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Actionable Research through Learning Analytics

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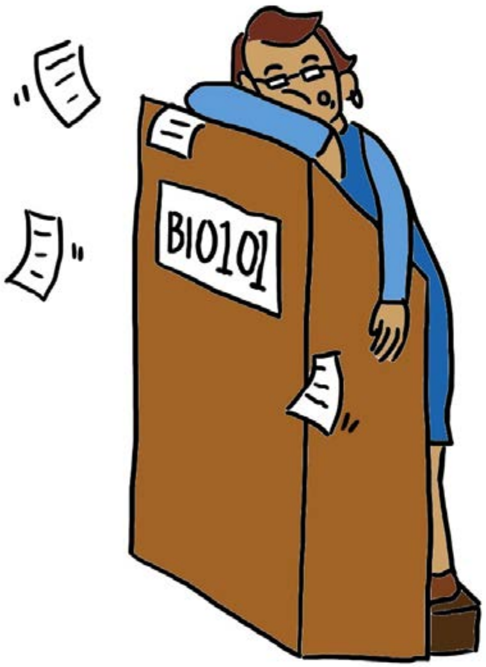
LED Lab
learning, education & design

SOLAR
SOCIETY for LEARNING ANALYTICS RESEARCH

“A new culture of learning needs to leverage social & technical infrastructures in new ways.” John Seeley Brown



Talk Overview

- SoLAR community
- Learning Analytics basics
- Learning Analytics at University of Michigan
- Where do we go from here…?

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Learning Analytics is…

"The measurement, collection, analysis and reporting of data about learners and their contexts for purposes of understanding and optimizing learning and the environments in which learning occurs."

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SoLAR: International Community for LA Research

Society for Learning Analytics Research (SoLAR)

Annual Conference

International Conference on Learning Analytics & Knowledge (LAK)

- Sydney, Australia March 5-9, 2018
- Phoenix, Arizona March 4-8, 2019

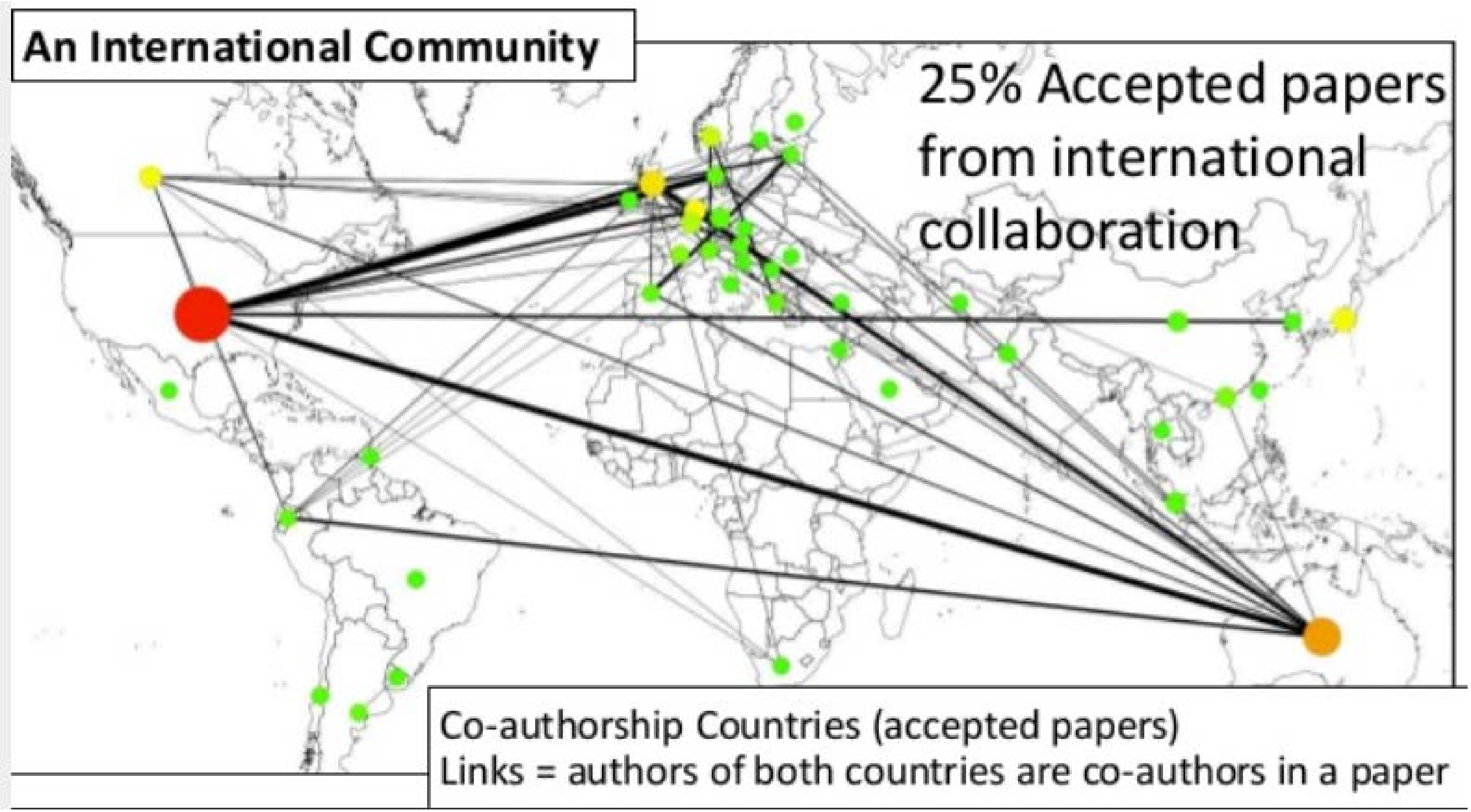
Summer Institute

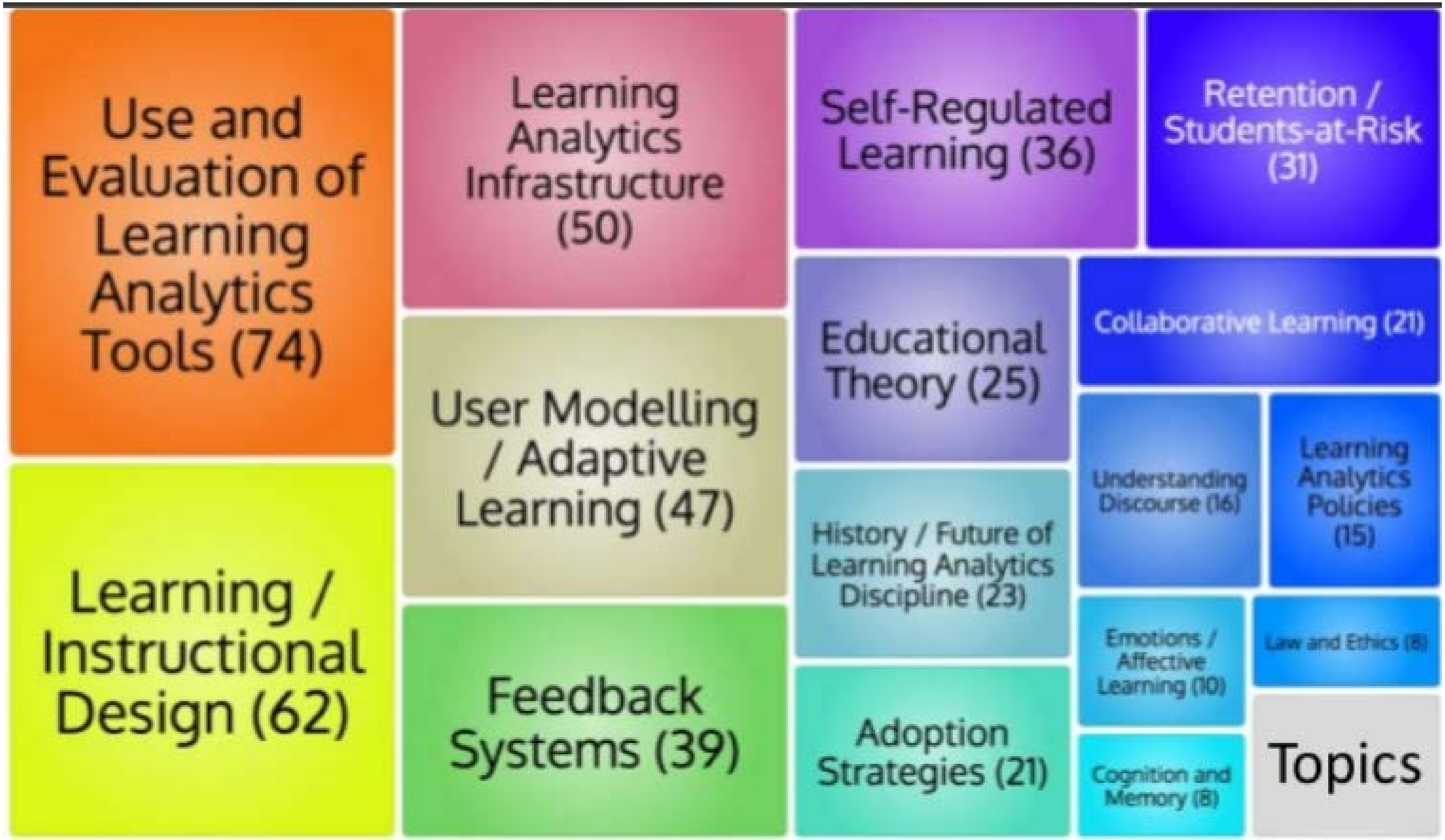
Learning Analytics Summer Institute (LASI)

- Teacher's College, New York June 11-13, 2018

Journal

- Journal of Learning Analytics


An International Community
25% Accepted papers from international collaboration
Co-authorship Countries (accepted papers)
Links = authors of both countries are co-authors in a paper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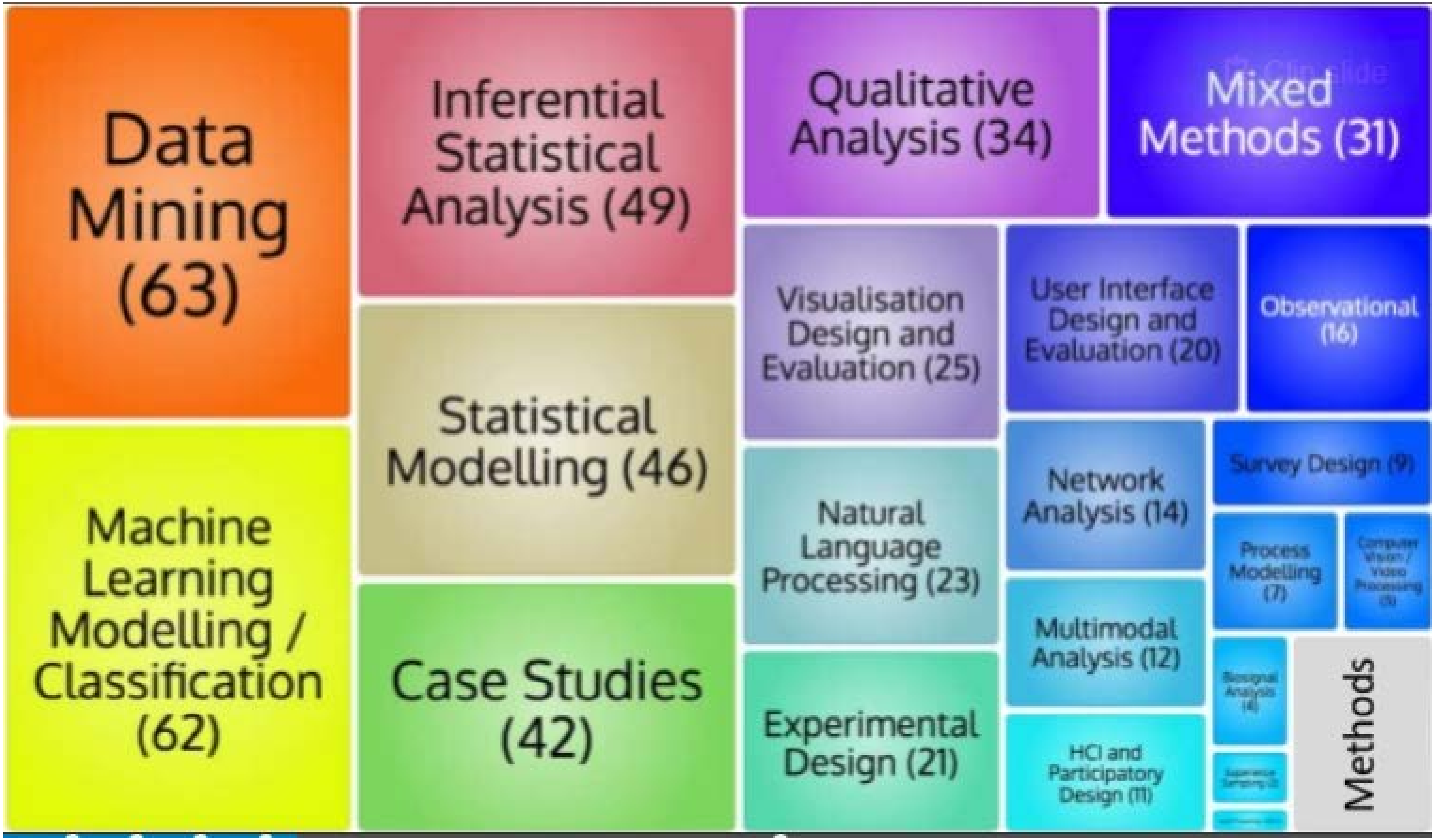
Topics


Data Mining (63)
Inferential Statistical Analysis (49)
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Methods

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Google Scholar

Search Scholar

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    - Educational Technology
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  - Humanities, Literature & Arts
  - Life Sciences & Earth Sciences
  - Physics & Mathematics
  - Social Sciences
- Chinese
- Portuguese
- Spanish
- German
- Russian

GO LAK!

Top publications - Educational Technology   Learn more

	Publication	h5-index	h5-median
1.	Computers & Education	88	121
2.	British Journal of Educational Technology	48	66
3.	The Internet and Higher Education	43	68
4.	Journal of Educational Technology & Society	41	62
5.	Journal of Computer Assisted Learning	40	63
6.	The International Review of Research in Open and Distributed Learning	38	85
7.	Educational Technology Research and Development	32	50
8.	International Conference on Learning Analytics And Knowledge	32	49
9.	Australasian Journal of Educational Technology	31	47
10.	International Journal of Computer-Supported Collaborative Learning	28	38
11.	IEEE Transactions on Learning Technologies	27	42
12.	TOJET: The Turkish Online Journal of Educational Technology	26	48
13.	TechTrends	26	40
14.	Distance Education	25	47
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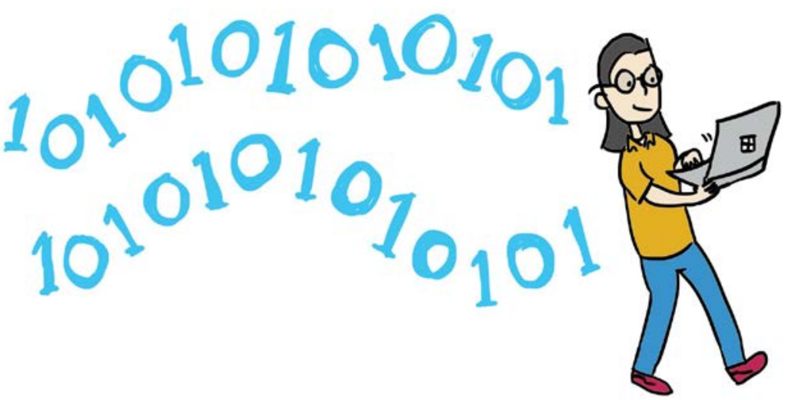
Learning Analytics Basics

LA: Data Science for Education

We have been doing research on educational data for a long time…

What's changed?

- Theories about learning
- Pedagogy
- New data sources



Data-Rich Environment: Evidence of Learning

Process of learning: How we learn

– Multi-modal records of student activity: clickstream from online tools, sensor data, eye tracking, library use, resources accessed, etc.

Products of learning: What we know

– Discussion posts, blogs, tweets, hashtag use, etc.

Datasets & Sources

Uses data drawn from learning technologies and related information available in the **student data warehouse** and **vendor tools**:

- grades and student records,
- written evidence of learning (e.g. essays and assignments), and
- temporal interactions (e.g. engagement with course resources, textbooks, and tools)

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Examples of LA Methods

Sequence Mining

- RQ: How do course selections influence GPA?

Prediction Models

- RQ: Among freshman entering with strong high school record (GPA > 3.8), who will do poorly (GPA < 2.0) at the end of their first year?

Clustering

- RQ: Given three categories – under achieving, over achieving, as expected – what categorizes the students who are under achieving?

Text Mining

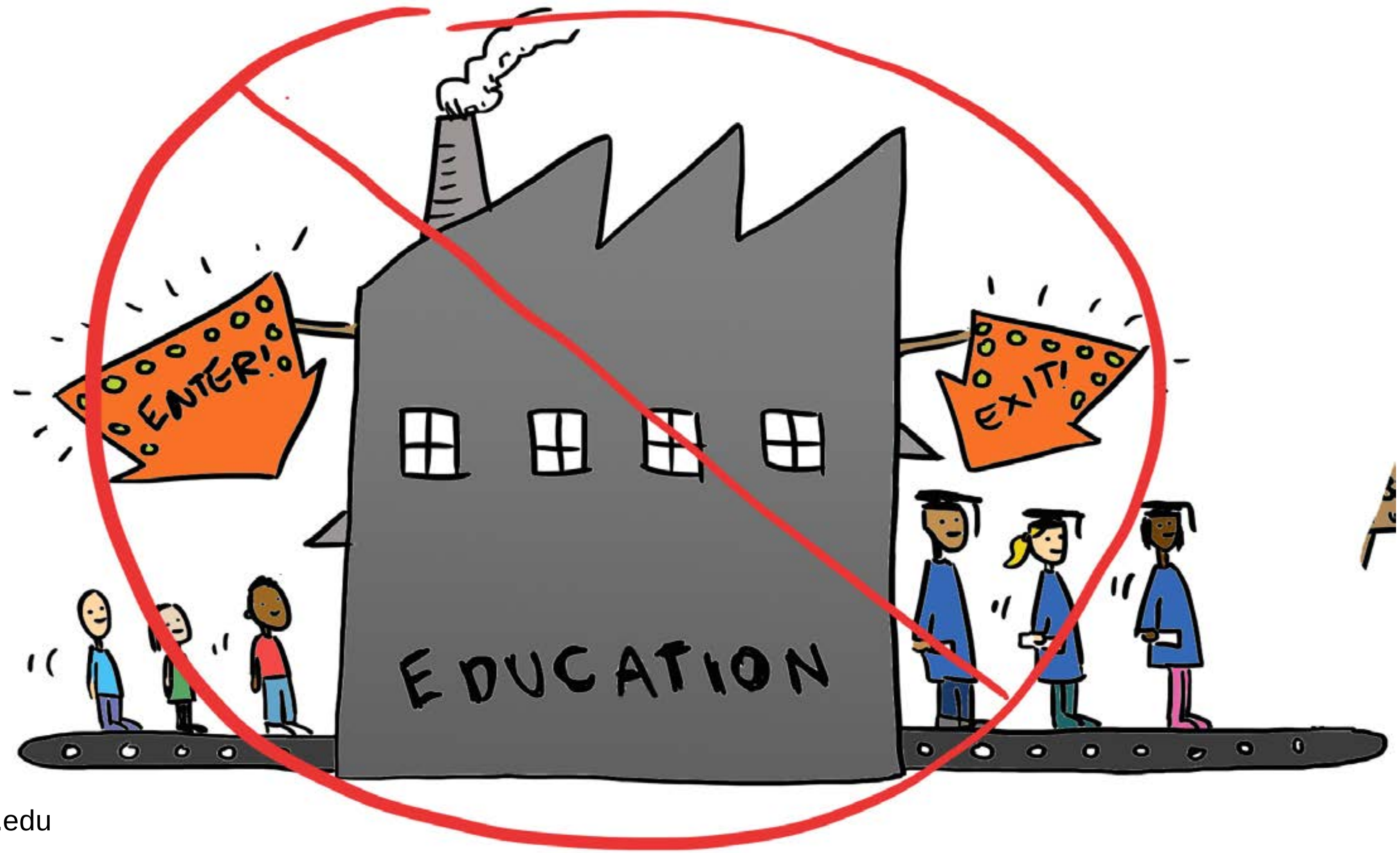
- RQ: Can we classify students based on messages they contribute to a discussion forum?

Potential Applications

- Predict student success
- Identify opportunities for intervention
- Determine what a learner does/does not know
- Monitor a student's behavior & engagement level
- Personalize the learning process
- Help instructors refine content
- Measure student improvement beyond test scores
- Improve student retention & completion

adapted from http://www.edudemic.com/big-data-education-2/

UM's Institutional Initiative to Leverage Learning Analytics



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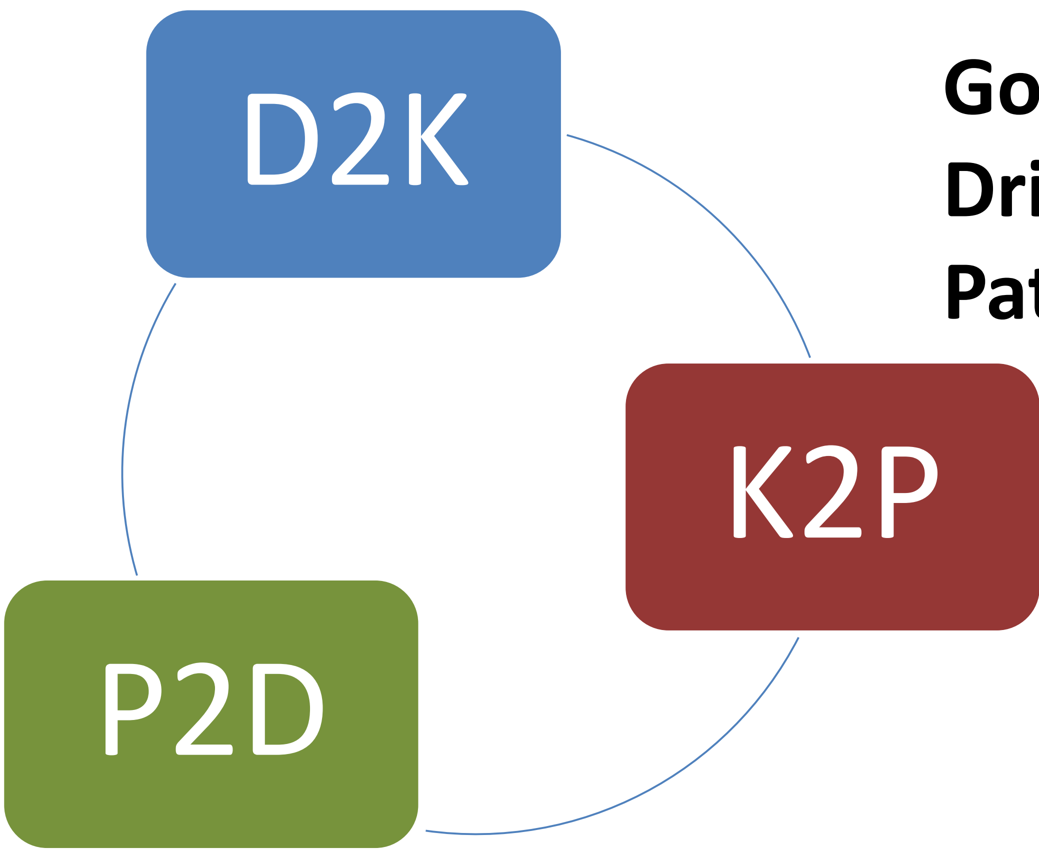
Actionable Research:
Data to Knowledge to Practice



Goal= Create Data-Driven Academic Pathways to Success

Learning Analytics @ UM

- Brief History
- Key Drivers
- Goals
- New tools and practices
- Where are we going

UM Context: Large Public Research-Intensive University

- 200 Years old
- 19 Schools and colleges
- 6,800 faculty
- 29,00 undergraduates; 15,700 post-graduates
- 9,200 total courses offered
- 110 courses have 200+ students enrolled [1/3 of all credit hours]

My Early LA Investigations @ UM

Supporting PhD student progress (2005)

Supporting faculty research collaboration (2006)

Social tagging (2007)

Supporting student collaborations (2007)

Understanding LMS use (2009)

“The pervasiveness of these systems [LMS] calls for larger studies across courses, disciplines, and institutions where the *lessons learned* can be generalized and more widely disseminated.”

Brief History of LA @ UM

- Integrated student data warehouse established
- Individual faculty projects (e.g., my early work)
- Symposium on Learning Analytics at Michigan (SLAM)
- Provost-supported Learning Analytics Task Force
- Creation of Office of Academic Innovation
- Identified thrust area for new Michigan Institute for Data Science (MIDAS)
- Host SoLAR's learning analytics summer institute (LASI 2016 & 2017)

Goals for UM Learning Analytics Work: Learn from Every Student

Provide an integrated **student data ecosystem** for research leading to student success

Create **unique a test bed** for investigating student learning, including text processing and real-time applications

Protect **student privacy** while maximizing usefulness of data

Demonstrate **value and scalability** of existing and future high-value applications

Current UM Datasets & Sources for Learning Analytics

(circa 1996-present)

- Student Records
- Recruiting & Admissions
- Financial Aid / Student Financials
- College Resources Analysis System (CRAS): Collapsed Instructor & Course data
- Human Resources & Payroll
- LMS: CTools / Canvas
- Kaltura video content
- Lecture Capture

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ABOUT | SUPPORTING STUDENTS | DATA & RESEARCH | BLOG | NEWS

LEARNING ANALYTICS DATA ARCHITECTURE (LARC)

DATA & RESEARCH

LEARNING ANALYTICS DATA ARCHITECTURE (LARC)

WHAT IS LARC?

The Learning Analytics Data Architecture (LARC) Data Set is a research-focused data set containing information about students who have attended the University of Michigan since the mid-1990s. The data is meant to help answer typical learning analytics questions about students, their academic careers, and their class outcomes. The data is divided into that which is constant throughout a student's academic career (e.g., ethnicity, SAT test scores, high school GPA, and earned degrees), that which can change from term to term (e.g., academic level, academic career, term GPA, and enrolled credits), and that which can change from class to class (e.g., subject, catalog number, earned grade, etc.).

From Innovation to Scale

- Faculty innovators develop TEL tools
- Research teams test them (small scale)
- If effective, need to move from innovation to infrastructure (large scale)

  and

- Research teams evaluate commercial products

DIG Digital Innovation Greenhouse

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Supporting Academic Advisors

Teasley, Lonn, et al.

Student Explorer: Early Warning System

- User Centered Design: developed with academic advisors
- Uses real-time data from LMS
- Underlying algorithm calculates students' risk by norming grade and activity on a course-by-course basis
- Began in 2010 with 4 advisors in 1 program with data from 100 freshman
- Now – 67+ advisors in 5 programs with data from 16,000+ undergrads
- Key tool for identifying struggling students before it's too late to intervene

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Students

Name ▾	Student ID	Status

Course Site ▾
EECS 281 W16
MATH 116
MATH 116 019 WN 2016
PHYSICS 140 100 W16
STATS 250 WN 2016

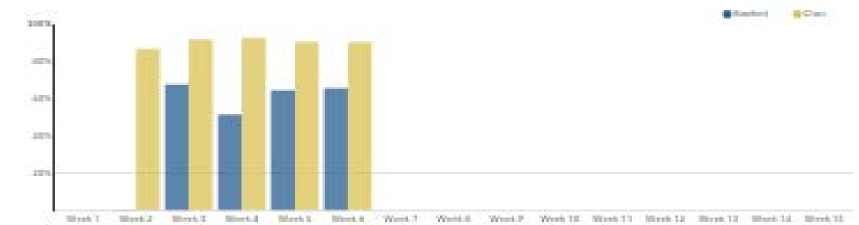
Help improve Student Explorer by sending us your feedback: student-explorer-help@umich.edu

< Back to Course List

Course Site: ASTRO 142 001 WN 2016

Data Source: Canvas

Cumulative Score



Weekly Activity

Assignments

Note that this list may not reflect all assignments included in current score calculation. For a complete list, please refer to the source system.

Assignment	Due Date	Points Earned/Possible	Student Percentage	Class Average	Grader's Comment
Mid-term exam		/ 30	0.0%	100.0%	
Pre-class 2/18 (Practice Test)		/ 25	0.0%	100.0%	
Final exam		/ 60	0.0%	100.0%	
Pre-class 1/19	Jan 19, 2016	10 / 10	100.0%	92.8%	
Pre-class 1/21	Jan 22, 2016	10 / 10	100.0%	89.8%	
Weekly Project 1	Jan 26, 2016	0 / 20	0.0%	101.0%	
Pre-class 1/26	Jan 26, 2016	10 / 10	100.0%	90.4%	
Weekly Project 2: part 2	Jan 27, 2016	5 / 5	100.0%	80.5%	
Weekly Project 2: part 1	Jan 27, 2016	15 / 15	100.0%	93.0%	
Pre-class 2/2	Feb 2, 2016	9.17 / 10	91.7%	86.9%	
Weekly Project 3: part 2	Feb 3, 2016	6 / 10	60.0%	69.5%	

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Research Questions

- How do advisors use dashboard & how does advisor use affect student performance?

- How do students interpret dashboards & how does that affect their motivation?

Supporting Students

E Coach

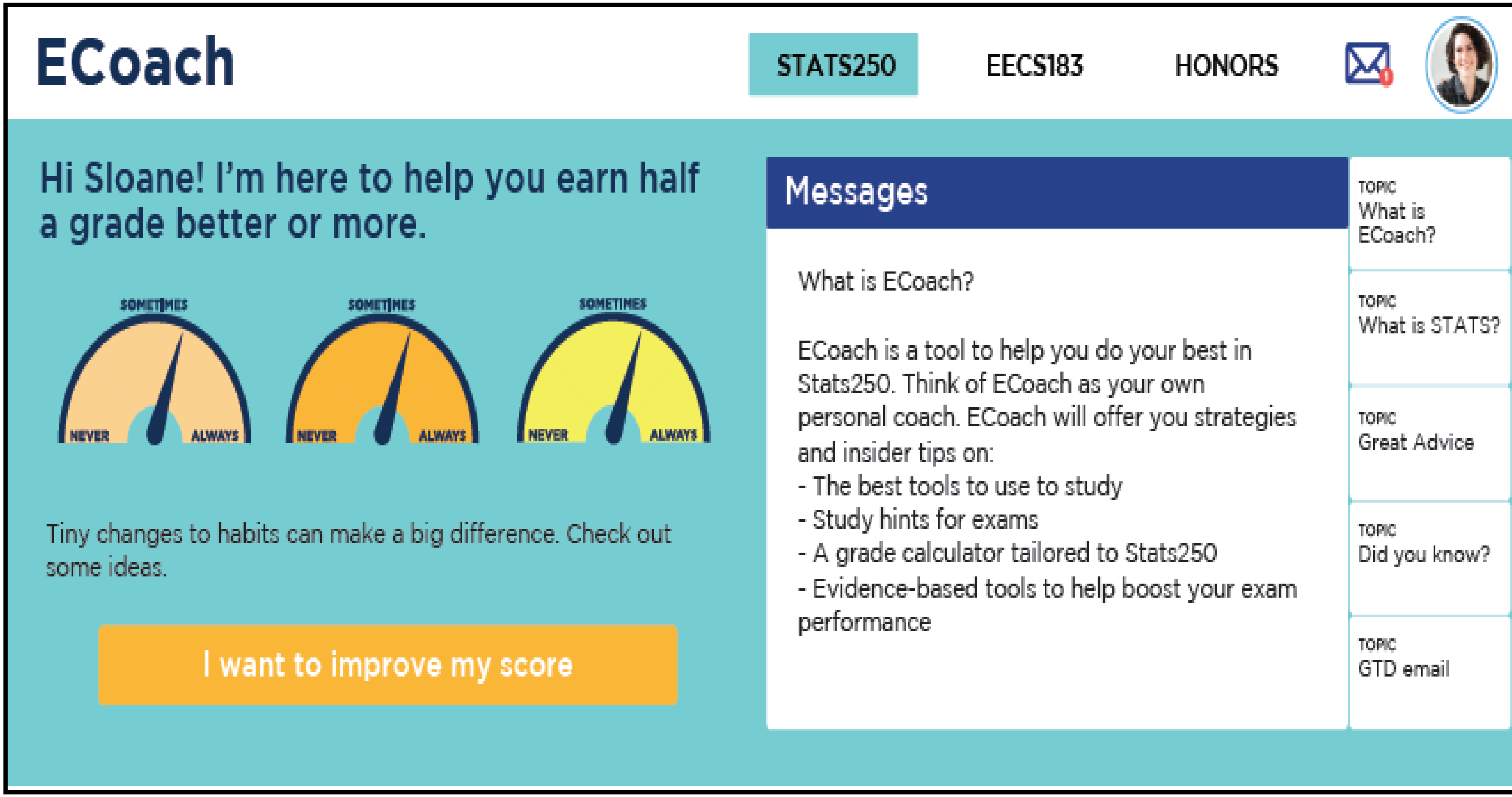
[E²] COACH

Personalized Messaging to Students

McKay, et al.

ECoach: Tailored Communication

- Built on digital health coaching system
- Uses real-time info about students to tailor feedback, advice, & encouragement
- Tailoring what to say and how to say it: testimonials from peers, behavior change experts
- Used since 2012 by 10,000+ students
- Delivered to every student in fall term
- Designing interventions to change the future for students

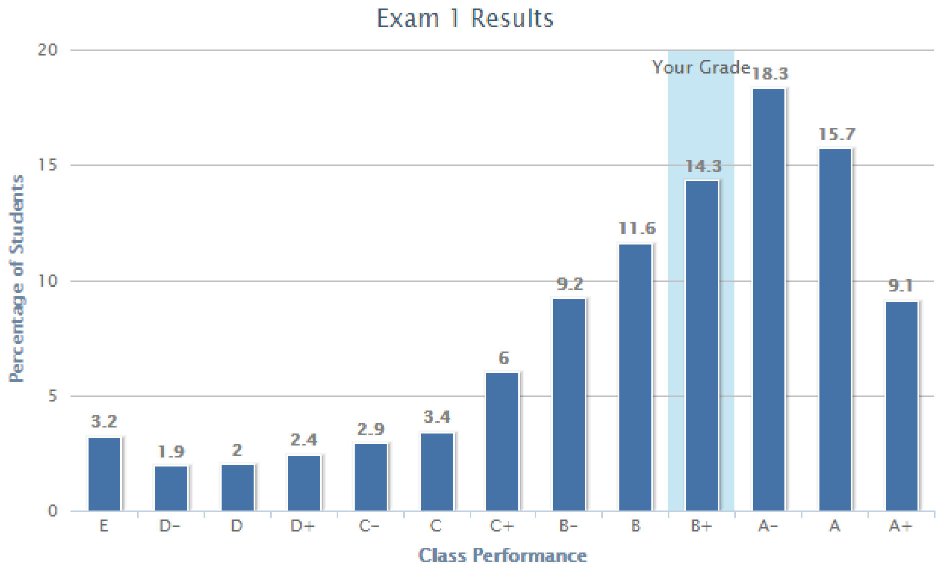

ECoach
STATS250
EECS183
HONORS
Hi Sloane! I'm here to help you earn half a grade better or more.
SOMETIMES
NEVER
ALWAYS
SOMETIMES
NEVER
ALWAYS
SOMETIMES
NEVER
ALWAYS
Tiny changes to habits can make a big difference. Check out some ideas.
I want to improve my score
Messages
What is ECoach?
ECoach is a tool to help you do your best in Stats250. Think of ECoach as your own personal coach. ECoach will offer you strategies and insider tips on:
- The best tools to use to study
- Study hints for exams
- A grade calculator tailored to Stats250
- Evidence-based tools to help boost your exam performance
TOPIC
What is ECoach?
TOPIC
What is STATS?
TOPIC
Great Advice
TOPIC
Did you know?
TOPIC
GTD email

Welcome back, Zoe.

You made it through the first statistics exam.

You scored a **63 out of 75 points** or **84.0 %**, which corresponds to a letter grade of **a B+.**

Here is where your exam grade falls in the class-wide distribution of exam grades.



What can you do now?

Research Questions

- Can techniques from health behavior interventions lead to changes in student behavior?
- Which are the important features of personalization to create effective feedback?

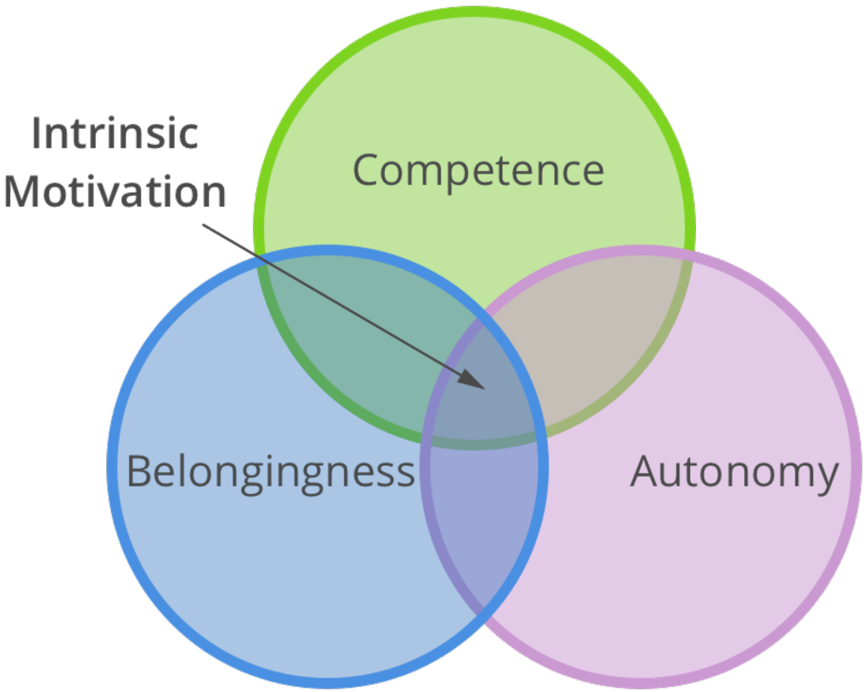
Supporting Faculty

Fishman, Holman, et al.

GradeCraft:
Gameful Learning Management System

- An LMS – with a couple of key changes
- Instructors design more assignments than students need to do, giving students autonomy over their work (within bounds)
- All students start with 0 points and earn up to the grade they want
- Grade Predictor tool to help students set goals
- Used since 2011 by 30 instructors, 10,000+ students in 58 courses
- Key tool for supporting autonomy and intrinsic motivation in the classroom

A Pedagogical Approach Inspired by Good Games



Based on Self-Determination Theory

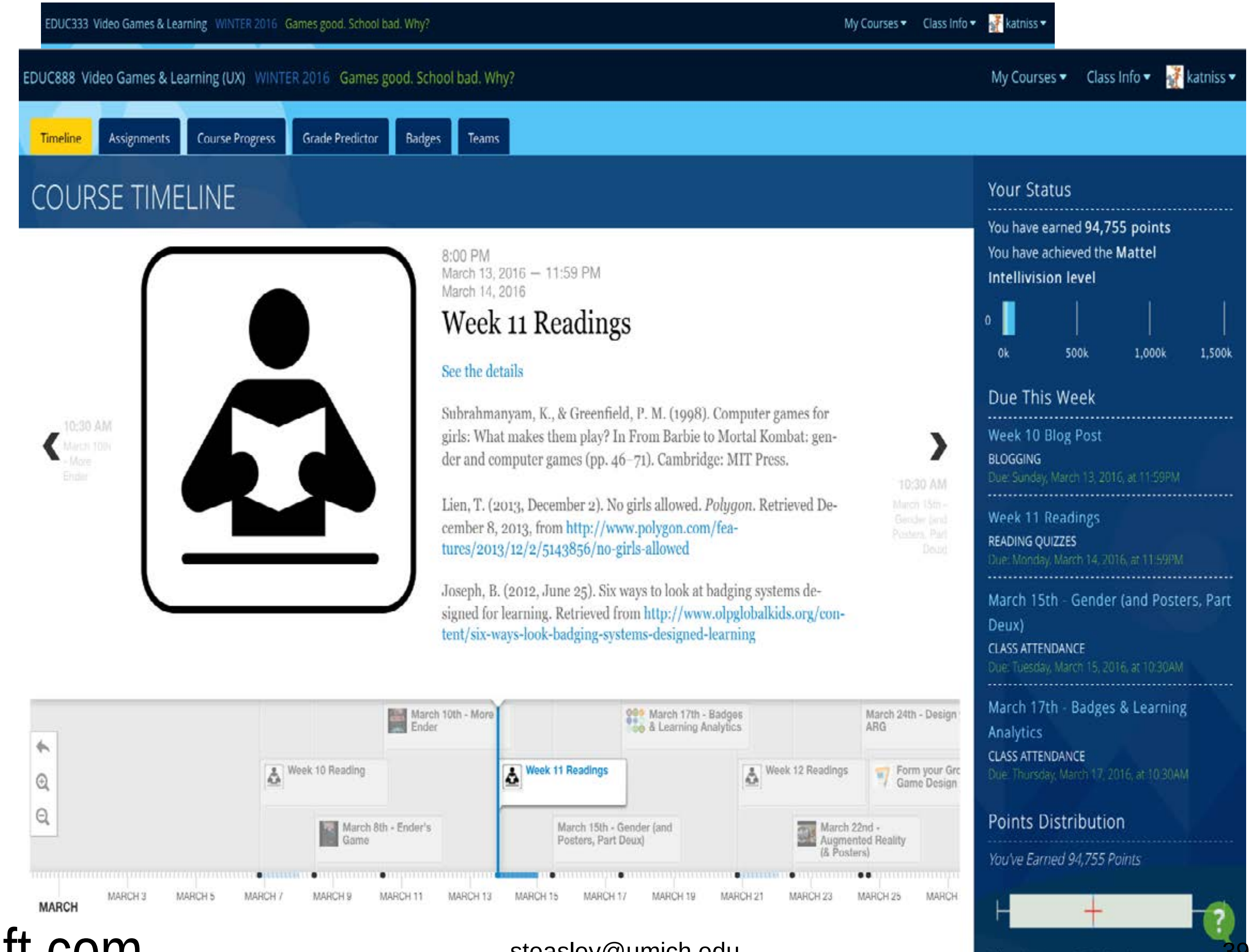
Earn up

Increased Autonomy

Freedom to Fail

Tangible Progress

Design Elements



gradecraft.com

Research Questions

- How does assignment choice affect student success?
- How do students strategize about assignment selection based on their achievement orientation?
- How does course context affect student strategies?

http://gamefulpedagogy.com/

My Current Focus: Learner Dashboards

- Enables students to monitor their progress and compare their performance against that of their peers.

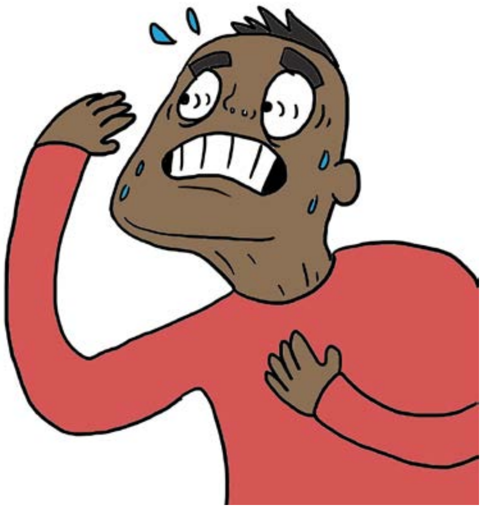
- Goal = supports metacognition and self-regulation

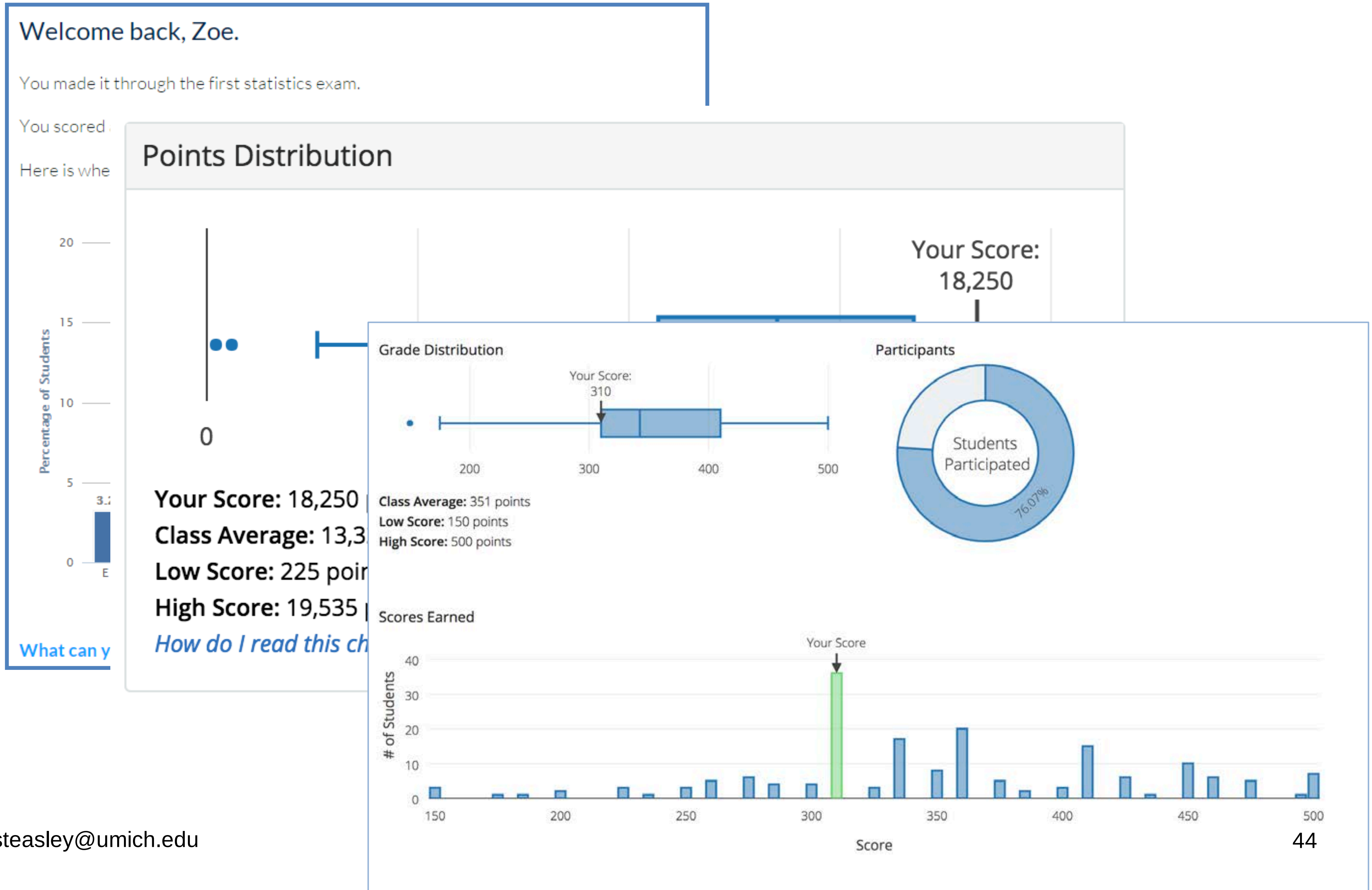
Need for Research

- Bodily and Verbert (2017) reviewed 93 studies of systems presenting some data to students:
  - Reported visualization design = 0
  - Did needs assessment = 6%
  - Did usability testing = 11%
  - Study effect on student behavior = 16%

Open Questions

- Are students able to interpret the information provided, and do they know what to do with it?
- Which students find this information motivating versus demotivating, and under which circumstances?



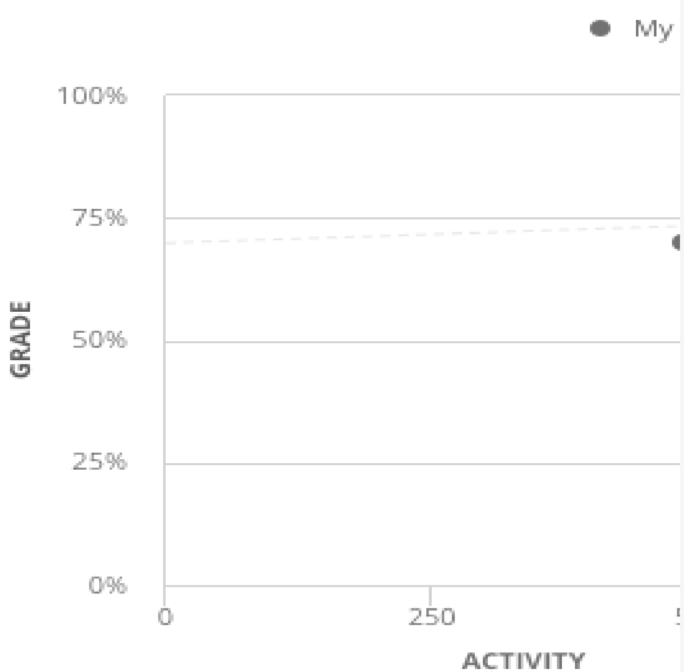

Welcome back, Zoe.
You made it through the first statistics exam.
You scored
Here is whe
Percentage of Students
What can y
Points Distribution
Your Score: 18,250
Your Score: 18,250
Class Average: 13,3
Low Score: 225 poir
High Score: 19,535
How do I read this ch
Grade Distribution
Your Score: 310
200
300
400
500
Class Average: 351 points
Low Score: 150 points
High Score: 500 points
Participants
Students Participated
76.07%
Scores Earned
Your Score
# of Students
Score

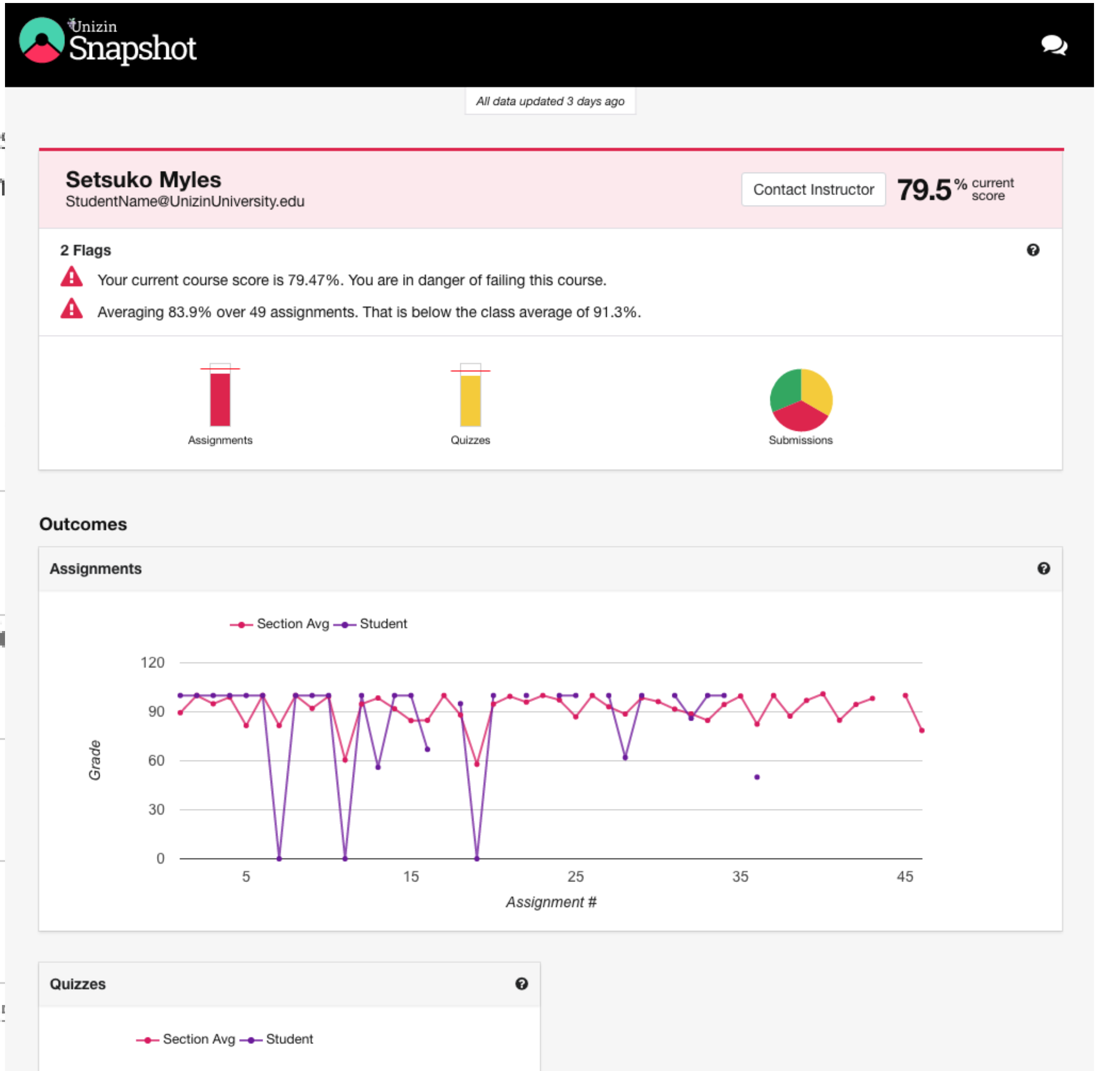
Gateway Course I

How Am I Doing?

You're doing really well in Gateway Cour
Consider reaching out to another studen
study help!

Current Class Status





Study 1

- We gave 1 undergrad course (Fall) and 1 Masters-level course (Winter) access to Course Monitor dashboard as tool in Canvas
- Students could use it through whole semester
- Surveyed students at end of term about their overall assessment of the value of the information
- We collected log data of use

Research Questions

- What are students' viewing preferences (i.e. for individual vs. comparative performance feedback)?
- How do students' use of the dashboard affect their assessment of their performance?
- Are there different effects of dashboard use on different kinds of students?

Survey Data

Study One (undergrads)	Mean	Study Two (masters)	Mean
Viewing my own performance on Course Monitor	2.75	Viewing my own performance on Course Monitor	2.64
Viewing my own performance on Course Monitor relative to the class average	3.25	Viewing my own performance on Course Monitor relative to the class average	3.29
Resulted in me feeling more positive about my performance in the course	2.13	Resulted in me feeling more positive about my performance in the course	2.57

0 = Not at all important, 1 = Slightly Important, 2 = Somewhat Important,
3 = Very Important, 4 = Extremely Important

Results

low frequency of use over term

comparative performance view was **rated higher** than just seeing own

reported **positive effect** on students' good about their performance in the course

Conclusions, so far…

- Most students found the dashboard visualizations informative and liked the comparative performance feedback
- Most students expressed interest in having such a dashboard available to them *in theory*, although most students didn't access it much *in practice*
- Caveats- limited sample of high achieving students in a competitive environment, & design issues with dashboard

What Can We Do Now?

- Build models of student behavior to diagnose students' academic challenges -> effective interventions before failure
- Design personalized learning trajectories that address the diversity of students & their preparation for learning at specific types of higher ed institutions
- Create interfaces for advisors, faculty & students to make data visible, understandable, and valuable
- Evaluate interventions, revise theory, re-design tools…

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Data to Action

Students, advisors, faculty get the data. They decide what to do with it.

Experts get the data. They interpret and make decisions for students, advisors, faculty.

A spectrum of information agency…

Everyone gets data. Have experts help students, advisors, faculty interpret data.

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Big Vision: Where Do We need to Go?

- Use institutional data to innovate teaching & learning
- Develop new models for effective instruction and fair assessment
- Create shared datasets that allow cross-institutional analyses
- Assume risks of exposing what does and doesn't work in higher ed - and for whom

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Ethics of LA Data Use

- What kinds of data do we think is important to be collected about learners?
- What kind of data is unnecessary?
- What kind of control do we want to have over the learners' data?
- What kind of control do we want learners to have over their own data?
- What kinds of risks are we concerned about?
- Do we need policy about collection or use? Or both?

Many Thanks to:

LED Lab students
UM faculty & staff colleagues
SoLAR community

& my illustrator- Anders Finholt

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