

Developing an Outcomes Assessment Instrument for Identifying Engineering Student Misconceptions in Thermal and Transport Sciences (NSF DUE - 0127806)

Results of Thermal and Transport Concepts Delphi Study
(italicized concepts refer to low understanding/high importance rankings)

CONCEPT	Understanding Data Median (interquartile range)			Importance Data Median (interquartile range)		
	Round 1	Round 2	Round 3	Round 1	Round 2	Round 3
1. Adiabatic vs. Isothermal Processes	7.5 (6-8)	8 (6-8)	8(6.75-8.25)	9 (8-10)	9 (9-10)	9 (9-10)
2. <i>Bernoulli Equation</i>	7 (4-8)	6 (5-7)	6 (5-7)	9 (7-10)	9 (8-9)	9 (8-9)
3. Compressible vs. Incompressible Flow	5 (3-7)	6 (4-6.5)	6 (5-7)	7.5 (6-8)	7 (7-8)	7.5 (7-8)
4. <i>Conservation of Linear Momentum</i>	5 (3-6)	5 (4-6)	5.5 (5-6)	9 (8-10)	9 (8-10)	9(8-9.25)
5. <i>Differential vs. Integral Analysis</i>	4.5 (3-6)	4 (3-5.25)	4 (4-5)	7 (6-9)	8 (6-8)	8 (7-9)
6. Dimensional Analysis	6 (4-7)	5.5 (4.25-7)	6 (5-6.25)	7 (5-7)	6 (5-8)	7 (5-8)
7. <i>Entropy & 2nd Law of Thermodynamics</i>	4 (2-6)	4 (3-5)	5 (3-5.25)	8 (7-9)	9 (8-9)	9 (8-10)
8. Extensive and Intensive Properties	8 (6-9)	8 (7-8)	8 (7-9)	7 (6-9)	8 (7-9)	8 (7-9)
9. First Law of Thermodynamics	8 (7-9)	8 (7-9)	8 (8-9)	10 (10-10)	10 (10-10)	10 (10-10)
10. Fluid vs. Flow Properties	7 (5-8)	6 (5-7)	6 (5-6)	7 (5-9)	7 (5-8)	7 (5-8)
11. Heat Transfer Modes	8 (6-9)	8 (6.25-8)	8 (7-9)	9 (8-10)	9 (9-10)	9 (9-10)
12. <i>Heat vs. Energy</i>	6 (5-8)	6 (5-7)	6.5 (5-7)	9 (8-10)	9 (8-10)	9 (8-10)
13. <i>Heat vs. Temperature</i>	6 (4-8)	6.5 (5-8)	7 (6-8)	9 (8-10)	10 (9-10)	10 (9-10)
14. Ideal Gas Law	8 (7-9)	8 (8-9)	8 (8-9)	9 (8-10)	9 (9-10)	9 (9-10)
15. <i>Internal Energy vs. Enthalpy</i>	6 (3-7)	5 (4-6)	6 (5-6.25)	8 (7-9)	9 (8-9)	9 (8-9)
16. No-slip Boundary Conditions	8 (6-9)	8 (7-9)	8 (8-9)	8 (7-9)	9 (8-9)	9 (8-9)
17. Nozzles and Diffusers	6 (5-8)	6 (6-7.5)	7 (6-7)	7 (5-9)	7 (6-8)	7 (6-8)
18. Pressure	8 (6-9)	8 (7-8)	8 (7.75-9)	9 (8-10)	10 (9-10)	10(9.75-10)
19. <i>Reversible vs. Irreversible Processes</i>	5 (4-7)	5 (4-6)	5 (5-6)	8 (8-9)	9 (8-9)	9 (8-9)
20. Spatial Gradient of a Function	4 (3-7)	5 (4-6)	5 (4-5)	7 (3-9)	7 (6-8)	7 (6-8)
21. Specific Heat Capacity	7 (6-8)	7 (6-7)	7 (6-8)	8 (7-10)	9 (8-9)	9 (8-9)
22. <i>Steady-state vs. Equilibrium Process</i>	5 (3-8)	5 (3-6)	5 (4-5.25)	8 (5-10)	9 (7-9)	9 (8-9)
23. Steady-state vs. Unsteady-state Process	8 (7-8)	8 (7-8)	8 (7-8)	9 (8-10)	9.5 (9-10)	9.5 (9-10)
24. <i>System vs. Control Volume</i>	7 (4-8)	6 (5-7)	6 (6-7)	8 (6-10)	9 (8-10)	9 (8.5-10)
25. Temperature Scales	7 (5-9)	8 (8-9)	9 (8-9)	8 (6-10)	9 (8-10)	9 (9-10)
26. <i>Thermal Radiation</i>	6 (4-8)	5 (5-6)	5 (5-6)	7 (5-9)	8 (6.75-8)	8 (7-8.25)
27. Thermodynamic Cycles	7 (5-8)	7 (6-7)	7 (7-8)	8 (8-10)	9 (8-10)	9 (8-9.25)
28. <i>Viscous Momentum Flux</i>	5 (3-7)	4 (3.75-5)	4 (3-4)	7.5 (6-9)	8 (7-8)	7 (7-8)

Understanding Scale	Importance Scale
0 = no one understands the concept	0 = no at all important to understand the concept
10 = everyone understands the concept	10 = extremely important to understand the concept