

## Study goals

- To explore undergraduate students' understanding of Surface area-to-volume ratio (SA/V)
  - Whether, and how they understand SA/V
  - Whether, and how they understand the connection between SA/V and property change

## Methods

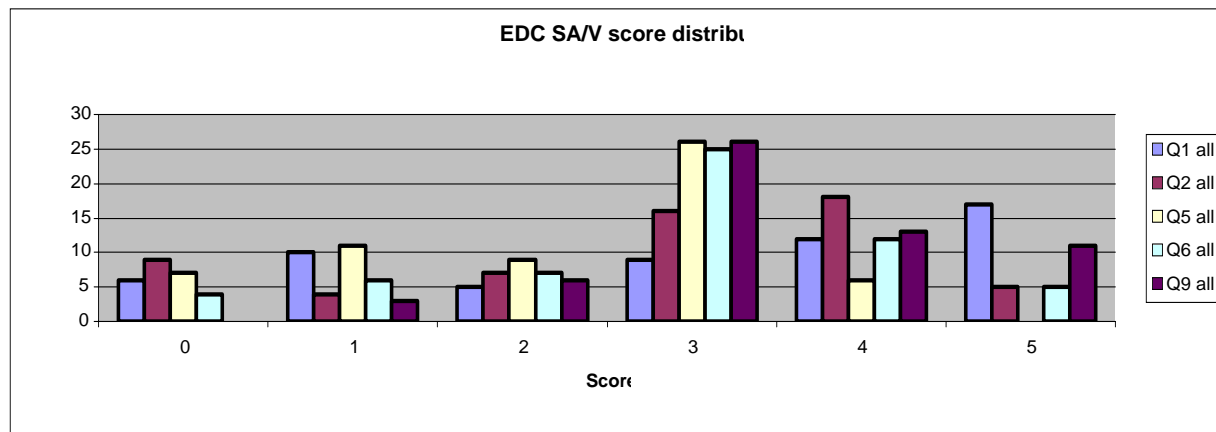
- Participants
  - 30 students enrolled in a quarter-long freshmen Engineering design course (Spring 07)
- Procedures
  - Written test on 5 SA/V questions at the beginning (pre) and the end (post) of the course
    - Multiple-choice questions with written justification of the choice required
    - 29 students completed the pre-test, and 30 students completed the post-test
  - Semi-structured interviews on 4 SA/V questions between the administration of the pre- and post-test
    - 8 randomly selected students completed the interview

## Abstract

An exploratory study employing written tests and interviews was conducted to probe undergraduate students' understanding of the concept "surface area-to-volume ratio". Preliminary results suggest that while students appear to know the basic idea of the concept, their understanding may be partial and/or situated in limited contexts.

## Preliminary results - Pre/post tests

- Pre- & post-test responses were graded on a 0-5 scale (Inter-rater reliability Kappa = 0.75)
- Paired t-test showed no significant pre vs. post differences ( $p > 0.05$ ), thus pre- and post-responses were combined ( $n=59$ ) to demonstrate the range of variations
- Responses demonstrated an understanding of SA/V, but a good portion of the responses were limited to "Surface Area (SA)" only, without explicit discussion of SA/V (see figure below)



- Scores above 4: Correct choice + Explanation demonstrated an understanding of SA/V and its relationship to property change
- Score of 3: Correct choice + Explanation limited to SA only and its relationship to property change
- Score below 2: Correct choice + Explanation not related to SA/V or SA; Correct choice + No meaningful explanation; Or Wrong choice

## Preliminary results - Interview

- All students have the basic understanding of SA/V, at least in terms of its mathematical formulation
- For some students, understanding of SA/V may truly mean "SA" only, without taking "volume" into consideration
- Understanding of the connection between SA/V and property change is primarily situated in the context of reactivity and solubility, and is explained in terms of more surface and/or more molecule/atom exposure
  - Influenced by prior class instruction
- Varied understanding of the range of size/scale in which the connection between SA/V and property change can be observed
  - Continuous throughout all size range vs. limited range only (e.g. nanoscale only)
  - Objects' size difference needs to meet a "threshold" value in order for property change to be observed

## Future direction

- Further probe students' understanding of SA/V
  - SA/V or SA only
- Further examine students' conception of the connection between SA/V and property change
  - Limited type(s) vs. all types of properties
  - Applicability in terms of size/scale range
  - Influence of "visible vs. non-visible" experience on the difference in size/scale and/or the "threshold" value
- Instructional practices that influence students' conceptions