NTNU

Norwegian University of Science and Technology

LESS WORK AND MORE IMPACT WITH PROBLEM BASED LEARNING

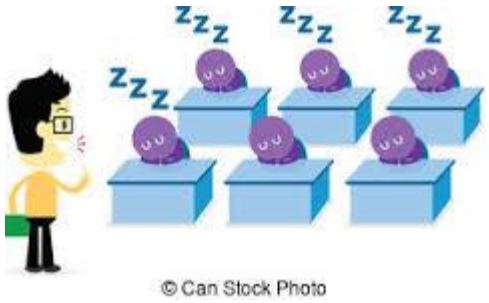
Seminar in innovative education

B.A. Grimes
Department of Chemical Engineering
Norwegian University of Science and Technology

How to teach?

- My experience
- Simply present material in formal lectures?
- Am I motivating the students? Do I generate **interest**?
- Are the students retaining knowledge?
- Do the students reflect on the material in the course?

What I wanted…



What I observed…

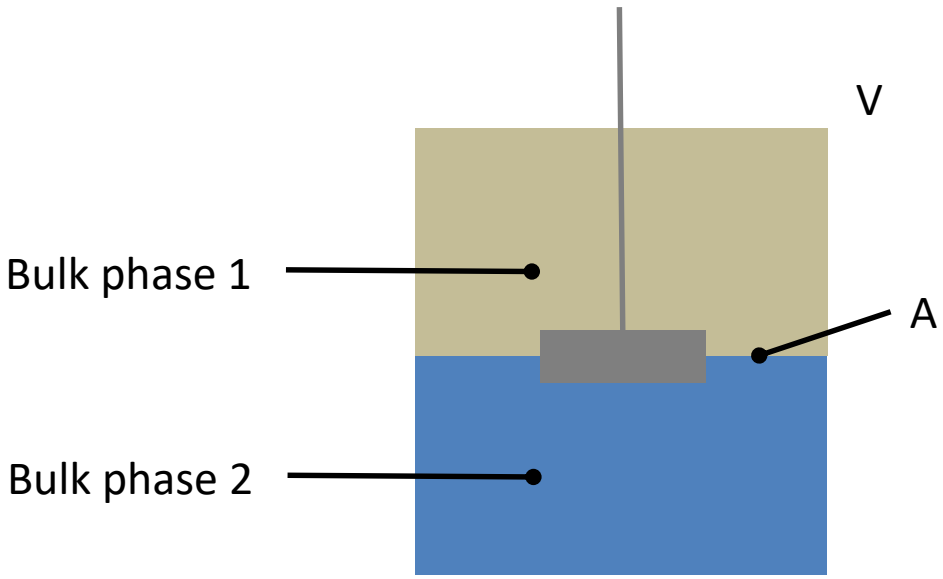
Problem based learning (PBL)

- Used in the PEDUP course to teach PBL
- Forces the students to participate in the lecture
- Less demanding to make slides/lecture notes
- Easier to plan lectures
- Facilitates the students to reflect on the course material
- Well suited to the topic I teach (practical modeling)
- So, why not?

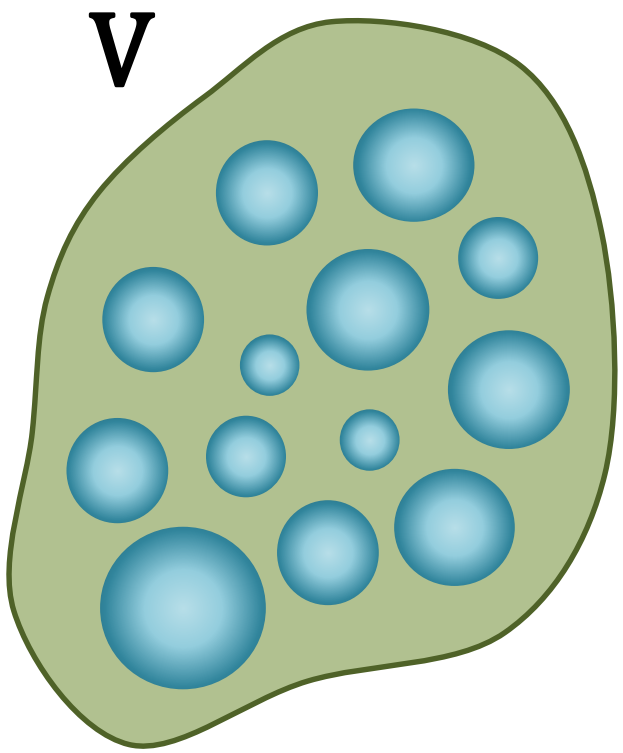
PBL Example

If an emulsion is prepared with an initial surfactant concentration, C_0, in the oil before the emulsification, would the interfacial tension in the emulsion be the same as that measured in the experiment with a surfactant concentration of C_0? Why?

Experiment

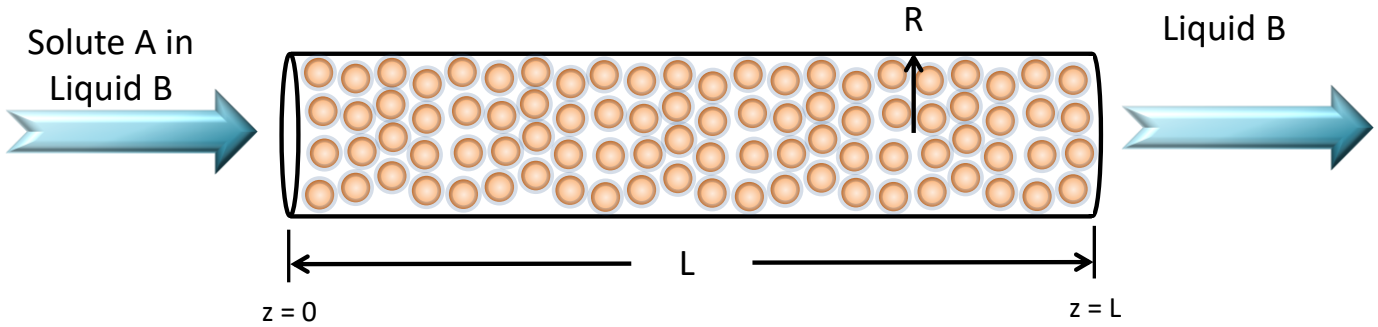


Colloidal Dispersion



PBL EXAMPLE

Transport in a packed bed - Adsorption



Compound A is present in a liquid B at a very dilute concentration, C_{A0}, and we would like to purify compound A with a column packed with spherical adsorbent particles having radius, R_p, and void fraction, ε. Component A will adsorb onto the surface of the particles according to an equilibrium Langmuir isotherm:

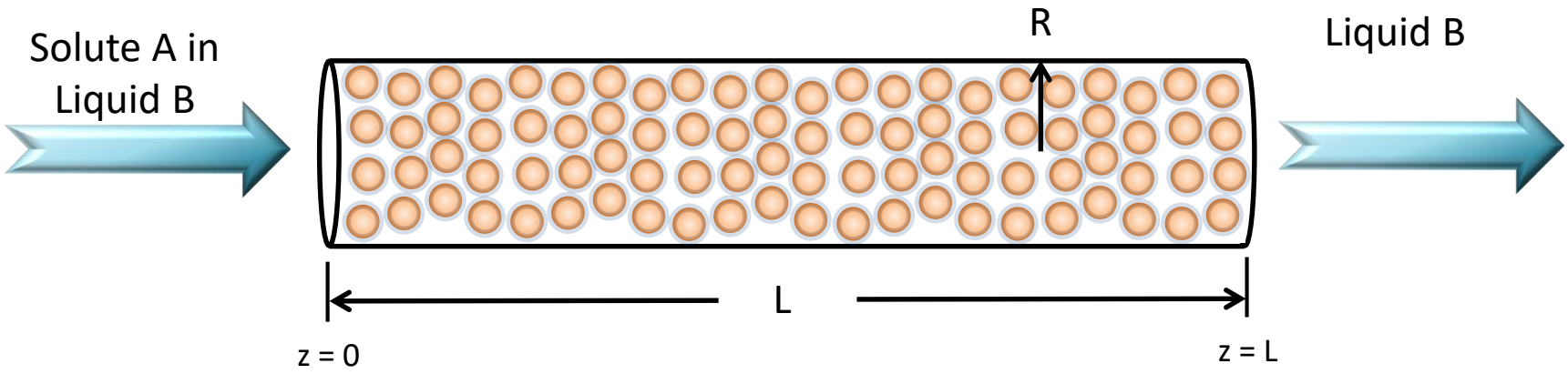
$$\Gamma_A = \frac{K_L C_A{}^*}{1 + K_L C_A{}^*} \Gamma_\infty$$

Initially, pure liquid B is flowing through the column at a volumetric flow rate Q. At the time t = 0, the feed stream is switched to the solution of dilute A in liquid B.

Develop a model for the dynamic evolution of component A through the packed bed. First consider the particles to be non-porous. Then consider the particles to be porous with a void fraction, ε_p.

PBL Example

Transport in a packed bed - Adsorption



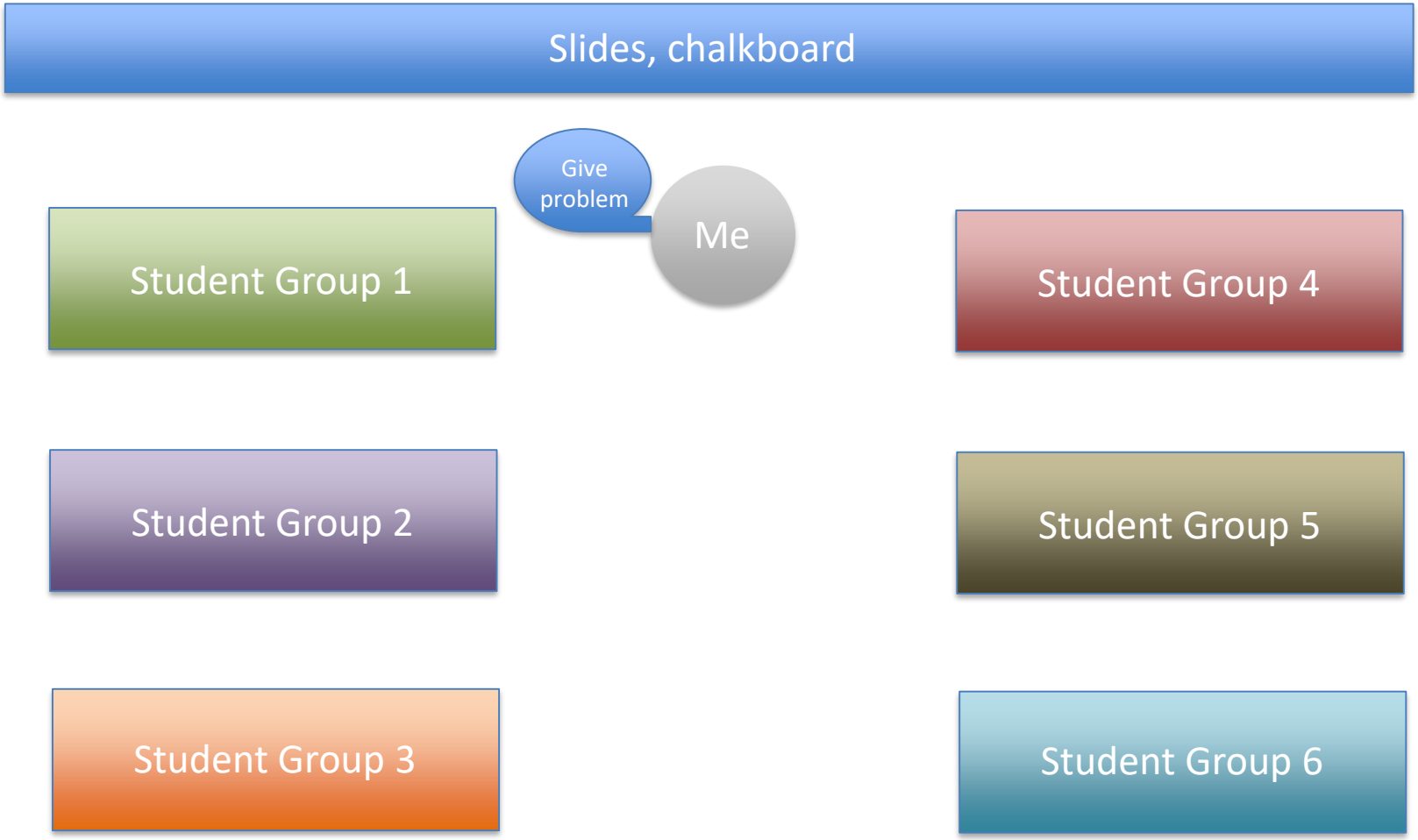
First, define the model domain, define variables, and write assumptions about the geometry and length scales.

Second, write the general mole balance equation for this system and define the initial and boundary conditions.

Third, what problem have we done in class that could help us define an expression for the flux from the liquid in the packed bed to the surface of the particles?

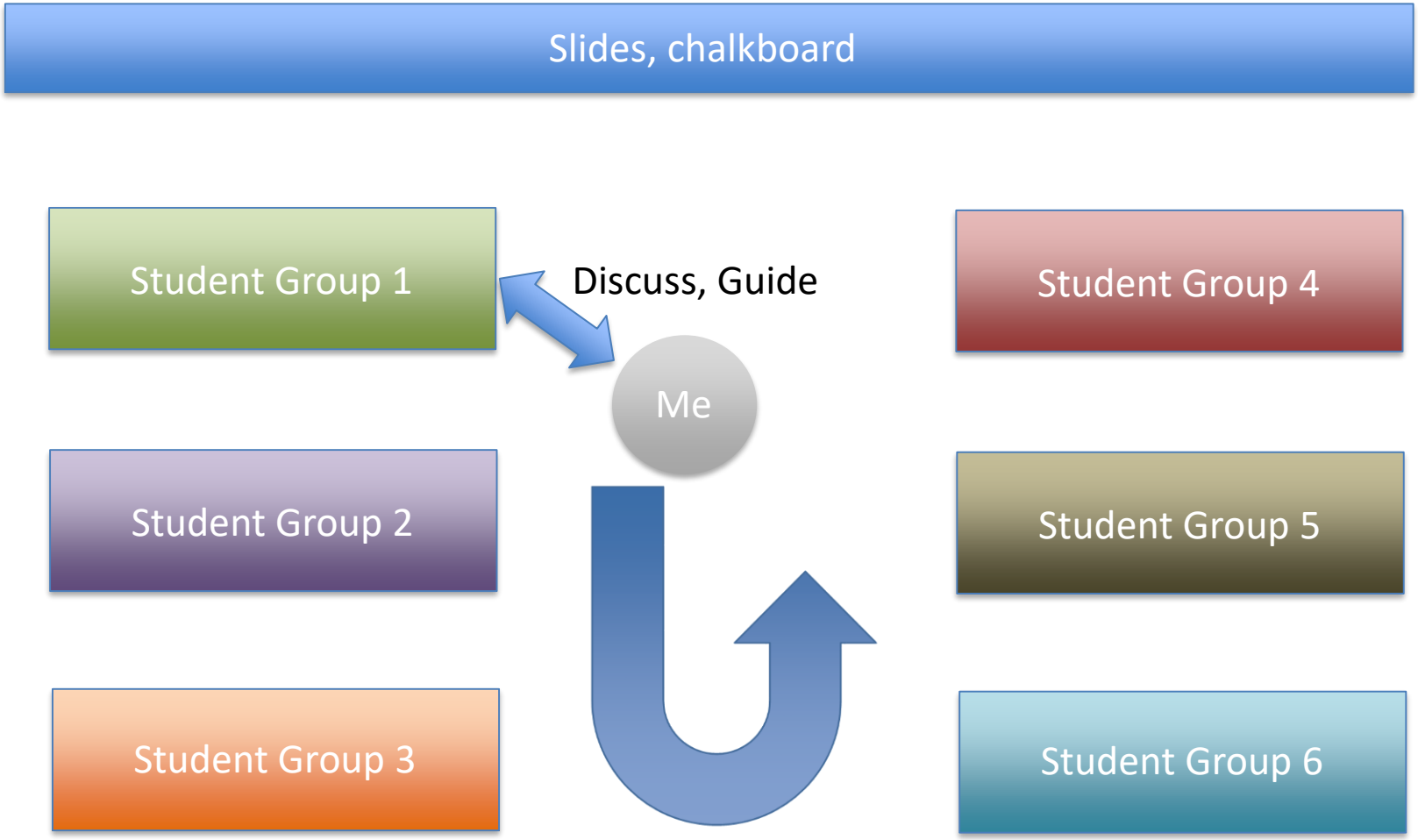
PBL Application

Step 1: Give problem, give hint at what they are trying to achieve (try to tie each problem to a course learning objective)



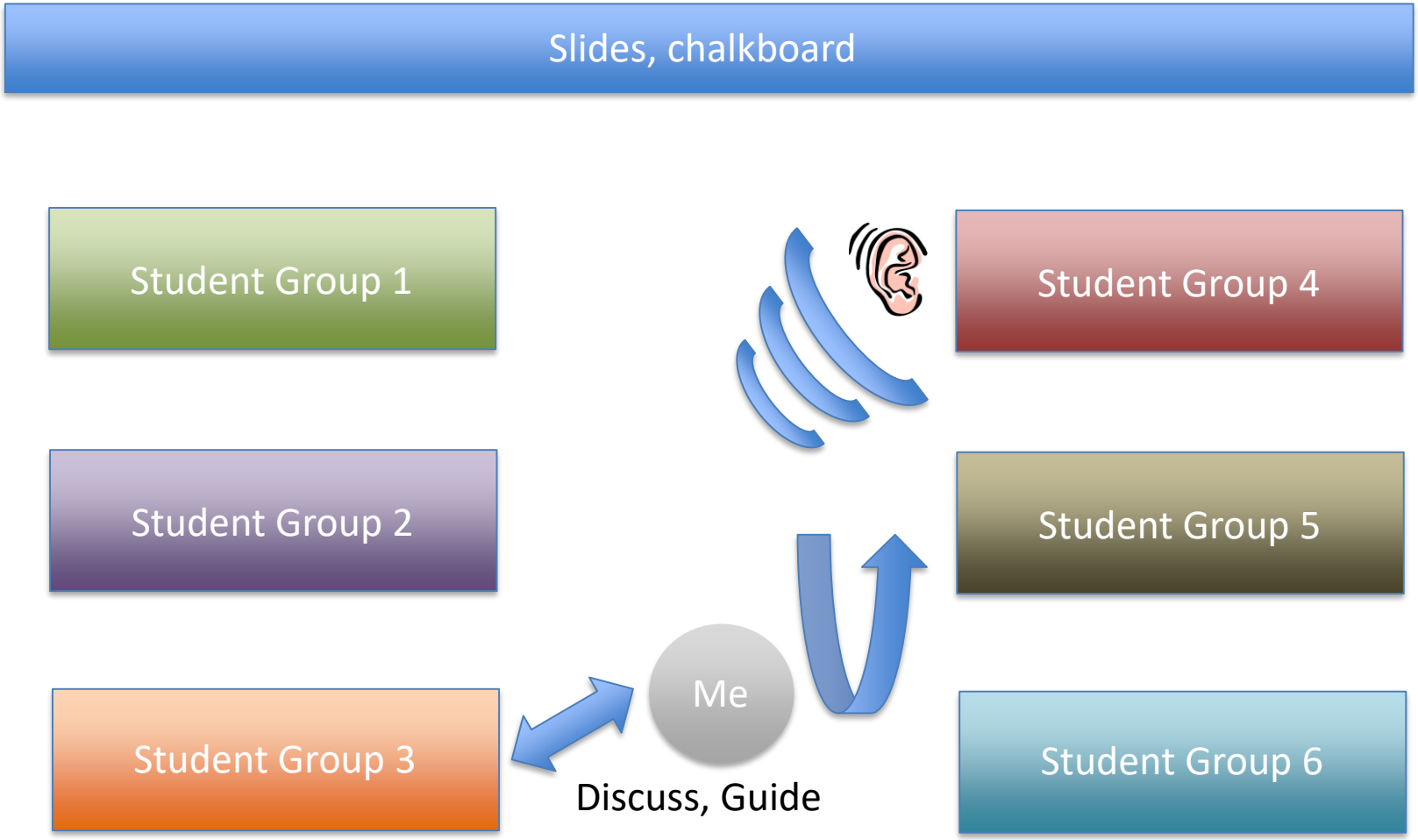
PBL Application

Step 2: Move around the room, comment on student progress, ask questions to lead them to the correct approach.



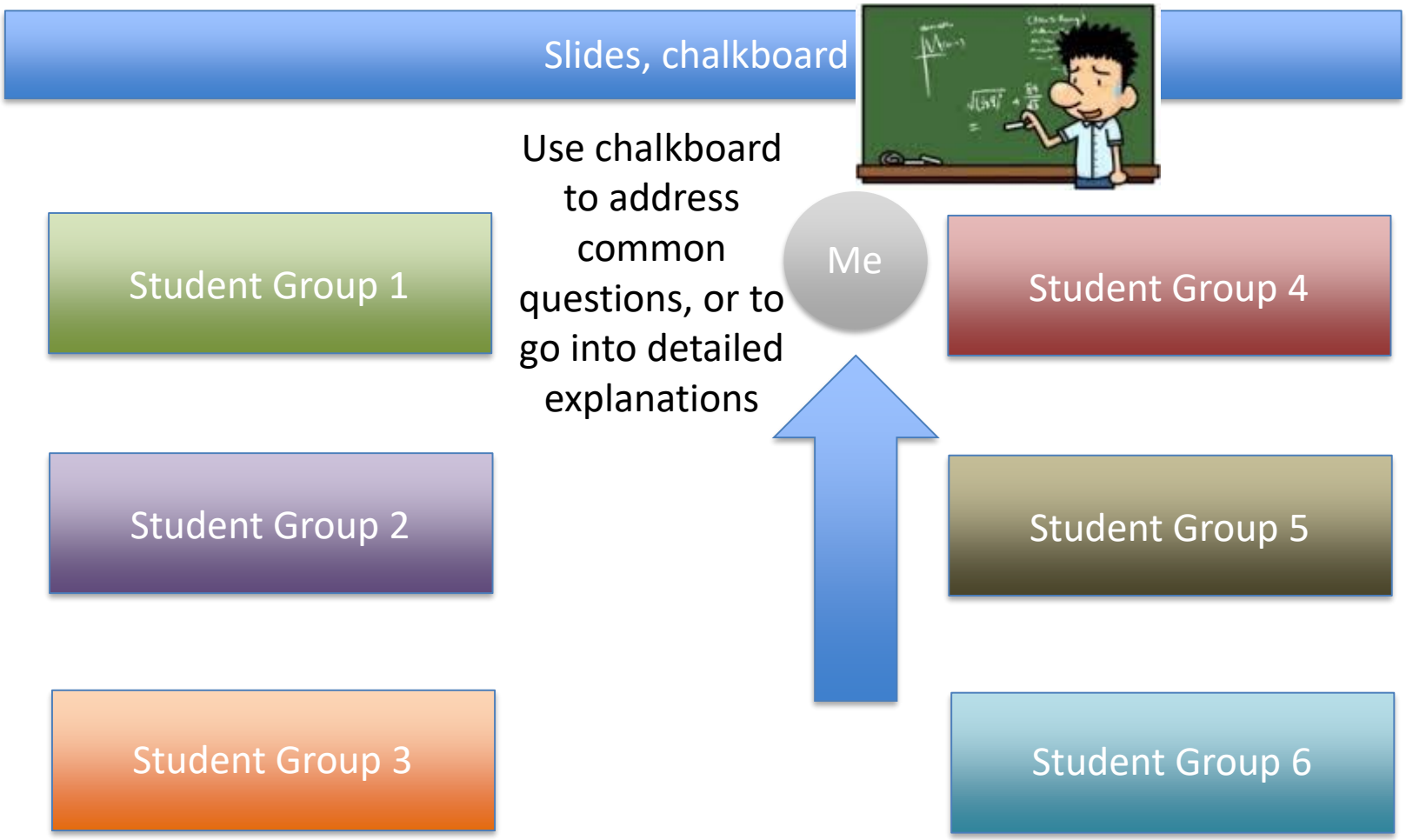
PBL Application

Step 2: Move around the room, comment on student progress, ask questions to lead them to the correct approach.



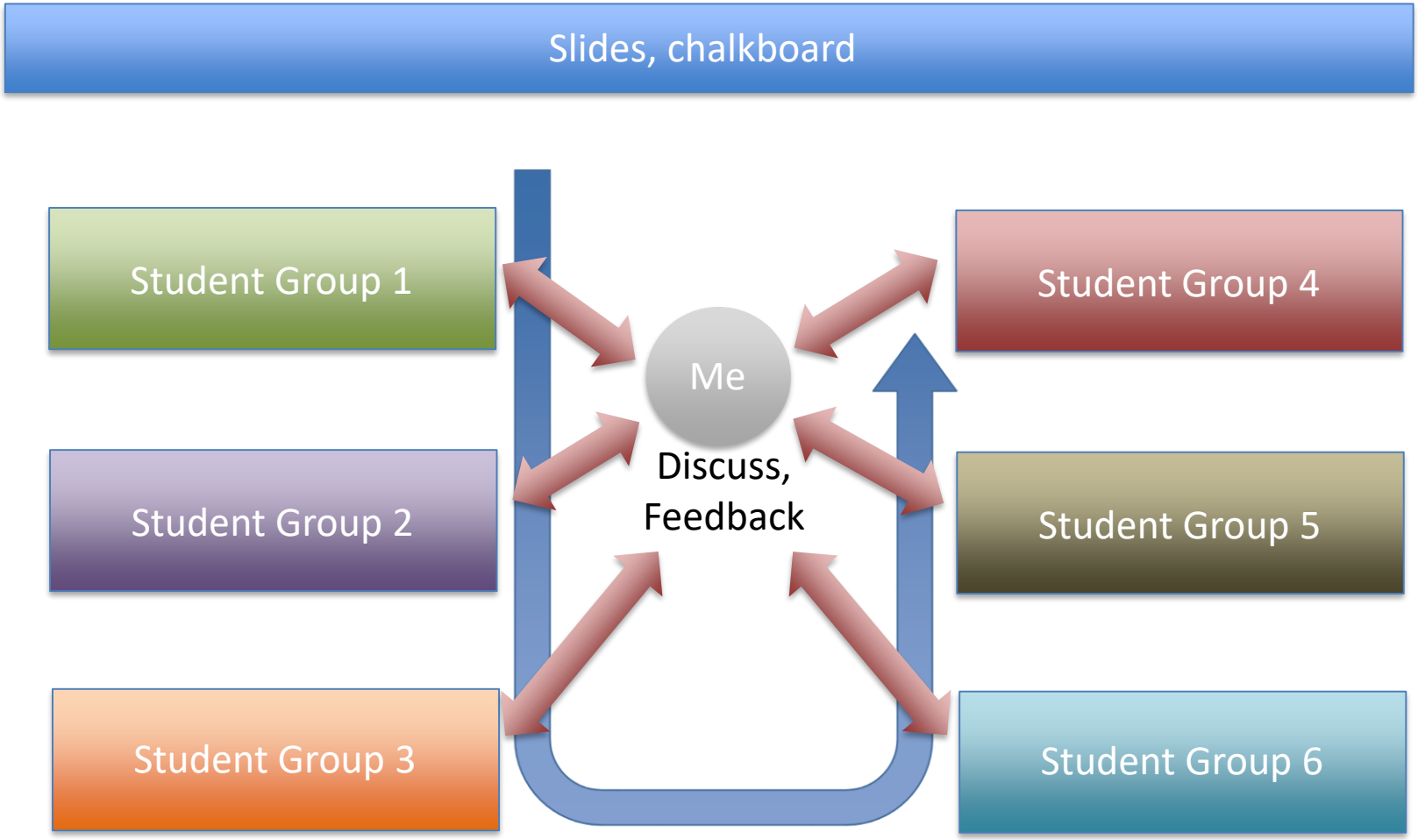
PBL Application

Step 3: Once you get an idea how the students are progressing, use the chalkboard to address common questions or provide detailed explanations.



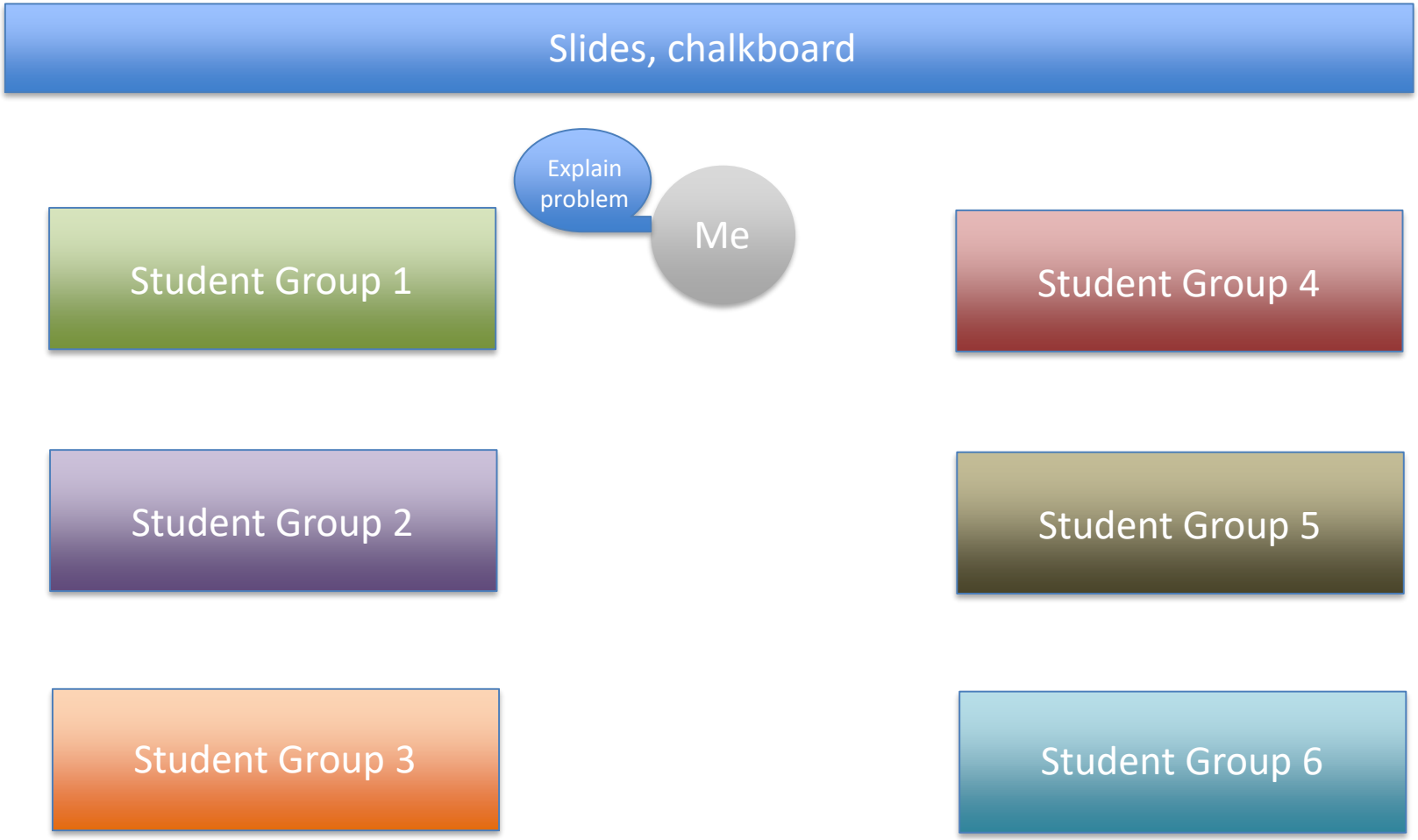
PBL Application

Step 4: After initial student understanding was assessed and addressed, make one more trip around to see if they corrected mistakes.



PBL Application

Step 5(1): Explain the answer with a brief slide, explain what they were trying to achieve, repeat process with the next part or new problem



Pros and Cons of PBL

- Instant feedback
- Facilitates lecture improvement
- Instruction tailored for individuals
- Easy to prepare for lectures
- Better exam performance
- Good feedback from students

- You have to think on your feet an know your stuff
- Time management
- More difficult to apply to large groups
- Not straight forward to apply to all subjects
- You must take the time to ensure that the problems meet the course learning objectives
- You'll cover less material

Discussion

- Is this approach to PBL relevant to any course you teach?
- What difficulties you foresee in applying this approach to one of your courses?
- What alternative approaches from your experience have worked to facilitate learning and retention for your students?