements of the accrediting body. In our case NAAB, CIDA and NASAD had different criteria and expectations that required us to "tweak" the *Kepler* sites slightly while keeping the overall logical architecture of the sites intact. The accreditation team user experience is of paramount importance in editing and presenting visual artifacts and descriptive information. Since most teams today have still not participated in fully digital accreditation visit, the *"Kepler"* digital user interface must recreate and improve the team experience in analog display environments. Only essential information that provides evidence satisfying board mandated criteria is included in the body of visual evidence. Team members can easily orient themselves at all times as they search. The overall structure of the academic program and courses vis-à-vis student performance criteria must be apparent to avoid confusion or disorientation. Team members can drill down starting at any point on the home screen to find what they are looking for. Each image is indexed with pertinent metadata describing what it is, who produced it, in what course and section it was produced, in what semester it was produced, and what performance criteria it is intended to satisfy. Ease of evaluation is optimized through multiple viewing options including clickable thumbnail sets, easy zooming and panning functions, and large scale slide show for each evidence set.

3   Conclusion

Traditional analog based educational environments have historically relied on a group of dedicated individual instructors working, for the most part, on their own. Syllabi are constructed every semester and handed out to students with a copy going to the main administrative office.

Design students work with their instructors and hand in projects. These projects get evaluated in isolation and the students receive a grade. The next term the process begins again. Except for an academic transcript, almost nothing at all survives from one term to the next that proves each step of the way students are being well prepared to enter into a design profession.

Anyone who has participated in an interview at a professional design firm knows that academic grades almost never determine who will be hired for a position. Rather than fixating on an academic transcript, design professionals determine the quality of a prospective hire by looking at a portfolio of work. It makes sense for design schools to be at least as focused on the same qualitative indicators as we evaluate our own programs and chart a path for the future. In order to clearly understand and communicate what is going on in our design programs, everyone with a stake in student achievement should be looking at the student work all the time.

National design and regional scholastic accreditation boards are increasingly requiring that a closed communication loop be created to connect all members of an academic community together. Through leveraging the technological infrastructure and culture already in place at an increasing number of design and other studio based academic programs to view the actual student work, a clear qualitative assessment of curricular and pedagogical decisions is possible. This synthetic visual body of evidence is what the design community values over objective numbers and verbal descriptions. We respond to this comprehensive display of visual information and make decisions based on this collective body of work evidence. The more transparent the work display system is to the greatest number of participants in the academic community, including our respective accrediting bodies, the better able we can communicate our

collective aspirations, successes and challenges with each other, close the loop and continue to improve the nation's design education system.

As stated above, the ultimate aim of *Kepler* is to develop greater cohesion and clarity between all members of the academic community through an open system of sharing stated curricular objectives and work results. It is our hope in the College of Architecture and Design at NJIT that, through sharing key details of this successful initiative here, others will be able to reproduce similar results to benefit their own architecture, art, design and other studio based programs across the country. It must be happily noted that, as of this writing, several design schools are implementing similar systems to support internal coursework management such as Roger Williams University's School of Architecture, Art and Historic Preservation, or digital accreditation including Northeastern University School of Architecture, the University of Michigan's Taubman School of Architecture, and Texas Tech University Lubbock School of Architecture. We hope to be able to leverage this technological accomplishment to help grow a larger national community made up of multiple institutions all transparently sharing best practices as well as challenges with each other and finding ways to achieve our common goals as design educators.

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[1] James Madison in letter to W.T. Barry Aug. 4, 1822. Published in *The Writings of James Madison Vol. IX* (G.P. Putnam's Sons, 1910) p. 103.

[2] As a School of Architecture Dean's initiative, a small development team reported directly to Dean Urs Gauchat. Working under the aegis of the CoAD Director of information Technology, Glenn Goldman and Univerity Associate Provost for IT, David Ulman, the project team was

given wide latitude to explore and invent. The team included the project leader and policy specialist, Associate Dean John Cays, the system architect, Mike Hoon, the technical specialist and coordinator, Mike Kehoe, IT assistant, Jahanzeb Jabbar, and advanced implementer and troubleshooter, Kim DeFreitas. With generous financial support from SOA alumna, Jeanne Perrantoni and in collaboration with the entire CoAD academic community, the *Kepler* system reached full implementation in the spring of 2007. Burcak Ozludil has been a key developer of protocols and technical troubleshooter since 2007 and led the evidence collection and preparation team during the first NAAB 2008 visit. Since 2011, she took up the lead role in Kepler's migration to an enterprise level solution through several generations of SharePoint.

[3] Two parts of *Kepler* are specifically intended to aid students in the collection, management and publishing of their own work. The second *Kepler* component involves the collection and safeguarding of a DVD produced and delivered by each student at the end of each semester. The DVD contains the source files in the native file formats used to create the edited JPEG online posting. All work from all classes in a student's semester is "salt mined" and serves as a backup for the student in the event of a catastrophic loss of data due to hardware failure, accidental deletion or any other unfortunate event. This has proved to be exceedingly useful to several students who have been able to reconstitute entire lost semesters.

[4] In 2007, the external assessment proposal was met with cautious enthusiasm by the progressive and forward thinking leadership in the National Architectural Accrediting Board (NAAB) and the collateral assessing organizations American Collegiate Schools of Architecture (ACSA), National Council of Architectural Review Board (NCARB), American Institute of Architects (AIA) and the American Institute of Architectural Students (AIAS.) In February of 2008, an especially large and experienced NAAB accreditation team led by Marilys Nepomechie, FAIA and Professor from Florida International University was sent to conduct NJSOA's six-year review. After the visit, where all evidence was reviewed exclusively through the digital Kepler site, the team commented enthusiastically on how invisible the digital interface became and how much more work they were able to assess relative to that available in a traditional analog evidence room. NJSOA received high marks for both the form and content of the accreditation visit and was granted a full six-year accreditation by the NAAB. In 2014, team chair, Daniel Friedman from Washington University led the second fully digital NAAB team visit. He made special mention of the positive qualities inherent in a system optimized for digital presentation and viewing of all course work evidence.