Collaborating Across Boundaries to Engage Undergraduates in Computational Thinking

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The College of New Jersey

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Introductions

- Presenters
  - ✓ Background
  - ✓ Roles
- Participants
  - ✓ Name, Affiliation
  - ✓ Classes typically taught
  - ✓ Have you taught a collaborative class?
  - ✓ What are you expecting from the presentation?

Collaborating Across Boundaries to Engage Undergraduates in Computational Thinking

Hypothesis

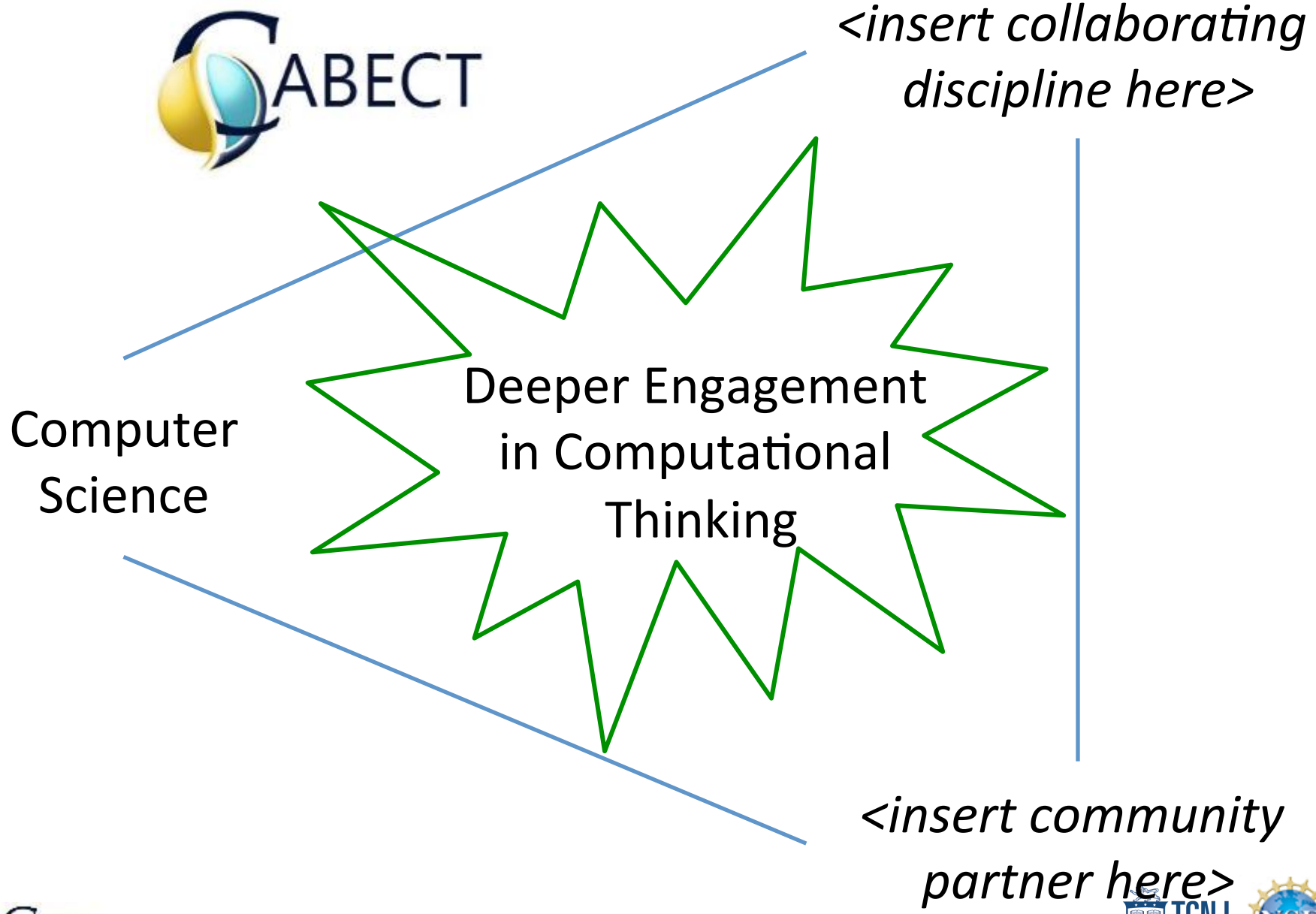
To increase motivation toward, and interest in, computing careers, undergraduate students must be immersed in multidisciplinary collaborative experiences where they are creators of computational solutions and internalize the relevance of and interconnectedness between classroom learning and the community they live in.

Goals

- Create an experiential and engaging learning environment to immerse computer science and non-computer science majors in computational thinking.
- Study the learning environment to articulate the processes, products, challenges and strategies that manifest creative and collaborative problem solving.

Goals

- Formalize a model for courses that collaborate across disciplinary boundaries and with a community partner.
  - ✓ Develop a model for collaborating in courses across disciplinary boundaries.
  - ✓ Develop a model for a meaningful sustainable collaboration with a community partner.


<insert collaborating discipline here>
Computer Science
Deeper Engagement in Computational Thinking
<insert community partner here>

The Pilot Project

- Habitat for Humanity, Trenton Area, NJ (HH) acquires properties to build houses. Often these sites are brownfields (contaminated with industrial wastes) and must be cleaned up prior to construction.
- Computer science students are collaborating with journalism students and HH to develop an online system called SOAP (Students Organizing Against Pollution).
  - ✓ To help HH estimate costs for cleaning up properties
  - ✓ To empower citizens to learn, share, and contribute pollution data, and become active participants in environmental advocacy and public policy deliberations.

Journalism

Computer Science

Habitat for Humanity

The Pilot Project

- Builds on the cooperative expertise model of distributed CS education.
- Collaborating class sessions are held in the same timeslot but independently.
- Classes meet 3-4 times during the semester to brainstorm, share progress reports and plan next steps.
- Class visits by Tom Caruso, Executive Director of Habitat for Humanity (HH) and Nicky Sheats, Director of Center for Urban Environment (expert on environmental justice).
- Field trip to Trenton, NJ to visit HH office, acquired properties, and contaminated sites.

The Pilot Project

- Assignments and class projects are based on "problem".
- CS class designs and develops modules to address concerns and needs raised by the journalism class, Dr. Caruso and Dr. Sheats.
- Journalism class researches trusted sources for data and explores new technologies and techniques for storytelling, data interpretation and improving user experience.
- Introduces "computational journalism."

Computational journalism

"The application of computational thinking to all aspects of journalism and digital publishing: beat monitoring, idea generation, newsgathering, verification, distribution and audience engagement around news and information relevant to one or more audiences… Rich Gordon, 2011

Example: USA Today's Ghost Factories

What is a Brownfield?

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What We Did In Spring 2013

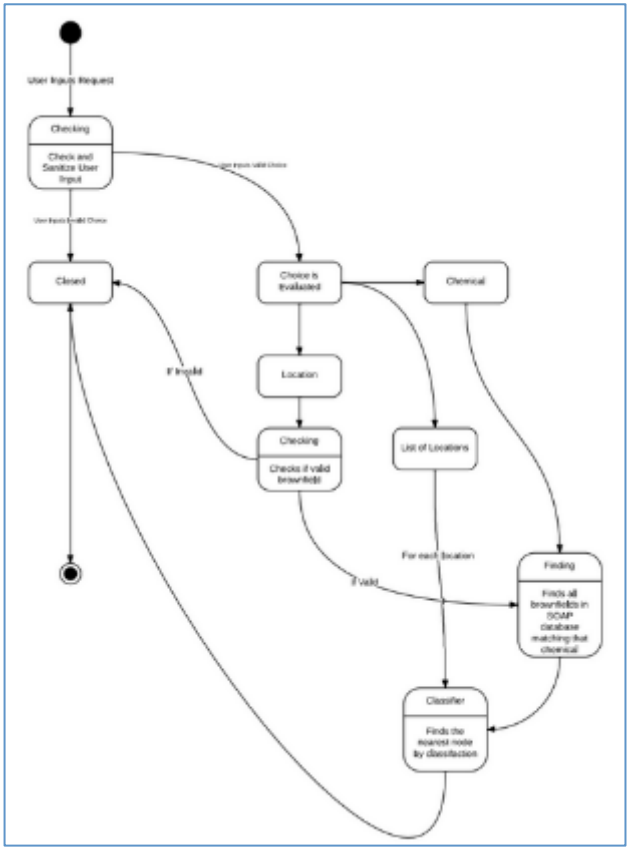
Habitat for Humanity® of Trenton

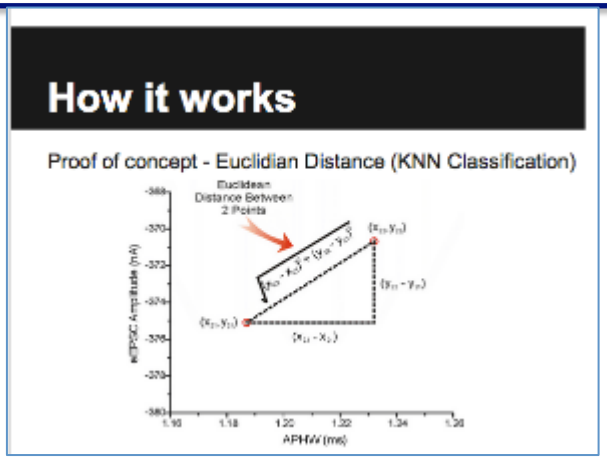
Software Engineering ⟷ Blogging and Social Media

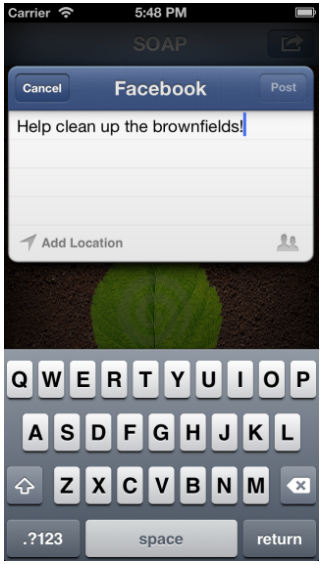
The Pilot

- Class visits and field trips

Artifacts

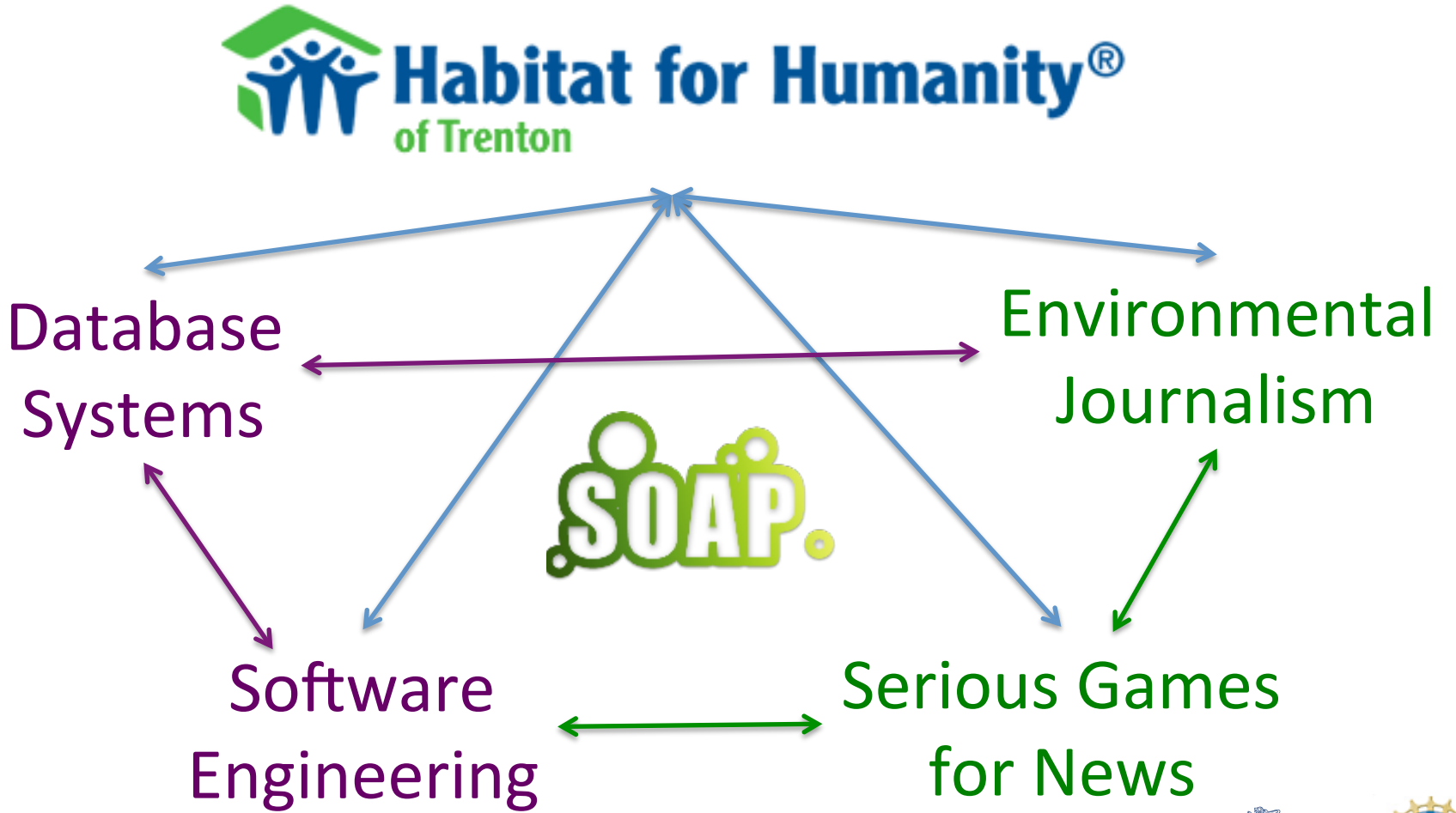

User Inputs Request
Checking
Check and Sanitize User Input
Closed
Choice is Evaluated
Chemical
Location
Checking
Checks if valid brownfield
List of Locations
Finding
Finds all brownfields in SOAP database matching that chemical
Classifier
Finds the nearest node by classifaction

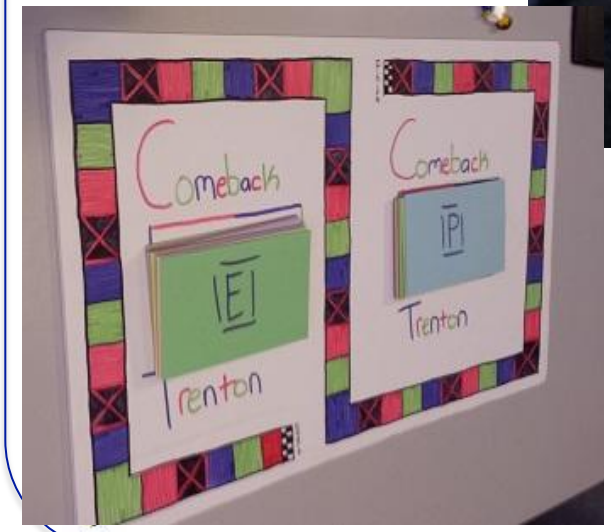

How it works
Proof of concept - Euclidian Distance (KNN Classification)
Euclidean Distance Between 2 Points
APHW (ms)


Carrier
5:48 PM
SOAP
Cancel
Facebook
Post
Help clean up the brownfields!
Add Location

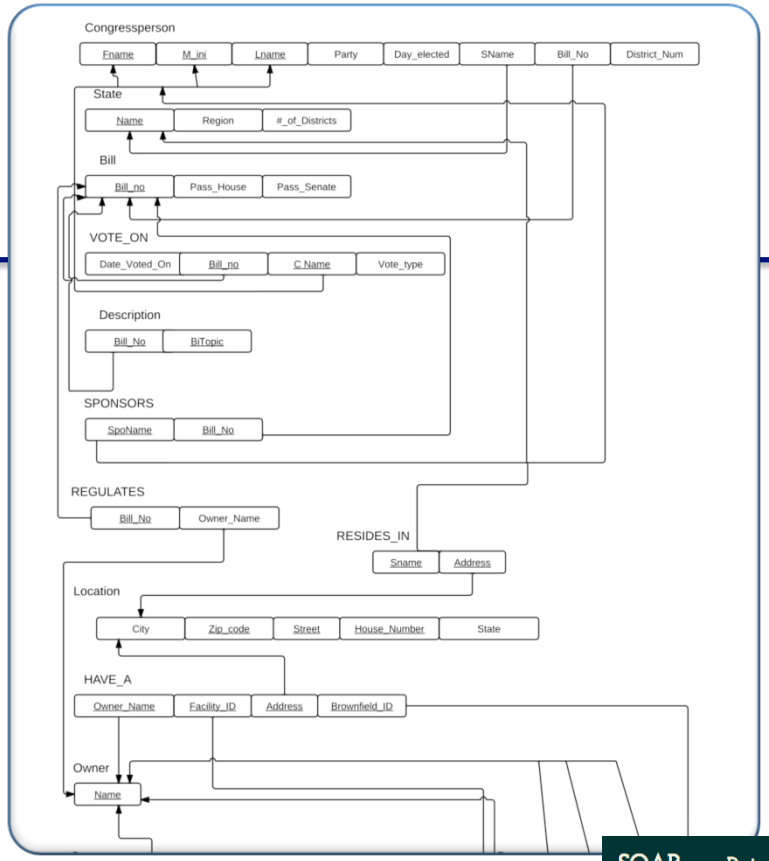

Carrier
5:42 PM
SOAP
Brownfield Map
Donate

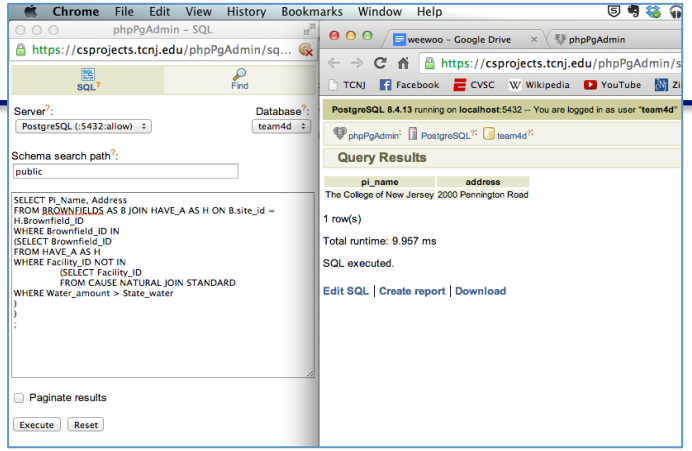
What We Did In Fall 2013

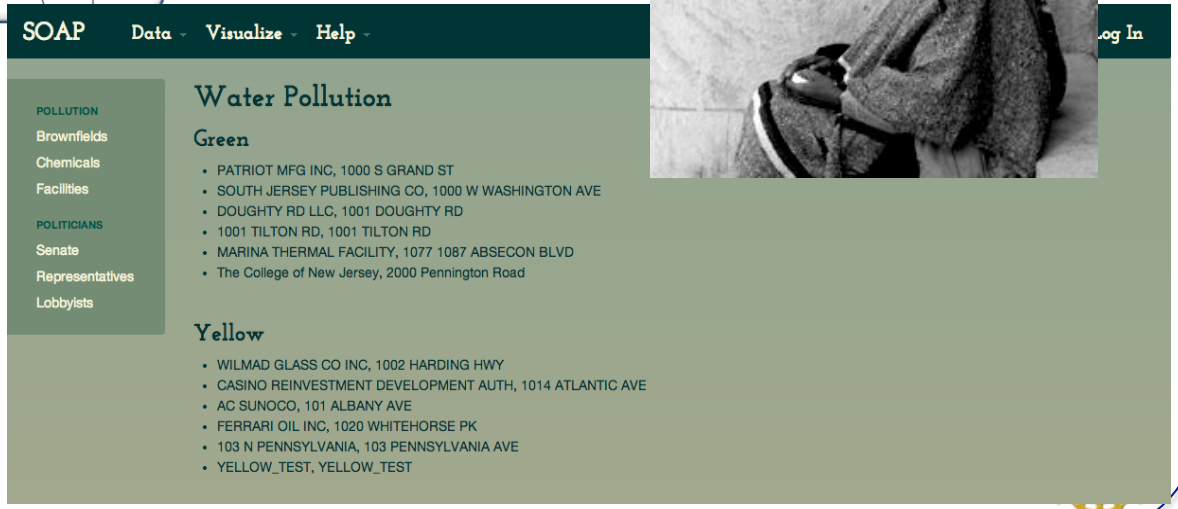



Comeback
Trenton
Comeback
Trenton

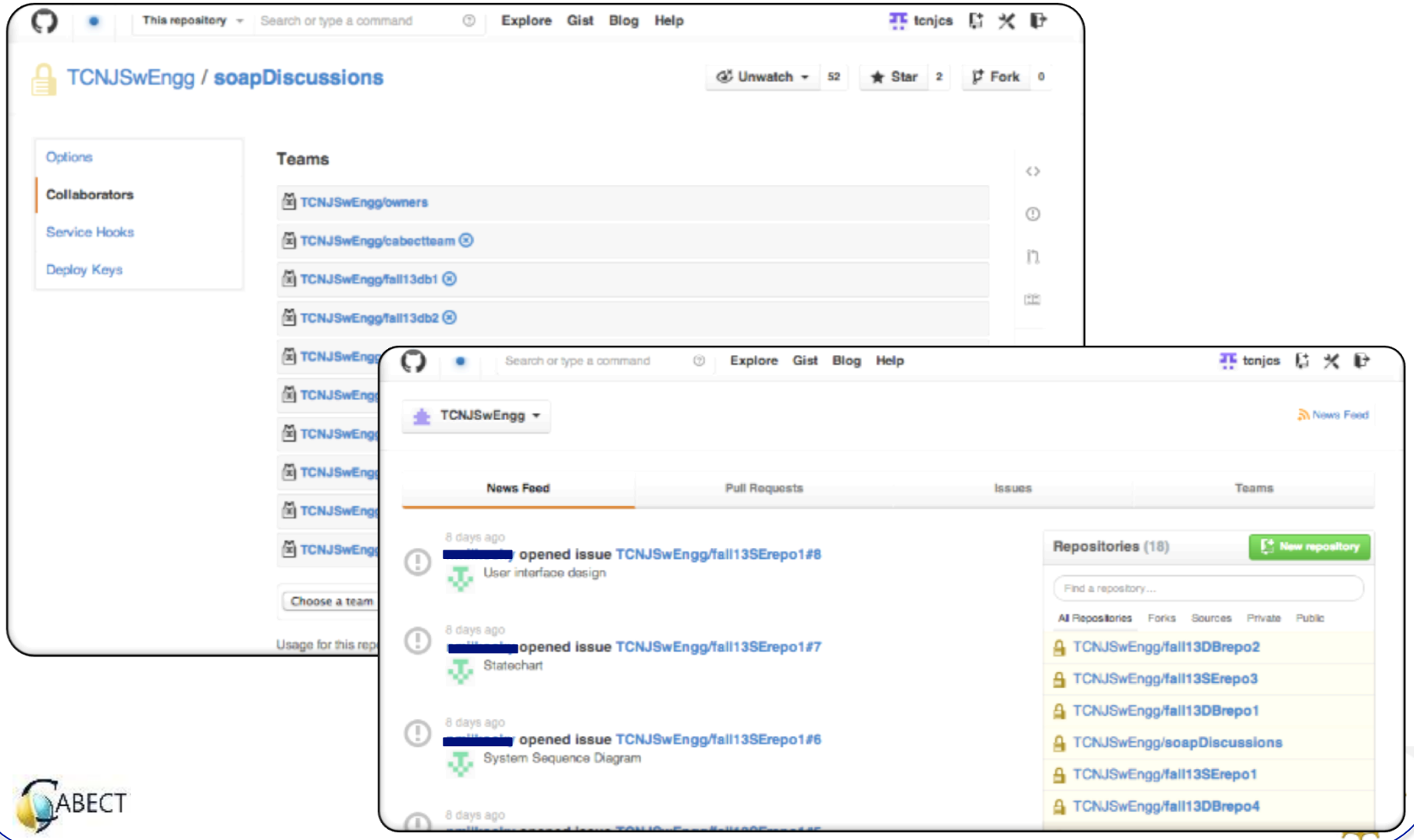
Artifacts


Congressperson
Fname
M_ini
Lname
Party
Day_elected
SName
Bill_No
District_Num
State
Name
Region
#_of_Districts
Bill
Bill_no
Pass_House
Pass_Senate
VOTE_ON
Date_Voted_On
Bill_no
C Name
Vote_type
Description
Bill_No
BiTopic
SPONSORS
SpoName
Bill_No
REGULATES
Bill_No
Owner_Name
RESIDES_IN
Sname
Address
Location
City
Zip_code
Street
House_Number
State
HAVE_A
Owner_Name
Facility_ID
Address
Brownfield_ID
Owner
Name

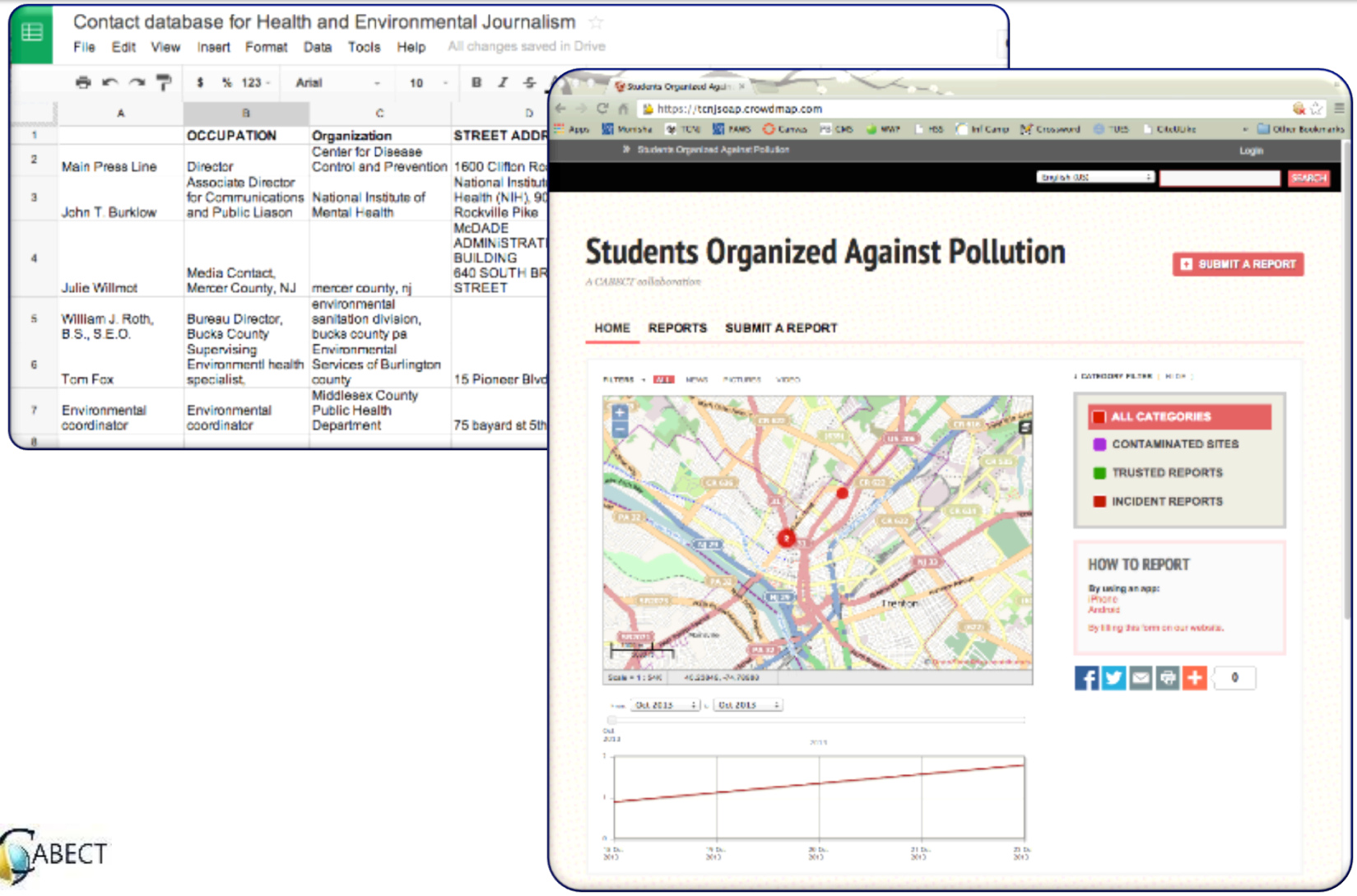

Chrome File Edit View History Bookmarks Window Help
phpPgAdmin - SQL
https://csprojects.tcnj.edu/phpPgAdmin/sq...
SQL
Find
Server:
PostgreSQL (:5432:allow)
Database:
team4d
Schema search path:
public
SELECT Pi_Name, Address
FROM BROWNFIELDS AS B JOIN HAVE_A AS H ON B.site_id =
H.Brownfield_ID
WHERE Brownfield_ID IN
(SELECT Brownfield_ID
FROM HAVE_A AS H
WHERE Facility_ID NOT IN
(SELECT Facility_ID
FROM CAUSE NATURAL JOIN STANDARD
WHERE Water_amount > State_water
)
)
;
Paginate results
Execute
Reset
weewoo - Google Drive
phpPgAdmin
https://csprojects.tcnj.edu/phpPgAdmin/s
TCNJ
Facebook
CVSC
Wikipedia
YouTube
PostgreSQL 8.4.13 running on localhost:5432 -- You are logged in as user "team4d"
phpPgAdmin
PostgreSQL
team4d
Query Results
pi_name
address
The College of New Jersey
2000 Pennington Road
1 row(s)
Total runtime: 9.957 ms
SQL executed.
Edit SQL | Create report | Download


SOAP
Data
Visualize
Help
Log In
POLLUTION
Brownfields
Chemicals
Facilities
POLITICIANS
Senate
Representatives
Lobbyists
Water Pollution
Green
PATRIOT MFG INC, 1000 S GRAND ST
SOUTH JERSEY PUBLISHING CO, 1000 W WASHINGTON AVE
DOUGHTY RD LLC, 1001 DOUGHTY RD
1001 TILTON RD, 1001 TILTON RD
MARINA THERMAL FACILITY, 1077 1087 ABSECON BLVD
The College of New Jersey, 2000 Pennington Road
Yellow
WILMAD GLASS CO INC, 1002 HARDING HWY
CASINO REINVESTMENT DEVELOPMENT AUTH, 1014 ATLANTIC AVE
AC SUNOCO, 101 ALBANY AVE
FERRARI OIL INC, 1020 WHITEHORSE PK
103 N PENNSYLVANIA, 103 PENNSYLVANIA AVE
YELLOW_TEST, YELLOW_TEST

What We Did In Fall 2013



What We Did In Fall 2013



What We Did In Spring 2014

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What We Are Doing in Fall, 2014

To date:

- User testing of existing SOAP site, review of content and modules completed but not yet integrated
- SE students: Use case diagrams for user feedback
- Journalism students Sanborn maps, scraping practice
- Coming soon, proposals for new modules

Finding our own “ghost factories”

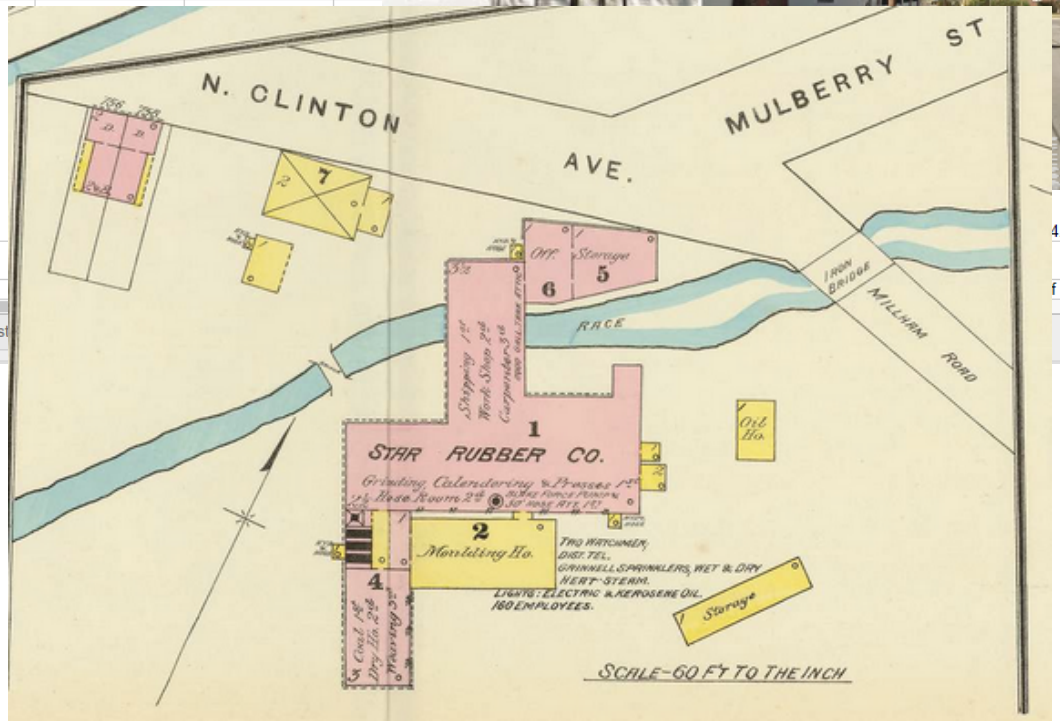
Industrial sites - historical environmental data

File Edit View Insert Format Data Tools Help All changes saved in Driv

SIC

IC	Name	Alternate names	Products	Date
	Acme Porcelain Works			
	Acme Sanitary Pottery, Co.		East Trenton Rd	
	American Crockery Company		standard tableware and sanitary ware	
	Anchor Pottery			
	Artistic China			
	Artistic China			

Pottery | Other indust

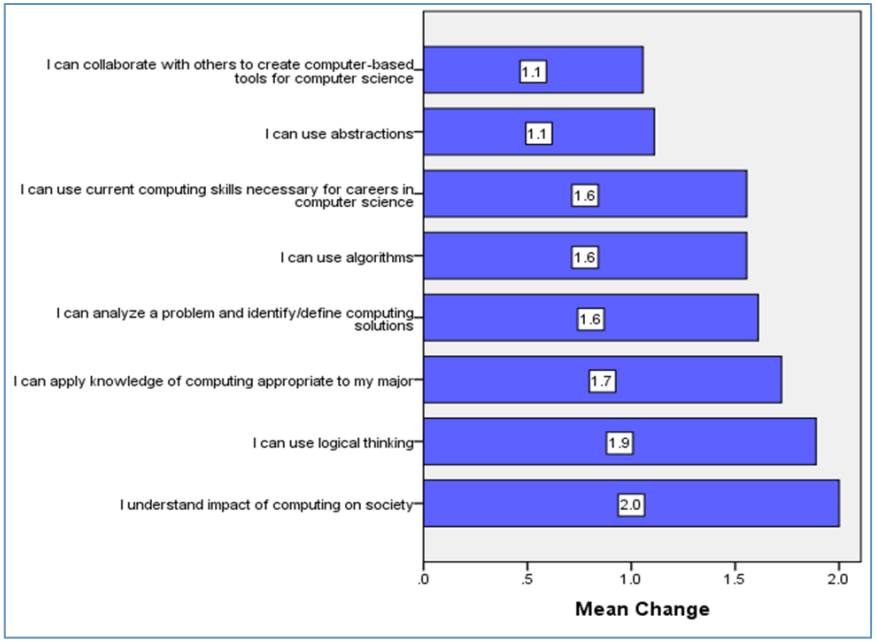


Preliminary Results

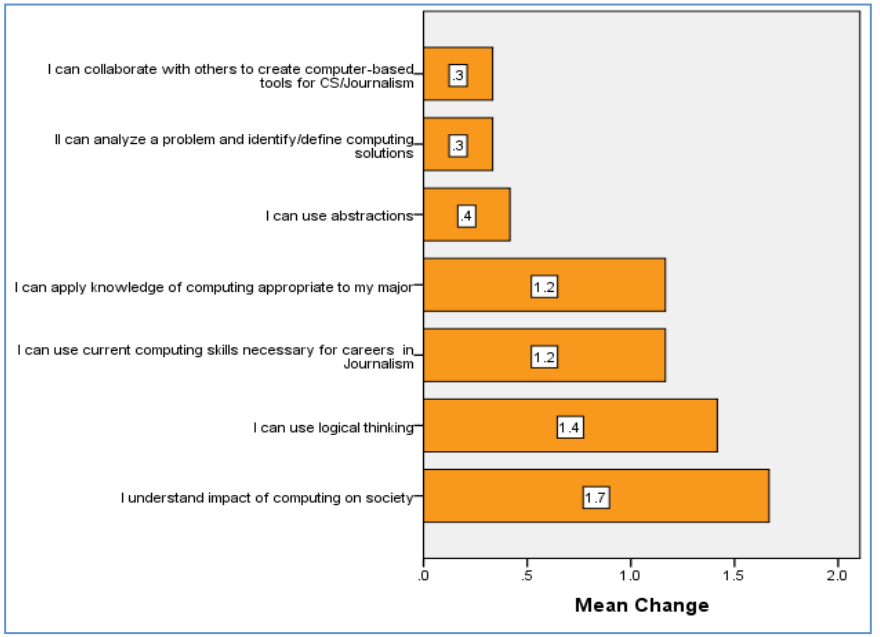
- Students in both classes self-reported greater understanding of computational thinking from pre-test to post-test.
- Students in both classes recorded highest gains in understanding how computing affects society.

Preliminary Results

Computer Science Students (N=21)



Journalism Students (N=21)



Change in mean of post-test self-reported level agreement from pre-test level of agreement, measured on a 4 point scale where 4 = Strongly Agree, 3 = Agree, 2 = Disagree, 1 = Strongly Disagree;

Data shows that Computer Science students demonstrated greater changes overall, with up to two points of mean change from class.

Preliminary Results

"It has provided a new point of view of Computer Science that I didn't know of before. As well as thinking about design decisions in a way that is effective from the computer programmers point of view, we also need to take into account how the system will be used by others. Also, dealing with stakeholders in the system by directly asking them questions was a more effective way of laying out system requirements than just imagining what they would want."

"The collaboration was helpful in learning about requirements gathering and planning the system and the user interface. It helped us learn how to balance the interests of all stakeholders and develop a solution to an important problem in the system. This is what a software engineering course is meant to teach students and I found it to be a very valuable experience."

Challenges and Concerns

- Understanding the scope of involvement and where the other class “fits”
- Students collaborating across courses beyond designated meeting times.
- How does the additional time for collaborative activities impact content coverage?
- ??

Questions

- How do you incorporate ethics into all stages of the project so that students are constantly aware of needing to make ethical decisions?
- What kinds of collaborative activities make sense?

Obstacles / Challenges

- Time
  - ✓ To develop the course
  - ✓ To cover content
- Keeping faculty engaged / committed
- Finding a community partner
- Institutional support

Outcomes for the Community Partner

- Students develop a sense of personal social responsibility.
- The partner gets applications that enable them to efficiently carry out tasks.
- The partner gets informative online resources that promote a better understanding in the community about the issues being investigated and addressed.

Questions for discussion

- What kinds of projects in your course(s) might work for this model?
- To which community partners can you reach out?
- What institutional support is available?
- What additional institutional support is needed?

Implementing the Collaboration I

Brainstorming in small groups – 35 minutes

- Specific concerns
  - ✓ Logistics
  - ✓ Administrative support
  - ✓ Others ??
- How we addressed them
- Ideas on how these can be addressed

Outcomes for Journalism

- Students in can describe similarities between the process of doing journalism and that of developing software.
- Students recognize the need for computational thinking in their own discipline.
- We see a positive impact on the accuracy, timeliness, rhetorical velocity and amplification effects of student journalism.

Assessing Outcomes

- Self assessments
  - ✓ First Day of Class
  - ✓ Middle of the semester
  - ✓ At the end of the semester
- Project

How can you be involved in CABECT?

- Sign up to be an early adopter of the model.
- Recruit a faculty collaborator from another discipline, preferably non-STEM.
- Identify a community partner to work with.
- Adapt and apply the model.
- Provide us with anonymized assessment data and feedback on the model.
- Post your ideas and resources on CABECTPortal.

What Help Can We Provide?

- Best practices for developing similar collaborations at your institution.
- Pitfalls to be avoided and how to deal with them.
- Instructional materials for the courses in our project.
- Assessment and evaluation instruments with instructions on adapting and administering them.
- Documentation and configuration scripts for using the technology needed for such collaboration.

"Hand-holding" throughout the process.

For more information

- CABECT website: http://tardis.tcnj.edu/cabect
- S. Monisha Pulimood, PI pulimood@tcnj.edu
- Kim Pearson, co-PI kpearson@tcnj.edu
- Diane Bates, evaluator bates@tcnj.edu