Learning Analytics Task Force: Three years of progress

Tim McKay
March 27, 2015
What is Learning Analytics?
Whatever it is, it seems pretty new!
Whatever it is, it seems pretty new!
Learning analytics

Learning analytics is the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs.\[1\] A related field is educational data mining. For general audience introductions, see:

- The Educause Learning Initiative Briefing [2]
- The Educause Review on Learning analytics [3]
- And the UNESCO "Learning Analytics Policy Brief" (2012)[4]
What is Learning Analytics?

An instrumented world
Seeing much more than we do directly

Measurement, collection, and analysis...

Digital tools remember faithfully what they have measured
Digital tools digest information, first in simple, then perhaps in sophisticated ways

Not only numbers: text, images, video – all that we might sense
Students, on campus and off
Faculty, staff – our whole community

of data about learners
and their contexts

Understanding context requires the most capacious vision
Using instruments to extend our experience, refine our senses, and enable us to digest and learn from more than our limited brains and the 24 hours of direct experience we receive each day will allow...
Why do Learning Analytics?

Dual goals:
Understanding teaching and learning
Making teaching and learning better

For purposes of understanding and optimizing learning and the environments in which it occurs

Learning is a human process, deeply context dependent. We will not find universal laws, and must remain vigilant and responsive to change.

Data provides the best way to remain aware of every student as an individual – without it we can’t hope to tailor the education of every student.

This ability to attend to *every* student is especially important as our community becomes more diverse.
Who is Learning Analytics for?

The reason to gather and digest all of this information is to inform those who might benefit:

- Administrators
- Faculty
- The public
- Staff
- Parents
- Students: the most important audience
Learning analytics is for us all. But students have the most to learn and must remain the focus.
Origins of LA at Michigan...
Grades introduced in 1912
Grades introduced in 1912

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</table>

Year: 3 juniors, and 2 freshmen.

Arthur C. Hall,
Registrar.
Clarence S. Yoakum: VP for Educational Investigations
The following data are selected from a mass of material in the files which relate to the progress of students, insofar as that can be gauged by grades. The rela in later semesters is not h found is probably low. Nev for it deals with the large at the greatest point of st record is also included.

**CORRELATIONS SHOWING HOW WELL UNIVERSITY GRADES PREDICT OTHER UNIVERSITY GRADES**

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<td>.660</td>
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<tr>
<td>Total - 1st Sem. with 2nd Sem. Engineers</td>
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<td>.696</td>
<td>.684</td>
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<tr>
<td>Total - 1st Sem. with 2nd Sem. L. S. &amp; A.</td>
<td>.680</td>
<td>.706</td>
<td>.663</td>
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<tr>
<td>Total - 1st Sem. with 2nd Sem. Freshmen</td>
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<td>.647</td>
<td>.669</td>
<td>.678</td>
</tr>
<tr>
<td>Total - 1st Sem. with 2nd Sem. Sophomores</td>
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<td></td>
<td></td>
<td>.682</td>
</tr>
<tr>
<td>Total - 1st Sem. Fresh. with 1st Sem. Soph.</td>
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<td></td>
<td></td>
<td>.557</td>
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<tr>
<td>Total - Freshmen Year with Sophomore Year</td>
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<td></td>
<td>.675</td>
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The total result indicates most strongly that there is a large element of chance in the selection of individuals for college entrance. This result might be expected, since grades for different years in college correlate for the most part only in the fifties.

The study covered some ten thousand individuals over a decade. It is one of the most comprehensive investigations on record in the number of individuals studied.
A pause while data languished

• Fricke’s report marked the end of what began with Yoakum and others in the first decades of the 20th century
• Several decades of relative disregard for data followed, while, ironically, computers appeared on the scene

• UM Data Warehouse: Born in the mid-90s
• Digitally mediated instruction emerges and leaves rich traces
• Academic information about 100,000+ students from admission to graduation
• ART born in 2002...
Re-emergence of LA for UM...

• The USE lab: Stephanie Teasley, Steve Lonn, and many colleagues
• Initially focused on LMS data from CTools:
  – learner-content
  – learner-learner
  – learner-instructor
• Initial explorations of digitally mediated education – clickstreams, interaction data, activity
• Several efforts emerging from physics
  • Gus Evrard, LSA ITS, and ART 1.0: 2001/2002
    – Access to information in the UM data warehouse
  • McKay, Evrard, and Gerdes: the better-than-expected project 2008+
    – Efforts to understand how preparation affects performance in large introductory courses

In November of 2010, Stephanie Teasley and I met to discuss exploring a larger learning analytics community at Michigan and launched the SLAM series
We originally proposed a series of “academic analytics” seminars. Running AA meetings didn’t sound fun...

Begun in Fall 2011

- We aim to bring together people interested in understanding our academic mission through analysis of data
- We are a Rackham Distinguished Faculty and Graduate Student Seminar

And an M-Community group: learning-analytics@umich.edu

Bi-weekly seminars

- September 14: Timothy McKay, UM Physics
  49,000 Physics Students: Who Does Better Than Expected?
- September 28: Rebecca Matz & Mark Banaszak Holl UM Chemistry
  Concurrent Enrollment in Lecture and Laboratory Enhances Student Performance and Retention
- October 12: John Campbell, Associate Vice President for IT, Purdue
  "Signals": The Past, Present, and Future Application of Analytics
- October 26: Anne Gere, UM Education and English
  Quantitative Measures of Writing Ability
- November 9: David Pritchard, MIT Physics
  Patterns, Correlates, and Reduction of Homework Copying

Volunteer to talk/send suggestions to McKay

Funding from Office of the Vice President for Research and the Horace H. Rackham School of Graduate Studies
Acronymic genealogy: From the SACUA AAAC to LATF

• 2010-11 Academic Affairs Advisory Committee completed an “assessment report” for Provost Hanlon

• This led to the Learning Analytics Task Force
  – LATF was given a three year to term make UM a great place for learning analytics

1. Explore the UM information environment and recommend to the Provost improvements designed to make Michigan a world-class environment for learning analytics research.

2. Design and execute a funding program to support the best learning analytics projects proposed by the University community.

3. Review the metrics used to assess teaching and learning at Michigan.
LATF Membership

- **Anne Ruggles Gere:** Arthur F Thurnau and Gertrude Buck Collegiate Professor of Education and English, Director Sweetland Center for Writing
- **Barry Fishman:** Arthur Thurnau Professor of Education, School of Education and Professor of Information, School of Information
- **Hosagrahar V Jagadish:** Bernard A Galler Collegiate Professor of Electrical Engineering and Computer Science, Professor of Electrical Engineering and Computer Science
- **Mika LaVaque-Manty:** Arthur F Thurnau Professor of Political Science and Philosophy, College of Literature, Science, and the Arts
- **William J Gehring:** Arthur F Thurnau Professor, Professor of Psychology, College of Literature, Science, and the Arts
- **Stephanie Teasley:** Research Professor of Information, Director of the LED Lab in the Office of Digital Education and Innovation
- **Susan Dynarski:** Professor of Public Policy, Gerald R Ford School of Public Policy, Professor of Education, School of Education and Professor of Economics, College of Literature, Science, and the Arts
- **Timothy A McKay (Chair):** Arthur F Thurnau Professor of Physics, Astronomy, and Education, Director, LSA Honors Program
- **Stephen DesJardins:** Professor of Education, School of Education and Professor of Public Policy, Gerald R Ford School of Public Policy
- **Joanna Mirecki-Millunchick:** Professor of Materials Science and Engineering and Director of MEngin, College of Engineering
Building Community for Learning Analytics at Michigan
Building Community

• LATF adopted SLAM seminars and asked CRLT to run them

• Last year, SLAM drew 662 attendees from 15 schools and colleges
  – All SLAM talks, including video, are online
  – Last year the talks received 9000+ hits

• Learning Analytics Fellows programs in winter 2013 and 2014
  – Annual cohorts working together to explore LA and become involved
  – Many projects done by fellows, important discoveries were made
  – Examples: Chemistry placement and HSSP

Thanks to Rachel Niemer, Pam Fisher, Mary Wright, and all of CRLT for making SLAM and LA Fellows such a success!
Shultz/Gottfried/Winschel: Chemistry Placement Analysis

Traditional 2:2 Introductory Chemistry Curriculum Model:

- 2 Semesters General Chemistry
- 2 Semesters Organic Chemistry

Michigan 1:2:1 Introductory Chemistry Curriculum Model:

- HIGH SCHOOL CHEMISTRY
  - AP scores of 3, 4, 5
- PLACEMENT EXAMS
  - above 70th percentile chemistry and 30th percentile math
  - below 70th percentile chemistry and/or below 30th percentile math
- Structure and Reactivity I and II (organic chemistry) with Laboratory
  - chemistry, non-science pre-meds or pre-health
- Macroscopic Investigations and Reaction Principles (general chemistry) with Laboratory
  - Biology
- Chemistry 130
  - Chemistry 210 & 215
  - Physical Chemistry Principles and Applications
Placement by Ethnicity

- ▲- Reported AP above 2
- ○- Placed Orgo, no AP

Chem Placement

2 or More  Asian  African American  Hispanic  Not Indicated  White
Regression Discontinuity

Chem Placement

Average Grade in Physical Chemical Principles

Advised General Chemistry

Advised Organic Chemistry

average grade drops after placement cutoff

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<tr>
<th>Course</th>
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<th>RD-IV</th>
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<td>w/ covariates</td>
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<td>Physical Chemical Principles</td>
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<td>0.342 (0.094)</td>
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<tr>
<td>w/ covariates</td>
<td>0.169 (0.052)</td>
<td>0.342 (0.093)</td>
</tr>
</tbody>
</table>

Note. RD = displays results from primary linear model, RD-IV = displays results from regression discontinuity instrumental variable model. Standard errors are reported in parenthesis.

***p<0.001 (two-tailed).
Brooks, Morgan, Maltby: Living-Learning Impact

Example: Health Sciences Scholars Program at Michigan

Live-in learning community
Longitudinal data collected from 2004-2010
One of several at Michigan, thousands of students

RQ: How does participation in the learning community impact student outcomes?

Our interest was looking especially at two risk groups:
• First in family to attend university
• Ethnic minorities

Background Research: Literature generally filled with “feel good” stories about learning communities, we wanted more quantified results.

Photo Credit: UM HSSP Program

Brooks, Chavez, Tritz, and Teasley, Learning Analytics & Knowledge, 2015

AAC&U Diversity, Helen Morgan, Jennifer Maltby, Christopher Brooks, March 2015, California
Quasi-Experimental Design

Our Method: Matched Samples

Step 1: Identify potential sources of bias in your population and determine how to measure them, such as:

- Achievement level of learners from student information systems
- Interest in the treatment through:
  - Applications to participate
  - Surveys on student outcome interests (e.g. CIRP)
  - Sign-ons to tech-based treatments
- Demographics and other proxies for latent characteristics (e.g. first in family to attend school)

Step 2: Find the best matches for your sample in the general population
- Linear assignment problem (min-cost, max-flow), Hungarian method

Data elements matched on:
- ACT score (or converted SAT)
- Academic school enrolled in
- At risk support program enrollment (2)
- Year enrolled
- Honors enrollment status
- Credit hours achieved
- Citizenship
- Ethnic group (self-reported)
- Sex
- Previous research program experience
- Family income (bands)
- First in family to go to college
- Self-identification of being interested in pre-health programs

Brooks, Chavez, Tritz, and Teasley, Learning Analytics & Knowledge, 2015
Living Learning

Example results

All students in LC:

No statistical significance 😞

Under represented minorities:
(self-identified Black, Hispanic, & native American)

<table>
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<tr>
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First in Family:

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<tr>
<td>Science PhD/MD/DO/DDS</td>
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<td>4</td>
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HSSP significantly increased the likelihood of BS and advanced degrees for underrepresented and first-generation students.
MOOCs: a surprise addition!

- We did not see MOOCs as a part of the picture for LA (or education) in 2010
- Michigan joined Coursera as a founding partner in early 2012
- Since then, Michigan have taught courses enrolling over 2 million
- Typically <10% of these students ‘complete’
- Ironically, the MOOC environment, for now, is in less well suited to learning analytics than residential classes
- Our students are part of a long-standing community – we know them better, work with them longer, and interact with them more deeply
Can we use a MOOC to create a global fellows program?

• This summer: an LA Fellows program for all of Higher Ed
  – UM MOOC on **Practical Learning Analytics**
• A smörgåsbord: choices of participation levels from the merely curious, to snackers, diners, and gourmands
• Collectively, concretely ponder learning analytics
  – **Keep it practical:** focus on using traditional student record data, the kind every campus has
  – **Make it interesting:** address questions raised by an array of stakeholders, including campus leaders, faculty, staff, and especially students
  – **Provide analytic teeth:** support each example with both realistic data and sample code
Working to open the data for use, on campus and off
Opening data on campus

• On campus: LA Fellows program helped bring data together, developed an MOU for data access – simplifying the process considerably

• James Hilton and DEI finishing up new campus-wide privacy statements to support sensible openness

• We have created personal connections among experts familiar with many data sources: Steve Lonn leading “Learning Analytics Data Architecture” team to establish clean research data sets for all to learn from
LEARNING ANALYTICS:
MEMORANDUM OF UNDERSTANDING REGARDING ACCESS TO AND USE OF CERTAIN APPLICATION, ENROLLMENT, AND POST-MATRICULATION DATA FROM THE UNIVERSITY OF MICHIGAN

This Memorandum of Understanding ("MOU") sets forth the terms and conditions by which Principal Investigator <__________________> ("Researcher") will be permitted to access and use a dataset ("Dataset") consisting of institutional data from the University of Michigan (the "University"). The Researcher agrees to abide by the data use protocols set forth herein.

1. As a prerequisite to receipt of the Dataset, the Researcher must submit to the Office of the Registrar documentation of the UM-IRB application/approval/exempt status.

2. The Researcher ensures that she/he shall access and/or use the Dataset only as permitted in this MOU and shall fully abide by all terms and conditions set forth herein.

3. Each Researcher shall access and/or use the Dataset solely to conduct research in accordance with the Study Proposal. Any other use of the Dataset requires specific prior written authorization from the University.
# Emerging LA Data Architecture

**DW Data Fields - Draft Recommendation**

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Opening data beyond campus

• Summer 2013: LATF program presented to all CIC Provosts
  – They endorse CIC-wide comparisons of LA results
  – Sloan Foundation support awarded in February 2014
  – First comparison meeting November 2014

• Comparison of grade penalties and gendered performance patterns across 10 institutions
  – Paper based on 5+ institutions currently in the works
Comparing an anonymous course

Big gendered performance differences found on all the campuses we examined
A big research archive: CIC plus?

• Could we build a multi-institutional dataset providing a total picture of the impact of research universities?
  – Research data: What do we do, and how much?
  – Teaching data: Who do we educate and how?
  – Outcomes: What comes of all this effort many years later?

• IRIS: Institute for Research on Innovation and Science at ISR
  – Sloan/Kauffman funded
  – Jason Owen-Smith et al.
  – Research expenditure data: a portrait of university research

• Working to add LA data

• Then census data etc: employment, life outcomes...real impacts
Building a research community at UM and beyond

Images from the 2015 SoLAR Learning Analytics and Knowledge Conference Michigan is a founding Member of SoLAR – Stephanie Teasley on the board.

Our own Dr. Chuck delivering the opening plenary: note GradeCraft is in there...
Putting the data to use
DIG: Personalization at Scale

1. Build a strong team of “innovation to infrastructure” developers: collaborate with innovators and adopters
2. Build out/combine Student Explorer and E²Coach for personalization
3. Oversee the creation of a next generation Academic Reporting Toolkit: ART 2.0
4. Establish Communities of Practice for Ed/Tech innovations: inform design
5. Help support the development of new data-driven student support tools
ART 2.0: making sure everyone can learn from our data

Draft Recommendations from the 2010/11 AAAC Study of Assessment

The following recommendations stem from a review of assessment on the UM campus undertaken by the SACUA Academic Affairs Advisory Committee during the 2010-2011 academic year. We present the recommendations here in short form. Background and more detailed explanations of the recommendations are included in the report which follows.

It is worth noting that these recommendations largely parallel the 2010 recommendations of Accreditation Working Group on the Learning Environment.

1. Take steps to improve access to and utilization of existing University data relevant to assessment.

- Support a new round of development for the ART system as a path to increasing the use of data which the University already gathers within the UM ITS Data Warehouse. Place a faculty committee with experience in assessment activities in charge of defining the new tools to be developed and the methods to be used. Provide appropriate staff support to enable development of these tools.

- Ensure that all important assessment data are federated with other University data in the data warehouse. The E&E data are of special concern in this regard.

- Increase investment in continuous assessment data by making it broadly available across the campus community (to faculty, students, and administrators) and by showing faculty, relevant staff, and administrators how to use it.
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4/6/15
Who takes a course?
What do physics majors take?

UM Grades by Course: Courses (>10 students) of PHYSICS Majors (N=291) takers since Fall 2007

What have I taken?
How have I done compared to Physics Majors?
How connected am I?
DIG Design Jam #1

- DIG will help to create ART 2.0 – a window into UM data for students, faculty and staff
- DEI and DIG will host Design Jam #1 tonight from 5:00-8:00 in the DEI Lab on Washington
- Students will help us decide what to show, when, how, and to whom

Digital Innovation Greenhouse – Design Jam #1: Course Selection and Registration in the 21st Century

Date/Time
- Date(s) - 03/27/2015
- 5:00 pm - 8:00 pm

Location
- Digital Education & Innovation Lab
- 500 E. Washington St. - Ann Arbor
- Events

Register here.

If you think selecting classes using the course guide then registering for them in Wolverine Access is easy as pie, smooth as silk, a piece of cake, child’s play, a cinch, or a walk in the park, this DIG Design Jam is not for you.

If, on the other hand, you find choosing and registering for classes a sclerotic nightmare, a hard nut to crack, like nailing jelly to the wall, finding a needle in a haystack, shaving a Yik, or swatting flies with a sledgehammer, this is it: the perfect opportunity to finally do something about it.

We’re looking for a group of student innovators willing to design tools that would demystify the course selection and registration process. These tools should give students the information they need, presented in transparent ways, at just the moment when they need it. They should help each student find rich, engaging ways to build disciplinary expertise while broadening their horizons in life-changing ways. Using data, these tools should help each student learn from the experience of all.
Putting Data to Use: tools that act directly

- Exploring Learning Analytics: projects that act directly on data
  - E²Coach: provides personalized coaching
  - Student Explorer: aggregates information in real time
  - GradeCraft: organizes data to allow game-inspired personalized classes

- How do we help develop digital engagement tools?
  - DIG: the Digital Innovation Greenhouse within DEI for on campus community building and scaling
  - Perry Samson: growing an Ed/Tech business incubator on Liberty for off-campus scaling
The future for learning analytics

• Activities of the LATF now advancing to new, potentially permanent homes
  – Data-driven tool development: the Digital Innovation Greenhouse (DIG) within the Office of Digital Education and Innovation (DEI)
  – Learning Analytics Research: the emerging Michigan Institute for Data Science, CIERS, CEDAR, UMILA
  – Larger community: industry connections, SoLAR, PLA MOOC
My own focus and goals?

• Using learning analytics tools to educate in ways which were once impossible
  – Flexible, adaptive, instructional design allowing for both student agency and attentive assessment
  – Measuring behavior and connecting it to learning
  – The ability to digest and draw information from massive amounts of rich student work: NLP at LAK
  – Remote, free, asynchronous education from experts to millions which is personalized