# A Dictionary of Collaborative Learning Techniques for MAT135/136

| | CoLT | Is a technique in which students | It is particularly useful for: |
|---|---|---|---|
| **Discussion** | 1. Think-Pair-Share | Think individually for a few minutes, and then discuss and compare their responses with a partner before sharing with the entire class | Preparing students to participate more fully and effectively in whole class discussions |
| | 2. Round Robin | Generate ideas and speak in order moving from one student to the next | Structuring brainstorming sessions and ensuring that all students participate |
| | 3. Buzz Groups | Discuss course-related questions informally in small groups of peers | Generating lots of information and ideas in a short period of time to prepare for and improve whole-class discussions |
| | 5. Three-Step Interview | Interview each other and report what they learn to another peer | Helping students network and improve communication skills |
| **Reciprocal Teaching** | 8. Learning Cell | Quiz each other using questions they have developed individually about a reading assignment or other learning activity | Providing opportunities for students to model or observe group processes in a discussion setting. |
| **Problem Solving** | 13. Think-Aloud Pair Problem-Solving | Solve problems aloud and try out their reasoning on a listening peer | Emphasizing the problem-solving process (rather than the product) and helping students identify logic or process errors |
| | 14. Send-A-Problem | Try to solve a problem as a group, and then pass the problem and solution to a nearby group who does the same; the final group evaluates the solution | Helping students practice together the thinking skills required for effective problem solving and for comparing and discriminating across multiple solutions |

| | | | |
|---|---|---|---|
| **Problem Solving** | 16. Structured Problem Solving | Follow a structured format to solve problems | Dividing problem-solving processes into manageable steps so that students don't' feel overwhelmed and so that they can learn to identify, analyze, and solve problems in an organized manner |
| | 21. Team Matrix | Discriminate between similar concepts by noticing and marking on a chart the presence or absence of important, defining features | Distinguishing among closely related concepts |
| | 22. Sequence chains | Analyze and depict graphically a series of events, actions, roles, or decisions | Understanding processes, cause and effect, and chronological series, and organizing information into an orderly, coherent progression |
| | 23. Word Webs | Generate a list of related ideas and then organize them in a graphic, identifying relationships by drawing lines or arrows to represent connections | Figuring out and representing relationships; show both the destination and sights along the way |

**1. Think-Pair-Share**

Group size          pairs
Time on task        5-15 minutes
Duration of groups  single session

<u>Preparation</u>
- Spend time developing an engaging question or problem that has many potential responses.  Try responding to the question yourself.  Decide how you are going to present the problem (worksheet, overhead, whiteboard), and how you are going to have students report out

<u>Procedure</u>
1. Pose the questions to the class, giving students a few minutes to think about the question and pose individual responses.
2. Ask students to pari with another student nearby

3. Ask student A to share his or her responses with student B, and then Student B to share ideas with student A. Suggest that if the two students disagree, they clarify their positions so they are ready to explain how and why they disagree. If useful, request that pairs create a joint response by building off of each other ideas

<u>Examples</u>
- What makes a written argument effective? Collection: write responses on the board, and compare to the instructor generated list. Then they refined it and combined the evaluation criteria

<u>Variations</u>
- Export "think" step out of class
- Give students time to write their responses before pairing "Write-Pair-Share"
- Think-Pair-Square: share with another pair before or instead of whole-class discussion

<u>Advice</u>
- Allow enough time to think – at least a minute for individual responses
- Announce time limit, but gauge by decimal levels
- To prevent domination, set time limits for each student response
- Reporting out: have each pair share most important point with the whole class. Following reports, conclude with a synthesis to validate student responses by bringing out the good points that they brought up. Gently correct any responses that are incorrect, and add points that weren't covered. If appropriate, provide learners with an expert response. You can randomly call on student pairs or collect a written version if the class is large.
- To promote active listening during report out phase, randomly call on students and ask them to summarize what the reporting student just said.
- If there is a lot of difficulty or confusions, use a Minute Paper: *What aspect of the prompt question was most difficult for you to answer?* or *ON what points did you and your partner agree, and on what points did you disagree?*

**2. Round Robin**

Group size          4-6
Time on task        5-15 min
Duration of groups  single session

<u>Description</u>
Round
Robin is primarily a brainstorming technique to generate ideas but do not elaborate, explain, evaluate, or question the ideas. Group members take turns responding to a question with a word, phrase, or short statement. Effective in generating lots of ideas because it requires all students to participate, and discourages comments that interrupt the flow of ideas. Ensures

equal participation.  The ideas can be compiled in a list that services as the basis for a next-step assignment

<u>Preparation</u>
Crafting a prompt that can generate a sufficiently rich array of responses that can be expressed quickly and succinctly is important.
Practice by thinking of and listing as many responses as you can.  You can use the length of your list to predict the duration and decide whether they should rotate through Round Robin more than once

<u>Procedure</u>
1. Ask students to form groups of 4-6
2. Explain that the purpose of brainstorming is to generate many ideas.  Group members take turns, moving clockwise, and respond to the question.  Inform students that to prevent interrupting or inhibiting the flow of ideas, they must refrain from evaluating, questioning, or discussing the ideas.
3. Ask students to assign a recorder, if applicable
4. Tell students whether or not they will go around the group once or multiple times, announce a time limit, and pose the prompt.
5. Ask one student to begin by stating an idea or answer allowed.  Continues until all students have participated

<u>Examples</u>
- *Identify  a force that influences the competitive business environment*.  After groups generate ideas, professor moved from group to group asking recorder to share one new idea.  Wrote ideas on the board.

<u>Variations and Extensions</u>
- Works best for generating ideas, but it can be used to structure a regular group discussion, Decide if students should be able to respond to previous students' comments or whether they should express only new ideas
- Can also be used for memorization type things

<u>Observations and Advice</u>
- Use only for straightforward tasks
- Set time limit, and establish some ground rules, such as allowing a student who has nothing to contribute to pass.
- Can use written assignments to alleviate anxiety (CoLT 25: Round Table)
- Need to use ideas so they see the value f ideas and input. Whole class discussion is one option, but it might work with another one (CoLT 19: Affinity grouping or CoLT: Word Webs)

**3. Buzz Groups.**

Group size          4-6
Time on task        10-15 minutes
Duration of groups   single session

Description
Buzz groups are formed quickly and extemporaneously to respond to course-related questions. Each group cam respond to one or more questions; all groups can discuss the same or different questions.  Discussion is informal, and students do not need to arrive at consensus, but simply exchange ideas. Serve as a warm-up to whole-class discussions. They are effective for generating information and ideas in a short period of time.  Because students have a chance to practice their comments and to increase repertoire of ideas, the whole-class discussion that follows is often richer

Preparation
- Decide what the buzz groups will discuss
- Craft one or more engaging discussion prompts that tend toward conceptual rather than factual and stimulate an open-ended discussion of ideas
- Try responding to the questions yourself to ensure a variety of responses
- Choose how you are going to present the prompt

Procedure
- Form groups; announce the discussion prompt and the time limit
- Ask group members to exchange ideas in response to prompts
- Check periodically to see if groups are still actively focused.  If off-topic, shorten the time.
- Ask students to return to the whole-class discussion and restate the prompt to begin

Examples
- Can you recall a situation in which you experienced or observed gender-based discrimination?  In Same-sex groups
- *What is the difference between a consolidation and a merger> Have you had any experience with either?  What are some of the issues that would attend a consolidation or merger?*

Variations and Extensions
- Assign groups a task other than responding to questions.  Instead ask them to generate questions or ideas, share information, or solve problems
- Relaxed Buzz Groups: Hold discussion without formal questions but rather as an opportunity to discuss the course text in general, or a specific assigned reading. Students do not need to report out.  They can question, highlight passages, look for a thesis, and identify flaws.

- Snowball groups: Groups can combine again before whole class discussion

Observations and Advice
- Students might miss important issues so be prepared to offer them during the closure period

Snowball: students may feel disjointed or shaken up by the process.  Warn them in advance.
- Reporting out: go around the room and ask groups to report out the group's most important points
- Can follow up with CAT 23: Directed Paraphrasing.  Ask students to summarize he most important ideas or information from their Buzz Groups discussion, imagining that the paraphrase would provide a succinct summary to a student who was not able to attend class that day.


**5. Three-Step Interview**

Group size      2, then 4
Time on task    15-30 min
Duration        single session

Description.
- Three steps are 1) student A interviews B 2) student B interviews A.  3) students A and B summarize their partner's responses for students C and D and vice versa.
- The questions may probe for values, attitudes, prior experience, or comprehension of the course material.
- Creates opportunities for students to network and improve communication skills. Interviewers must listen carefully… Interviewees practice expressing thoughts succinctly. Since the spotlight is solely on them and they are not exchanging comment as in a discussion situation, their responses require a high degree of personal commitment
- Interviewers must understand and incorporate the information gathered from their interviewees' responses at a deep enough level to be able to summarize and synthesize

Preparation
Develop a list of interview questions prior to the class session.  Interview questions that are particularly effective ask a person about the opinions or experiences related to course content.

Procedure
1. Students divide into groups of 4 and subdivide into pairs A-B and C-D
2. A interviews B and C interviews D for an announced length of time.  The interviewer asks questions, listens, and probes for further information but does not evaluate or respond.
3. Partners reverse roles and interview each other for the same amount of time.
4. Students A and B introduce each other with synthesized summaries of their partner's interview response to Students C and D.  Students C and D do the same for A and B.


Examples

- *What musician recording today do you think people will still be listening to, and why?* To collect: write all musicians on the board and identify characteristics they have in common.
- Calculus: What homework problem did you find the most difficult and why>? Write the numbers of the problems on the board after the activity – then the majority of problems are the same for all groups; he knew this but knew this would be reassuring for struggling students. Then focused discussions on the parts that students had trouble with

Variations and Extensions
- Decide upon a general topic, and ask each student to develop interview questions themselves
- Rather than asking questions that generate new information, use this as an activity for students to review what they learned from a lesson.
- Team Interview: 3 group members interview the fourth in depth

Observations and Advice
- Useful in drawing out students' experience and knowledge from outside of the class.
- Try to create questions that are likely to generate lots of different responses.
- Generally students should interview students they don't know well
- Make sure you have a time limit
- Only use reporting out with a reporter role if there is enough time and it is important for everyone to hear the responses.
- Can extend this activity with RSQC2: recall, summarize, question, connect, comment on the 3-step interview (e.g. Recall the most important response from the interview you conducted of your partner?) – write responses

## 8. Learning Cell

Group size      pairs
Time on task   15-30 min
Duration        single session, multiple, or all term

Description.
- Students individually develop questions about a reading assignment or other learning activity and then work with a partner, alternating asking and answering each other's questions
- Engages students in actively thinking about content, encouraging questions, and teaching students how to check their understanding
- Creating questions about an assignment requires students to think about it in a different way than taking notes on it – think analytically, elaborate as they put it into their own words, and use appropriate language

- Can encourage students to pursue deeper levels of thought
- Motivates students to practice interpersonal skills such as giving feedback in nonthreatening ways, maintaining focus, and developing and sustaining mutual tasks.
- Students learn to question, explain, admit confusion, and reveal misconceptions.
- An effective partner can be a role model.

## Preparation
Prepare students by teaching them how to write good questions.

## Procedure
1. Ask students to individually develop a list of questions and answers dealing with the major points raise din the reading or other learning assignment
2. Form student pairs
3. Explain the process by which you want partners to alternate asking and answering each other's questions.
4. Student A begins by asking the first question, and student B answers the question. Student A offers corrections and additional information until a satisfactory answer is achieved.
5. Reverse roles and repeat.

## Examples
- A professor started out by handing out questions for Topic 1 and discussed what made a good question (getting student input).  Then she  asked students to create questions on their own that addressed Topic 2.  Can help to break up a long class (cover Topic 2 in between)

## Variations and Extensions
- Use activity regularly as an opening activity for class sessions (McKeachie, 2002)
- Vary by having different students read different materials – have them "teach" the essentials to other students.
- Guided Reciprocal Peer Questioning Provide students with generic question stems to guide their writing (*Explain why _____, Why is _____ important? Compare ___ and _____. Summarize _____).*  See more question Stems in Diagram 4.1.
- Vary type of question.  On one assignment, ask an essay.  Then crate 5 multiple choice or T/F questions.

Rather than having students do this orally, have them do it written.
- Ask students to write more open-ended questions that might not have a single "right" answer.  Then they may pose questions that interest, puzzle, or inspire them.

## Observations and Advice
- Consider using an "entry ticket" approach, requiring students to be prepared in order to participate and allowing pairs to re-form if a student is not prepared.  Students who are not prepared lose participation points

- To assess: ask students to write out 2 questions their partner should b able to answer leaving space for their peer to provide a brief written answer.  Only do this sparingly to alert students to its importance.  Also, could wrap up by asking a student to volunteer an especially interesting, creative, or provocative question posed by their peer.

## 13. Think-Aloud Pair Problem Solving (TAPPS)

Group size      pairs
Time on task   30-45 min
Duration        single session or multiple

Description.
- Pairs receive a series of problems as well as specific roles – problem solver and listener – that switch with each problem. The problem solver "thins aloud", talking through the steps, attempting to understand the reasoning behind the steps, and offering suggestions if there are missteps.
- Helps students practice what they have read about
- Places emphasis on the process rather than the product, helping students diagnose errors in logic
- Can help increase student awareness of a range of possible successful approaches to problem solving
- Improves analytical skills: formulate ideas, rehears concepts, understand the sequence of steps underlying their thinking, and identifying errors in someone else's reasoning.
- Since it requires students to relate information to existing conceptual frameworks and apply existing information to new situations, it can also promote deeper understanding

Preparation
Spend sufficient time developing an appropriate set of field-related problems that students can solve within a limited time frame.  The problems should engage student sin basic problem-solving skills such as identifying the nature of the problem, analyzing the knowledge and skills required to reach a solution, identifying potential solutions, choosing the best solution, and evaluating potential outcomes.  To be most effective, the problems should challenge students, requiring them to concentrate and focus their attention, whether they are solvers or listeners.

Procedure
1. Ask students to form pairs and explain the roles of problem solver and listener. The role of the problem solver is to read the problem aloud and talk through the reasoning process in attempting to solve the problem.  The role of the listener is to encourage the problem solver to think aloud, describing the steps to solve the problem.  The listener may also ask clarification questions and offer suggestions, but should refrain from solving the problem.
2. Ask students to solve a set of problems, alternating roles with each new problem
3. Concludes when students have solved all problems.

<u>Variations and Extensions</u>
- CoLT is typically used for problems with single answers, but may also be used for more open-ended problem solving
- If all pairs have worked on the same problem set, select pairs at random to report our their solution or take a vote on the most challenging problems and share and examine solutions with tips for improvement as a class.

<u>Observations and Advice</u>
- Consider preparing students by having students practice problem solving as a class prior to this activity
- Student problem solvers may not be comfortable having their logic exposed to other students.  Student listeners may not be trained in logic, so they may not be able ot note difficulties.  It is important to have established a high level of trust in the class prior to using this activity.  May be good to have students work with pairs they are familiar with.
- It is particularly important to have an additional problem (an extension or a "sponge)' on hand for students who complete the problems quickly.
- Recommend using assessment techniques with TAPPS, since students can reinforce faulty – as well as correct – information and problem solving processes.
    - Problem-Recognition Tasks (CAT 19): either before or after activity; ask them to recognize and identify the particular type of problem that it represents.
    - Documented Problem Solutions (CAT21):After they have completed activity, ask them to document their problem solutions and submit it for review.
        - Use as a pre-assessment by giving students 2 problems – one of low difficulty and one of medium difficulty. Their results of their efforts can be used to determine the best level at which to begin whole-class or small-group instruction
        - Ask students with elegant, well-documented responses to explain their solutions to a partner, a small group, or even the whole class
        - Since most students have little experience reflecting on their own problem-solving processes, students may need help learning how to do this.  To ensure peers give each other thoughtful and thorough feedback, consider giving credit.

**14. Send-A-Problem**

Group size      2-4
Time on task   30-45 min
Duration        single session

<u>Description.</u>
- Each group receives a problem, tries to solve it, and passes the problem and solution to a nearby group.  Without looking at the previous group's solution, the next group works

on the problem.  After as many passes as seems useful, groups analyze, evaluate, and synthesize the responses to the problems they received in the final pass and report the best solution to the class.
- 2 stages: solving problems and evaluating solutions
- First stage: provide students the opportunity to practice each other and learn from each other the thinking skills required for effective problem solving.
- Second stage: help students learn to compare and discriminate among multiple solutions

Preparation
Determine how many problems you will need. Decide how to present the problem. Consider attaching a problem outside of file folder or envelope where solutions can be placed.  Also think carefully about instructions regarding time limits, and the order in which students should pass the problem (e.g. clockwise).

Procedure
1. Form groups of 2-4, and take time to describe the activity, give instructions, and answer questions
2. Distribute a different problem to each group, asking each group to discuss the problem, generate possible solutions, choose the best solution, and record and place their response in a folder or envelope
3. Call time, and pass to the next group
4. Upon receiving new problems, students repeat
5. Repeat as many times as seems useful and appropriate
6. Students in the final group review, analyze, evaluate, and synthesize, adding any additional information they wish.
7. Teams report on the responses contained in the folder they evaluated.  As groups report out, add any points that groups missed and reinforce correct processes and solutions

Variations and Extensions
- Consider allowing students to generate their own list of problem sthey would like to see the class solve
- Consider using this as review before an exam.

Observations and Advice
- Most effective for developing several thoughtful solutions for more complex problems that do not have a single right answer.  In some situations, it may be effective for single-answer problems that students just learned in a lecture or reading assignment.  IN this why it can replace traditional drill-and-practice exercises by adding in higher-order thinking skills during the solution-evaluation stage

- Prepare problems and work through solutions to determine the amount of time it will take to solve problems.  Be sure to choose problems that are roughly equal in complexity and time.
- If teaching large classes, have several groups work on the same problem.
- Be specific about time limitations.
- Have several extensions (additional problems) ready to fill-in if groups finish early.
- If students have been working on different types of problems, *What's the Principle* (CAT20) is especially useful, as it quickly gathers useful information about how well students were able to identify the type of problem.
    - Instead of focusing on identifying the type of problem, this CAT focuses on the middle step: deciding the principle or principles needed to solve the problem.
    - Give students a few problems and ask them to state the principle that best applies to each problem. This will help you evaluate student ability associated with specific problems, with the general principles used to solve the

Topics
Implicit differentiation, optimization (open vs. closed intervals, etc)

## 16.  Structured Problem Solving

Group size        4-6
Time on task    1-2 hours
Duration          multiple sessions

Description.
- Provides students with a process for solving a complex, content-based problem within a specified time limit. All members must agree to a solution and must be able to explain both the answer and the strategy.
- Gives students a format so they have a place to begin.
- Keeps students from going astray or engaging in irrelevant steps.

Preparation
Create a problem complex enough to require students to use sophisticated problem-solving skills.  Use research and current questions as a resource.  Identify a problem-identification and solving procedure that is appropriate to the type of problem.  Solve the problem yourself using the problem-solving procedure to uncover any difficulties or errors.  You may wish to create a handout that includes both the problem and the problem-solving steps

Procedure
1. Organize students into teams and assign a complex problem to solve
2. Ask students to solve the problem using the specific steps you have identified.  The following is an example (Dewey Six-Step)
3. Ask teams to report out their solutions, describing to the rest of the class the steps they took to solve the problem.

<u>Examples</u>
- N/A

<u>Variations and Extensions</u>
- Discovery Learning: structure a multilayer discovery task in which you provide students with data. Students identify problems, generate hypotheses, test hypotheses, and apply conclusions
- Have students write responses to *What do you know? What do you need to know? Where can you find out?*
- Have students use CoLT 22: Sequence Chains to flow-chart the steps as they develop the plan to solve the problem.
- CATs for assessing problem-solving skills
  - CAT 19: Problem Recognition Tasks – identify particular type of problem each example represents.
  - CAT 20: What's the principle – asks students to decide what principle or principles to apply in order to solve the problem
  - CAT 21: Documented Problem Solutions – Ass students to track steps in solving a problem.
  - CAT 22 – Audio- and Videotaped protocols

<u>Observations and Advice</u>
- Can be an effective way to introduce students to the problem-solving process within a disciplinary process
- By explicitly guiding through the problem-solving steps helps students develop discipline-specific metacognitive skills.  They need to step back and observe their own thinking processes
- Advise students that during the initial stages they should let the creativity flow, and not judge, evaluate, or criticizes proposed solutions

**21. Team Matrix**

Group size      pairs
Time on task   10-20 min
Duration        single session

<u>Description.</u>
- Discriminate between similar concepts by noticing and marking on a chart the presence or absence of important, defining features.
- Useful in tasks in which students mix up shared and uncommon attributes
- Helps students to understand the distinctions

<u>Preparation</u>

Choose 2-3 related concepts.  Identify and make a list of elements or features that differentiate the concepts.  Consider a list of features that both concepts possess. Create a matrix with the concepts in the top row, and either the categories for comparison or identifying features in the left column. Check to make sure you can fill the matrix yourself, so you can uncover and correct any problems. Create a blank matrix for students to fill-in as groups.

Procedure
1. Form pairs and distribute the blank matrix as a handout, have students copy it, or draw on board.
2. Have partners come to consensus and complete the matrix
3. Move to a whole-class discussion to compare group matrices with the instructor matrix, or ask partners to submit completed matrices for evaluation

Examples
- N/A

Variations and Extensions
- Have teams create their own matrices by considering: what concepts do you want to compare? What features (or characteristics) do they have? How are the items similar or different based on these characteristics?
- Include similarities by including a column for "both".  To make it more challenging, include a "neither" column
- Could use overlapping circles of a Venn Diagram

Observations and Advice
- Adaptation of *Defining Features Matrix*
- Try to create categories whose interconnectedness is complex enough to require thought to identify.  Simple, binary distinctions will feel like busy work.
- Consider asking students to copy their group matrix to assist in their study
- Closing: Project blank and have students guide you; project your own completed matrix and have students check answers; submit their completed matrices

Examples:
- Optimization on closed vs. open intervals

## 23. Word Webs

Group size       2-4
Time on task   30-45 min
Duration        single session

Description.
- Word webs are collaborative versions of a concept map.  A central word, phrase, or question is placed on a shared writing space to serve as the stimulus. Students generate

a list of related ideas and then organize them in a graphic, identifying relationships by drawing lines or arrows.

- Helps students analyze a complex concept by breaking it down into component parts and clarifying relationships
- An effective starting point, helping students relate new information to prior information.

Preparation

Choose a concept for students to map, and map it yourself so you can uncover potential problems.  Your own diagram can also serve as a model against which to assess group work.  Map a parallel concept to demonstrate the process to students.  Decide what to sue as a shared writing space, and bring this and coloured markers or crayons to class.

Procedure

1. Describe and demonstrate process to students
2. Form teams and distribute paper and markers
3. Present the central concept that students will graph
4. Ask student teams to brainstorm, writing a list of terms and phrases that express core concepts and supporting details.
5. Have students sketch out a diagram starting with the central idea and adding primary, secondary, and tertiary associations.
6. Suggest that students determine the ways in which the items are related, drawing lines and arrows to show connections
7. Ask students to add new ideas and relationships as they construct the web

Examples

- N/A

Variations and Extensions

- Instead of having students brainstorm list of ideas, provide them with a list and ask them to graph out the relationships between items, adding any new ideas that they can contribute.

Observations and Advice

- How you close this activity depends upon the purpose for having students construct word webs.  Teachers often use the CoLT to prepare for another activity.  Or, use as basis for a whole-class discussion, asking team spokespersons to show and explain the ideas in ttheir groups' webs
- From Student Engagement Techniques - Well-developed schema: expert quickly grasps new information in useable form because connections to existing knowledge are numerous.  The Learning of a novice, however, is laboured and slow, not because the novice is less intelligent than the expert, but because connections between new information and existing schemata are sparse - there are no hooks on which to hang the new information, no way to organize it.

<u>Topics:</u>
- Use for unit summaries, and a course summary (develop a "mental map".