How BRIDGES can help with Engagement

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Engagement and Motivation

- Well understood that student engagement is an important predictor of student achievement.
- Engagement can span many dimensions[1]:
  - skills engagement
  - participation/interaction engagement
  - emotional engagement
  - performance engagement
- Engagement and motivation are closely tied to each other
- How do we motivate and engage students?
- What engagement strategies can we use?

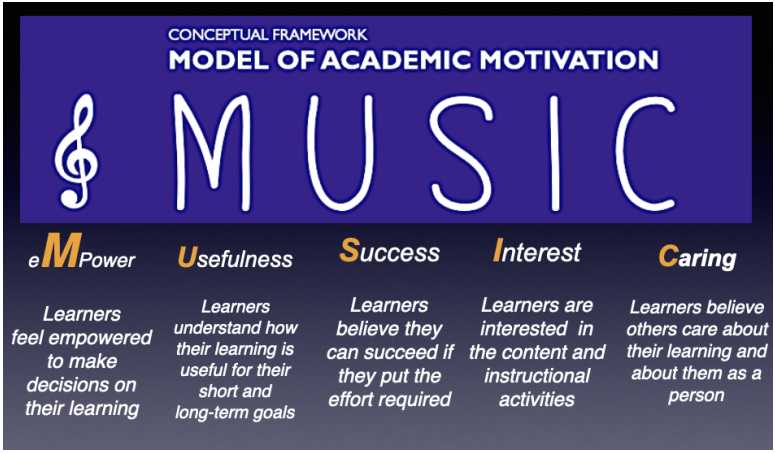
[1] Handelsman et al., A Measure of College Student Course Engagment, Journal of Educ. Res., 2005

Engagement Strategies

- **Active Learning:**
  - Pair Programming
  - Flipped classroom
  - Group work/collaboration/Light Weight Teams
  - Quizzes
- **Content Based**
  - Real world data integrated into curriculum, demonstrate relevance
  - Align with student interests, values, social relevance

BRIDGES focuses on content based engagement

The MUSIC Model of Engagement



[2] Jones, B.D, Motivating Students to Engage in Learning: The MUSIC Model of Academic Motivation, Intl. Journal of Teaching and Learning in Higher Ed., 2009

Engaging Students: Experiences from an online OOP Course [3]

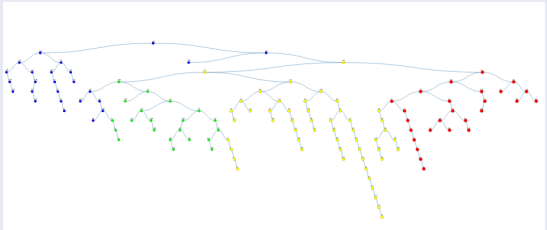
Two semesters of an online project based OOP course, using student reflections after each course module

- **Visible Rythmic Structure.** Visual map of modules that follow a rythmic structure with milestones for preparation, problem definition, solving, testing and reflection
- **Design before Coding.** Explicit requirements to get students to turn a project design (flow charts, diagram, pseudocode) prior to implementation lets students spend time thinking through the solution prior to coding.
- **Transparent Expectations and Instructions:** Clear course goals, assignment descriptions/purpose, expectations, rubrics and expected output, **presented in writing.**
- **Real World Projects, Tools, Data.** Careful selection and Use of engaging projects that use real world applications and data and tools and technologies.
- **Happy Challenges:** Challenged to think, encourage creativity and allow for flexibility/choice in activities. Students feel challenged, but also very satisfied to 'figure it out'
- **Sustained Reflection.** Reflection points after each module helped students communicate their personal success/failure/venting and how/what they are learning;

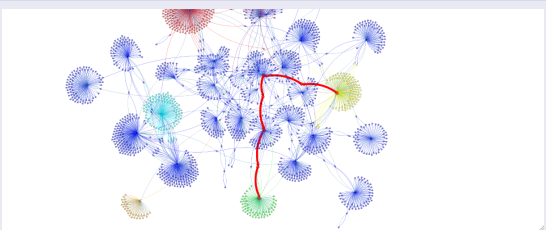
Engagement Using BRIDGES: Visual and Interactive

- BRIDGES generates **visualizations** of data structures (**that students implement!**), algorithm outputs as a mechanism for engaging students.
- Visualizations of classic CS concepts can be helpful in making them real and more meaningful.
- Student feedback has been very positive, appreciating the features of BRIDGES that enables them to **see what they code and produce**.

Indexing USGS Earthquake



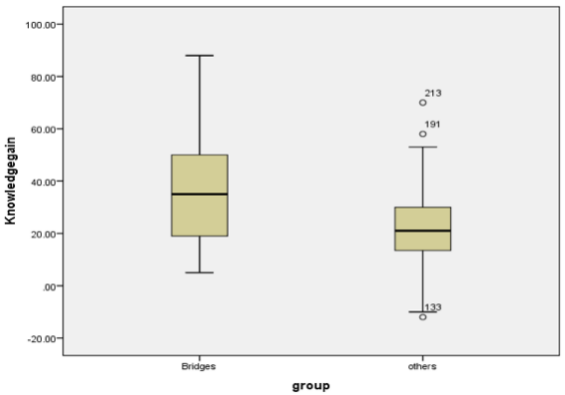
Bacon Number [IMDB Data]



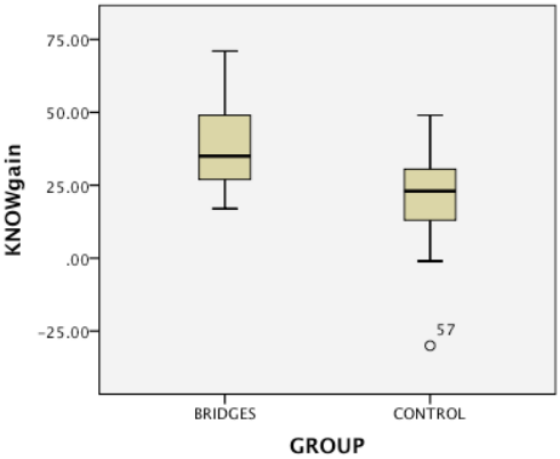
Engagement Using BRIDGES: Use Real-World Data

- Using **real-world data** in course work is an important engagement tool
- Students respond to working with data from real-world scenarios/data: weather/climate, maps, medical, census, books, music, videos, games
- Data is everywhere, the harder part is
  - Accessing data in a ready-to-use form for course work
  - Mapping the right data to course work to meet objectives.
- BRIDGES supports a number of datasets ready to use in early CS courses:
  - **Earthquake Data:**
    List<EarthquakeUSGS>eq_list = bridges.getDataSource().getEarthquakeUSGSData(100)
  - **IMDB Actor-Movie Data:**
    List<ActorMovieIMDB>am_list = bridges.getDataSource().getActorMovieIMDBData(1813)
  - **Open-Street Map Data:**
    OsmData osm_data = bridges.getDataSource().getOsmData("Charlotte, North Carolina", "default")

Results: Students in BRIDGES sections gained more knowledge



Fall 2014



Spring 2015

Results: Students in BRIDGES sections progressed faster in CS

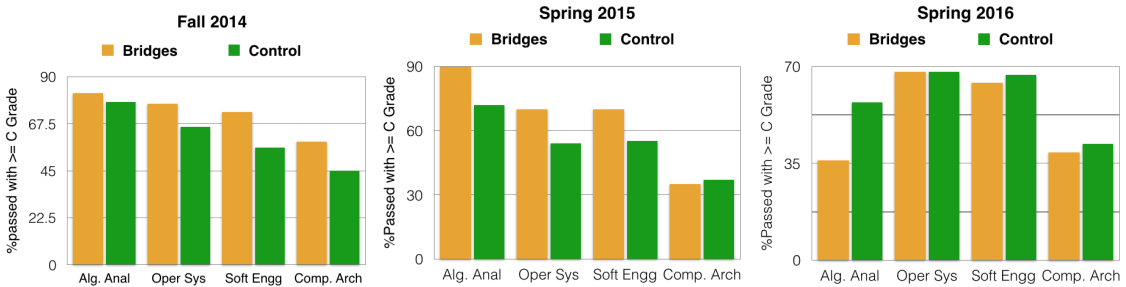


Figure: Comparing long-term student achievement between students who used the BRIDGES toolkit in the Data Structures course vs. Control group. The evaluation was performed with 3 cohorts of students (Fall 14, Spring 15, Spring 16).
Analysis performed Spring 2019.