Heuristic refinement via modeling in chemical engineering K-12 education

This poster will let you take a walk through the existence and possibilities of heuristic thinking in chemical engineering. It contains the overview of the findings of a literature survey done on heuristics, chemical engineering education, and modeling in chemical education. It ends with the discussion of the ongoing designing of a pilot study for 11th-grade students based on heat transfer of space shuttles.

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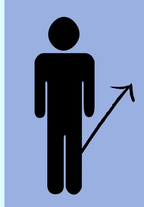
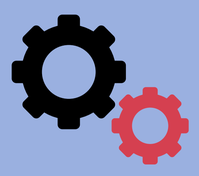
INTRODUCTION

Heuristics
Inherently intuitive
Cognitively demanding situation
Time and resource constraint
Fast and Frugal techniques



Heuristic-analytical models
Heuristic-analytical reasoning (Evans 1984)
Dual theory of cognition(Evans 2006)



Modeling
Representation
Model exploration
Model scaffolding
Systems thinking
Model construction
Validation

OBJECTIVE

- Identifying different types of heuristics and heuristic models used by K-12 students in chemical engineering.
- Checking the possibilities of modeling as a scaffolding agent for heuristic refinement/shift into analytical thinking in chemical engineering subjects

METHODOLOGY

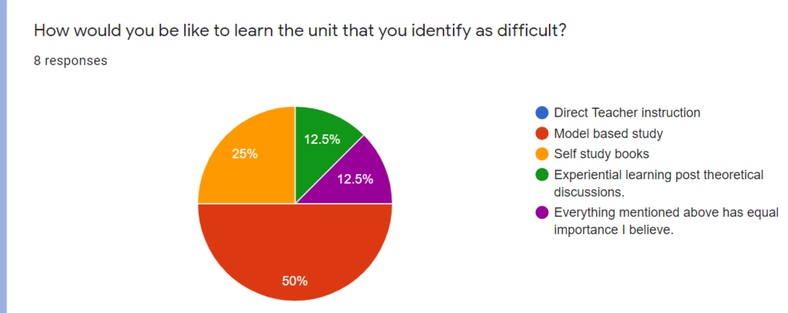
Literature survey on heuristics
Literature survey on heuristics in chemical engineering
Literature survey on the use of modeling in chemical education
Google form survey on modeling in chemical engineering and subject difficulty
Pilot Study design

RESULTS OF LITERATURE REVIEW

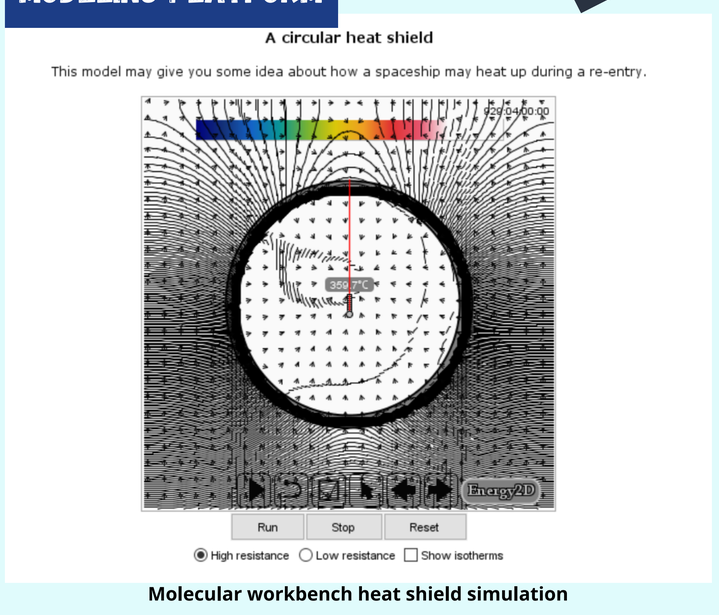
- Ten heuristics to tame in chemical education (Talanquer, 2014)
- Reduction, representative, one-reason decision making and, recognition most commonly used heuristics in chemical education.
- Incorrect representations and biases exist in the analytical stage if not addressed or strongly objected at the first stage.
- Modeling has become a dominant way of thinking(Luisi, 1990)
- Thinking with models enables chemists to visualize the entities or processes for planning experiments, support reasoning, and constructing knowledge

GOOGLE FORM RESULTS

Survey of 8 students
Ph.D. and M.Tech students in chemical engineering
Units found the most difficult to comprehend in chemical engineering:
Mass transfer, thermodynamics, entire transport phenomenon



MODELING PLATFORM



Molecular workbench heat shield simulation

PILOT STUDY DESIGN

Targeted audience : MPC (Class 11 and Class 12 students)

Kalpana Chawla's Columbia disaster
[Authentic context]

Heat shield (Heat Transfer concept)
NCERT Chapter 11(Thermal properties of matter(Physics)

Thermal expansion, coefficient of volume expansion, thermal stress, Young's modulus Heat capacity, specific heat capacity Melting fusion, melting point, boiling point Conduction, Thermal conductivity, convection Radiation are few of the concepts that are introduced in the textbook that pertains to the heat shield

Problem statement(for students): Design a heat shield(that could have helped protect the Columbia space shuttle) with the material of your choice and test it against the conditions through the modeling platform **(molecular workbench heat shield simulation)**.
Report your findings in technical terms(?), graphical or pictorial representations

Pre-test, Scientific reports, Representations of models
Drawings, Interaction recordings
Think aloud questions

FUTURE WORK

Refining problem statement
Designing pre-tests, rubric for a scientific report, hands-on experience of prospective students with Molecular workbench
Looking at different facets of modeling for the refinement of heuristic