UTMOST 2

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Undergraduate Teaching of Mathematics with Open Software and Textbooks

Improving Undergraduate STEM Education, Development and Implementation, Engaged Student Learning

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Educational Research Study

To better understand teacher and student use of textbooks.

Methods

- Two open source electronic textbooks: linear algebra (Beezer) and abstract algebra (Judson)
- Sixteen courses at eleven institutions (variation by research intensity, size, location)
- Periodic logs filled by teachers and students over the course of a semester
- Teacher and student surveys of attitudes towards mathematics and technology
- Beginning and end of term assessment of student growth (mathematical maturity and course content knowledge)
- In-situ visits for seven courses that included planning and classroom observations and discussion of textbook use by teachers and students
- Commentaries on analytics user data collected automatically

Analysis

- Description of generation of documents (lecture notes) and the similarities and differences between users of electronic and print formats
- Description of use of textbooks in classroom and the similarities and differences between users of electronic and print formats

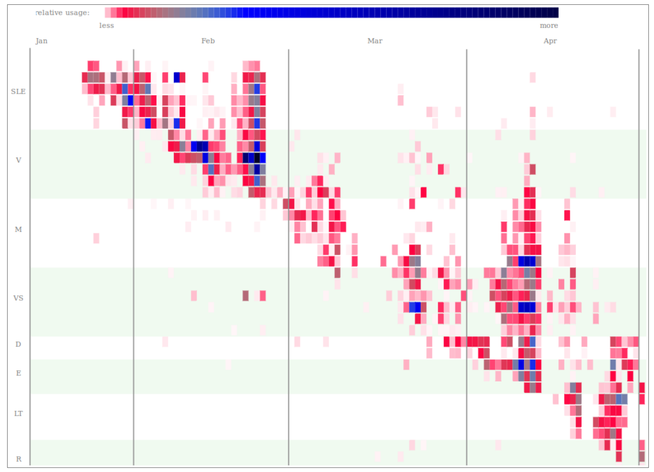
Findings—Teachers

- Use a variety of resources in generating their lecture notes
- Use features that they would use in their regular lesson preparation

Findings—Students

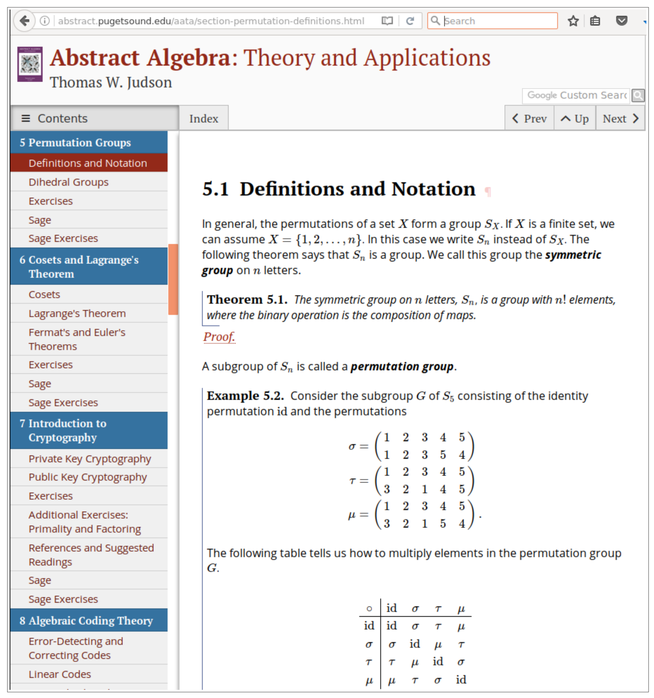
- Students' use of textbook depends on teachers' expectations of those uses: if teachers ask students to read the textbook, students will do so. If the teachers suggest using examples for solving homework, students will do so. If teachers bring new proofs, students will skip proofs on textbooks.
- Students find it difficult to describe what exactly they do when using their textbooks. Responses are too general.

Analysis of Student Textbook Use



Heat Map: Sections on vertical, Days on horizontal

Online Textbooks from PreTeXt Source



PreTeXt Authoring Language

- Separate structure and content from presentation
- Obtain multiple outputs from single source
- Markup with author-friendly XML, process with XSL stylesheets
- Output: Highly interactive web pages with sophisticated navigation
- Output: High quality print and PDF via LaTeX
- Output: EPUB, Jupyter notebooks (work in-progress)
- `pretextbook.org`

Embedded Sage Cells

- Sage Cell Server provides embedded computations, with zero setup
- Sage Cell Repository of examples, under construction
- `sagecell.sagemath.org`, `sage-cell-repository.wikidot.com`

AIM Open Textbook Initiative

- 47 vetted and approved undergraduate mathematics textbooks
- Editorial Board
- Evaluation Criteria
- Author's Guide
- `aimath.org/textbooks`

Evaluation

External project evaluation provides formative and summative evaluation on processes, program events, research implementations, and participant feedback, using survey, interview, and observational data.

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