

### Research Question

To what extent do scenarios and format affect students' responding to hydrostatics problems?

## Introduction

As part of a large investigation into when students learn and forget introductory physics topics, the data here are drawn from clinical interviews with students enrolled in an introductory physics class for engineering majors. The interviews focus on validating a short task on Archimedes' Principle and Pascal's Law; thus, the protocol asked students to solve 10 related problems in multiple-choice or freeresponse format.

# Validating a Short Hydrostatics Assessment

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#### Problem 1

There is a small pond with a boat (mass m1) in it. The density of water is pw. Answer the following questions: A. What is the volume of water displaced by the boat?

B. You put a rock (mass m2, density p2) onto the boat. What is the volume of water displaced by the boat (with the rock on it)?

C. You drop the rock off the boat and it sinks to the bottom. What is the volume of water displaced by the boat and the rock?

**D.** Compare the volume of water displaced in B and C. In which scenario is the depth of the pond greater? Imagine that you can measure the depth of **\the water.** 

**Data:** According to our data, seven out of eight students can solve this problem correctly. They write down math formulas step by step from parts (A) to (D). But they quickly forget their results from complicated math.

- based on data collected here.

A child is playing with toys in the bathtub, including a large toy boat with various crew members. You notice that the water level in the tub suddenly gets slightly lower. Which of the following actions by the child could have resulted in that change in water level? Choose all which apply.

A. The child dropped a crew member from the boat into the tub, and the crew member sank to the bottom of the tub. B. The child dropped a crew member from the boat into the tub, but the crew member floated in the water.

C. The child threw a crew member from the boat onto the floor outside of the tub. D. None of the listed options would cause the water level in the tub to become lower.

**Data:** Very low percent of students could give the right answer (both A and C). Most of time, they forget choice A even though they just finished problem 1 correctly. Also, they are not inclined to use a lot of math here. They just think about the scenario conceptually, and write simple math to get \an answer quickly.

## Conclusion

\* Different scenario and format of problem could affect students' answer significantly. Students could better apply their knowledge when the problem is more familar to them and more easy to deal with at one time/ \* We observed that students consistently behaved in the same manner and used generally the same mental processes when they were trying to solve the problems. An answer making epistemic game is identified



### Problem 2