Introducing a real-world design problem to an intro water resources engineering course: effects on cognitive skills, understanding, and perception of value

Carolyn B. Voter and Steven P. Loheide II, Department of Civil and Environmental Engineering, UW-Madison

MOTIVATION and APPROACH

Course Description: CEE 311 Hydroscience is an introductory water resources engineering course required for civil engineers. There are 60-70 students each semester, mostly senior civil engineers.

Issues:
- Incoming interest in water resources is inversely related to interest in construction and structural (the most popular specialties)
- High frustration with urban hydrology topic, frequently cited as the topic most in need of change.
- No design component in the course

Learning Objectives: After intervention, students are able to:
- Design stormwater management facilities
- Perceive gains in their understanding of water resources
- Perceive value to their future academic and professional career in learning water resources

Intervention: Add a homework set where students design a stormwater detention basin.
- Provides a real-world example
- Synthesizes previous course concepts: design storms, infiltration, runoff, unit hydrographs, reservoir (puls) routing

Approach:
1. Focus on the urban hydrology topic (one of 12 course topics), since it is the most directly related to other civil engineering specialties.
2. Separate the technical unit hydrograph concept from the rest of the topic.
3. Make design homework very structured to reduce technical obstacles to understanding.

RESULTS and CONCLUSIONS

Students can...design stormwater management facilities
Grades increased on the same design-based final exam question in the intervention year, as did overall course grades (neither are statistically significant).

Students...perceive greater gains in their understanding
Perceived gains in understanding made during the Urban Hydrology topic increased in the intervention year relative to the control year.

Students...perceive more value to their future careers
Most notably, the percent of students who view urban hydrology as not valuable dropped by a factor of 2 in the intervention year relative to the control.

UNEXPECTED OBSERVATIONS

Technical obstacles remain important
While many students found the assignment straightforward and very helpful for synthesizing their understanding of course concepts, others were frustrated with unit hydrographs.

Several noted there was a disconnect between the effort required for the real-world problem and its weight on their final grade. These students would have preferred more practice with problems that were less applied, but more similar to what appears on the final exam.

What was the most confusing part of the design homework?

What is the most important thing you learned from the design homework?

Room for improvement in perception of value
Surprisingly, student perception of value clearly decreased over the semester with the intervention. This is the first time we tracked this; it will be interesting to revisit in future semesters to see if it is a typical trend.

How confident are you that this class will be valuable to your future academic and professional career?

ACKNOWLEDGEMENTS

Many thanks to Corey Poland and Devin Wixon for substantial help designing and implementing this teaching-as-research project.

Delta Internship Project

Carolyn B. Voter and Steven P. Loheide II, Department of Civil and Environmental Engineering, UW-Madison

MOTIVATION and APPROACH

Course Description: CEE 311 Hydroscience is an introductory water resources engineering course required for civil engineers. There are 60-70 students each semester, mostly senior civil engineers.

Issues:
- Incoming interest in water resources is inversely related to interest in construction and structural (the most popular specialties)
- High frustration with urban hydrology topic, frequently cited as the topic most in need of change.
- No design component in the course

Learning Objectives: After intervention, students are able to:
- Design stormwater management facilities
- Perceive gains in their understanding of water resources
- Perceive value to their future academic and professional career in learning water resources

Intervention: Add a homework set where students design a stormwater detention basin.
- Provides a real-world example
- Synthesizes previous course concepts: design storms, infiltration, runoff, unit hydrographs, reservoir (puls) routing

Approach:
1. Focus on the urban hydrology topic (one of 12 course topics), since it is the most directly related to other civil engineering specialties.
2. Separate the technical unit hydrograph concept from the rest of the topic.
3. Make design homework very structured to reduce technical obstacles to understanding.

RESULTS and CONCLUSIONS

Students can...design stormwater management facilities
Grades increased on the same design-based final exam question in the intervention year, as did overall course grades (neither are statistically significant).

Students...perceive greater gains in their understanding
Perceived gains in understanding made during the Urban Hydrology topic increased in the intervention year relative to the control year.

Students...perceive more value to their future careers
Most notably, the percent of students who view urban hydrology as not valuable dropped by a factor of 2 in the intervention year relative to the control.

UNEXPECTED OBSERVATIONS

Technical obstacles remain important
While many students found the assignment straightforward and very helpful for synthesizing their understanding of course concepts, others were frustrated with unit hydrographs.

Several noted there was a disconnect between the effort required for the real-world problem and its weight on their final grade. These students would have preferred more practice with problems that were less applied, but more similar to what appears on the final exam.

What was the most confusing part of the design homework?

What is the most important thing you learned from the design homework?

Room for improvement in perception of value
Surprisingly, student perception of value clearly decreased over the semester with the intervention. This is the first time we tracked this; it will be interesting to revisit in future semesters to see if it is a typical trend.

How confident are you that this class will be valuable to your future academic and professional career?

ACKNOWLEDGEMENTS

Many thanks to Corey Poland and Devin Wixon for substantial help designing and implementing this teaching-as-research project.

Delta Internship Project