

## Karl's Story Process Metallurgy Researcher

- Dissolution Kinetics – liquid-solid interface
- Iron Ore Desliming – solid-solid interface
- Metal-oxide reduction roasting – gas-solid interface

## Dissolution Kinetics

- Theory – Governing Equation for Mass Transport

$$(\nabla c \bullet \underline{v}) = D \nabla^2 c$$

- Research – rotating disk
- Practice – leaching of silver bearing copper

$$v_y \frac{dc}{dy} = D \frac{d^2c}{dy^2}$$

## Iron Ore Desliming

- Theory – DLVO [ $V(h) = V_A(h) + V_R(h)$ ]
- Research – streaming potential
- Practice – recovery of iron from low-grade  $\text{Fe}_2\text{O}_3$  ores (Selective removal of silicates)

## Metal Oxide Reduction Roasting

- Theory – catalyzed gas-solid reactions  
Boudouard Reaction [ $\text{CO}_2 + \text{C} = 2\text{CO}$ ]
- Research method – thermogravimetric analysis
- Practice – extraction of Ti from  $\text{FeTiO}_3$ , Al from  $\text{Al}_2\text{O}_3$  – bearing minerals

## First Teaching Experience

- Practice – Third-year course in metallurgical reactions – thermodynamics and kinetics



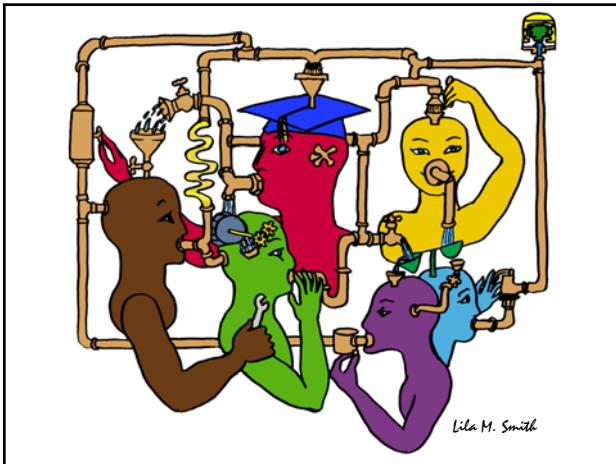
Lila M. Smith

## Engineering Education

- Practice – Third-year course in metallurgical reactions – thermodynamics and kinetics
- Research – ?
- Theory – ?

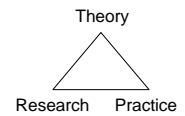
University of Minnesota College of Education  
Social, Psychological and Philosophical  
Foundations of Education

- Statistics, Measurement, Research Methodology
- Assessment and Evaluation
- Learning
- Knowledge Acquisition, Artificial Intelligence, Expert Systems
- Social psychology of learning – student – student interaction



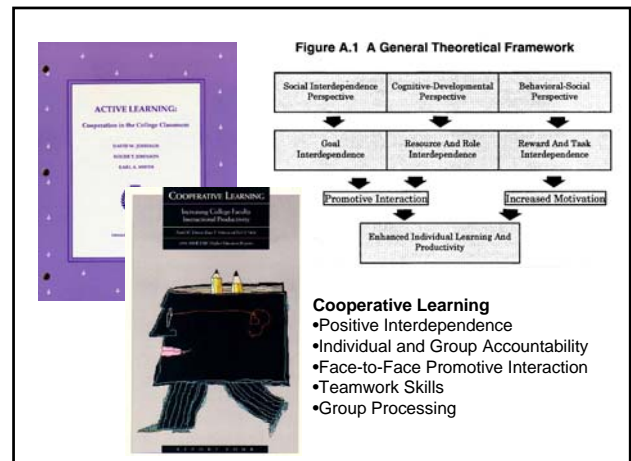
## Cooperative Learning

- Theory – Social Interdependence – Lewin – Deutsch – Johnson & Johnson
- Research – Randomized Design Field Experiments
- Practice – Formal Teams/Professor's Role



## Student – Student Interaction Lewin's Contributions

- Founded field of social psychology
- Action Research
- Force-Field analysis
- $B = f(P, E)$
- Social Interdependence Theory
- "There is nothing so practical as a good theory"



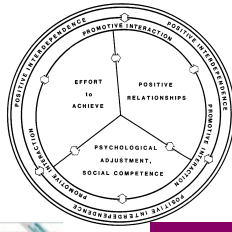
### Cooperative Learning Research Support

Johnson, D.W., Johnson, R.T., & Smith, K.A. 1998. Cooperative learning returns to college: What evidence is there that it works? *Change*, 30 (4), 26-35.

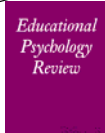
- Over 300 Experimental Studies
- First study conducted in 1924
- High Generalizability
- Multiple Outcomes

#### Outcomes

1. Achievement and retention
2. Critical thinking and higher-level reasoning
3. Differentiated views of others
4. Accurate understanding of others' perspectives
5. Liking for classmates and teacher
6. Liking for subject areas
7. Teamwork skills



January 2005



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