

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

*Delta Internship Project*

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## MOTIVATION and APPROACH

**Course Description:** CEE 311 Hydrosience 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)

		Construction					TOTAL
		none	a little	some	high	extreme	
Water Resources	none	0	0	0	0	3	3
	a little	0	0	2	5	8	15
	some	2	1	4	1	4	12
	high	1	2	2	0	3	8
	extreme	4	4	2	0	0	10
	TOTAL	7	7	10	6	18	48

- High frustration** with urban hydrology topic, frequently cited as the topic most in need of change.
  - ↳ Large focus on technical skill, less on “big picture” or connections to other specialties
- 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:**

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

	Timeline	Milestone	Assessment
	Week 1	Start of Class	Pre-Survey
	Week 4	Infiltration	
	Week 6	Runoff & Unit Hydrographs	
	Week 8	Reservoir (Puls) Routing	
	Week 12	Urban Hydrology	<b>Design Homework</b>
	Week 15	End of Class	Post-Survey
	Week 16	Finals Week	Final Exam

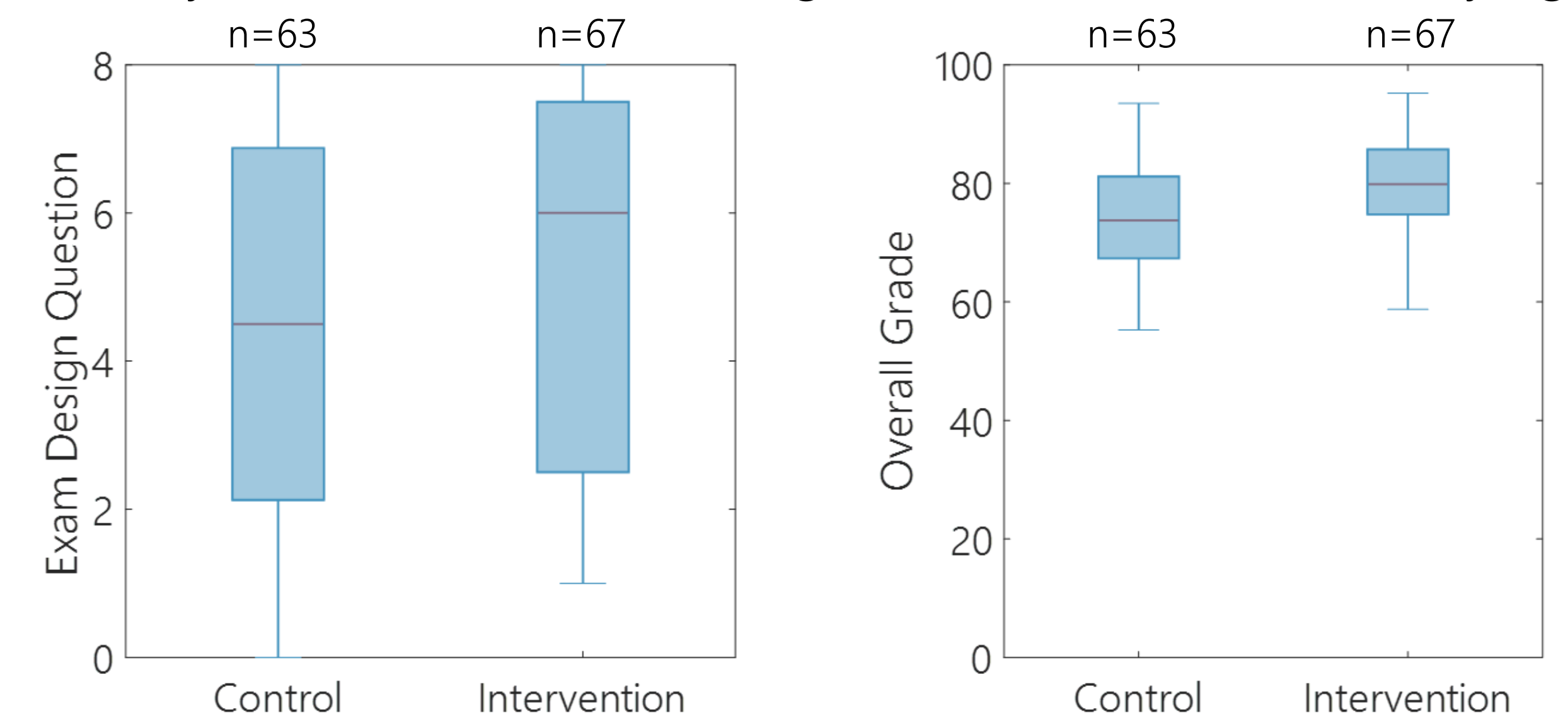
## ACKNOWLEDGEMENTS

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

## RESULTS and CONCLUSIONS

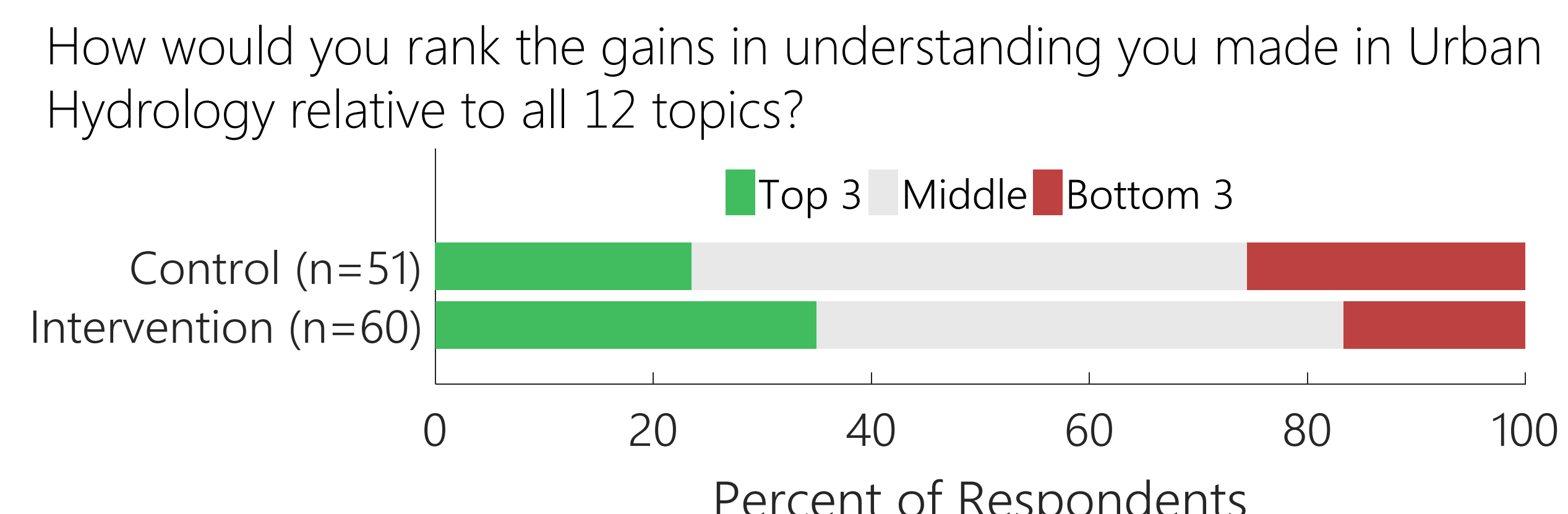
Students can...**design stormwater management facilities**

**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.

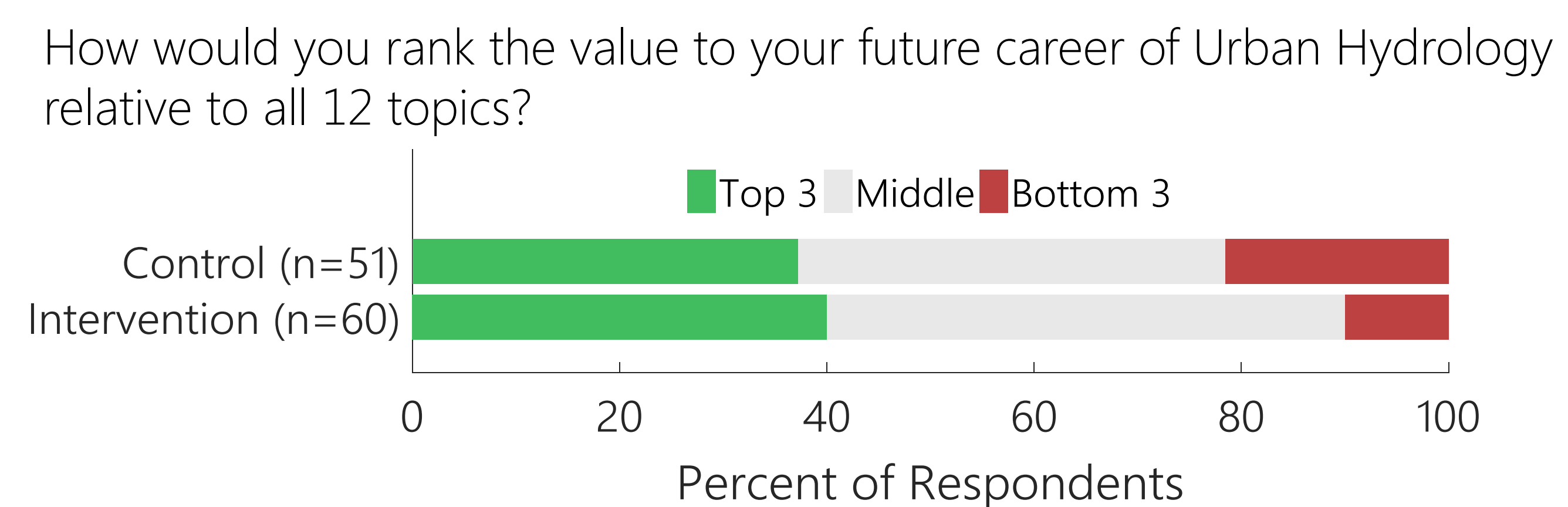


Students who appreciated the “big picture” purposes of the design homework were more likely to perceive large gains in understanding in urban hydrology.

Most Important Part of Design HW	Gains in Understanding: Urban Hydrology Rank			
	Top 3	Middle	Bottom 3	TOTAL
Nothing	2	4	2	8
Technical Practice	2	8	3	13
Impact of Urbanization	1	4	1	6
Real World Example	3	1	1	5
Synthesizing Concepts	13	11	3	27
TOTAL	21	28	10	59

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



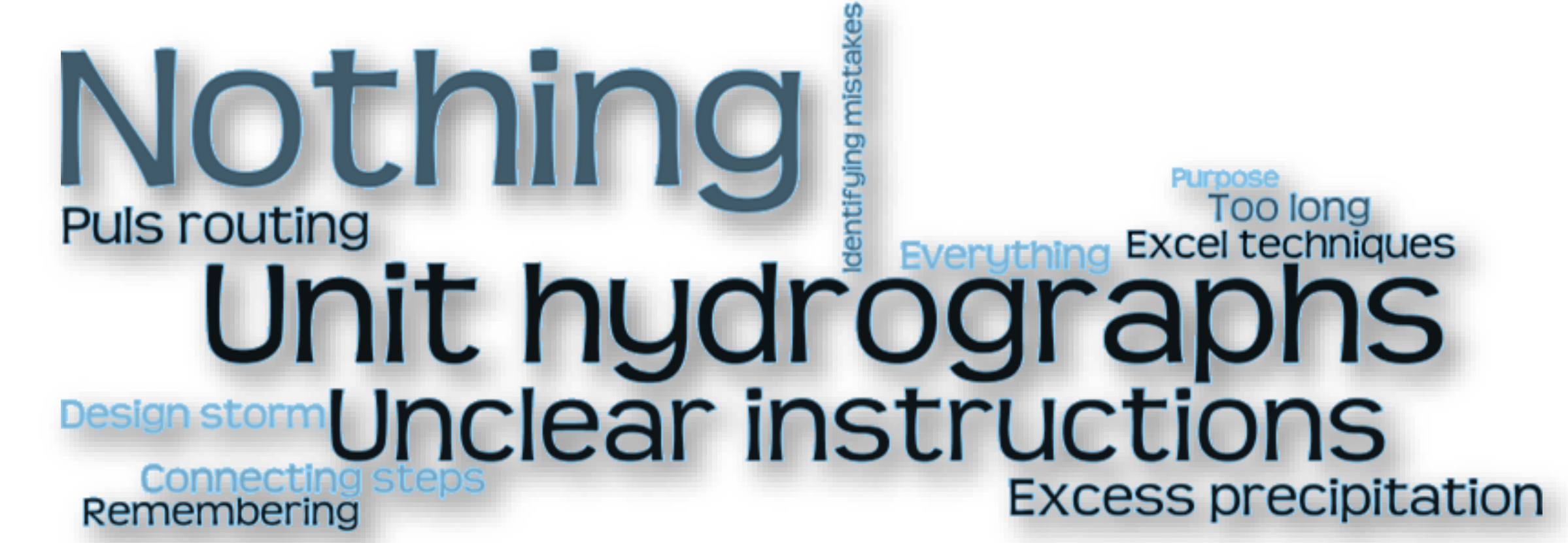
## UNEXPECTED OBSERVATIONS

**Technical obstacles** remain important

While many students found the assignment straightforward and very helpful for synthesizing their understanding of course concepts, others were **frustrated by Excel skills** and specific course concepts (e.g., 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?



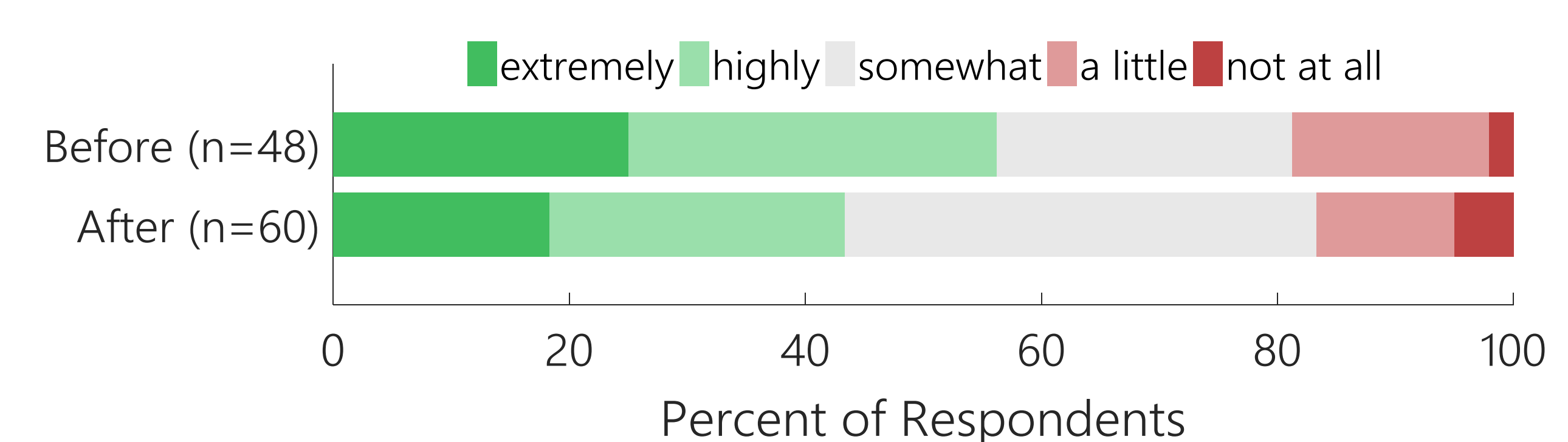
What **other thoughts** do you have about the design homework?



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?



In the future, **more explicit connections** between water resources and other civil engineering specialties could be explored in all problems sets to try to mitigate this.