

Donald R. Woods, "Problem-based Learning: resources to gain the most from PBL,"
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A. How to...move toward PBL

A.1 Osterman feedback lecture, A-1

A.2 MPS-Osterman feedback lecture, A-4

A.3 Use feedback forms, A-11

A.4 Feedback forms, monitor, mark, A-13

A.5 Guided Design, A-16

A.6 Relaxed Guided Design, A-18

A.7 Socratic facilitation, tutor-directed case example, A-19

A.1 Osterman feedback lecture

For a description and some details see Woods (1991).

Before class:

- 1. Identify a topic section of your course that has about 3 to 6 h of lectures and that ends with a homework assignment**
- 2. Present the homework assignment first as the "big context problem".**
- 3. Prepare the major themes of the reading material and divide it into 20 min section**
- 4. Identify meaningful, short, 5 min problems for in-class work. These can be simplified versions of a large assignment. For example, "Identify the key issues in the task..." "Plot three data points... (instead of 52)**
- 5. Create the learning guide for each 1 h of lecture indicating the**

Reading: to be done before the lecture

Bring to class: what they need in-class

Mini-lecture: outline the key ideas for the first 20 min "lecture"

Activity: In-class problem: pose the problem

Second mini-lecture: outline the key ideas for the second 20 min "Lecture"

For next day: outline what they need for the next day.

Example: Table A-1.

6. Create the transparencies for the mini-lectures.

Example: Table A-2.

7. Duplicate copies of the full set of learning guides and the transparencies for all of the lectures. Hand this out 1 week before the series starts.

Describe the expectation that students learn before class and use the in-class time to work together to apply and solve problems.

Present in class:

1. Pose the "Big context problem" first.

2. Raise the various issues the problem suggests and lead into the subject of the first mini-lecture. Bring a timer set for 20 min because when you lecture, it's too difficult to keep track of time.

3. After 20 min, ask pairs or groups of students to work on the problem. (Anyone who didn't do the learning before class will now see that they are unprepared. They will do the reading for next class. That's why you need to try this experiment for at least 3 classes.)

4. During this time, you circulate so as to answer questions, see how well the students understand and get "feedback" about the quality of their learning so far.

5. After 5 min of students actively working cooperatively on the problem, summarize, respond to what you have seen or to questions that are causing difficulty so that after a total of 10 min on the activity you can..

6. Complete the next 20-min mini-lecture and end with the reminder of the assignment for next day.

About the series of Feedback lectures

- 1. The big-context problem is used at the start of the activity; close out a particular series with a return to use the subject knowledge to "solve" the big-context problem.**
- 2. Extensions of other types of problems you can now solving using the knowledge.**

So What?

- 1. This method helps you shift the learning to before the classroom activity**
- 2. You get feedback about the quality of the learning from the activity**
- 3. You can use your skills to help them with the problem solving processing in-class.**
- 4. This overcomes the 20 min boredom that always sets in after 20 min to "lecture"**
- 5. Students are active and cooperative**
- 6. Involves opportunities for processing skills**
- 7. It has elements of problem based because you pose the problem first. This models the use of the problem to drive the learning. Granted, the teacher structures the subject knowledge and what to learn and the resources. However, there is now a global, problem context.**
- 8. How to use HTGTM in this context? Very little.**
- 9. Why do it? It brings in some of the fundamentals to improve learning; it is a minor shift from the traditional lecture; my experience has been that it is extremely effective (both in the quality of learning, and in the student evaluations about the course).**

For more:

See Woods, D.R. (1991) J of College Science Teaching 20, Mar/April 298.

Example preparation page: Table A-1 Example transparencies: Table A-2A.2 MPS-Osterman feedback lecture

This adds structure to the 10 minute Activity.

In the Osterman feedback lecture, the students bring their native problem solving, interpersonal skills (or lack thereof), to the 10 minute Activity. We can use this opportunity to start explicitly developing "process skills."

The term "explicitly develop" means:

- 1. We have/set learning objectives that describe the skills. (Examples are given in Section D.3.)**
- 2. We ask students to gather evidence to illustrate process in achieving the goals/objectives.**
- 3. We assess their progress.**
- 4. We assess their skill.**
- 5. We should legitimize this by including this in the course outline, in the calendar description and by including questions about it on the final exam (or whatever other assessment method we use).**

Students will appreciate this because:

- 1. They know the value of these skills; having the skills will help them obtain summer jobs or good placement experience.**
- 2. Adding the structure (especially items 2, 3 and 4) will develop their confidence that they have these skills.**

Example explicit activity to include:

- 1. TAPPS: talk aloud pairs problem solving. A description of a longer workshop is given in Table 3-2 as MPS 1 and by Woods (1984). Use the ideas given in this article and have one person listen (in the pair of students) as the other person talks aloud while solving a content-independent problem. Ask both to reflect and complete feedback forms. Time: 10 min. The next session, reverse roles and repeat. In the third session, ask/reflect about the feedback forms; introduce the importance of monitoring. The fourth session, repeat using subject-rich problems plus concern for accuracy. The fifth session, repeat using subject-rich problems with accuracy. Submit the evidence sheets together with a 1-page**

reflection/assessment. Example problems in Pharmacy given in Table A-3; in Nursing, Table A-4; in Engineering, Table A-5. For more, see Section C.3.

2. Strategy: TAPPS plus strategy board. A description of a longer workshop is given in Table 3-2 as MPS 4 and by Woods (1985), and HTGTM p 3-23. Use the ideas given in that article; ask one person to talk aloud and move a marker to identify the stage they are working on. The other person, in the pair, listens. Use it first in a content-independent Terry Sleuth detective story (HTGTM p. 3-26). Extend to add monitoring and to use Terry Sleuth problems in the context of your subject discipline. Examples are given in Tables A-6, A-7 and A-8 for Pharmacy, Nursing and Engineering, respectively. For more see Section B.3.

3. Hypothesis generation and creativity. A longer workshop is described in Table 3-2 as MPS 7 and by Woods (1986). Use components of it in the 10 min Activity.

4. Group skills: described in HTGTM p. 5-19. The first 10 min Activity focuses on the feedback form [HTGTM p. 5-9] and the terminology. The second session, create a group of 4 to 5 with individual observers who use the feedback form. Ask group to do a task; then the group assesses their progress. Finally have observers give feedback to their individual clients. This is described in Table 3-2 as MPS 27-28 and by Woods (1989) and Section B.5.

References

Woods, D.R. (1984) MPS Awareness workshop, *J. of College Science Teaching*, 13, 470.

Woods, D.R. (1985a) MPS Strategy workshop, *J. of College Science Teaching*, 14, May, 523-525.

Woods, D.R. (1986) MPS Creativity workshop, *J. of College Science Teaching*, 15, Feb, 410.

Woods, D.R. (1989) MPS Group skills workshop, *J. of College Science Teaching*, 19, Nov, 109.

Table A-3 TAPPS for Pharmacy

Pharmacy 240

Some drugs need to be refrigerated at 2 -10°C; some kept in a cool place at 10 - 15°C while others can be stored elsewhere at temperatures that might exceed 15°C. Which of the following must be refrigerated?

- 1. adrenaline injection**
- 2.influenza injection**
- 3.benzylpenicillin sodium**
- 4.procaine penicillin injection**
- 5.phenoxymethylpenicillin tablets (Penicillin V)**
- 6.chloramphenicol eye drops**
- 7.typhoid vaccine**
- 8.streptase (streptokinase and streptodornase powder)**
- 9.insulin injection**
- 10.other**

Pharmacy 231 (created with the help of Suzi Woods)

Which of the following, if any, would be used to treat hypertension:

- 1.timolol**
- 2.ASA**
- 3.phenobarbitol**
- 4.oxymorphone**
- 5.propranolol**
- 6.epinephrine**

Pharmacy 232 (created with the help of Suzi Woods)

Some of the following drugs vasodilate (V); some prevent clotting (C); some are α blockers (B) and some may be none of the above (N). Classify each of the following as to the category with the symbols V, C, B, or N.

- 1.ASA _____
- 2.prazosin _____
- 3.heparin _____
- 4.hydralazine _____
- 5.digoxin _____
6. captopril _____
- 7.propranolol _____
8. phenoxybenzamine _____
- 9.epinephrine _____
10. yohimbine _____

*******Pharmacy 233 (created with the help of Suzi Woods)**

Which of the following would be prescribed for problems related directly to the cardiac-vascular system?

1. imuran
- 2.heparin
- 3.diazepam
- 4.meperidine
- 5.propranolol
- 6.prazosin

7.vigabatrin

8.azathioprine

Pharmacy 234 (created with the help of Suzi Woods)

What is common to most of the following and which do not belong to the largest common group:

1.lidocain

2.phenobarbitol

3.digoxin

4.diazepam

5.potassium bromide

6.vigabatrin

7.meperidine

Pharmacy 235 (created with the help of Suzi Woods)

What is unique about this collection of drugs:

1.calciparine

2.valium

3.lanoxin

4.diazepam

5.azathioprine

6.heparin calcium

7.digoxin

8. imuran

Table A-4 TAPPS for Nursing

Case 600

A patient has 150 meq/L sodium level in his blood. Which of the following evidence is consistent with this information:

- a. ruddy complexion**
- b. heart rate 70**
- c. chronic cough**
- d. perspiring on a relatively cool day**
- e. nervous and agitated**
- f. argumentative with clear logic**
- g. comatose**
- h. other (specify)**

Case 601

A patient has a haematocrit of 0.60. Which of the following evidence is consistent with this information:

- a. pale complexion**
- b. heart rate 110**
- c. chronic cough**
- d. normal reading**
- e. mopping her brow**
- f. nicotine stains on the first two digits of her left hand**

- g. complains of dizziness**
- h. breathing is slow and deep**
- i. pupils are slow to respond to bright light**
- j. other (specify)**

Table A-5 TAPPS for Engineering

Table A-6 Terry Sleuth for Pharmacy

440: Terry Sleuth and the Case of Mr. Smith (created based on Dunn et al. (1985) and with the help of Nancy Koppert)

JoAnne perused the recent newsletter which contains an article about forgeries. The article warns pharmacists about possible forged prescriptions that are being presented to obtain drugs of abuse. Recently, forged prescriptions had appeared for a patient using the name Karl or Robert Smith. Furthermore, Smith, of the Queen's Road trailer park, had tried to obtain prescriptions for morphine from two pharmacies on the same day. "Ahah" she thought, "I had better watch out for that. It is common knowledge that I keep a large stock of Morphine, Codeine and valium." She glanced up and noted her long time friend but retired pharmacist/detective Terry Sleuth. She called Terry over and pointed out the notice..."Look at all the stuff we have to worry about these days." Terry greeted her and looked at the notice. Further conversation was curtailed because JoAnne went to the counter to attend to Mrs. Franchuk. JoAnne turned and looked through the "cool storage". She turned in frustration..."There should be some Procain penicillin injection here. It was restocked last week. But I don't see it." Terry scanned the shelves.. Benzylpenicillin sodium, adrenaline, Streptase, Penicillin V tablets... but no Procaine penicillin injection. Terry commented, "Don't you have a new assistant? Perhaps, she stored it in the refrigerator, even though it need only be stored in a cool place."

JoAnne turned, opened the refrigerator and then beamed at Terry..."Here it is. Thanks for solving that one!"

While Joanne was completing the prescription for Mrs. Franchuk, a stranger approached the prescription counter. He was tall, dark, about 35; his tanned skin and poise suggested self-confidence and work outdoors.

Despite that poise there seemed to be a nervousness as he flicked his eyes around the Pharmacy. When Mrs. Franchuk chatted her way out of the store, he passed his prescription to JoAnne. She read it, paused, excused herself, and then went to the back to phone. Worry seemed to encompass her brow. She then came over to Terry. As gently as if she was handling a timebomb she set down the prescription on the counter. It was written for Mr. Phil Smith and signed by Dr. Kershaw. She added.. "I know Kershaw, this is his signature, I phoned his office. Kershaw is in emergency, all the receptionist could do at this time is to confirm that Phil Smith is a patient of Kershaw; although she doesn't recall Smith being in for an appointment recently.

The prescription was for 2 x 200 mL bottle of Codeine Phosphate, 60 Valium Tablets 5 mg, Streptase (a million units) and Ventolin inhaler. JoAnne recalled that Streptase was a powder mix of streptokinase and streptodornase used for anticlotting. In the UK she recalled it was called Varidase.

Mr. Smith's well-cultured voice interrupted their thoughts. "Could I please have the prescription filled. I am a little pressed for time. I'm catching an 11 o'clock flight overseas on business. I was lucky I caught Dr Kershaw on his way to some emergency. I just would hate to be in the Philippines without that medication."

JoAnne looked at Terry. Terry said..."I don't think you should fill that prescription." Why?

Table A-7 Terry Sleuth and Nursing

Case 320 Terry Sleuth and the Case of the Questionable Holter Monitor (developed with the help of M. Lea and D. Patton)

Jane looked puzzled, "Ah - Terry would you mind coming over and looking at the tracing from a Holter monitor," she called out as Terry walked past the office. Terry was pleased to see a challenging new problem and this sounded like one just from the tone of Jane's voice.

Terry looked at the output recording and scanned it. It all seemed to be the normal set of blips except for the place where Jane pointed where the trace was absolutely flat. "See there; not even a wiggle!" The darn machine must be acting up again. Remember last week when Mr. James was hooked up to it, the whole last 5 hours was straight like this. He said that

the monitor slipped off his shoulder and hit the concrete. They were supposed to repair it before they hooked it up to Mrs. Kaplinski.

Terry looked at the trace again. Terry was a little puzzled. "Tell me more about Mrs. Kaplinski."

"Well," said Jane, "she's a 21 year old secretary who has complained of fainting spells, dizziness and weakness. She says it is not related to any stress, but she is a little vague about that. She did mention that she's very frightened of hospitals and needles, and that she has fainting spells when blood is drawn."

"Hmm," said Terry. "Did you ask about any family emotional problems like suicide?"

"No," Jane responded. "I felt that I had sufficient information so I referred her to Dr. Smitzer, the neurologist on Ward 7. He's not the greatest, but he was the only one in at that time. He diagnosed a possible convulsive disorder."

"Did he tell you the basis of his decision?" asked Terry.

"No, you know him; if we asked he would think we were questioning his competence."

"So, next you hooked Mrs. Kaplinski up to the Holter monitor?" asked Terry.

"No. We gave her a complete physical and here are the records," replied Jane.

Terry scanned what might be the most pertinent data and saw:

Hct:33.2

Hgb:14.6

WBC:11.2

Na: 143

K: 4.3

Cl:90

CO₂:26

BUN: 4

Glucose:48

"Rinnng..." "Excuse me Terry while I answer the phone. Hello, Stebbing speaking." The conversation lasted a short while. Then Jane hung up, turned to Terry and said, "that was the lab; they were trying to do a 2 h P.C. on Mrs. Kaplinski when she became ashen pale, lost consciousness and convulsed." Jane continued, "too bad that stupid Holter monitor doesn't work."

Terry looked carefully at Jane and said...

What did Terry say?

Table A-8 Terry Sleuth and Chemical/Mechanical/Civil Engineering

A.3 Use feedback forms

Make the implicit explicit by using feedback forms. Table A-9 offers various levels of reflection you might ask students to do. For the use of feedback forms only, use column 2 of Table A-9. Identify the process skills that you wish to reflect on. Select the appropriate feedback form from HTGTM and ask the students to complete the form whenever it is appropriate.

Example A-1

Chantelle wants to apply a little more focus on developing the student's "lifetime learning skills." She feels she can allow perhaps 5 minutes per tutorial. She is willing to try feedback forms. Now what?

An Answer

From Table A-9, Chantelle notes that she might try an "awareness" and "skill" checklist. From HTGTM, in Feedback forms following p A-2, she considers only the section on Self-directed, interdependent learning. The description is:

aware of the educational fundamentals and uses these to teach others, sets explicit learning objectives that have measurable criteria to identify achievement and that are achievable with the resources available, considers a wide range of learning resources, and willingly draws on peers as resources, agonizes through the difficult parts of the subject [instead of skipping these and hoping they are not pertinent], creates forms of evidence to show accomplishment and applies these to both the knowledge learning and the process used."

Chantelle realizes that she must spend some time ensuring that the students understand this description. She asks the students to discuss with each other the meaning of the terms in this description and pose any questions for clarification. The group then discusses and clarifies the meaning.

In the next session, she asks students to rate their own awareness and skill in the process as described above.

Comment

Time must be spent ensuring that all students are clear as to the dimensions of the skill being considered. Chantelle does a nice job here. She does not lecture at them. She poses the problem to them and let's them identify what they need to know.

Example A-2

In the next session, Rene rates his awareness as 10 and his skill as 10. Although Chantelle is working with tutorless groups (so that she is not present in Rene's group) based on her general observations she would rate Rene as 6/10 on awareness and 4/10 on skill. What does she do now?

An Answer:

Using the forms in isolation without asking them to hand them in with evidence means that the students have been empowered to do the task yet are not held accountable. The key, missing ingredient is evidence. Chantelle might respond to Rene as follows:

"Rene, I am delighted that you rate yourself highly on both awareness and skill. What evidence would you supply to an independent observer that you are aware and skilled with, for example..

"considers a wide variety of learning resources"?"

At this stage Rene probably would respond "I'm not sure, I just know."

"Let me help you then, could you supply a list of the resources you considered in preparation for the last "teach" session. Would the list include a range of different sources? or one book? who did you consult? and so on.. I'm sure you can think of imaginative ways of generating evidence of your awareness and skill. What can I do to help you gather that evidence?"

Comment

Chantelle correctly focuses on evidence and positively shows a willingness to help Rene collect the kinds of data that will quantify "intuitive feelings" both by her and by Rene.

Table A-9 Successive levels of feedback and monitoring

If you wish to develop	Level 1: complete single form on awareness and skill for selected process skills; example 2-page covering memo type report is given in Section F-2	Level 2: complete specific forms for targeted skills. Checklist to be completed by individual after a task involving target skills. For progress, ask them, over the period of time, to maintain their strengths and shift one of the "areas to work on" to a strength. Ask for evidence to be supplied to substantiate the claim. see Section F-2 .	Level 3: form completed from Level 2, plus reflective journal plus collection of evidence to substantiate claims plus narrative describing efforts to apply the skill in a subject domain or in everyday life other than your PBL group.
Change & stress management	Awareness and skill form following p A-2 in HTGTM .	Table 1-5, p. 1-9; HTGTM , self-monitoring stress. plus worksheet See Opportunity Table 1-6, p. 1-11; HTGTM	Usually a 10 to 15 page journal completed once per week. An Example is given in Section F-4 .

Problem solving skills	After each of four successive problems or cases the students self-rate their awareness and skill. Use a scale of 0 to 10 with 10 being very aware and very skilled.	Table 3-6, p. 3-21; HTGTM , 12-item checklist for problem solving. The list is structured so ask them to focus on the first items first, then progress down the list.	
Interpersonal & group skills	Ask them to add a covering memo reflecting on the significance and personal interpretation of the ratings and the progress in the ratings.	Table 5-1., p. 5-9: HTGTM , four dimension of Task and four dimensions of morale. Individuals complete; can be combined with personal contribution to the group, as described in Section 5.3-6, p. 5-11, HTGTM .	
Team skills		Described in Section 5.4-4, p. 5-13; HTGTM or use form in Section F-5 .	
Chairperson skills		Table 5-5, p. 5-17; HTGTM . Team to complete.	
Self-directed, interdependent learning		Table 7-3, p. 7-15, HTGTM . Ask all members of the group to complete this feedback for you whenever you contribute to the "teach meeting."	
Self-assessment		Table 9-6, p. 9-10, HTGTM ; self, peer or tutor complete this.	
Knowledge structure		Concept map,	
Experience knowledge		Listing of numerical values for a case.	
Principle of successive approximation & optimum sloppiness		Structured list with priorities for a case with indications of the resources needed at each level.	

A.4 Feedback forms, monitor, mark

Here we add more structure to the approach described in Section A.3. Columns 3 and 4 in Table A-9 summarize Levels 2 and 3 for this approach. Forms are completed by peers, self or tutor.

Monitoring

These are given to the student who reflects on this evidence, draws conclusions and sets goals for improvement. Over a period of time, varying from 1 week to 10 weeks, the student

- reflects on the application of the skill in different contexts: other PBL experiences, other courses and in everyday life. S/he gathers evidence to support claims about the use of the skill.**
- sets goals for improvement, establishes criteria and the forms of evidence s/he wishes to gather. Then, over a prolonged period of time, s/he gathers the evidence, reflects on it and makes claims about accomplishment.**
- students summarize the results. Sample forms are given in Table A-10 and illustrated in the example in Section F-5.**

Marking

The tutor assesses the student's summary report based on completeness, quality of the evidence, consistency in interpreting the evidence objectively and relating the criteria-evidence to the objectives. An example feedback form is given in Table A-11.

**Table A-10 Example forms to guide the reflective journal writing
Table A-11 Example tutor's marking guide for the journals**

A.5 Guided Design

Guided design is an extremely powerful approach. It is relatively easy to implement; it can be used in large classes with tutorless groups. Wales, Nardi and Stager (1994) describe it as follows

"Students working in teams of four to six are guided one step at a time through each of the decision-making operations by a set of printed "instructions" and "feedback" pages prepared in advance by the teacher.

Each student receives a copy of the instruction, which explains the operation about to be performed and asks the student to complete it. When the students are ready, the teacher checks their ideas and approves of what they have done or suggests some additional ideas to consider. When the teacher is satisfied with the work, each student is given a copy of the printed feedback, which describes what a typical student group might be expected to do. If the feedback is well written and the students in the class have done an appropriate amount of thinking, the two results should be in close agreement. This combination of feedback from members of the group, from the teacher, and from the printed material helps students develop the reflective thinking skills that they need. The printed material also helps ensure that similar skills will be developed in multisection courses taught by different instructors."

The printed instructions and feedback constrain the student approach and, to some extent, control the ownership of the learning. Students are not allowed to deviate far from the preset pattern. Ideas for relaxing this limitation are given in Sections A-9 and A-10.

This "limitation" is indeed one of the great strengths of this approach. It provides the tutor with the degree of quality control and monitoring that allays instructor's fears that the students are "learning the wrong things" or are "not learning the right things." Guided Design is an excellent way to get started.

Since it takes so much effort to create the printed instructions and feedback sheets, try to locate modules and materials from those who have already developed them. Table A-12 lists some of the resources.

References

Colvin, S.T., D.A. Kilmer and J.E. Smith (1972) "Guided Design in environmental education," *Engineering Education*, 62, 907-908.

Cox, Cheryl and A. Ponting, Pharmacy, University of Alberta, Edmonton, AB T6G 2N8. personal communication; series of 18+ case problems worked up for PBL following the generalized Guided Design format.

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Pawlak, S.M., N.G. Popovich, J.W. Blank and J.D. Russell (1989)
"Development and validation of Guided Design Scenarios for problem-solving instruction," Am. J. Pharm. Education, 53, 7-16.

Popovich, N.G. (1995) Purdue University, Lafayette, IN 47907-1335. Nick has developed several dozen Guided Design modules in the context of pharmacy.

Wales, C.E., R.A. Stager and T.R. Long (1974) "Guided Design," West Publishing Company,

Wales, C.E., A. Nardi and R. Stager (1993) "Emphasizing Critical Thinking and problem Solving," Chapter 8 in "Educating Professionals: responding to new expectations for competence and accountability," L.Curry, J.F. Wergin and Associates, ed., Jossey Bass, San Francisco, CA.

Wales, C.E. and R.N. Hageman (1979) "Guided Design Systems approach in Nursing Education," J. Nursing Education, 18 38-45.

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Table A-12 Some "Guided Design" problems

Discipline	
Medicine	
Nursing	Wales and Hageman (1979)
Occupational Therapy	
Pharmacy	Pawlak et al. (1989) Cox and Ponting, Jang and Solad (1990), Popovich (1995)
Engineering	Wales, Stager and Long (1974)
Accounting	
English	
Social work	
Environmental education	Colvin et al. (1972)

A.6 Relaxed Guided Design

Guided Design starts with a problem. It provides structure for the problem solving processing. The structure is more a "problem solving" application to the problem "what do I need to know to solve this problem?" In many ways it mirrors the eight steps of: (HTGTM p. 6-1)

- 1. Explore the problem, create hypotheses, identify issues. Elaborate.**
- 2. Identify what you know already that is pertinent.**
- 3. Identify what you do not know.**
- 4. As a group, prioritize the learning needs, set learning goals and objectives, and allocate resources. Members identify which tasks they will do.**
- 5. Individual self-study and preparation.**
- 6. Return to group, share the new knowledge effectively so that all the group learn the information.**
- 7. Apply the knowledge to solve the problem.**
- 8. Assess the new knowledge, the problem solution and the effectiveness of the process used. Reflect on the process. Elaborate on the problem.**

Thus, in relaxing the formality of all the paper shuffling back and forth, in relaxing the need for the detailed preparation of the feedback forms, identify those parts of Guided Design that you can relax. First, you need to

pose the problem. The rest is a question of using imaginative ways to monitor the group's progress; so that they are assured that they are on task, and so that you have similar assurances. The advantages of starting with the traditional, detailed feedback Guided Design is that you provide everyone with a template for problem solving and working your way through the process. Table A-13 gives some options for relaxing the formality of the feedback in Guided Design.

Table A-13 Some options for relaxing Guided Design

You could	Details	Example
Use 8 check points: one after each step.	Ask them to reflect on the process used and submit those reflections after each step. Use the Guided Design "Thinking about Thinking" template.	

Provide the 8 processing-step template	Handout or a visual image.	
Tutor facilitate the feedback through the 8+ processing steps	Small group complete the tasks. Then tutor collects the input from all verbally and facilitates a discussion before releasing them to do the next task	See Section A.7
Use 1 check point:	Check the learning objectives in the middle of step 4; validate these before the groups proceed.	In the MPS approach, this is our only intervention.
Monitor throughout	Interactive computer conferences provides an interesting way that the tutor can monitor the process. This is tutor intensive	Ponting and Cox use this approach in their distance-learning PBL
After the case.	Debrief the groups after the case is completed; or have the groups debrief each other. Popovich (1995) uses this approach.	

A.7 Socratic facilitated, tutor-directed PBL

The socratic facilitated, tutor-directed approach was pioneered in the Business Schools. However, the business schools tended, in general, to use the approach to synthesize and illustrate the application of knowledge already learned. One might refer to this as Problem-based Synthesis, PBS. Thus, after students have had courses in human resources, accounting, finance, economics and marketing, they will have a "policy" course that is case taught. This approach illustrates how students can integrate and apply the knowledge they have already learned. In the context of the book HTGTM and this book, we consider using the problems to drive the learning rather than synthesize it after we have learned it. Hence, Problem-based Learning, PBL. Table A-14 illustrates the difference in approach. This comparison is misleading in that some PBL programs in business schools use cases to "learn new knowledge," and sometimes medical schools use cases to "synthesize previously-learned knowledge." However, the polarized distinction is useful to help use make the best uses of books written on facilitating the business school "synthesis" approach. I recommend Erskine et al. (1981) as a very helpful, how-to-do-it book on socratic facilitation. Although it is written primarily for the typical business school case approach, the book provides a rich set of suggestions that can be used in the medical school PBL approach.

A.7-1 In-class facilitation

The socratic approach has been applied successfully to large classes for Problem-based learning by Lea Ann Hansen, in Pharmacy at the Virginia Commonwealth University, Richmond and by Ted Cleary, Pathology, University of Adelaide, Adelaide, South Australia. Table A-15 summarizes their approaches to model the eight-stage problem solving process used in a typical PBL activity. Also given in Table A-15 is another option for socratic facilitation of the problem solving process. Tables A-16 and A-17 show the context and timing of the process used by Hansen and Cleary, respectively. Table A-18 illustrates the transparencies that might be used in Guided Design facilitation of the process.

A.7-2 Personalized self-directed DA-E dialogue

The socratic facilitation approach was used in printed format for engineers by Rudd and Watson (1968) through their Devil's Advocate- Engineer dialogue. Herethe problem is posed and, through an imaginary conversation between the Devil's Advocate DA (or tutor) and the Engineer, E (or student), the student is asked to answer a series of questions posed by the tutor. The questions and answers are printed such that the student can wrestle with the question and arrive at his/her answer before uncovering the recommended answer. Table A-19 shows a paper/computer individualized layout of the process. The line in the left hand margin visually reminds the student when to stop uncovering the information, when to pause and formulate a student response. Computer technology makes this style obsolete, but Table A-19 illustrates an approach.

A.7-3 References

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Table A-14 Two applications of socratic facilitation

	"Typical" Business school Case, PBS	"Typical" Medical school case, PBL
Focus on	Synthesis and integration of previous knowledge to solve problem.	Learning new knowledge and using to solve problem
Tends to be	Problem-based synthesis of previous knowledge.	Problem-based identification and learning of new knowledge and synthesis to solve the problem.
Tutor Facilitation tends to focus on	Problem solving approach to solve the case based on previously learned knowledge.	Problem solving approach to identify (and learn) new knowledge needed to solve the problem.
Typical facilitation sequence	1. What is the problem?	1. What is the problem, the factors that are important, what is your hypothesis about what is happening?
	2. What is the relevant information?	2. What do you know already?
		3. What new information do you need to know?
		4. Prioritize learning issues, identify learning resources, contract to teach each other.
	5. Self-study to learn new information and resolve how best to teach the others.	
	6. Teach each other; does everyone now know the key new knowledge?	
	3. What are the alternatives for solving the problem?	7. Use the new knowledge to solve the problem
	4. What are the decision-criteria?	

	5. What's the most appropriate decision?	
	6. What is the plan for implementation?	
	7. When and how does implementation happen?	
	8. What is the overall evaluation? [Erskine et al. (1981) p. 141]	8. Assessment, reflection, elaboration about the process used, and about the problem solved.

Table A-15: Three example options of using socratic facilitated, tutor-directed PBL for large classes

Hansen's approach with 110 in Pharmacy	Cleary's approach with 120 to 150 in Medicine	"Guided Design" variation with 40 to 60 in Engineering;
Total time per case: 3 h/case	four, 2-h sessions: 8 h/case	three, 2-h sessions: 6 h/case
Problem: Problem statement given to the students 1 week in advance. They are to individually, or in groups, explore the issues ahead of time.	Session 1: Problem distributed to students in class. Tutor introduces the case.	Problem distributed to students in class.
Issues: Session 1: tutor facilitates discussion: students list issues, tutor writes issues on the board (without comment) and then later asks students to defend/debate. The tutor's role throughout is to intervene and add critical thinking and expert judgement throughout. This is to ensure that the students are "on-track." Time: 50 min	3 to 5 minutes in buzz groups to clarify terminology, identify issues; then they report what they talked about: the importance, symptoms and hypotheses. Tutor records (without comment) Group prioritizes hypothesizes and learning issues with tutor's facilitation. Time: 50 min	Tutor structures the questions, the responses for the process through the whole case. This is Guided Design in the sense that the tutor tries to model the process, anticipate and pose the relevant and irrelevant issues likely to be raised by students. The tutor prepares the whole process; poses questions and answers on transparencies and reveals the issues as the activity progresses.

<p>Learning contracts/resources and student task for next meeting: students are asked to pursue their assessment of the case, work in groups of their own if this facilitates their learning and to individually prepare a written analysis following a structured format: Symptoms, Observations, Assessment, Plan (SOAP)</p>	<p>Tutor offers ideas about resources to help students pursue hypotheses. Students invited to study one or more learning issues singly or in cooperative groups. The tutor's role throughout is to intervene and add critical thinking and expert judgement throughout.</p>	<ul style="list-style-type: none"> - What would you do first? - Why? - What information do you need? -where would you locate that? - If this is the resulting information, now what? - What don't you know?
<p>Synthesis of Learning done primarily as individuals or in learning groups. Not facilitated in class.</p>	<p>Done within and outside of class; tutor facilitates two more meetings where previous knowledge is reviewed, buzz groups formed to share findings, group share via the tutor. First, focus on initial learning knowledge, then focus on patient information, and then focus on the data to gather via physical examination. Simulated patient is present for second cycle; knowledge expert is available during the third cycle.</p>	<ul style="list-style-type: none"> - If I give you that information (here it is) now what? <p>Students participate as small buzz groups, diads, triads, individuals. Tutor collects ideas, asks group to assess the ideas and, when is convinced that they understand what has been explored, the tutor reveals the new information, discusses it and goes on to the next question.</p> <p>The approach can also be presented as a self-paced conversation between the tutor and the student (the Devil's Advocate and Engineer approach of Rudd and Watson, 1968).</p>
<p>Solving Case Students come to second meeting (2 h) with their individual assessments and plans. Tutor facilitates gathering of viewpoints, and the analysis, exploration and resolution.</p>	<p>Students come to the fourth meeting prepared to arrive at a working diagnosis. Tutor facilitates.</p>	<p>The approach can also be presented as a self-paced conversation between the tutor and the student (the Devil's Advocate and Engineer approach of Rudd and Watson, 1968).</p>
<p>Reflection Done throughout with additional feedback on the individual SOAP analysis of the case.</p>	<p>Done throughout. Journal writing required for one of the cases.</p>	<p>Reflective journal writing required for the case.</p>

Table A-16 Hansen's approach illustrating the context and timing of the tutor facilitation meetings.

	Meeting 1, 1 h	Meeting 2, 2 h
problem statement	Problem statement given to the students 1 week in advance. They are to individually, or in groups, explore the issues ahead of time.	
1. Read, elaborate, explore issues, hypotheses.	tutor facilitates discussion: students list issues, tutor writes issues on the board (without comment) and then later asks students to defend/debate. The tutor's role throughout is to intervene and add critical thinking and expert judgement throughout. This is to ensure that the students are "on-track."	
2. Identify what know already.		
3. Identify what don't know: list learning issues.		
4. Prioritize learning issues.		
identify possible learning resources,		
contract with each other.	Students invited to assess the problem and their plan of action. students work singly or in cooperative groups. Each must write their own analysis following a structured format: Symptoms, Observations, Assessment, Plan (SOAP)	
5. Self-study		
6. Bring back new knowledge		Students come to second meeting with their individual assessments and plans. Tutor facilitates gathering of viewpoints, and the analysis, exploration and resolution.
7. Solve problem		
8. Reflect, elaborate		

Table A-17 Cleary's approach illustrating the context and timing of the tutor facilitation meetings.

	Meeting 1, 2 h	Meeting 2, 2 h	Meeting 3, 2 h	Meeting 4, 2 h
problem statement	Distributed at the meeting, tutor introduces	Simulated patient present	Clinical specialist present	

1. Read, elaborate, explore issues, hypotheses.	3 to 5 minutes in buzz groups to		tutor reviews previous meeting, 3 to 5 minutes in buzz groups to share findings.	
2. Identify what know already.	clarify terminology, identify issues;	tutor reviews previous meeting, 3 to 5 minutes in buzz groups to share findings.	Groups then share, with tutor facilitating.	
3. Identify what don't know: list learning issues.	then they report what they talked about: the importance, symptoms and hypotheses.	Groups then share, with tutor facilitating.	Analyze, hypothesize, generate new learning issues and seek new information from the a physical examination.	
4. Prioritize learning issues.	Tutor records (without comment) Group prioritizes hypothesizes and learning issues with tutor's facilitation. Time: 50 min	Analyze, hypothesize, generate new learning issues and seek new information from the "simulated patient." Tutor records (without comment) questions, issues and simulated patient responses.	Tutor records (without comment) questions, issues. Guest clinical specialist gives 10 to 15 min generic input without revealing diagnosis or answering specifics about the identified learning issues.	
identify possible learning resources,	Tutor offers ideas about resources to help students pursue hypotheses. The tutor's role throughout is to intervene and add critical thinking and expert judgement throughout.	Tutor offers ideas about resources to help students determine what information would they seek through physical examination. The tutor's role throughout is one of recording information.	Tutor offers ideas about resources to help students explain the physical signs and evidence. The tutor's role throughout is to record and nurture critical thinking.	

contract with each other.	Students invited to study one or more learning issues singly or in cooperative groups.	Students invited to work singly or in cooperative groups.	Students invited to work singly or in cooperative groups.	
5. Self-study				
6. Bring back new knowledge				Through buzz groups, group sharing and tutor facilitation, the group address the specific diagnosis, the differential diagnosis, the specific investigations that are likely to resolve these so that the group arrives at a working diagnosis or a differential diagnosis.
7. Solve problem				
8. Reflect, elaborate				

Table A-18 Transparencies illustrating socratic facilitation in the context of process design of a sulfuric acid plant (from *Teacher's Guide to Process Design and Engineering Practice*, 1994). **Table A-19** Paper copy dialogue between the tutor (DA) and the student (E) in the context of colloids and surface phenomena. (from *Surfaces, Colloids, and Unit Operations*, 1990)