Designing in-class, group-based worksheet activities

What are they, Why use them, and When?

Guided in-class, group-based worksheet activities are opportunities for the expert to guide novices in thinking that they cannot (yet) reliably do on their own. Using peers (groups) helps scale up the interactions in large classes because they will help each other with new or novel thinking. Peer interaction also supports metacognitive growth and development of reasoning skills. Whatever the purpose, in-class worksheet activities enable peer support and expert intervention in a controlled environment for ALL students in the course. If the activity does not benefit from these three opportunities, perhaps it could be done as an assignment.

To achieve these objectives, avoid activities where the logical step would be to divide the work. Consider exercises that create opportunities for different groups to select different "correct" answers. Then, follow up can include defending these decisions with arguments based on the course concepts. Practicing basic skills is probably best left to homework or labs, unless expert intervention will help ensure students don't go wrong during their first encounter with a concept or procedure.

Worksheet Elements

Key elements of in-class worksheet activities, in four categories. These are based on STLF meetings from March 14, April 18, May 2 and August 1, 2012. First level items are in the form of questions to help users design and improve their inclass teaching activities. Some additional references are included at the end.

Context, Goals and Evaluating effectiveness

Here are notes about what to consider prior to designing a worksheet.

1. The #1 key element is clear, succinct learning goal(s) for the activity which align with course goals.
   a. Is the activity a "preparation for learning"? Is it a "synthesis" opportunity? Or is it a "practice session"?
   b. Best for learning goal(s) to be clear and visible to students and to instructors, but keep succinct.
   c. Also, think about "teaching goals", which answer the question "why do I want to use a worksheet activity here and now?"
2. What product will students generate? Good ideas include ...
   a. Higher level (Blooms Taxonomy) tasks work best. For example, have students make a decision, produce a prediction, produce a ranking, or make a judgment (e.g. best/worst/ most efficient) Use verbs for higher "Bloom's" levels -- there are many web resources.
   b. Have students product be graphical or a sketch.
   c. Does the result of student work look similar to a take home assignment? If so why do it in class using groups and worksheets?
   d. It is usually best to avoid products that depend simply on a procedure (such as solving a quantitative problem).
   e. Significant writing may cause more "solo" than "group" work. Time is probably better spent "thinking" and discussing.
3. Be prepared to tell students how they will benefit from working on this exercise, in groups, at this moment in the course.
4. Can any instructor or TA run this activity with just the worksheet, or might a note about implementation be needed? Can the exercise *degrade gracefully* (i.e. is it relatively robust to instructor inexperience or other uncontrollable circumstances)?
   a. Include hints to instructors on projected slides (small font may be fine).
   b. Milestones at 5-10 minute intervals are important to help students stay on track.
   c. Be prepared to "give" intermediate results if they are crucial to continuing the work. If appropriate thinking is the purpose rather than "answers" this should be fine.
   d. Use feedback to indicate success to students even if work was generally not completed.
5. What happens if students run out of time?
   a. Ideally, the activity design can be resolved gracefully even if time runs short because the point is to practice thinking and to benefit from peer and group support.

b. Sometimes, picking up next day can work, but perhaps the exercise is too complicated if this happens.
c. If necessary, resolving with online resources may serve the purposes.

Motivation: how will students' attention be captured and retained?

Many items throughout this document contribute directly or indirectly to helping students "want" to do activities in class. Some instructors say "it's not my job to make students desire to work". However, we all work more effectively when the task is intriguing, interesting, valuable (to "me"), or even entertaining. Therefore, address motivation and learning will improve.

1. Is the subject matter or task known to be interesting to students? Have you told them this is the case?
    a. Give students some ownership of the task by including a choice, even if it is superficial (e.g. choosing the name for a rocket that is being designed).
    b. Any form of competition can be very engaging, depending on the students involved and the context.
2. Is the topic particularly relevant to individuals, society or the discipline?
3. Do students have to USE prior learning (from homework, pre-reading, or skills practice exercises)? Eg. Some instructors use inclass activities as followup to a lab or homework exercise.
4. Are you, the instructor, excited by the issue being dealt with? Can you incorporate your experiences the lesson?
5. Were details of the activity designed with motivation in mind?
    a. Were purposes and learning goals clearly articulated and visible?
    b. Are milestones "just right"? See Logistics below.
    c. Is the level of challenge appropriate?
    d. Can slower students still accomplish something?
    e. Do quicker students have follow-up tasks?
6. Will students see clearly that they are becoming more "expert" at something?
7. Do students see their own work in feedback sessions, even if only sampled?
8. Does the exercise start in a way that supports early success?
9. Is there an emphasis on relevance to exams or labs, etc.? Are the linkages to these clear? (it helps to use similar formats)
10. Are any grades being awarded? For participation? For completeness? Correctness?
11. Will students be able to say "The instructor will give answers, so I do not have to work." This is as strong DE-motivator.
12. Are all activities in the course properly resolved? See also the Feedback section.

Design Decisions and Details

Questions to answer about optimal group size, worksheet design and deployment and using figures. These are not "rules" - they are recommendations for "common" settings.

1. What is the optimal size of groups for THIS PARTICULAR exercise?
    a. Pairs are commonly used for discussing clicker questions.
    b. Groups of 3-4 might be appropriate if ...
        i. The work involves reasoning about and applying concepts rather than discussing opinions or varying perspectives.
        ii. If tasks are not too complex, the benefits of "peer instruction" might be achieved more quickly in smaller groups.
        iii. The plan is to use rapidly formed, ad-hoc groups.
        iv. The room makes it awkward to organize into groups of more than 3 or 4.
        v. Students are in 1st or 2nd year (i.e. less experienced).
        vi. You have the capacity to provide feedback to many groups.
    c. Groups of 5-8 students might work if ...
        i. Groups will be the same throughout the term.
        ii. Students are expected to function as "high performance learning teams". In this case, five is considered a minimum by advocates of Team Based Learning, and 6 may be optimal.
        iii. Developing teamwork skills is a learning goal of the course.
        iv. Discussing several opinions or varying perspectives is a goal (i.e. if more opinions will be better).
        v. You want to reduce the number of worksheets you and TAs must review.
        vi. The task will be challenging - that is, if the judgement or decision will benefit from debate.
        vii. Students can face each other (possible even in lecture theaters).
2. How to arrange the room?
    a. Yes, group activities work fine in lecture theaters!

b.   Have students facing each other (e.g. one row turn around to face the row behind).
c.   Try to prevent having 4 or more students sitting in a row. The fourth (and beyond) often cannot contribute.
d.   Ad-hoc groups usually form up surprisingly quickly.
3.   How many copies? Consider one worksheet per **group** if you want to ...
   a.   Prevent students splitting work into solo chunks, and/or working alone.
   b.   Feedback will be offered by referring to student work. (Showing a group's work is much less threatening than showing an individual's work.)
   c.   Instructions AND the deliverable or product are simple. (Problem solving or written answer tasks require special care to avoid "solo" work taking precedent over group-based thinking.)
4.   How many copies? Consider one worksheet per **student** if ...
   a.   There are complex figures, equations etc. that students need to study during their work (see also figures below).
   b.   You want to let students take home their worksheets BUT, blank or completed worksheets could be delivered online, after giving feedback and resolving the exercise.
   c.   Worksheets will not be handed in.
   d.   Clickers will be used for the deliverables.
5.   How many pages? (Regardless of how many pages, keep in mind the efficiency of class time - i.e. simplicity is good!)
   a.   Try to prevent wasting time on "*trying to figure out what the instructor is getting at*".
   b.   Consider the time and cost of copying or scanning for recording or storing work to mark or give feedback.
   c.   Lots of white space is good.
   d.   Consider using the projector for figures (more below).
   e.   Include student names or numbers on group worksheets if participation marks are being given. Build this into the design of the page.
6.   How should I choose to project and/or print figures?
   a.   Projecting figures will help you discuss and address questions.
   b.   Student contributions will be easier if they can point to the screen.
   c.   When there is one sheet per group, all students can see and discuss projected figures.
   d.   Projected figures can include hints for the **instructor** about pacing and strategies.
   e.   Working on printed graphs or images can be an excellent form of deliverable.
   f.   Printing colour may be expensive for large classes.
   g.   Check photocopied figures -- details may get obscured!
   h.   Printed figures can be annotated and taken home (delivering online versions after class might serve this purpose).

Logistics: How to orchestrate or choreograph the activity?

1.   Do I need teaching assistance (TAs) in the class?
   a.   Yes if it will speed up delivery of worksheets (in class or as students enter the room).
   b.   Yes if you cannot visit all groups at least once during the activity.
   c.   Yes if they will be involved in reviewing the work and providing feedback.
   d.   Rule of thumb: very roughly 50 students per 'instructor'.
2.   Do you have a lesson plan for this activity? (Hopefully yes - they are useful!)
3.   Or at least sketch out a timeline for yourself and the TAs.
4.   Milestones - consider 5-10 minute intervals.
5.   If TAs will be helping, review the timeline with them before class.
6.   Consider giving your setup "lecture" before asking ad-hoc groups to form so that you don't have to talk over noise.
7.   Were learning goals or exercise purposes made clear to students?
8.   What if only 50% of students have achieved an intermediate milestone in time available?
9.   This may be OK, especially if practicing (and revealing) thinking is the main purpose.
10. How to collect the work (see also feedback)?
   a.   TAs will help make this practical. In some cases, TAs can collect work as students exit.
   b.   Easier if only one sheet per group.
   c.   Clicker questions for feedback might make this less important.
11. Can feedback (or worksheet resolution) be given later?
   a.   Immediate feedback is more effective than delayed feedback, so budget time for it. More on feedback below.
12. Consider tracking the timing (TAs can help) the first time you use the worksheet.

Feedback -- closing the learning loop

In-class worksheets are not the same as assignments or labs. Worksheets should enable "instant" feedback in the form of peer discussions AND instructor / student interactions. However, activities should also be resolved by the expert, either in class, online, or later. Bear in mind that *delayed* feedback is much less beneficial than giving expert input while (or soon after) students are actually doing the thinking.

Feedback to students

1. What constitutes useful feedback to students about their own learning?
   a. Give feedback on approach and thinking, not result, solution or answer. Feedback should reveal something about how experts THINK, not simply what the expert's conclusion was.
   b. Include (if possible) input on what might be done next, or even questions about next steps.
   c. Consider clickers for intermediate deliverables, or even the final "product". It depends on the task; designing suitable multiple choice questions for the exercise may be challenging.
   d. Posting answer keys online is fine because the answers are not supposed to be the main point. But see also "Can the instructor (or TA) simply tell everyone the answers?" below.
   e. For participation, consider a 0,1,2 or 0,1,2,3 grading scheme. Using 3 avoids the 50% grade; 1 is "done but inadequate", 2 is "on the right track", and 3 is "satisfactory".
   f. Rubrics can help clarify expectations, but avoid complexity if possible - these are not assignments or labs.
   g. Group discussions are automatic feedback loops that are tightly coupled to the activity.
   h. Of course, having the expert resolve the work is important for confirming correct & appropriate thinking, and for adjusting inappropriate thinking.
2. Is simply telling everyone the answers adequate?
   a. Maybe, if *telling* reveals an expert opinion or perspective and serves as resolution to a discussion or task.
   b. However, not if the telling simply provides a solution.
   c. Try to avoid sending any message that "the answer" is what counts rather than the thinking.
3. Can I get **students** to contribute to feedback for one another or a few other students? For everyone?
   a. Take time for volunteers to express their thinking, then have others react.
   b. What if there are no volunteers? Is "cold calling" (i.e. selecting a student or group to respond, rather than waiting for volunteers) a solution?
      i. Yes, if it is frequent and expected. Less good if done occasionally and "by surprise".
      ii. Cold calling a *group* may yield better results than cold calling an *individual*.
      iii. Cold calling different quadrants of the room, or rows, can work too.
   c. Try to keep track of students points using chalk, white board, document camera or computer and keyboard.
   d. Having students discuss their work with a partner or small group will give them feedback from their peers.
4. Is sampling of worksheets acceptable for generating feedback?
   a. Yes, especially if a few examples are offered as feedback.
   b. This way you can identify both inadequate and acceptable examples.
   c. Maybe even deliver some examples online if this can be done anonymously.
5. Finally, consider reminding students how to make use of this kind of feedback.

Feedback for the instructor
How will you know the activity was effective? Ask yourself "what does 'effective' mean to you in this particular case?" Some ideas for strategies to determine effectiveness:

1. Circulating while students work is crucial for gathering your own observations about student thinking.
2. You could jot down notes about what you noticed while helping students during the activity.
3. Align some quiz, midterm and/or final exam questions with worksheet activities.
4. Review clicker question results.
5. Use collected worksheets to compare student work to learning and teaching goals. Look for evidence that students have demonstrated appropriate thinking or changed how they think.
6. Consider using whole-class discussion sessions as follow-up. These "tell" you if students are generally on track or not.
7. Useful End-of-Term survey questions include "Are worksheet activities helping you grasp concepts?" or "Do you agree that spending time on worksheets is more effective than using the same time for more lecturing?"

References

1. Student group work in educational settings: http://www.cwsei.ubc.ca/resources/files/Group_work_SEI_8-08.pdf (Dated Aug. 2008, updated Jul. 2010)
   - Five references on that 2-pager.
   - Dan Meyer's blog post on 10 items to consider (URL to come)
2. Guidelines for running group worksheet-based activities: http://www.eos.ubc.ca/research/cwsei/resources/Guidelines-Groups.pdf
   - A two page checklist, with reasons as footnotes.
   - A third page includes some background information about why, characteristics of good exercises, etc.
   - Original version from October 2011, intended to help instructors in one specific course that uses 50 minute group activities (http://www.eos.ubc.ca/courses/eosc326/eosc326.htm).
3. Best practices resources should be perused for additional resources:
   - http://www.educause.edu/
   - http://cgi.stanford.edu/~dept-ctl/cgi-bin/tomprof/postings.php
   - http://www.theideacenter.org/research-and-papers
   - http://tblc.roundtablelive.org/
   - http://www.teachingprofessor.com/
   - http://blog.peerinstruction.net/
   - http://www.facultyfocus.com/
   - http://www.carnegiefoundation.org/
   - http://www.cmu.edu/teaching/eberly/
   - and others, and/or Canadian equivalents?

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