

Learning Activity 1: Problem Solving Through Self Questioning (Pythagoras Theorem)

Learning Behaviours: Problem solving - Getting started, getting unstuck

Teacher: BKD **DATE:** 11/5/05 **Class:** 9D Maths

Aim: to use the worksheet below to improve student problems solving skills with non-routine problems.

The idea was to train them to ask the sort of questions good problems solvers ask intuitively.

The process was to do an example on the board to show the questions could be used and then have them do the two examples following the prompt questions (and as a teacher refer them back to these and not provide any other answers) - note activity sheet below..

Problem Solving Through Self Questioning (mostly Thinking Questions): WORKSHEET

Q1. Find the length of the drain (heavier line in diagram) -

What needs to be found (answer)?

Can I draw the **problem triangle** (right-angled, with side to be found)?

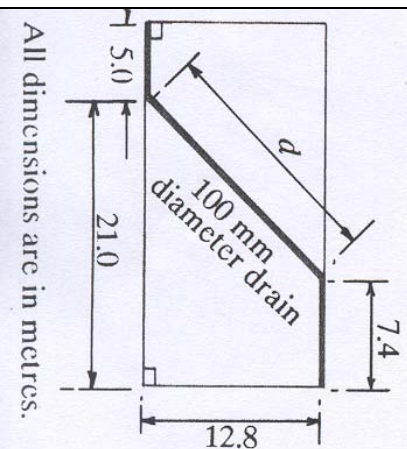
Do I have enough measurements in the **problem triangle** (need 2 sides

to find the other one!)? If no, can I find them out some way?

Use Pythagoras to solve the **problem triangle!**

Have I communicated my ideas clearly and fully?

Have I stated my real answer?



Q2. Find the length d in the diagram shown -

What needs to be found (answer)?

Can I draw the **problem triangle** (right-angled, with side to be found)?

Do I have enough measurements in the **problem triangle** (need 2 sides

to find the other one!)? If no, can I find them out some way

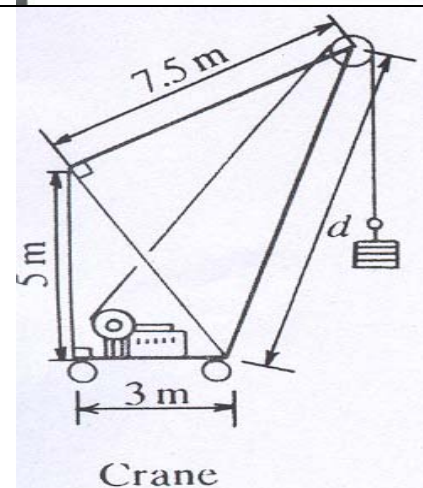
- do I need

to draw another triangle first and solve that?

Use Pythagoras to solve the **problem triangle!**

Have I communicated my ideas clearly and fully?

Have I stated my real answer?



Students then select 6 non routine problems from their texts and checklist their problems solving process of using self questioning.

Problem Solving Checklist: (select 6 problems to do from your textbook)	Q1	Q2	Q3	Q4	Q5	Q6
Identifies what needs to be found						
Draws the problems triangle						
Finds out other information needed						
Communicates clearly (working out) and states real answer						
Keeps trying / persists						
Uses other resources (book examples, group....)						
Uses “thinking” questions						

Discussion Tool: Role play / Discussion / Journal Writing

My aim was to promote discussion about their learning behaviours.

The role play was based on a real student / teacher conversation that had occurred the previous lesson. This was used to stimulate student thoughts for their diary entries. The example role played: during one lesson one student was clearly opting out of any responsibility for tackling the problem, “can’t do it!” - even as she was being lead through it self question by self question - we persisted until should use these self questions effectively (without giving her any answers). She became a very effective problems solver in time.

The following “self questions” (ones they had been using) were written on the board and the problem to be solved also put on the board i.e. the board represented the desk, another teacher played the part of the student in this role play (& I played myself the teacher).

Self Questions:

What needs to be found (answer)?

Can I draw the **problem triangle** (right-angled, with side to be found)?

Do I have enough measurements in the **problem triangle** (need 2 sides to find the other one!)? If no, can I find them out some way?

Use Pythagoras to solve the **problem triangle!**

Have I communicated my ideas clearly and fully?

Have I stated my real answer?

Problem:

A helicopter hovers at a height of 150metres above the ground and a horizontal distance of 200m from a beacon on the ground. Find the direct distance of the helicopter from the beacon?

Script: (intended - varied in delivery)

Jill: “Mr B I can’t do this one?”

Mr B: “ *What can’t you do?*”

Jill: “All of it”

Mr B: “*OK, what does the first self question ask?*”

Jill: “What needs to be found (answer)?”

Mr B: “*Well?*”

Jill: “ I don’t know “

Mr B: “*Read the question again*”

Jill: “I still don’t know what has to be found”

Mr B: "Go back, read the question again- what do you have to find"

Jill: "Yeh - you've got to find the distance from the chopper to the beacon, what is a beacon?"

Mr B: "Good, now you know what to find, the beacon is a light on the ground". Now what does the next self question ask?"

Jill: "I've gotta draw the problem triangle - but there no picture?" "I don't know how to"

Mr B: "Draw what you can and ask any questions you need to"

Jill: Draws chopper above the ground and a line 150m down to the ground. "but what does horizontal mean?"

Mr B: demonstrates on her diagram line to beacon. "Now what is the question asking for?"

Jill: "That length there - ah now I can draw the problem triangle, thanks I am right now". She draws problem triangle and solves the problem (but actually write down the real answer).

Jill: Mr B - can you check if this is the right answer?"

Mr B: "Do you follow through the self questions?"

Jill: "Yeh"

Mr B: "Well - your working is set out well but where is your real answer stated?"

Jill: "OK I'll do that but is it right?"

Mr B: "Is that a good question? - couldn't you check the answer in the back yourself?"

Discussions / Journal Entries:

1. Role Play -

Re-state aim of recent work - improve problem solving (Pythagoras) through use of self questions. Students told that we will go through a series of ideas relating to the role play, one at a time - they will have a chance to contribute to the discussion and then make a journal entry. Ideas / questions -

- a. General comments on the role play
- b. What poor learning behaviours were shown by Jill?
- c. Were there good learning behaviours shown? What were they?
- d. Student questions - did she ask good questions?
- e. Teacher responses - What did you notice about the teacher responses? Did he tell her any answers? Should he have told her more?

They were then able to add to their journal overnight.

The teacher playing the student tried to emphasise

- f. I didn't even try to read the question before I asked for help from the teacher
- g. Even when I was prompted to read the question I wasn't able to identify key words like "find"
- h. I relied too much on the teacher - "What do I do?", "Is this right?"
- i. I did not use the self questions until prompted by the teacher
- j. I did not show working out
- k. I did not check the answer at the end.

Student Comments

Summary of student journal responses (after class discussions and overnight entries)

1. Poor learning behaviours exhibited by "Jill"-

- a. "Asked many process questions (dumb ones, common sense ones)"
- b. "Couldn't spell"
- c. "Didn't get started for 20mins, should have check with group or asked the teacher"
- d. "She didn't read the question to see whether should could do it, no effort"
- e. "Didn't look at self questions"
- f. "She didn't ask her group how to do it"
- g. "Tried to rely on the teacher for the answers"

h. “She didn’t think before she asked questions”

2. Good learning behaviours exhibited by “Jill”-

- a. “Asked some thinking questions - about beacon....”
- b. “Communicated measurements correctly”
- c. “Show good working out”
- d. “Asked for help when stuck”
- e. “Realised her mistakes”
- f. “She kept on trying, didn’t give up and finally listened to the teacher”
- g. “Re-thought the questions when wrong”
- h. “She knew how to set out the diagram”
- i. “Ended up using self questions”

3. Responses by the teacher -

- a. “Good, he didn’t tell her the answer, he took her back to the self question steps over and over, he was getting her thinking”
- b. “Wouldn’t tell her the answers”
- c. “Good, he made her work out the problem”
- d. “He said thing like maybe, think about it...”
- e. “He could of explained it a bit more” (I questioned further on this point in the class discussion but the student were unable to say what but not the answers... - I will pursue this in a further class discussion)
- f. “Helped enough to get them motivated”
- g. “I think the teacher could have helped her more and explained it easier”
- h. “Encouraged her and didn’t yell at her when she got it wrong”
- i. “Help was clueless, he didn’t help at all”

Teacher Journal

What is my intention?

The worksheet clearly helped students develop their problems solving skills with all students doing much better than previous years (including the more difficult and 3D problems). The worksheet effectively drew their attention to the good learning behaviours involved.

The second challenge was how to engage students in a conversation about these behaviours, a straight diary entry seemed doomed to fail. In discussing my concern with the team somebody suggested role playing student approaches in using the sheet - great idea → value of meeting and sharing with colleagues.

What happened?

21/6/05 - Role play followed by discussion and journal entries (about 6 staff viewed the lesson).

1. I found the role play easy and enjoyable but probably went on too long (next time 10 min maximum). I expected the discussion to be difficult in terms of getting “deeper” responses and it was - students initially gave shallow responses, my hope is that they will take the time to add thoughts over night. As the process of “questions - discussion / journal entry” was repeated student responses did improve.
2. I did notice that their response to my questions re “the questions that Jill asked” were more in terms of learning behaviours. I believe this was because they had an existing understanding and language on questioning (“thinking questions are good because they promote discussion...”).

3. They clearly had trouble identifying and articulating the poor and good learning behaviours exhibited by Jill but started to “get into it” when asked about the teacher responses - here they were very clear that directing the student back to the self questions and not telling them the answers was important. They did identify poor learning behaviours as asking thin questions and negativity (not getting started, not having a go). They identified good learning behaviours as persisting with questioning, some good questions.
4. Two students felt though that I should have given more help but couldn't really say what (I left that with them and returned to it next lesson).
5. The teacher playing Jill - explained how he saw his role as the student, this was informative in terms of the learning behaviours we hope the kids would come up with. These comments were useful when did our final session on this after I have read their journals.
6. I think the final discussion on the “Biggest broom in the cupboard” experience (in summary - the kids were asked to solve a problem in pairs using the list of self questions - they didn't use these instead trying to solve the problem on a superficial level - the whole class was wrong after 15 minutes - they were then more firmly directed to use the questions and all subsequently solved the problem successfully). I believe the value of the self questions in problem solving is now clear to them. In our final discussion I would like to raise the issue of linking between classes - why didn't they do it?
7. If I were to repeat the exercise I think I would give the students more help with “learning language” - maybe a list of good learning behaviours to draw from (I would take their list from a previous activity (good student / good class / good teacher) and add a few).
8. It is important that we do visit each others classes to view some of these trials!
9. An observer felt all students were interested in the role play and about 80% of kids were on task during the discussion, about half of the students made no contribution. Students finished journals overnight.
10. The journal entries that students made were quite impressive and showed good views on the learning behaviours we were trying to highlight.
11. The lesson that followed (so I could read the journals) was on a new topic (Similar triangles) where there were given a discovery exercise to do. They did it in groups with little or no help - no ‘I can't do it’ i.e. they exhibited good learning behaviours! I praised them accordingly.
12. The following lesson involved a circle discussion where we went through a summary of their journal entries - this generated further good discussions. We also spoke about the “language of discussion” and how their views on questioning came through strongly and that we will reinforce the GLB's out of this series of activities.
13. One teacher observing the role play discussion made the following points
 - Always directing questions back at kids can become frustrating for kids if not done well
 - This work takes a lot of time - other teachers may have concerns of getting through the curriculum
 - Liked the self question approach to problem solving - kids obviously get better at using the approach, could develop and fairly generic set ??

What do I think the students got out of the event?

They linked back to a previous discussion on good questioning.

Success on a following test gave direct benefit for many students → improve learning behaviour through self questioning resulted in better marks.

What might I change next time around?

Shorter role play, maybe get students to play part in role play