ITA Transcripts

Title:	Teaching Problem Solving with Transcripts
Focus:	Transcripts can be used to illustrate points in a reading or handout on teaching techniques, as well as in classroom activities. Here is an example of a handout I use in my coursepack for a course for prospective ITAs. The points are illustrated by excerpts from a variety of transcripts, including those I've put on the website.
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ELI 380/381--IGSI Courses
Hints on Teaching Problem Solving in Class

When a teacher shows how to work a problem in class, his or her goal is to give an understanding of that problem to the students, so that they can solve ones like it. Solving a problem is, therefore, like giving an example; it illustrates some technique or reasoning. To teach problem solving effectively, you must:

a. know the purpose of doing the problem
b. take account of your students, to bring about understanding in their minds

The most common complaint about teachers who demonstrate problem solving in class is that they face the board and mumble to it. These teachers may become so involved in working the problems that they forget the audience altogether. Here are some suggestions to help you avoid this pitfall and turn your demonstration of problem solving into meaningful teaching.

1. First, **introduce the problem** in an interesting way that relates doing the problem to the purpose of doing it. Tell the class not just what they are going to do but why. In the introduction to the problem below, you can see how the GSI first introduces the idea of the "golden rule steady state" and then introduces the problem as an application of the concept.

Econ IGSI (Ana) [referring to a graph on the board]:
IGSI: So, if you have, if you can have different K-star, which one is your best K star? ... what should be the criteria, to decide the K-star that is the best for us?
S: C-star.
IGSI: Yeah, because we care about consumption, so whatever steady state will give you the maximum consumption, you go for it. Okay? ... So, this is your K-star of golden rule. At this K-star you maximize the consumption in the economy, okay? If you away, if you are away from this, you're gonna have less consumption either way. ... if you go further to the right, it's falling, if you go

further to the left, it's falling. okay? Any question on the golden rule steady states? Okay. [6 sec, erasing some space to work] Is it number 3.2? yeah. So I'm gonna do number 3 and try to use this picture [of the golden rule steady state] to explain number 3.

2. **Maintain student involvement** through frequent eye contact and checking questions, questions which make them do the next step in the problem, using their names, and responding to their contributions positively, with enthusiasm.

a. **eye contact** is essential, even when working at the board for extended periods of time. Try to stand when writing so part of your face is still visible to the class. Frequently look over your shoulder, especially when asking checking and content questions, and when summarizing. Pause frequently to face the class fully and talk with them, using the board as a visual aid before resuming board work. Without such contact with you, students will lose interest in the problem.

b. **Frequent checking questions** maintain a communicative link with students, even when the teacher does not wait for a reply. Note how frequently the 2 IGSIs below use such questions. These tags add a level of intensity and involvement to the problem solving.

Hydaulics Lab IGSI (Fatih):
So in the end the only unknown is a Q. This is known. The only unknown is a Q. You pull a Q out of it, **right?** You can do that easily. Now we have a Q. Well, look at this now, you wanna calculate the energy at this point. Suppose as an example you know what the energy at this point is, **agreed?** You know that there's an entrance into the pipe, so there has to be some loss associated with that, and you know how to represent the two, **don't you?** The hot loss, let's call this entrance, is going to be equal to what? Help me out here. What is it equal to?

Econ IGSI (Ana):
If an increase in West Germany, you have a smaller K-star, and you have a smaller, smaller Y, little-Y. So, same thing, **okay?** And since, well but this is the steady state, so, this is like, you know, in a month. This is the steady state though, but you still have the same answer, **see that?** So K falls, little-Y falls, **right?** What happen to big-Y? If N increase <S: it went up> What if the, what is the growth rate of big-Y? N plus G, good. So if N goes up, the growth rate is going up, so big-Y is going up, so same result, **okay?** So, if you can just, well you know, if this immigration is large enough to change the population growth, you still have the same result. Okay. that's for labor. Let's do it for capital.

[Notice also how these two IGSIs use the pronouns *you* and *we* to keep students involved. They also use command forms (*look at this now, help me out here*) and ask rhetorical and real questions in addition to their checking ones.]

c. Asking real questions, so students supply the next step in the problem solving keeps the class actively involved. This is a kind of meaningful checking question for you, too--if students can answer, you know they follow you in this part of the problem. By contrast, if you give the answer, you learn nothing about their understanding.

Math IGSI (Olga):
GSI: And the question is the same, find f of 4. Well, what should we do? [8 sec pause, GSI looks at the class]
S: Start out the same way, wouldn't you?
GSI: Start out the same way, right. The idea is the same. ... so you start out the same way. Differentiate this integral. The derivative of this integral now is going to be what? You're gonna have to use the formula I gave you yesterday, the general formula, which says that if I have a u up here which is not just x, it's a function of x, and I wanna differentiate this integral, what do I do? replace the t by [pause]
S: u
GSI: by u. It's gonna be f of u. Times, times what?
S: d u
GSI: [nods] the derivative of u, d u d x. Remember, this came from the general. So, this is going to be f of x squared, and what's d u d x?
S: 2x
GSI: 2x, all right. so, the derivative of the left-hand side is this. That means it's equal to the derivative of the right-hand side. so f of x squared times 2x is equal to the derivative of this, which we found before to be cosine pi x minus x times p times sine pi x, okay? Well, I'm almost there. I'm looking for f of x. I don't quite have f of x, but I can solve for f of x squared. All right. What's it going to be?

d. using students' names keeps them involved in the process.

Examples of calling on students by name:
What makes them converge to the same point? Any thoughts? Elsie?
So what do you think, Bradley, what is the hydraulic grade line over there? [6 sec] How about anybody wanting to help him?
What is E-one Jeffrey, what do you think? Help me with this.

Examples of referring to a student's earlier question or comment (Ana):
The article notes that the regional income difference usually cause migration from poor to rich regions. Okay, now it comes to Brian's question. ... Okay, let's see if we can say something. [writing on the board] This is for you Brian.

It's P over gamma plus E, so Doug, that's where this thing comes into play. We have in open channel flow ...

e. responding to students' contributions positively, with enthusiasm, help, reassurance, and praise, encourages them to stay involved and keep responding.

Hydraulics IGSI (Fatih):
[In this transcript, underlining means two speakers are talking at the same time.]
GSI: In addition to that you can assume, for the rest of the problems, ... that the water temperature is this [writing on the board]. So this you will need, for, what do you need this for?
S: viscosity
GSI: Why did I give you the temperature really? Huh?
S: nothing [students laugh]
GSI: okay
S: viscosity
GSI: visc- you got it. Ann, you are right on the dot. exactly.
S: Do we only look at frictional losses or do we look at when it's entering the pipe and splitting off?
GSI: Gr- good question. Well, what I would suggest ...

S: I don't get that part where the um it says <GSI: mhm> uh C-D relates the flow to the headloss. <GSI: mhm okay um> How is it? How is that?
GSI: All right, well, let's see [writing on the board] Let's work it out together.

Econ IGSI (Seto):
GSI: ...yes Darrell .
S: monopolistic competition is uh is easier to enter into the market <GSI: mhm> than oligopoly or monopoly
GSI: okay . okay . thank you . free entry and exit . perfect competition ? <S: same> free ? same okay . ditto here . monopoly ? barriers to entry . oligopoly ? barriers . okay . all right good . we are making progress . what else (5) what else . yes ?

3. **Go step by step, using linking language** to make all your transitions clear. For example, use words like *first*, *so*, *now*, and *then*.

IOE Prof:
Now, **the first issue is** we have 4 parameters to deal with **before** we get into the derivation. I'm gonna show you an interesting concept that helps the analytical derivation considerably and that's called normalizing the rack. **That is**, we're gonna transform this rack into a slightly different type of rack, manipulate that, get the results, **and then** transform back to the original rack, **and basically what we're really doing is** transform the rack into uh time, and reduce the parameters. The way we normalize a rack is **first**, find the travel time to the farthest point in the rack vertically okay? **So**, let's say that travel time vertically is T-sub-V, **then** by definition, uh that's gonna be the height of the rack divided by vertical velocity. That's the time it will take the S-R machine to reach that point and remember we're modeling it as a continuous rack. The time it'll take to reach that point horizontally is gonna be rack length divided by uh horizontal velocity V-sub-H, okay? **And then**, we're gonna define the scaling factor, cap T, as the

maximum of those two, maximum of those two travel times. **So**, cap T, which I refer to as the scaling factor, is the maximum of T-sub-Vand T-sub-H.

Another way to link the steps in a problem is through repetition, **creating a chain of parallel or repeated phrases**. See the parallelism and contrast built below in the way the IGSI uses "I know" and "I don't know".

Hydraulics IGSI (Fatih):
Now, **I want to know** where the maximum pressure occurs, right? Then I refer to this equation. In this equation, as you can see, **I know** the velocity at each single location, right? No problem. Well, **I know** what Z is, it's given to me**. The only thing that I don't know is**--this. **I know** the energy as well. I just calculated it, right? So, **I know** the energy at each section, this section, this section, this section, this section, this section, and here. **I know** the energy. **I know** the velocity. **I know** Z. **Only thing that I don't know is** P. Pull P out of it. Look at the P distribution, and tell me, hey, along this P distribution, this is obviously the biggest, so this is the answer, right? [4 sec] Are we okay on this? Are we too fast, too slow?

Another kind of chain is created when the speaker introduces a noun phrase and then refers to it as a summary pronoun. Such a chain is underlined in the description below.

Hydraulics IGSI (Fatih):
What we wanna do is the following, we would like to meter this flow. In order to do that <u>we need to use different devices right, that we need to install into the system</u>, and <u>that</u>'s basically what we uh wanna do, and determine how much discharge can we actually get through by installing different meters, because <u>all the different meters have different head losses associated with them</u>, and <u>that</u>, in turn, influences the discharge going through the system, right? So, in part A, we have a, what do we have? um, sharp-edged orifice.

[Notice how the IGSI creates focus in the opening sentence, too, expanding a summary phrase "the following" into a fully specified phrase "to meter this flow".]

4. **Relate the steps in the problem to other problems and course material**, underscoring differences and similarities and offering reminders.

Math IGSI (Olga):
<u>Remember</u>, this f is a function of t here.
Let's look at part B. It's a <u>slightly more complicated</u>. ... And <u>the question is the same</u>, find f of 4.
<u>You're gonna have to use the formula I gave you yesterday</u>, the general formula. And the last part of 59 is part C, <u>which again is a variation</u>. um, and we have this [writes on the board]. And <u>we still want to find</u> f of 4. <u>Notice the difference with the other 2 parts is</u> that they give you the function here that you're integrating explicitly, okay? <u>but</u> they don't give you the upper limit. <u>Whereas before</u> we

didn't know what f was, little f, but we knew what the limit was. Okay, so this is a different kind of problem and they give you a hint. And the hint says integrate. So, let's follow the hint. Integrate this and you get what [pause]

5. **Close by focusing on the key technique, logic, or significance of the problem**. What did you want students to learn by doing this problem? Make sure you emphasize that message in the closing.

Econ IGSI (Ana):
So, both the immigration of labor from East Germany to West Germany and the lending, the ability to borrow of East Germany to West Germany, will speed up the convergence rate between the two, so East Germany can catch up faster. ... And you can tell which way the direction is. For labor, the labor flow from the poor coun- poor region to the rich region. But the capital flow from the rich region to the poor region. And both things speed up the convergence rate of the two countries, okay?

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