September 13, 2013:
Learning Analytics at U-M: An Update and Agenda for 2013-15

Tim McKay, Arthur F. Thurnau Professor of Physics and Chair of the Provost's Learning Analytics Taskforce
Learning Analytics at U-M: An Update and Agenda for 2013-15

Tim McKay

Acting Responsibly
Improving Practice
Demonstrating Impact
LA Task Force Charge

1. Explore the UM information environment and optimize for learning analytics
2. Fund a series of the best proposed LA projects at UM
3. Review the metrics used to assess teaching and learning at UM

- LATF will operate for three years
- Year 1
  - Began ELA grants program
  - First LA Fellows program
  - Continued SLAM
- Years 2 and 3
  - Final ELA grants
  - Continued SLAM and LA Fellows
  - Tool building and dissemination
LATF Membership

- **Anne Ruggles Gere:** Arthur F Thurnau and Gertrude Buck Collegiate Professor of Education, Director Sweetland Center for Writing
- **Barry Jay Fishman:** Associate Professor of Education, School of Education and Associate 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
- **William J Gehring:** Arthur F Thurnau Professor, Professor of Psychology
- **Stephanie Teasley:** Research Professor of Information, Director of the USE Lab in the University Library Digital Media Commons
- **Susan Marie Dynarski:** Associate Professor of Public Policy, Associate Professor of Education, and Associate Professor of Economics
- **Timothy A McKay (Chair):** Arthur F Thurnau Professor of Physics and Astronomy and Director of the Honors Program
- **Victor J Strecher:** Professor of Health Behavior & Health Education and Director for Innovation and Social Entrepreneurship, School of Public Health, Professor of Family Medicine
- **Joanna Mirecki-Millunchick:** Professor of Materials Science and Engineering, College of Engineering
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<th>Materials</th>
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<td>9/14</td>
<td>Tim McKay, Arthur F. Thurnau Professor of Physics and Chair of the Provost’s Learning Analytics Task Force</td>
<td>An Introduction to Student Learning and Analytics (SLAM) at U-M</td>
<td>Slides Video</td>
</tr>
<tr>
<td>9/21</td>
<td>George Siemens, Associate Director, Technology Enhanced Knowledge Research Institute, Athabasca University, Edmonton, Canada</td>
<td>Multi-Dimensional Learning Analytics</td>
<td>Slides Video</td>
</tr>
<tr>
<td>10/12</td>
<td>Learning Analytics Task Force members</td>
<td>U-M Resources for Learning Analytics Projects: Grants and Fellows Program</td>
<td>Slides Video</td>
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<td>10/19</td>
<td>Krishna Madhavan, Assistant Professor, School of Engineering Education, Purdue University</td>
<td>Interactive Large-Scale Data Analyses and Visualization for Learning</td>
<td>Slides N/A</td>
</tr>
<tr>
<td>1/9</td>
<td>Marsha Lovett, Director of Carnegie Mellon University’s Eberly Center for Teaching Excellence and Associate Teaching Professor in the Department of Psychology</td>
<td>Next-Generation Analytics with the Learning Dashboard</td>
<td>Slides Video</td>
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<tr>
<td>1/10</td>
<td>Bill Gerbing, Arthur F. Thurnau Professor of Psychology</td>
<td>Online Learning Resources in Psychology and the Bridge Program</td>
<td>Slides Video</td>
</tr>
<tr>
<td>1/23</td>
<td>Marlene Nirecki Millunchick, Professor of Materials Science and Engineering, U-M College of Engineering</td>
<td>Diverse Student Needs in Large Lectures through Screencasting</td>
<td>Slides Video</td>
</tr>
<tr>
<td>2/8</td>
<td>Dr. David Niemi, Vice President of Measurement and Evaluation, Kaplan, Inc.</td>
<td>Learning Analytics, Learning Metrics, and Learning Science</td>
<td>Slides Video</td>
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<tr>
<td>2/15</td>
<td>Nancy Kerner, Lecturer in Chemistry</td>
<td>Online Learning Resources in Chemistry and Statistics</td>
<td>Slides Video</td>
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<tr>
<td>2/15</td>
<td>Brenda Gunderson, Lecturer in Statistics</td>
<td>Ginger Shultz, Lecturer in Chemistry</td>
<td>Slides Video</td>
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<td>3/15</td>
<td>Vince Kellen, Senior Vice Provost for Academic Planning, Analytics and Technologies, University of Kentucky</td>
<td>OMG! The Future of Teaching</td>
<td>Slides Video</td>
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<td>4/12</td>
<td>Dr. Mika La/que-Manty, Arthur F. Thurnau Professor of Political Science and Philosophy; Dr. Barry Fishman, Associate Professor of Education and of Information; Stephen Aguilar, Ph.D. student in the School of Education; Caitlin Holman, Ph.D. student in the School of Information</td>
<td>GradeCraft: Exploring Online Use Data to Uncover Student Engagement</td>
<td>Slides Video</td>
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Exploring Learning Analytics Grants

• Exploring LA grants:
  – Funding for one or two years, typically at the $50-150k/year level
  – Consultation on what data is available and how to access it
  – Technical assistance for extraction of data sets
  – Consultation on statistical approaches to analysis
  – Help with applying for IRB approval for projects which require it

• 16 proposals – 8 funded

<table>
<thead>
<tr>
<th>Project Title</th>
<th>Principal Investigators</th>
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<tr>
<td>Engaging Faculty with Learning Analytics: Developing New Tools to Support Departmental Assessment</td>
<td>Mary Wright (CRLT) and Phil DeLoria (LSA)</td>
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<tr>
<td>Customized Course Advising at Michigan</td>
<td>Cinda-Sue Davis (MSTEM and WISE) and Steve Lonn (USE Lab)</td>
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<tr>
<td>Engaged Advising: Using Data to Construct a Narrative for Success</td>
<td>Meg Noori (CSP) and Steve Lonn (USE Lab)</td>
</tr>
<tr>
<td>Expanding E²Coach to Enhance Student Success in Introductory STEM Courses</td>
<td>John Wolfe &amp; Ginger Shultz (Chem), Laura Olsen (Biology),</td>
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<tr>
<td></td>
<td>Tim McKay (Physics)</td>
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<tr>
<td>Library Analytics for Student Success</td>
<td>Doreen Bradley (UM Library), and</td>
</tr>
<tr>
<td></td>
<td>Albert Bertram (UM Library)</td>
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<td>Arts at Michigan: Arts Engagement Project</td>
<td>Deb Mexicotte</td>
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<tr>
<td>Using LA to Coach Students to “Electrifying” Careers</td>
<td>Jamie Phillips (EECS)</td>
</tr>
<tr>
<td>Playful Analytics: Infusing a Learning Management System with Analytics that Motivate Learning and Support Teaching</td>
<td>Barry Fishman (SOE), Mika Lavaque-Manty (Pol. Sci.),</td>
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<tr>
<td></td>
<td>Stephanie Teasley (SI)</td>
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</table>
One example: E²Coach

- Large lecture classes are impersonal – providing generic encouragement and advice
- Student support should be aware of goals background, current status, confidence, trajectory, etc.
- Computer Tailored Communication (based on the Michigan Tailoring System) can provide this at scale.
- Personalization of education with the support of technology is a big LA theme
E²Coach has now been offered for three full terms, each time to 1900 students in all of our four large introductory physics courses. We are starting to realize the cycle back through research promised back in September 2011.
E²Coach 1: Tailored support for physics students

- Built on the *Michigan Tailoring System* developed at UM SPH
- Used LA and MTS to construct “E²Coach”: an *Electronic Expert* coaching system for intro physics courses

http://sitemaker.umich.edu/ecoach

- Original Development Team:
  - Department of Physics
  - CHCR in Public Health
- Project goals:
  - Improved performance and affect for *all* students
  - Cut performance disparities
- Offered to 5000+ students

The E²Coach I team:
Tim McKay, Kate Miller, Jared Tritz, Madeline Huberth in Physics
Vic Strecher, Ed Saunders, Holly Derry, Mike Nowak at CHCR
How does E²Coach work?

Where the real effort lies

Expertise of hundreds of students, dozens of instructors and behavior change experts

Detailed information about thousands of students and their current status

Individually personalized messages:
- what we all agree we would say to each student, if only we could...

The Michigan Tailoring System: a mature open-source software system for creating content designed specifically for an individual based on data about that individual

9/16/13

SLAM Kickoff 2013
With the final coming soon, let's come up with a study strategy that will help you to improve your exam scores. E²Coach wants to help make sure your studying goes the way you want it to!

It isn't just about how much time you're spending, but also about how you're spending that time. Let's take a minute to reflect:

1. Write down all the things you did to prepare for Exam 3
2. Which of these study techniques worked for you?
3. Which of these didn't work?
4. Are there resources you could be taking advantage of? The Physics Help Room? Office Hours?

Below are (What we think are) 'The 6 Most Important Things for Final Exam Studying'

To help you gauge how on track you are for a B that you're aiming for, E²Coach predicts your final grade by using your grades so far. You'll see this updated plot after each exam.
Impact of $E^2$Coach: first three terms

- Historical data shows that GPA in other UM classes is the best performance predictor.
- GPA accounted for 32% of the variance in students’ final physics grades, whereas when SAT and ACT scores predict only 13% of the variance in students’ final physics grades when considered together, without GPA.

- BTE score measures relative success:

$$BTE(G_{\text{actual}}, GPA) = \frac{G_{\text{actual}} - G_{\text{exp}}(GPA)}{\sigma_{\text{exp}}(GPA)}$$

- Four user groups defined for the first year data: non, low, medium and high users.

- Usage based on visits to the system and the number of independent weeks visited.
### Table 3: Descriptive usage characteristics of the user groups by term.

<table>
<thead>
<tr>
<th></th>
<th>Winter 2012</th>
<th></th>
<th>Fall 2012</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low Users</td>
<td>Moderate Users</td>
<td>High Users</td>
<td>Low Users</td>
<td>Moderate User</td>
</tr>
<tr>
<td>Number of Students</td>
<td>455</td>
<td>298</td>
<td>190</td>
<td>204</td>
<td>228</td>
</tr>
<tr>
<td>Mean Clicks</td>
<td>3.28 (3.39)</td>
<td>22.69 (11.23)</td>
<td>48.12 (28.46)</td>
<td>17.27 (5.07)</td>
<td>28.68 (10.54)</td>
</tr>
<tr>
<td>Mean Unique Weeks Visited</td>
<td>.86 (.68)</td>
<td>2.90 (.94)</td>
<td>6.51 (1.66)</td>
<td>1.55 (.54)</td>
<td>3.49 (.90)</td>
</tr>
<tr>
<td></td>
<td>Winter 2013</td>
<td></td>
<td></td>
<td></td>
<td>Note: Clickstream data and the number of weeks visited informed the user groups’ formation. Low users had clickstreams equaling or less than the median of their term and had two or fewer weeks of visits. High users had clickstreams above their term’s median, and visited at least five weeks of the sixteen-week term. Moderate users included the other types of usage behavior.</td>
</tr>
</tbody>
</table>
\[ \text{BTE}(G_{\text{actual}}, GPA) = \frac{G_{\text{actual}} - G_{\text{exp}}^{\text{course}}(GPA)}{\sigma_{\text{exp}}^{\text{course}}(GPA)} \]
Table 4: Descriptive preparation characteristics of the user groups.

<table>
<thead>
<tr>
<th>HS Physics Level</th>
<th>Mean BTE Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>none</td>
<td>-0.4</td>
</tr>
<tr>
<td>non AP</td>
<td>-0.2</td>
</tr>
<tr>
<td>AP</td>
<td>0.0</td>
</tr>
<tr>
<td>HS</td>
<td>0.2</td>
</tr>
<tr>
<td>Physics Level</td>
<td>0.4</td>
</tr>
</tbody>
</table>

High school physics has a significant impact on performance

Additional information gathered through E²Coach provides rich research resources
Gender performance disparity in Physics 140

Male students

Female students

Incoming GPA
Male and Female students both show improved performance, but female students still fall behind male students.
This fall: Big E\textsuperscript{2}Coach Expansion

• This term, E\textsuperscript{2}Coach is being offered physics, Chem 130, Stats 250, and MCDB 310
• 5183 students enrolled in these courses today
• For this, we have built a large new E\textsuperscript{2}Coach team including development groups from each course
  • Physics: McKay, Tritz, Michelotti, Huberth, Murdock, Debolt, Rosenberg, Chen
  • Stats: Gunderson, Caccaglia, Nielsen, Chavez, Mohapatra
  • Chem: Wolfe, Shultz, Ingelhardt, Sipowska, Konopko, Brancho
  • MCDB: Olsen, Balazovich, Trakimas

Support from ELA (Chem/Bio/Physics) and an NSF TUES-Type I grant (Stats)

9/16/13
Explore our coached courses!

- Fall 2013
  Stats 250
  ACTIVE
  Enter Coach

- Fall 2013
  Chemistry 130
  ACTIVE
  Enter Coach

- Fall 2013
  Physics 140, 240, 135, 235
  ACTIVE
  Enter Coach

- Fall 2013
  MCDB 310
  ACTIVE
  Enter Coach
Welcome to the MCDB310 E²Coach!

Welcome to E²Coach for Introduction to Biochemistry! We have a ton of tools to share with you to make this tricky class a little easier to handle. Here's what you can expect:

- Informative messages tailored to your goals and experiences
- Advice from MCDB310's most successful past students
- Detailed score breakdowns with visual comparisons and analysis
- Tips from your professors on studying and exam taking
- Resources to help you learn the material
- An up-to-date class calendar with reminders

You have already taken the E²Coach initial survey. If you'd like to verify that all your information is still correct, click here.

Click here to answer questions about MCDB310 specifically. Completing this survey releases your first message.

Check out our rotating tips below! You'll see a new one into the scientific literature has been made to show you what NOT to do, but also for your amusement.
Welcome! This site serves random problems from past exams given in courses at the University of Michigan.

Pro
blem
Ro
u
tt
le

You have attempted 5 problems and you got 3 right. Your accuracy is 60%. Your average time per problem is 38.8 seconds.

<table>
<thead>
<tr>
<th>Name</th>
<th>Date</th>
<th>Your Answer</th>
<th>Correct Answer</th>
<th>Time (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stats 250 Exam 1 F12 Problem 3</td>
<td>2013-09-12 13:10:01</td>
<td>B</td>
<td>B</td>
<td>19</td>
</tr>
<tr>
<td>UM Physics 135 Midterm 2 Fall 11 Problem 14</td>
<td>2013-08-28 10:50:01</td>
<td>D</td>
<td>D</td>
<td>16</td>
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<tr>
<td>UM Physics 135 Midterm 2 Fall 11 Problem 10</td>
<td>2013-08-16 14:41:48</td>
<td>C</td>
<td>C</td>
<td>83</td>
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<tr>
<td>UM Physics 135 Midterm 2 Fall 11 Problem 12</td>
<td>2013-08-15 14:23:48</td>
<td>D</td>
<td>E</td>
<td>36</td>
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<td>UM Physics 135 Midterm 1 Fall 11 Problem 19</td>
<td>2013-08-15 10:28:50</td>
<td>C</td>
<td>D</td>
<td>40</td>
</tr>
</tbody>
</table>
Winter 2013 LA Fellows Program

• Learning Analytics Fellows program
  – Winter 2013, two hours/week, projects and training
  – 17 senior & 14 junior fellows, most in teams

• Discussions of IRB, privacy, ethics, statistics, analysis approaches etc.

• One immediate consequence of the Fellows program – larger scale analysis of student performance patterns in classes

• Examined chosen classes for the relation between preparation and performance
Grade penalty = \<\text{GPA} - \text{Grade}\>
Small grade bonus

-0.13
Grade penalty and gender performance disparities for all 38 ‘giant’ classes at Michigan, with average enrollment > 400

Large courses using MC and SA exams for the majority of their grading
What’s going on here?

• In the US, women ‘underperform’ in many standardized testing environments

• Stereotype threat in socially constructed environments can easily cause this kind of ~10% performance difference

• The ‘law-like’ prevalence of these disparities challenges acultural explanations

• Could changing evaluative style change this performance pattern?
Learning Analytics Fellows Program
Winter 2013
Fridays, 11:00 a.m. - 1:00 p.m.

(Sessions with * before the date will consist of a meeting of the Fellows followed by attendance at the SLAM presentation).

LA Fellows Site: http://tiny.cc/LAfellows
SLAM Site: www.crit.umich.edu/slam
SLAM talks from last year: http://sitemaker.umich.edu/slam/schedule

If you have trouble accessing the editing functions of the Google Site, go to
https://sites.google.com/a/umich.edu and click on the Learning Analytics Fellows site there. I have no idea
why the site sometimes doesn’t recognize that you should have editing privileges. (RN)

By the end of this program, Fellows will:

- Be able to identify potential data sources from their teaching or professional work.
- Have explored data sets relevant to their teaching/professional work.
- Develop ideas for ways to apply learning analytics to improve teaching and learning at U-M.
- Be able to develop a proposal for an analytics project that could be submitted for an ELA
  (Exploring Learning Analytics) or Investigating Student Learning (ISL) Grant that
demonstrates an understanding of quasi-experimental methods, privacy concerns and the
future impact of the project.
- Develop a visualization describing their projects, results and future plans
New work on student trajectories

• Bringing together student records for all courses over the 1996-2012 period
• Examining how students move through the course sequences in a department
• Beginning to characterize individual student progression in more personalized ways
• How are they doing compared to similar students following comparable paths through the campus?
Enrollment in physics classes
Gender representation in physics

National fraction of Physics Degrees...
Enrollment in history classes
Gender representation in history
Avg. grades in physics

[Graph showing the relationship between average grades and average year of students for various physics courses, with specific courses like PHYSICS161, PHYSICS261, PHYSICS106, etc.]
Avg. grades in history
Avg. grades in history by gender
Fraction that Completed PHYSICS240
by Grade in PHYSICS140

Grade

Male
Female
Low Income
High Income
Good data supports grant-seeking

- Carl Weiman’s NSF WIDER grants: introductory teaching should be evidence-based and assessed
- Grant application for this supported by strong LA data about current state
- Received $2M, 3 year grant to support reform efforts in Physics, Chem, Bio, and Math starting in Jan. 2014
- Departmental reform teams supported by an interdisciplinary REBUILD committee: Researching Evidence Based Undergraduate Instructional and Learning Developments
- A rare opportunity to rethink these key courses – our chance to make a generational change in how we do this
Interactions with the larger community

• Society for Learning Analytics Research
  – UM a founding member

• International meeting

• Our own data would be greatly enhanced by combination with other institutions

• Exploring parallel analyses and data sharing across the CIC (Big Ten & U Chicago)

• Meeting held in July – slow but steady progress
Attempt at parallel analysis between Michigan and Minnesota: Intro Physics, Chem, Stats, and MCDB compared at the two...

Intriguing, but reveals the challenges of parallel analysis as well.

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<thead>
<tr>
<th></th>
<th>Minnesota</th>
<th>Michigan</th>
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<tbody>
<tr>
<td></td>
<td>M</td>
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<tr>
<td>Biochemistry</td>
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<td>.50</td>
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<tr>
<td>Physics</td>
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<td>.32</td>
</tr>
<tr>
<td>Statistics</td>
<td>.07</td>
<td>.08</td>
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</table>

Grade penalties by gender
MOOCs etc.

• Data from Michigan Coursera classes now flowing to Stephanie Teasley’s USE lab
• New postdoc there working on the analysis, in parallel with teams at other Coursera institutions
• They’ll be reporting on this at a SLAM talk later this semester
What’s coming for LATF

• Report with suggestions for changes in the teaching evaluation process (next SLAM talk)
• Design requirements for tools which will expose data to students, faculty, and administrators
• We will be looking for suggestions about what these tools ought to do
• New SLAM series this year – schedule online
• New LA Fellows group starting Jan. 2014, more focused: announced 10/15, appl. due 11/15
Student Learning and Analytics at Michigan (SLAM)

Sponsored by the Provost’s Task Force on Learning Analytics, Student Learning and Analytics at Michigan (SLAM) is a speaker series. Presenters will focus on the analysis and use of data about students, courses and academic programs— for the purposes of improving teaching and learning.

Click on individual topics below to register for upcoming events in the SLAM series. To view events from 2011-2012, click here.

### Academic Year

<table>
<thead>
<tr>
<th>SLAM 2012-2013</th>
<th>Apply</th>
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<td>SLAM 2013-2014</td>
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#### SLAM 2013-2014

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<th>Presenter(s)</th>
<th>Title</th>
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<tbody>
<tr>
<td>9/27</td>
<td>Mika LaVaque-Mnty &amp; David Cottrell, U-M Political Science</td>
<td>Evaluation of Teaching at U-M</td>
</tr>
<tr>
<td>10/4</td>
<td>Dan Russell, Google</td>
<td>Teaching 150K+ Students at a Time: The PowerSearchingWithGoogle.com Story</td>
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<tr>
<td>10/11</td>
<td>Steve Lonn, Stephanie Teasley &amp; Eric Koo, U-M USE Lab</td>
<td>Massive Michigan: A First Look at the Analytics of UM’s 2012-13 MOOC Courses</td>
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<tr>
<td>10/25</td>
<td>Virginia Kuhn, University of Southern California</td>
<td>Video Analytics: From Keywords to Keyframes</td>
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<tr>
<td>11/1</td>
<td>Christine Modey, Sweetland Center for Writing, U-M</td>
<td>Online Learning Resources in the Humanities and Engineering: Making and Measuring</td>
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<tr>
<td>11/15</td>
<td>Dan Hickey, Indiana University</td>
<td>Digital Badges</td>
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