

BoSCO: A tool to bridge learning analytics and curricular design

.... or “*Learning analytics for the masses*”

Robert Dunbar, Molly Dingel and
Xavier Prat-Resina

Center for Learning Innovation



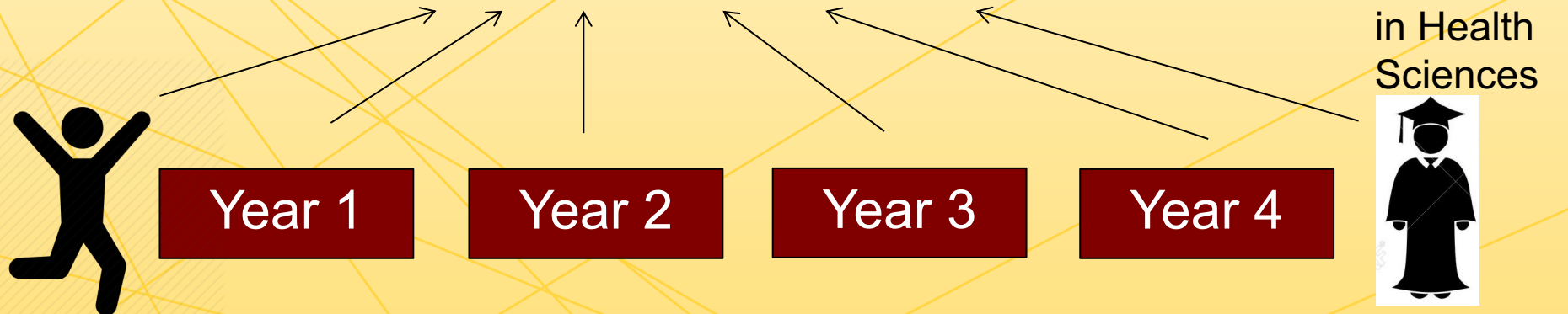
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Center for learning innovation @ UMR

<http://r.umn.edu/academics-research/cli>

Longitudinal study of student learning



Instructors work in different disciplines integrating content and learning strategies

- Work group and collaboration
- Technology focus
- Discipline integration oriented towards Health Science
- Civic engagement and capstone experience
- Wide use of active learning approaches
- Continuous and longitudinal assessment of learning



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A regular day in a teacher's life

Teachers!

You just graded a midterm exam

You think the grade is lower than last year's

Is it true?

...Last year's were better students?

...I should have seen this coming?



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The ADDIE model

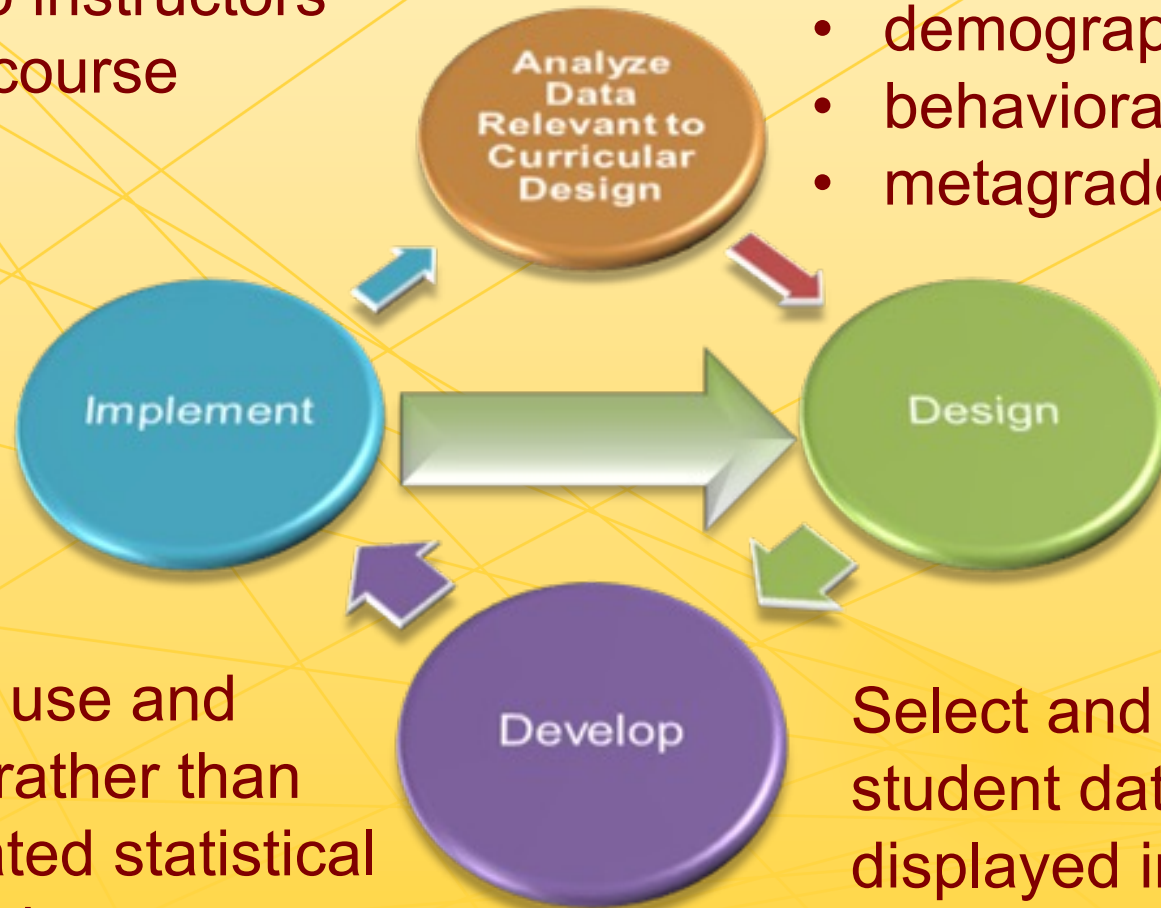


What does the tool need?

Available to instructors during the course

Include grades but also

- demographics
- behavioral surveys
- metagrades



An “easy to use and visual” tool rather than a sophisticated statistical analysis package

Select and combine student data to be displayed in many ways

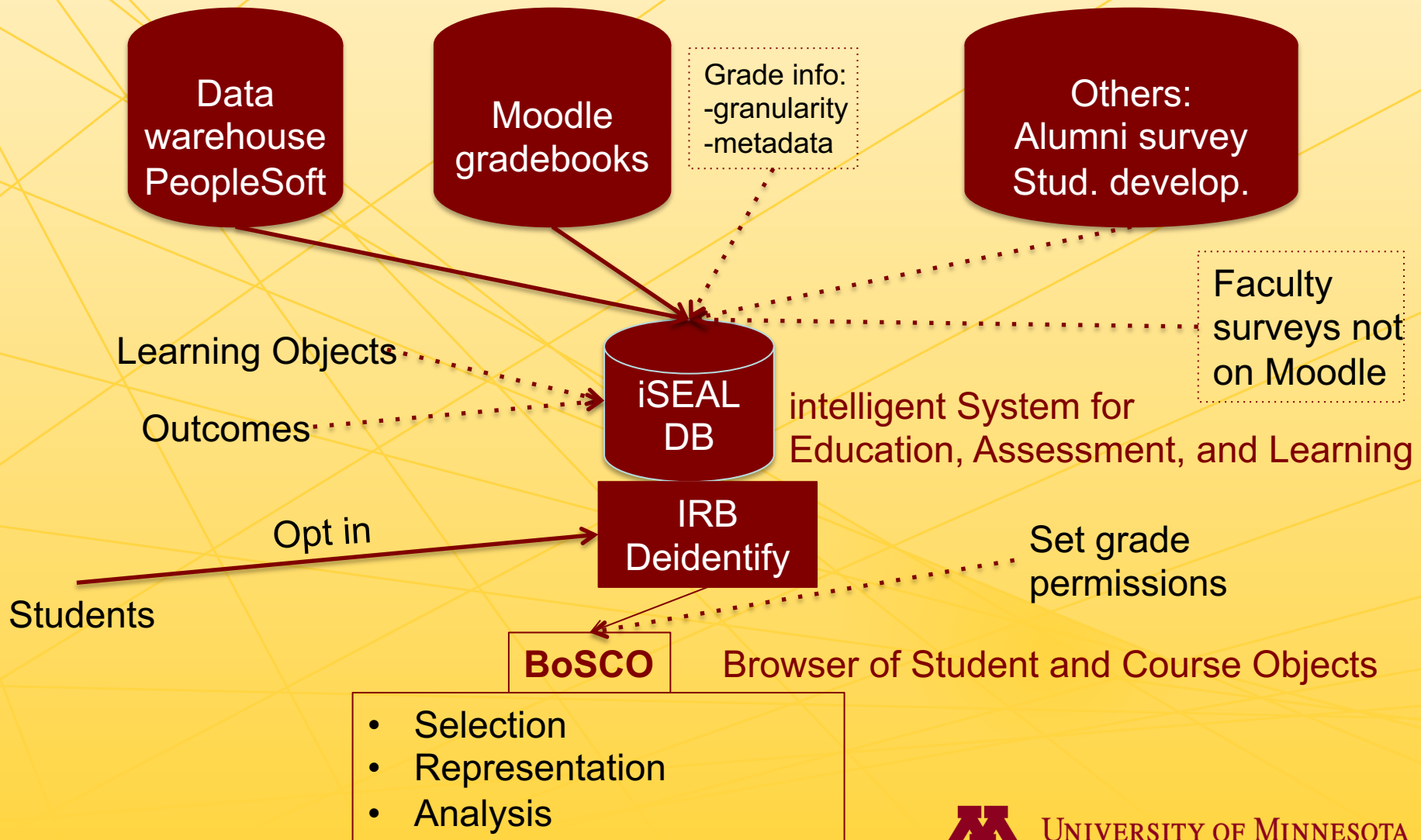


Where is all my data?

- Does your institution always use the same course management system? Same server?
- Do you have access to all data from all students that you ever taught?
- Do you keep track of student consent through the years?
- Do you have a systematic way to deidentify student data?



Data storage, access and display



BoSCO: A Browser of Student and Course Objects

- BoSCO: a hypothesis generator, an intentional browser, no spurious correlations, a radiography or the fingerprint of a curriculum
- Developed by and for faculty (still in beta)
- It runs on the browser
- Open source: available for download <https://sites.google.com/a/r.umn.edu/prat-resina/research/bosco>

Robert L. Dunbar, Molly J. Dingel, Xavier Prat-Resina

Connecting Analytics and Curriculum Design: Process and Outcomes of Building a Tool to Browse Data Relevant to Course Designers

J. of Learning Analytics. 3(1), 220-240, 2014

The quest to measure learning



BoSCO will allow you to browse, select, filter student data and download it for further analysis

"We believe that the $p < .05$ bar is too easy to pass and sometimes serves as an excuse for lower quality research,"

BoSCO: type of selections

Regular set

Courses	Semesters	Graded items
CHEM 2331 CHEM 2333 CHEM 4333	Fall 2011 Fall 2012 Fall 2013	Assign1 Assign2 Assign3 Final grade

Multisemester set

Courses	Semesters	Graded items
CHEM 2331 CHEM 2333 CHEM 4333	Fall 2011 Fall 2012 Fall 2013	Assign1 Assign2 Assign3 Final grade

Multicourse set

Courses	Semesters	Graded items
CHEM 2331 CHEM 2333 CHEM 4333	Fall 2011 Fall 2012 Fall 2013	Assign1 Assign2 Assign3 Final grade

BoSCO: type of representations

- Histograms (bar graph), Scatter plot, Timeline, Correlation matrix

BoSCO
A Browser of Student and Course Objects

	Chem2331;Fall 2010	Chem2331;Fall 2011	Chem2331;Fall 2012	Chem2331;Fall 2013	Chem2331;Fall 2014	Chem2333;Spring 2011	Chem2333;Spring 2012	Chem2333;Spring 2013	Chem2333;Spring 2014	Bioc3321;Spring 2012	Bioc3321;Spring 2013	Bioc3321;Spring 2014
Chem2331;Fall 2010	1.0000	0	0	0	0	0.7439	0	0	0	0.5260	0	0
Chem2331;Fall 2011	0	1.0000	0	0	0	0	0.6090	0	0	0	0.2240	0
Chem2331;Fall 2012	0	0	1.0000	0	0	0	0	0.7497	0.4491	0	0	0.6597
Chem2331;Fall 2013	0	0	0	1.0000	0	0	0	0	0.6169	0	0	0
Chem2331;Fall 2014	0	0	0	0	1.0000	0	0	0	0	0	0	0
Chem2333;Spring 2011	0.7439	0	0	0	0	1.0000	0	0	0	0.6353	0	0
Chem2333;Spring 2012	0	0.6090	0	0	0	0	1.0000	0	0	0	0.5729	0
Chem2333;Spring 2013	0	0	0.7497	0	0	0	0	1.0000	0	0	0	0.6004
Chem2333;Spring 2014	0	0	0.4491	0.6169	0	0	0	0	1.0000	0	0	0
Bioc3321;Spring 2012	0.5260	0	0	0	0	0.6353	0	0	0	1.0000	0	0
Bioc3321;Spring 2013	0	0.2240	0	0	0	0	0.5729	0	0	0	1.0000	0
Bioc3321;Spring 2014	0	0	0.6597	0	0	0	0	0.6004	0	0	0	1.0000

Examples

1. Understanding student preparedness in chemistry
2. Is Homework useful? Finding SLO/SDO in metagrades
3. Assess flipping the class: Avoid a control group
4. ACT engage: Behavioral surveys and student performance

Example 1: Understanding student preparedness in chemistry

- 2010-2014. Five years of General Chemistry
- Histograms: females vs males
- Scatter plots: understanding preparation.
 - ACT-math
 - GPA
 - Misconception chemistry and math survey
- Correlation matrix

→Decisions: Dropped students, repeating students, completely disengaged students

Example 2: Is Homework useful?

- Is there any correlation between homework performance and other assignments. Should there be any? How about meta-grades?

X	Y
Homework grade	Final grade
# of attempts	Exams grade
Grade at first attempt	Type B questions
Time taken	Type C questions

The fact that X and Y are not correlated does not mean that X is useless, rather they may address a different skill

2. Is Homework useful? Finding SLO/SDO in metagrades

- Beyond a final grade: Bundle grades and metagrades that describe different outcomes or skills
 - Quantitative skills: % (Type B test questions)
 - Follow through commitments: % (Homework and quizzes)
 - Preparedness % (Grade at first attempt on quizzes)
 - Commitment to one task and time efficient % (Time spent in quizzes)
 - Transfer and critical thinking % (Type C and ambiguous questions)

SDO and SLO may be found in “bundled grades” or metagrades rather than regular grades

Example 3. Flipping the classroom. Did it help?

- For non discussion-based courses, the course content is available to students at all time.
- For team teaching it sets a standard and gives more freedom to the class instructor.
- But is it helpful for students?

Day 1: Mon. March 23rd

Oxidation states and balancing redox reactions



lec5 1 chem2333



5 - 1 Video 1: Oxidation states and redox reactions



5 - 1 Video 2: Reduction and oxidation half-reactions



5 - 1 Video 3: Balancing redox reactions



Pre-class questions 5 - 1



class5 1 chem2333



Post-class 5 - 1

Xavier Prat-Resina et al.

“Exploring tools to measure the effectiveness of a flipped classroom in introductory Chemistry courses”

In preparation



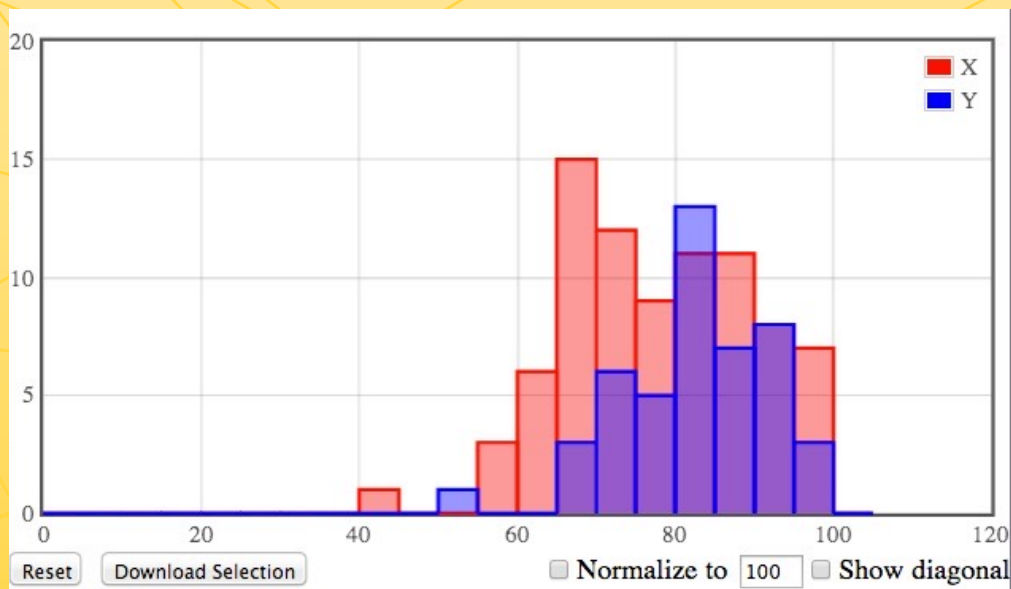
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3. Measuring curriculum innovations

+curriculum innovation

GenChem 1 – Fall2013 —————> GenChem 1 – Fall2014

different students
different years



Did it
make a difference?

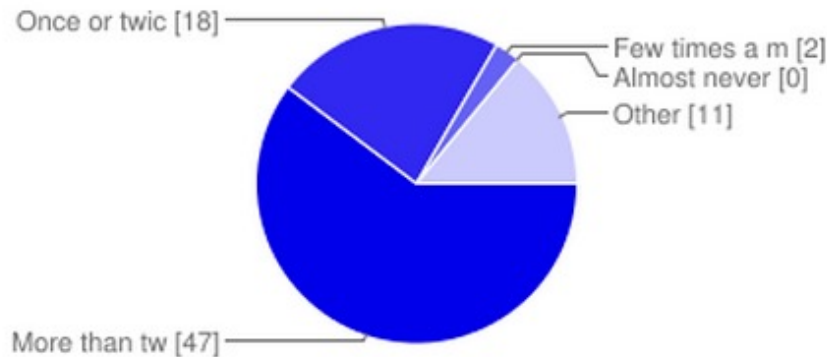


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3. Measuring curriculum innovations

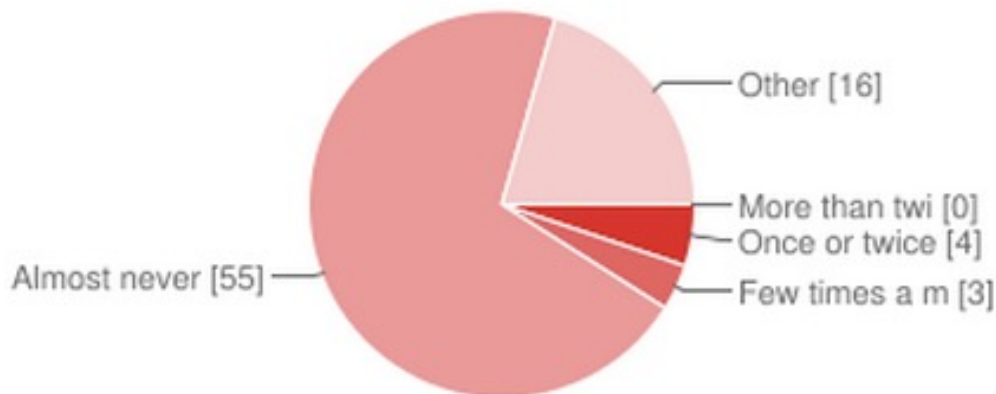
Ask students

How often did you watch the videos that instructors made for this course?



More than twice a week	47	60.3%
Once or twice a week	18	23.1%
Few times a month	2	2.6%
Almost never	0	0%
Other	11	14.1%

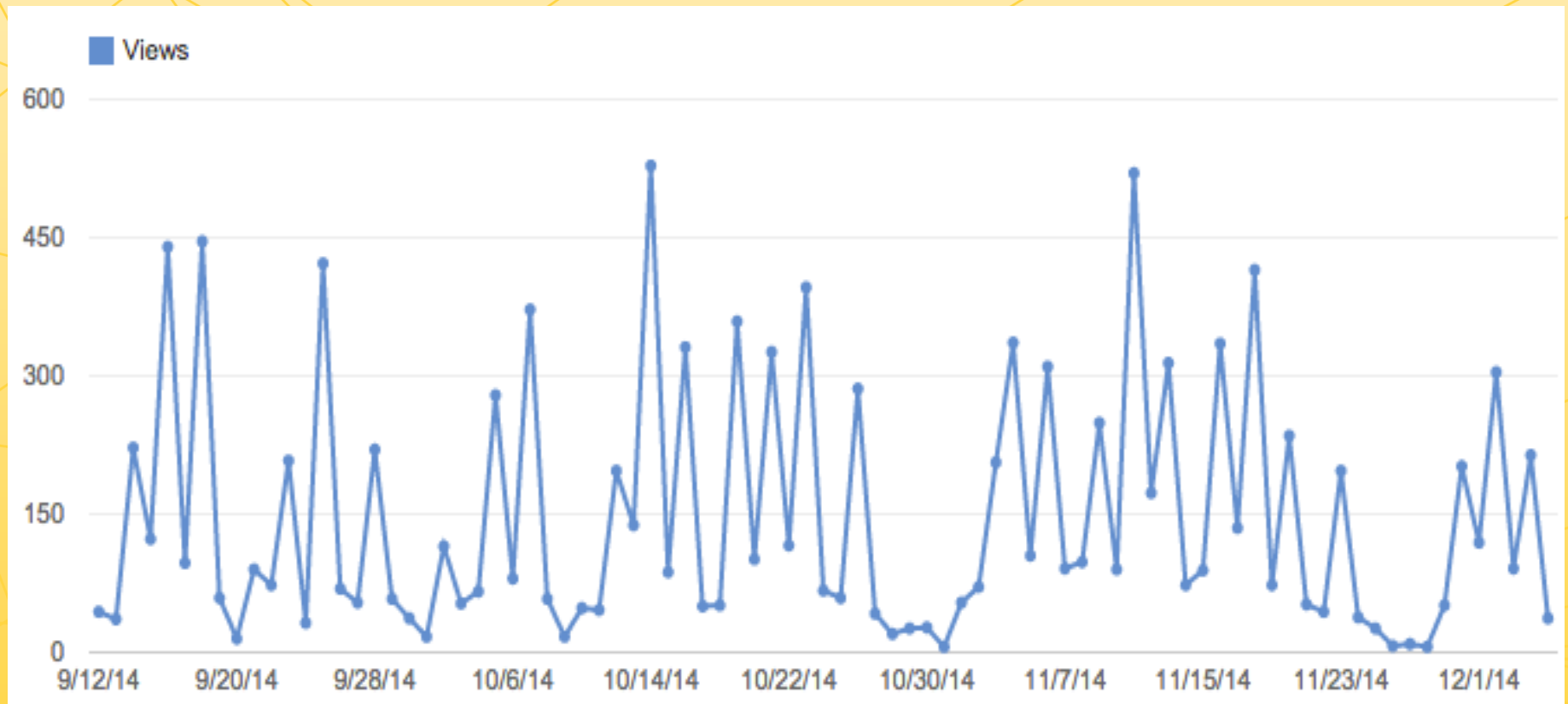
How often did you read the textbook?



More than twice a week	0	0%
Once or twice a week	4	5.1%
Few times a month	3	3.8%
Almost never	55	70.5%
Other	16	20.5%

3. Measuring curriculum innovations

Follow students trail: Youtube Analytics and Moodle Logs



3. Measuring curriculum innovations

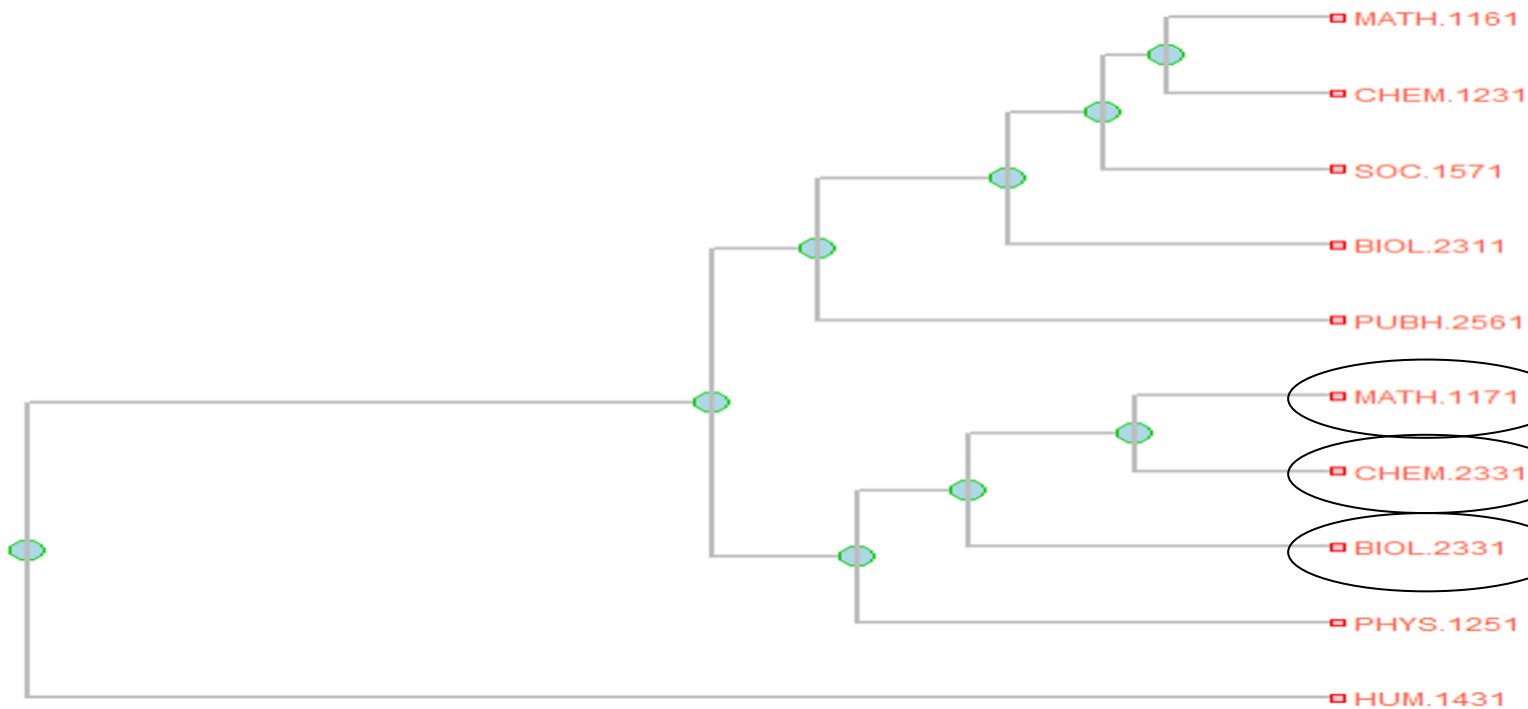
Follow students trail: Youtube Analytics and Moodle Logs

Student views vs student performance. (BoSCO)

3. Avoiding control groups

Measuring curriculum innovations by comparing student performance with previous course performances. The dendrogram of the curriculum.

Variable Correlation Clusters
core courses.csv using Pearson



Calc
GenChem1
A&P1

3. Matched pair analysis

Biology – Fall2013 —————> Biology – Fall2014

$\Delta\text{grade} = 0$ paired
(johnny-bio-f13, mary-bio-f14)

GenChem 1 – Fall2013 —————> GenChem 1 – Fall2014
+curriculum innovation

$\Delta\text{grade} = + \text{ o } -$ (johnny-chem-f13, mary-chem-f14)

mean(Δgrade) and student t-test

Acknowledgments: Dr. L. Dame and Dr. A. Petzold

Example 4. Behavioral surveys and student performance

Most of our students in our degree have taken ACT Engage Survey

Academic Success Index Probability
Retention Index Probability
Academic Discipline Scale Score
Academic Self-Confidence Scale Score
Commitment to College Scale Score
Communication Skills Scale Score
General Determination Scale Score
Goal Striving Scale Score
Social Activity Scale Score
Social Connection Scale Score
Steadiness Scale Score
Study Skills Scale Score

BoSCO: future developments

- Multiple selection of courses and semesters.
Multicourse/Multisemester set

Courses	Semesters	Graded items
CHEM 2331	Fall 2011	Assign1
CHEM 2333	Fall 2012	Assign2
CHEM 4333	Fall 2013	Assign3
		Final grade

Time graph: See how the current seniors did through the years.

Bar graph: Compare performance in biology courses with chemistry courses

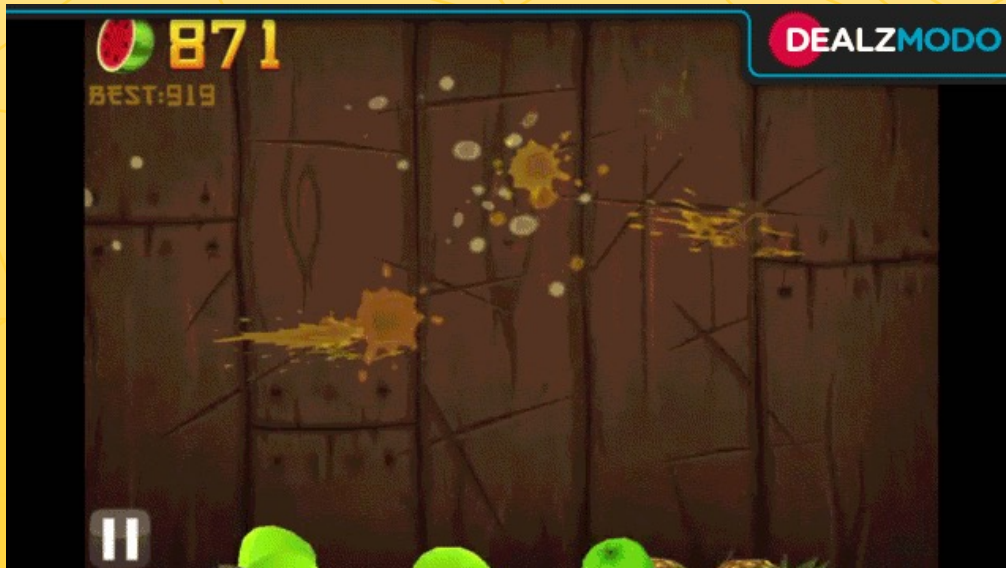
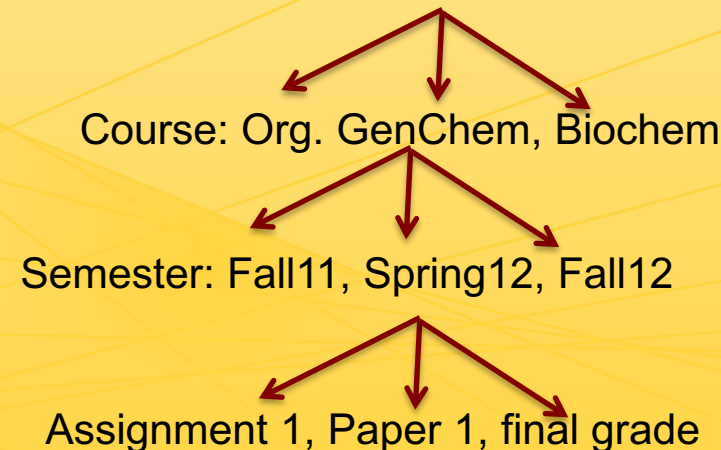
BoSCO: future developments

SLICE Showing Longitudinal Interactions of Course Events

Quiz 1		Test 1		Quiz 2		Test 2	Final
Question 1		Question A		Question a		Question 5	Question z
Question 2		Question B		Question b		Question 6	Question y
Question 3		Question C		Question c		Question 7	Question x
Quiz grade		Test grade		Quiz grade			



BoSCO: Top down Curriculum



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Conclusions

- BoSCO, an hypothesis generator.
- Some SDO and SLO may be found in metagrades
- Using matched-pair analysis to measure curriculum innovations.
- Behavioral surveys can contribute to curriculum design



Thank you