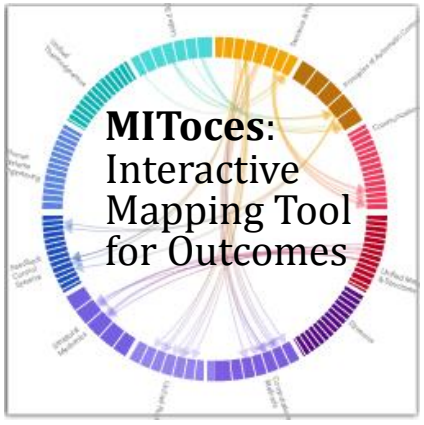
MIT AEROASTRO

Mapping Learning Outcomes and Topics across the MIT Curriculum

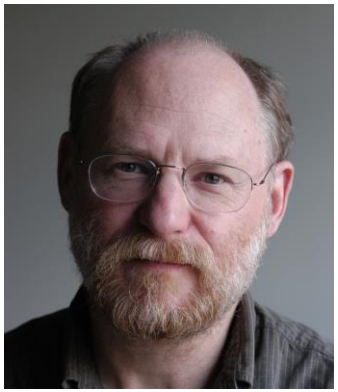
MIT ODL xTalks Series
May 6th, 2015

Crosslinks
By MIT students, for MIT students

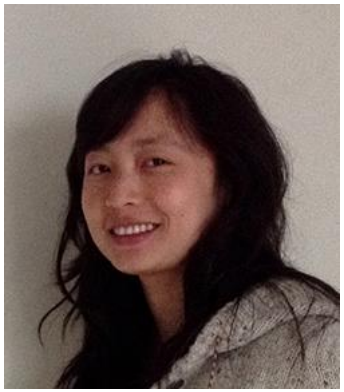


The Team

Karen Willcox



Haynes Miller



Luwen Huang

Joseph Seering

Carmela Lao

Katherine Nazemi

Emma Nelson

OFFICE OF DIGITAL LEARNING

Outline

- Why map?
- Mapping outcomes
  http://mitoces.mit.edu/
- Mapping topics
  http://crosslinks.mit.edu/

Our terminology

A learning outcome

> "what a student is expected to be able to ***do*** as a result of a learning activity"

A prerequisite outcome

> "an outcome that a student is required to have achieved before s/he can achieve another related outcome"

A module

> "a learning unit comprised of a set of outcomes" (generally relatively self-contained)

Why map?

To understand and document what we are teaching

- Catalog measurable outcomes and prerequisite relationships
- Maintain unified repository for outcomes across the Institute (“sequencing the DNA of the MIT undergraduate curriculum”)
- Communicate clear expectations to students

Why map?

To connect the pieces

- Contextualize learning for students by providing roadmap
- Connect faculty across subjects, departments, schools
- Catalyze discussion about different types of outcomes and what it means to be a graduate of the mapped program (cf. CDIO, ABET)

Why map?

To enrich our ability to revisit, refresh, re-use learning resources

- Make modular learning and assessment resources readily available with context.
- Navigate easily through related learning resources
- Connect resources to specific outcomes

Why map?

To inform our future educational innovations

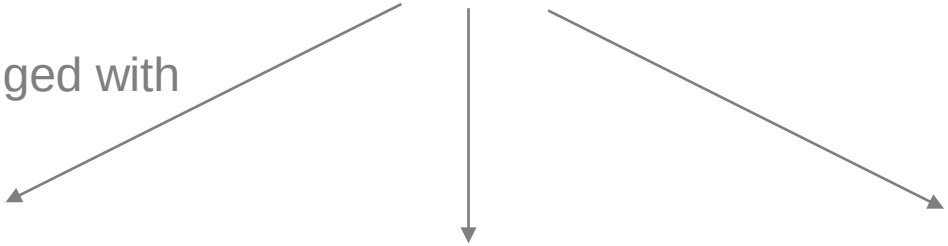
- Identify opportunities for modularity in the curriculum
- Identify opportunities for flexibility in the curriculum
- Create opportunity for competency-based assessment
- Enable personalized education and automatic recommendations

Mapping outcomes: Our model

Fundamental unit of the model

Learning outcome

Tagged with



Prerequisite outcomes

Module

Subject

Mapping outcomes: Our process

1. **Initial meeting** with faculty to outline goals of the project and explore any existing outcomes

2. If up-to-date outcomes, worked together to **edit the outcomes** to fit the project format by adjusting syntax or granularity

   If no up-to-date outcomes, reviewed subject materials (syllabi, lecture notes, psets) to propose **new set of outcomes**

3. Once an initial set of outcomes was agreed upon, worked together to group outcomes into modules and **develop links between outcomes** in the subject

4. Made **links between outcomes in the subject and prerequisite outcomes in other subjects**

5. Interest-groups of faculty met to discuss **sequences of subjects** and revise the outcomes and links within them

Output: a comprehensive draft of outcomes with department-wide approval.

Mapping outcomes: Our status

- More than **1100 outcomes** collected across **29 subjects**:

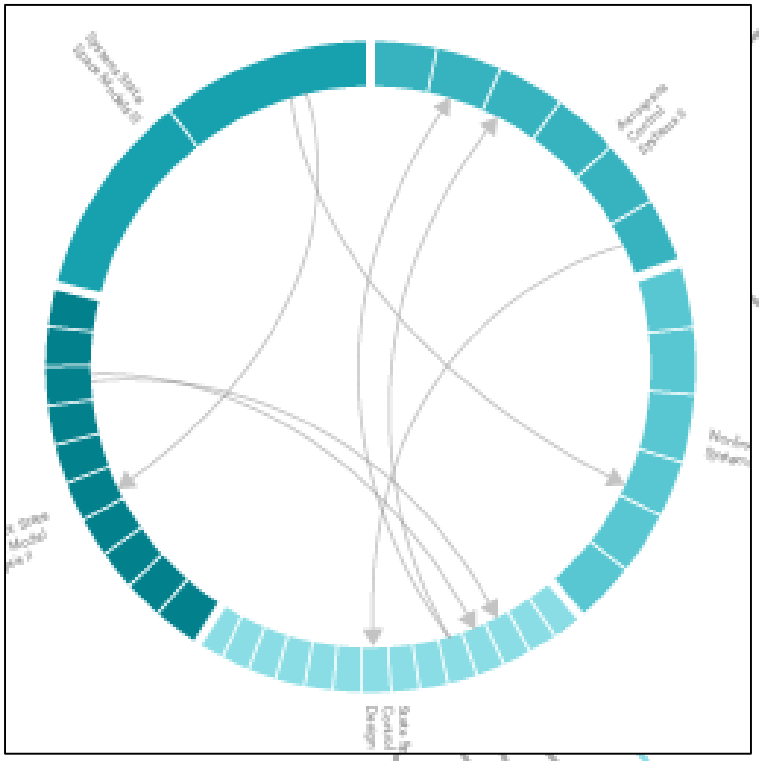
  all Course 16 subjects in UG curriculum that contribute towards degree requirements

  plus 8.01, 8.02, 18.01, 18.02, 18.03, 3.091

- Begun to collect documented outcomes from other subjects' webpages (6.02 and 6.041)

- Many linkages between subjects are in place; we are working to populate the database of linkages

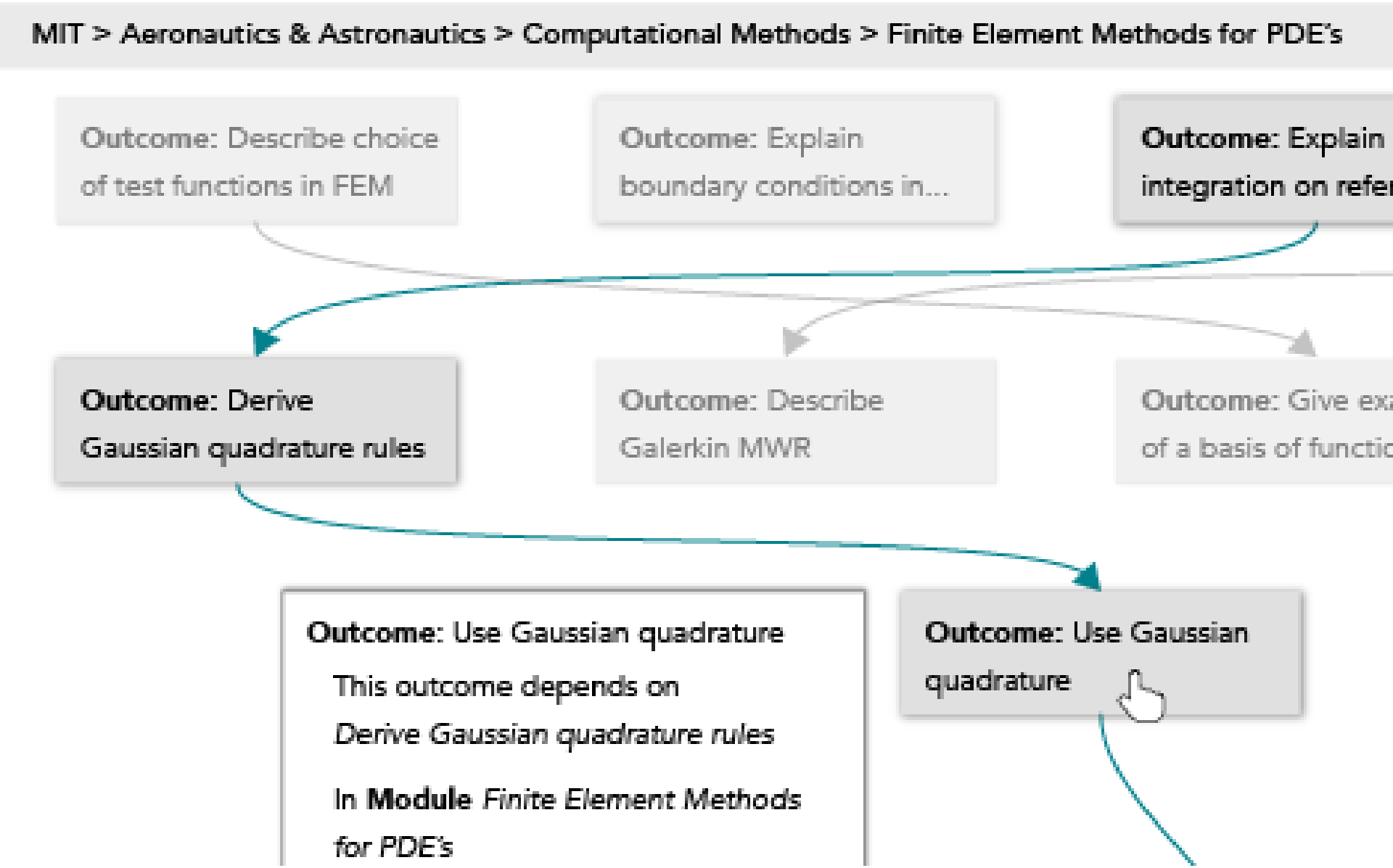
A feedback controls subject partitioned into five modules



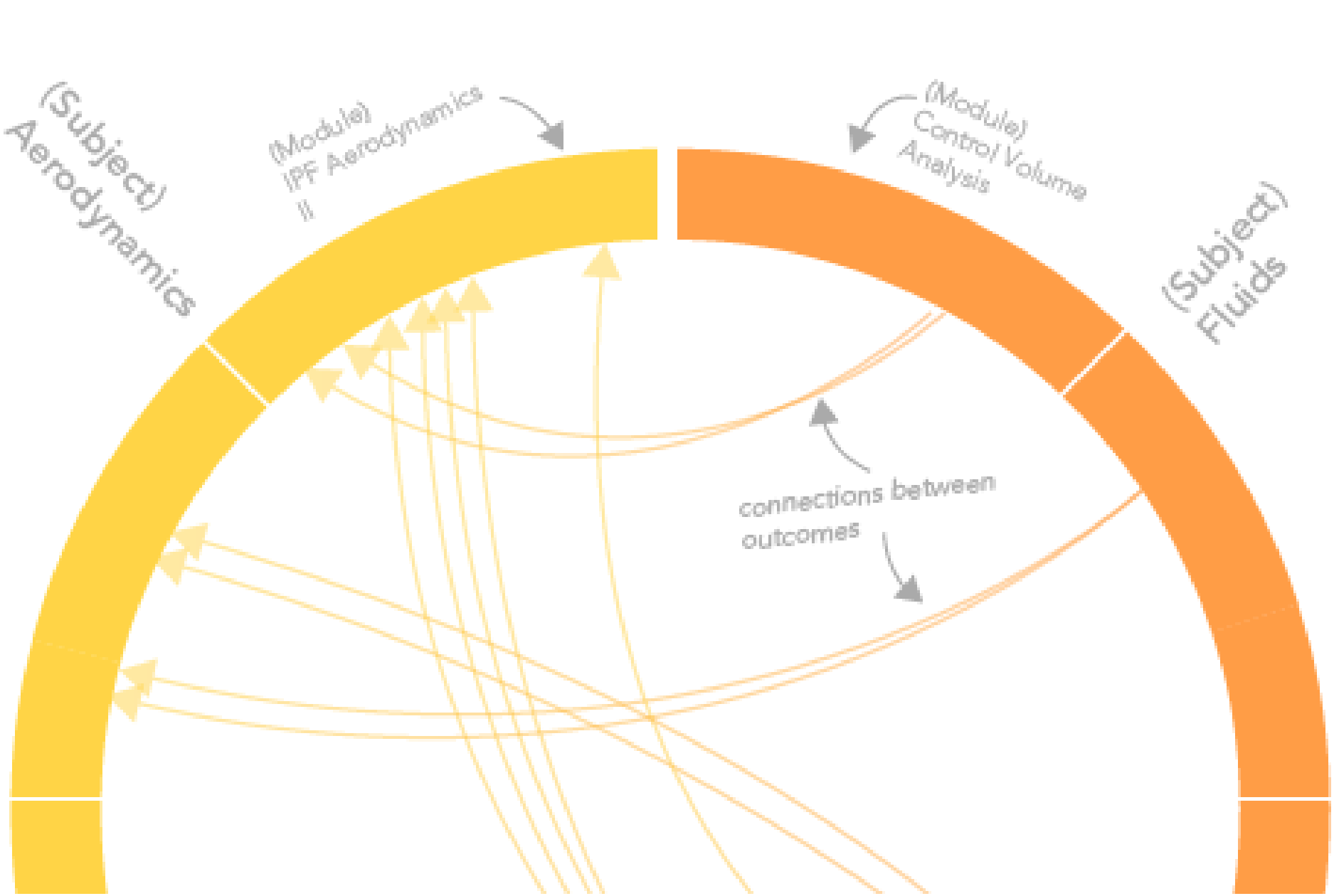
Outcome C.3.3: Students should be able to design control systems with eigenvalue placement

This outcome depends on **Outcome C.4.8** (students should understand detectability/stabilizability)

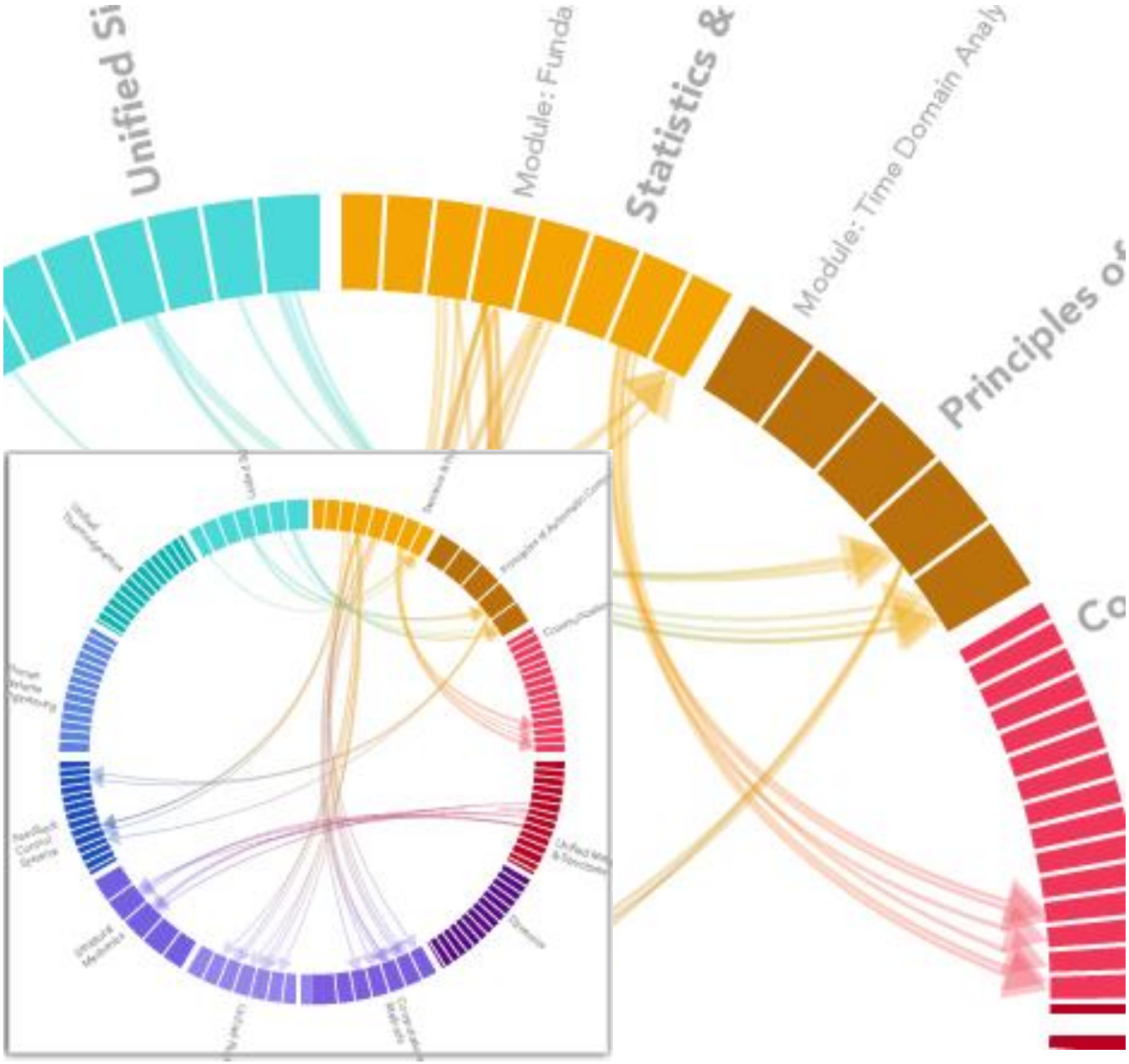
Outcomes arranged within a module



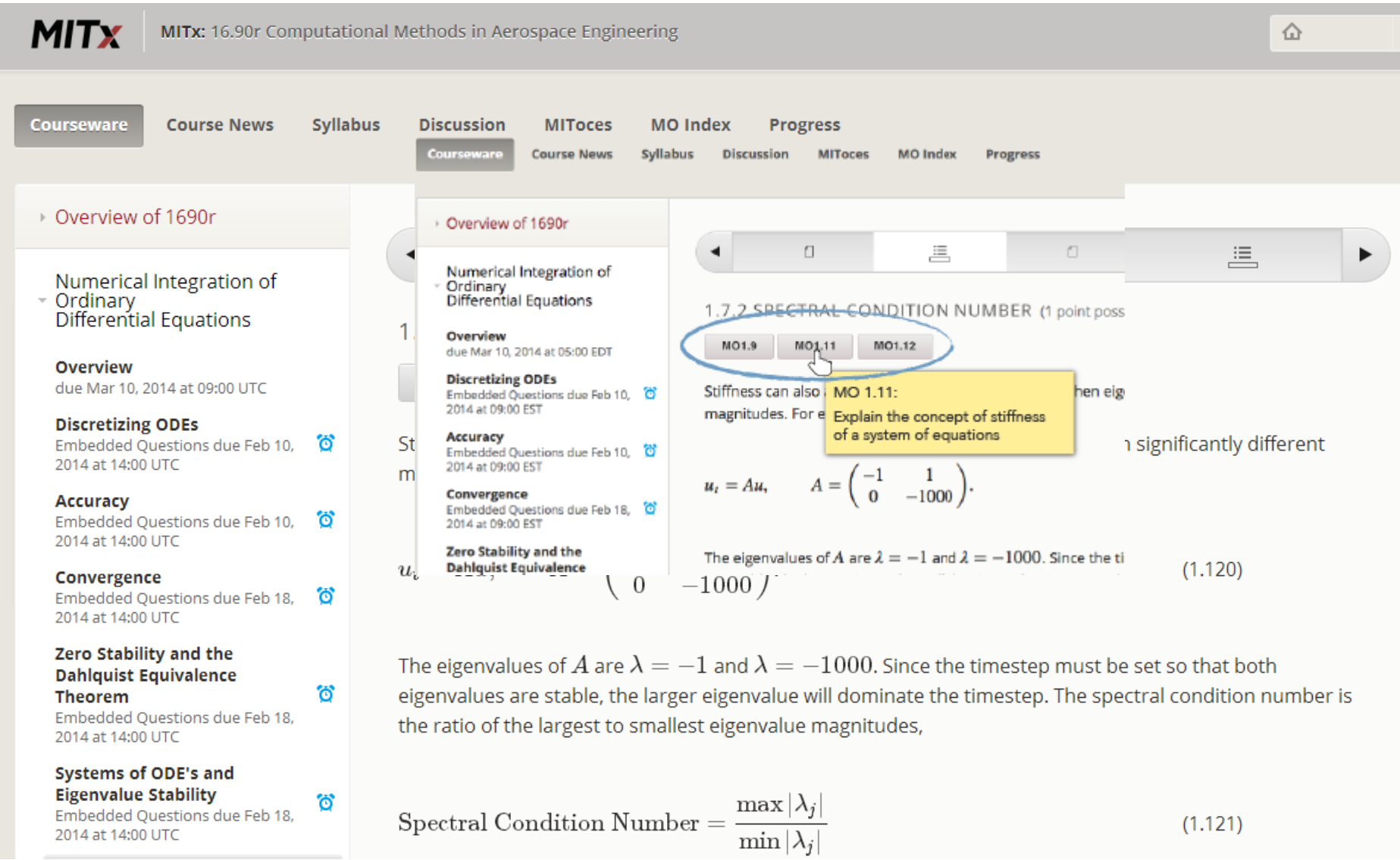
Interconnections between two subjects



Visualizing multiple subjects and modules



Embedding MITocses in lecture notes



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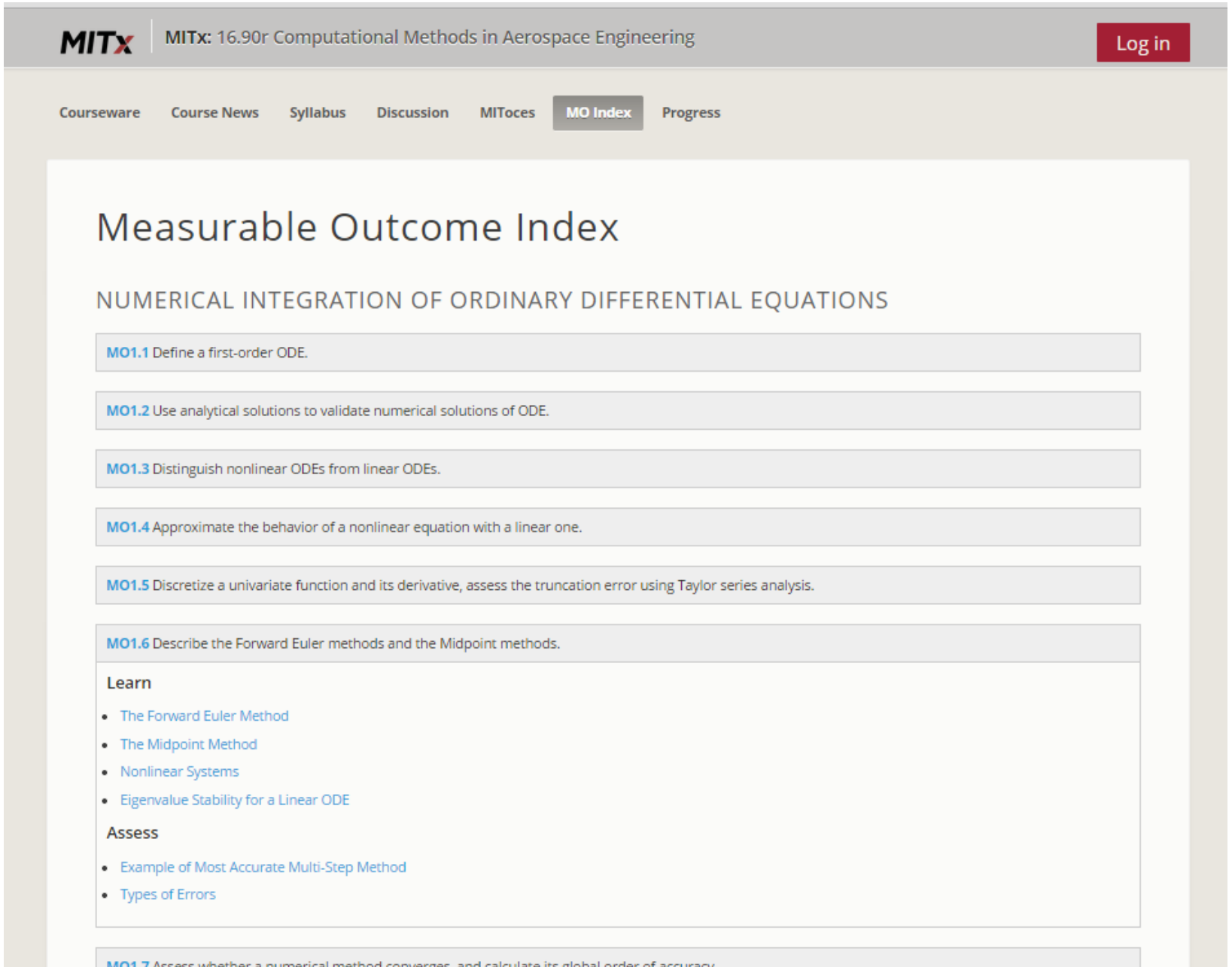
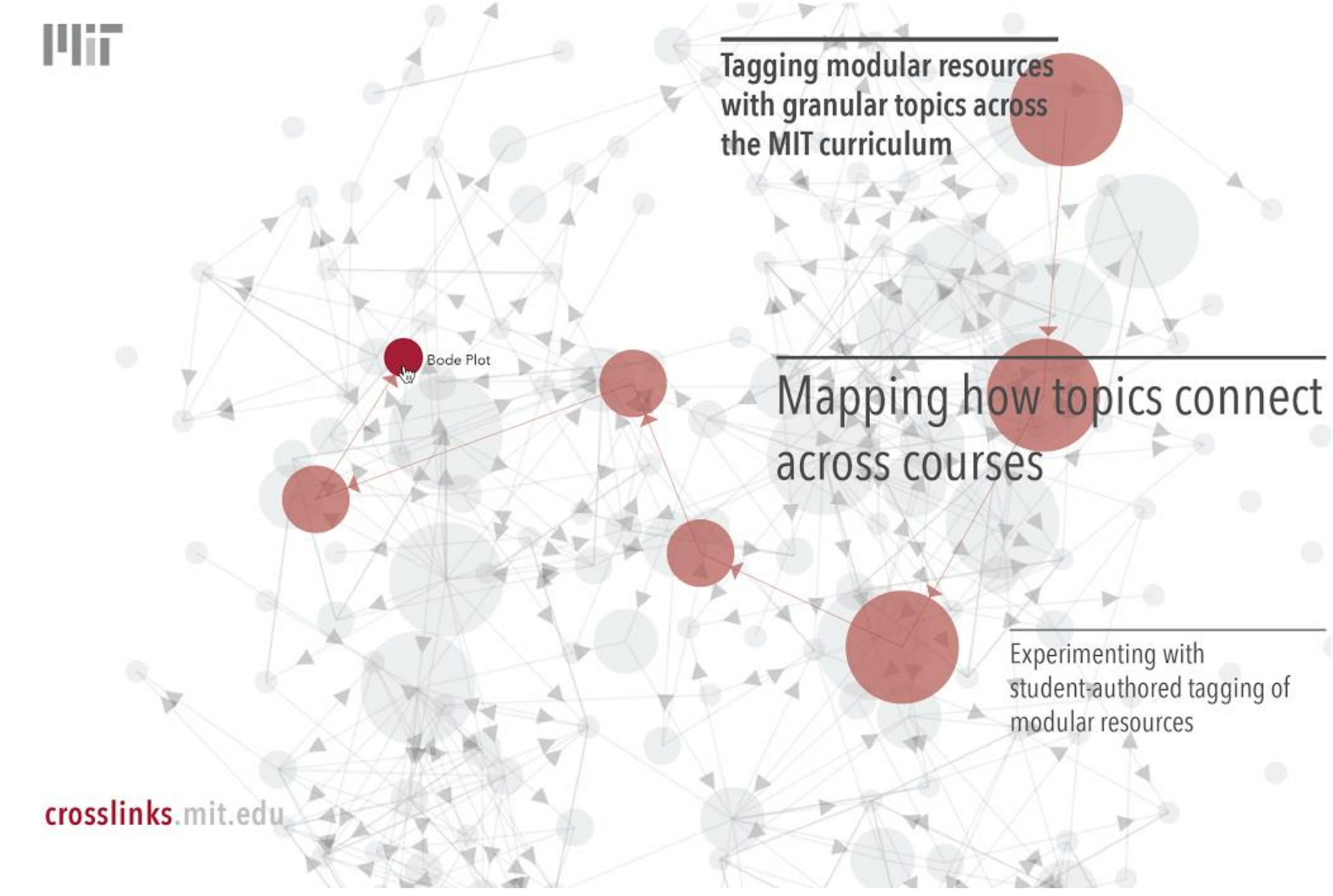


Has the outcomes mapping process been useful?

- Outcomes data collected so far has been used to:
  - Structure the use of the MITx platform in teaching 16.90 and 16.06
  - Help inform changes in Unified
  - Streamline content between Unified Fluids and 16.100
  - Inform a department-wide review of the AA UG curriculum
  - Identify specific issues/opportunities that need to be addressed (overlap/gaps between subjects, lack of outcomes in some subjects, lack of connections between subjects, connections with GIRs, etc.)

Crosslinks


Tagging modular resources with granular topics across the MIT curriculum
Bode Plot
Mapping how topics connect across courses
Experimenting with student-authored tagging of modular resources
crosslinks.mit.edu

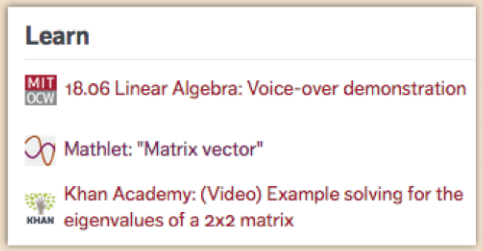
SIX FACETS OF COMPREHENSION

2 RELATE shows closely-related topics for a certain topic.

Through seeing related topics across MIT, the student gains a big picture understanding.

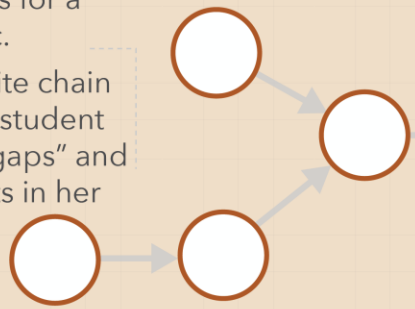
3 LEARN is a collection of links to course notes, modular videos and mathlets that teach the topic.

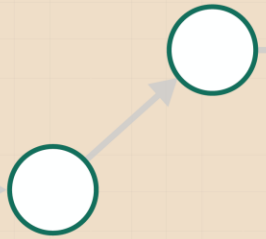
This aggregated collection of modular material enables the student to easily refresh specific topics.



1 PREPARE shows the prerequisites for a certain topic.

The prequisite chain enables the student to identify "gaps" and critical points in her abilities.





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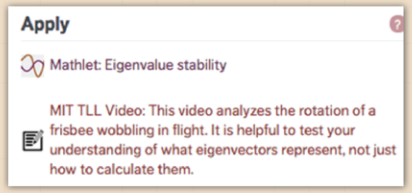
By seeing which topics lie ahead, the student grasps the motivation and context for the current topic.

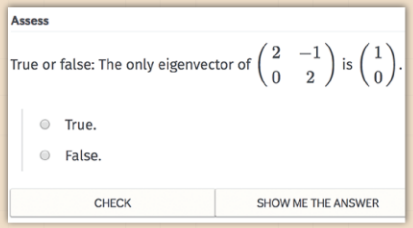


6 APPLY is a collection of links to interesting applications of the topic in later courses or in industry usage.

This section answers the question, "How is this useful in the real world?"

5 ASSESS is a collection of interactive finger exercises designed to assess the student's comprehension.

These exercises are drawn from selected MITx courses.



crosslinks.mit.edu

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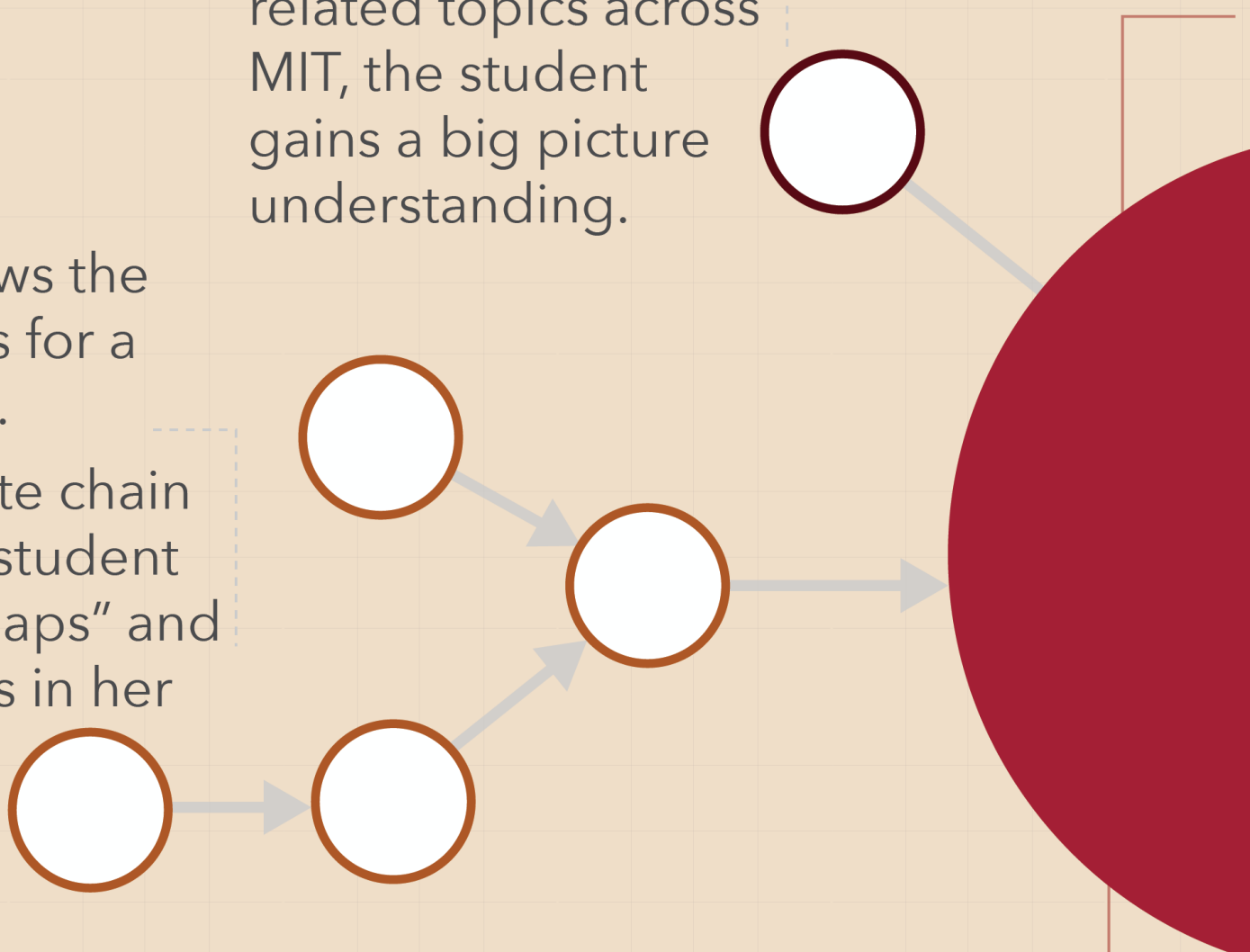

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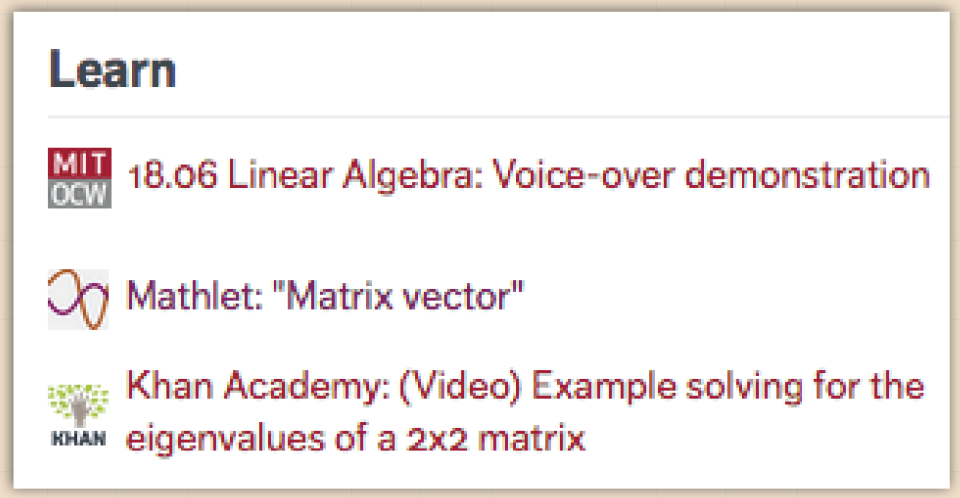

eigenvalue

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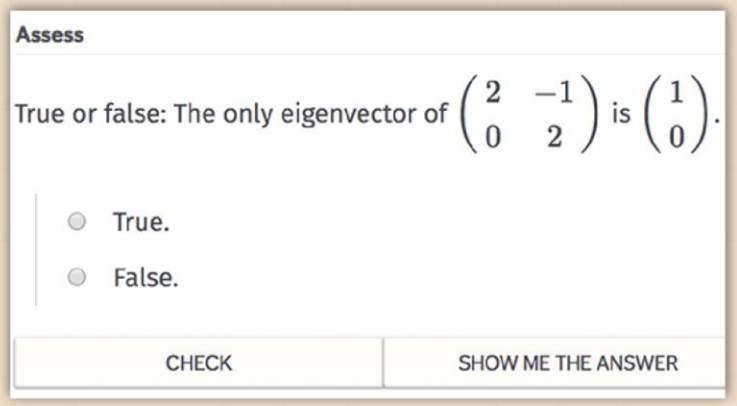
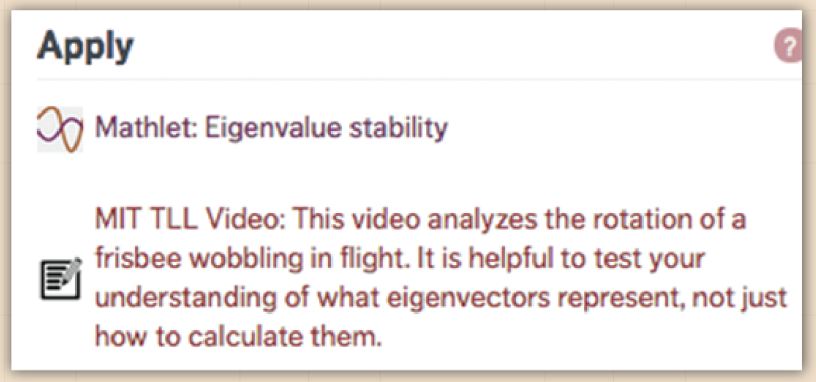


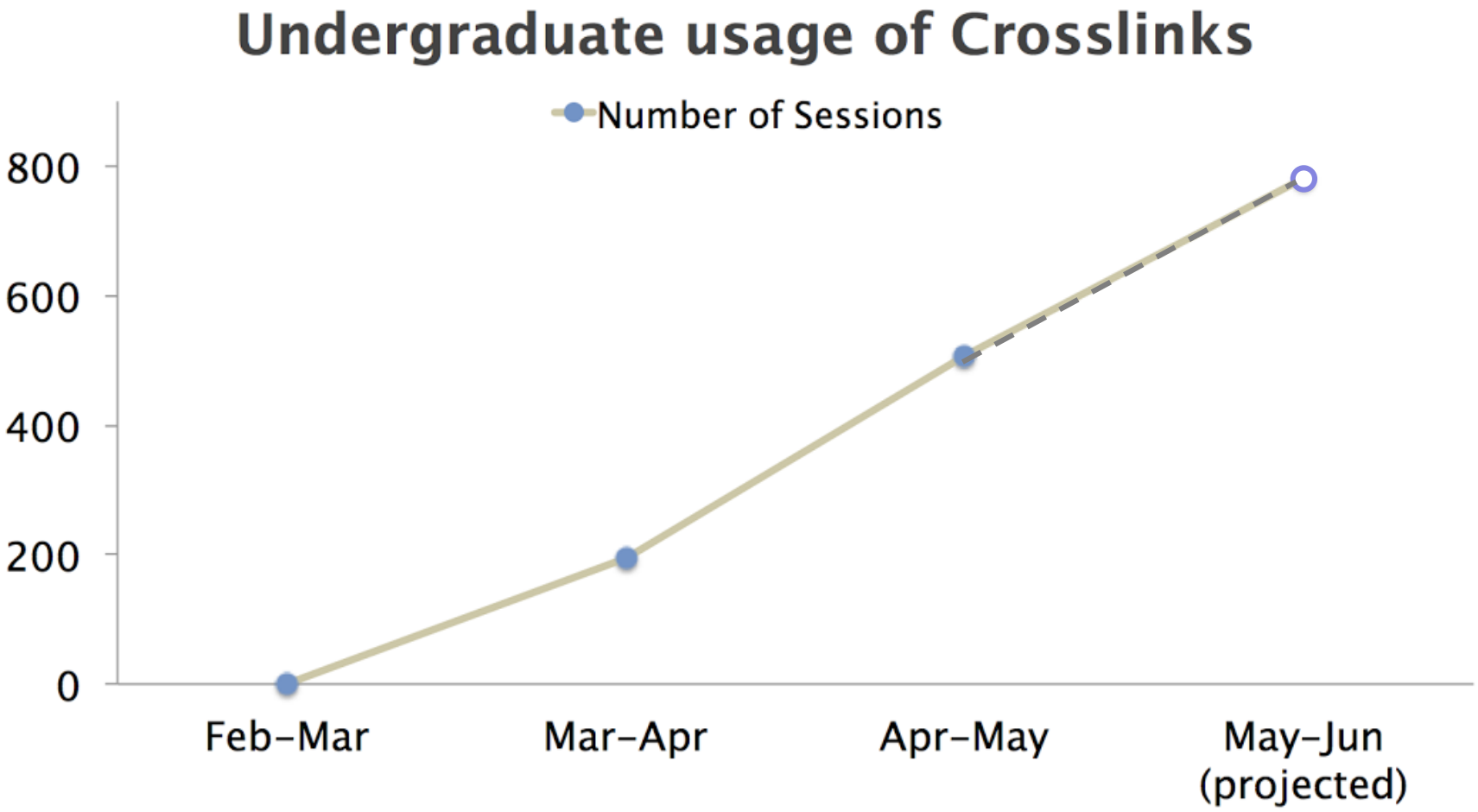


6 **Apply** is a collection of links to interesting applications of the topic in later courses or in industry usage.

This section answers the question, "How is this useful in the real world?"

Crosslinks adoption

In spring 2015, we launched Crosslinks to 18.03 and a table section of 8.02



session = a visit in a contiguous time frame (set to 30min)

Crosslinks adoption

Metric	April – May 2015
Users (students)	428
Sessions	564
Pageviews	3299

- In the past month, 428 undergraduate students used Crosslinks
  - 93 are returning users
- 6 students (outside of team) have edited => 1.4%
  - “In Internet culture, the 1% rule is a rule of thumb pertaining to participation in an internet community, stating that only 1% of the users of a website actively create new content, while the other 99% of the participants only lurk” – Wikipedia

User behavior

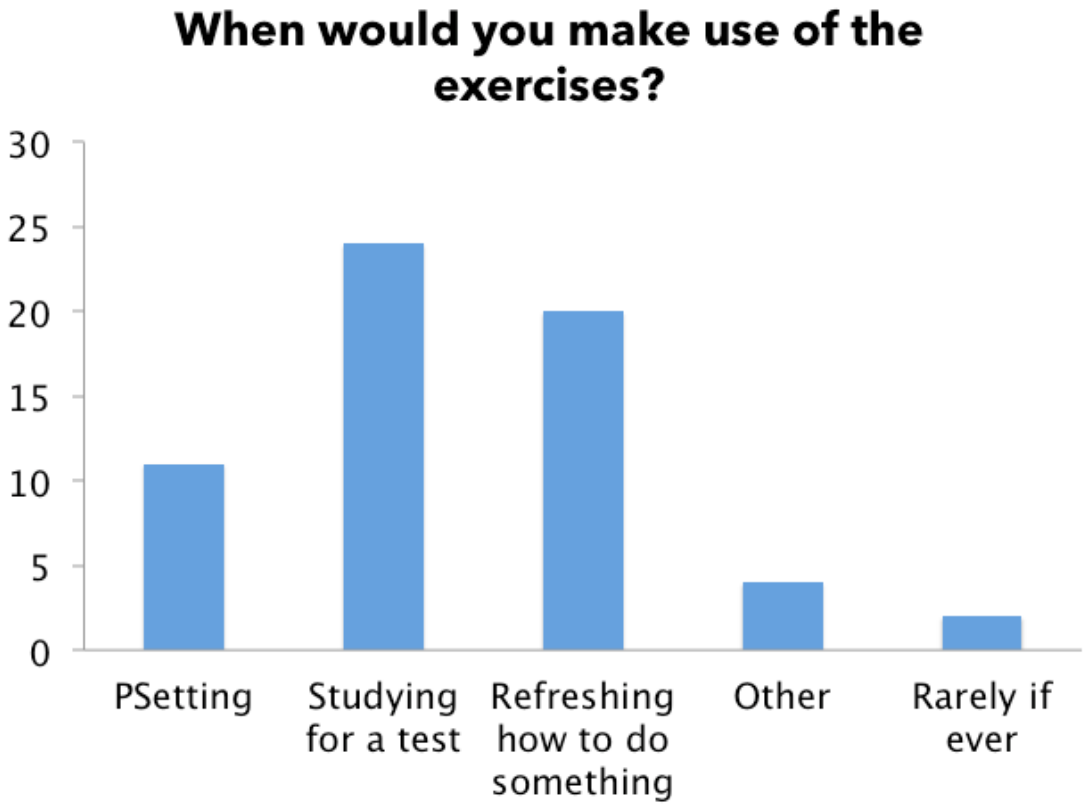
We look at the behavior of Crosslinks users in April/May 2015 (428 MIT UGs)

Metric	Crosslinks
Pages / session	7.06
Bounce rate	3.5%
Session duration	4:47 min

- High pages / session => students are visiting many pages
- Low bounce rates => students find the content engaging and relevant enough to visit other pages
- Long session durations => high levels of engagement
- OCW stats (6,587 MIT users): 5.39 pages/session; 28.5% bounce rate; 3.26 min session duration

Assessment feedback (1/3)

Students were asked when they would (if ever) use the interactive exercises:



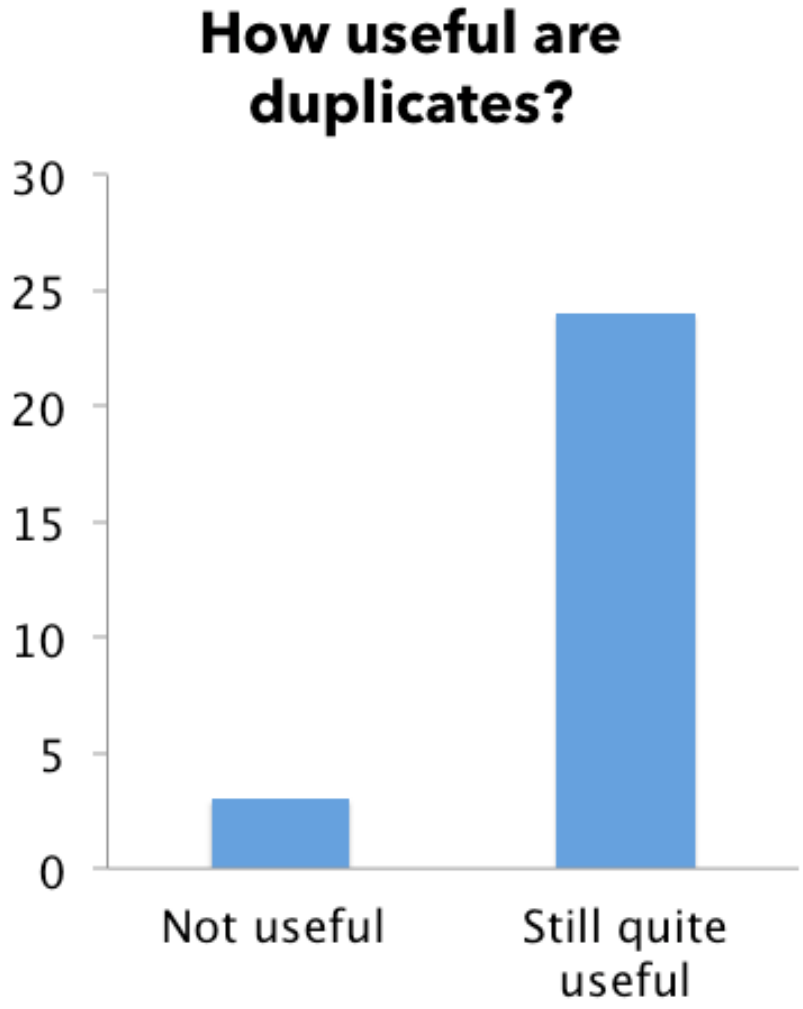
Interesting quotes:

- *"Other – to procrastinate because it's fun to check yourself" (4 students)*
- *"To help explain the topic to others" (1 student)*

Assessment feedback (2/3)

Students were asked to gauge the usefulness of exercises they already had access to on MITx:

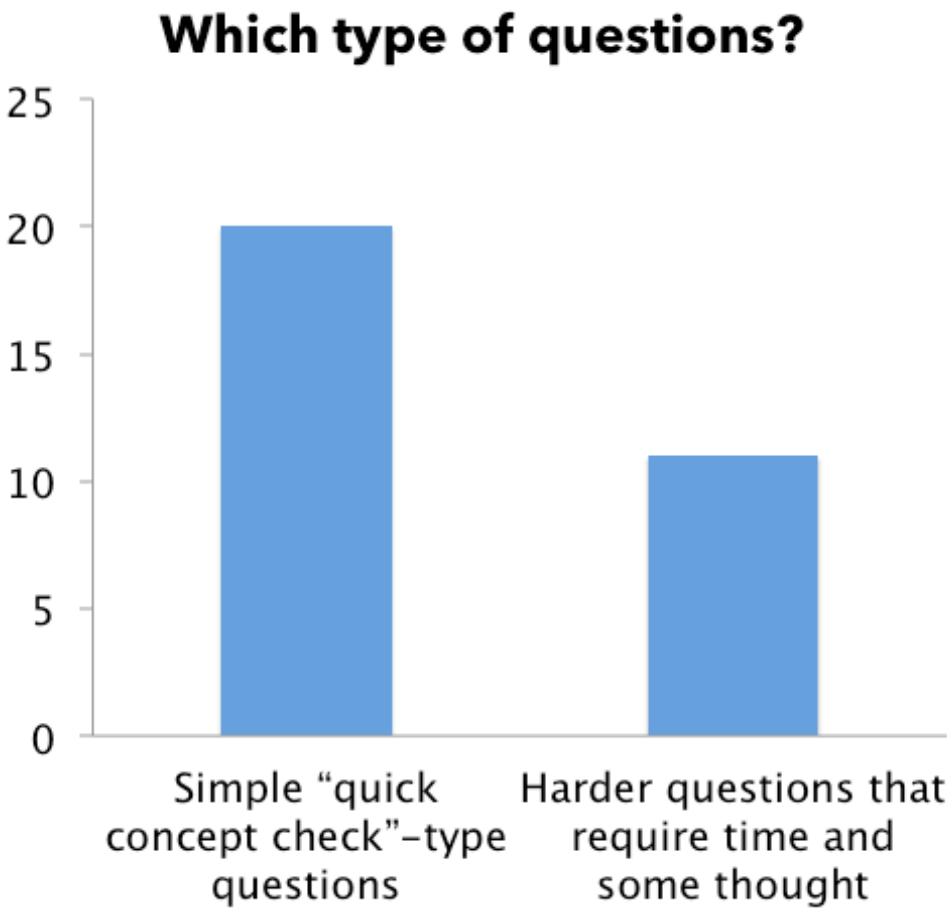
- *"Super useful to have it all consolidated in one place"*
- *"Looking at it by topic outside of MITx site helps affirm you really know it"*
- *"This is more concise and easier to find"*
- *"Useful because I don't have the fear of wrong submission"*
- *"I can't get access to MITx problems if I'm not taking the class"*
- *"I probably will have forgotten how to do all these problems after two weeks so good to have them on Crosslinks*



Assessment feedback (3/3)

Students were asked to indicate the preferred type of exercise (easy concept-check vs. harder types)

- *"Hard problems only if we have solutions"*
- *"Can we also get explanations? For a lot of problems on MITx, you can't see explanations when you're right or wrong."*



Qualitative feedback

Key insights from students:

- Students like modularity
  - *"I like it that things are organized by topic. It's more concise."*
- Students like aggregation
  - *"It's so useful to have everything in one place."*
- Students like the specific MIT angle
  - *"It's good to know that all this has been edited and vetted by MIT people, so I know it's going to be useful for my MIT work."*
- Students do care about the big picture, even if it's not materially impactful
  - *"It's interesting, and I think it must be subconsciously helpful when I'm learning it, but I don't think it'll actively lift up my grade. But I do think about how things connect together."*

Acknowledgements

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- Chad Lieberman