

Aligning Challenge-based Learning with Assessment: The Concept of “Transfer Appropriate Processing”

There is a concept in the cognitive literature called “transfer appropriate processing” (TAP) that is based on data showing that a particular type of learning activity may look good or poor depending on the measures used to assess the learning (Morris, Bransford & Franks, 1978). The idea of “transfer appropriate processing” is that we must design learning activities that fit the kinds of tasks we want people to do at the end of our courses and programs. This means that the tasks (assessments) we choose are crucial for making inferences about the quality of what was learned.

The TAP concept is relevant to BioEngineering because many ways to assess learning will fail to capture the value-added of having students engage in challenge - based inquiry that is designed to help them become adaptive experts. I think we are missing the value of many of the teaching innovations in VaNTH because our assessments are not truly aligned with what we hope our students learned. I try to elaborate this point below.

Example I: Michael’s Use of Different Measures: One paper I thought had been sent around last year but evidently got lost in transit is one that Ann Michael headed with a group of us at Vanderbilt. She taught an experimental and control class in the diagnosis and treatment of delays in early language development. One class received a traditional organization of content where different topics covered behaviorist approaches to language therapy, another covered social linguistic approaches, another covered Vygotskian approaches, etc.

A second class of students received an early precursor of a “challenge based approach”. The course was anchored around an initial video of a therapist doing speech therapy with a child. Students generated their initial thoughts about what they noticed. Then they received multiple perspectives from a behaviorist, social linguistic, Vygotskian, etc. These perspectives were each related to the anchoring challenge video. Students then mapped these experts’ perspectives into the text.

As expected, only some kinds of assessments showed the value of the challenge-based teaching compared to the traditional. Purely factual questions were expected to be the same for both groups--and they were. Differences occurred when students received new cases--one via video and one in text format--and were asked to comment on them from the three theoretical perspectives. Students in the experimental group did a much better job on these tasks than did those in the control group.

Note that Michael’s transfer task was open ended. She simply showed a video (or in the second case a verbal) description of an interaction between a child and a language therapist. She did NOT stop the video and say things like “how does this particular action by the therapist relate to the behaviorist concept of X or Y”, etc. And she did not say “imagine that the behaviorist stated his diagnosis as X--do you agree? The latter kinds of specific questions move the transfer tasks from (a) open ended tasks to where STUDENTS must do the noticing and searching for relevant information on their own to

(b) tasks where specific questions are heavily prompted. In short, the task now becomes much more like a multiple choice test.

Note that “real” experts have to do their own noticing of relevant information--they can't rely on someone always prompting them on what to look for and how to define each step of their task. So I conjecture that unprompted assessments are more “authentic” in terms of what we want our students to learn to be able to do. Remember the video of the houseboat expert? To be a true expert, he needs to notice features on his own (which he did). The “analyze the houseboat task” could be made progressively easy and even trivial if we stopped the video at various points with specific questions like “Gibson houseboats come with these kinds of rails (show picture). How do these compare with the railings in the video? To anticipate the argument below, I think that many of our Bio Engineering assessments are closer to the latter (heavily prompted) than the former (more open ended with more room to assess the kinds of processes related to “adaptive expertise”. (See the discussions of adaptive expertise that have been circulating).

Example II: Research on Complex Problem Solving in the Context of Jasper: As a second example of differences between open ended and heavily prompted assessment environments, consider research on the LTC's Jasper adventures. Each adventure is an approximately 15 minute story that ends in a challenge which requires a great deal of complex thinking and mathematical calculation. All the data needed to solve the problems have been embedded in the story line--but there is also lots of irrelevant data. Students have to formulate a plan, devise learning goals for finding the relevant information, and then working to solve complex problems.

In one set of studies we took the highest scoring sixth grade students on standardized math tests and asked them to solve a Jasper without any prior instruction on it. They were terrible at it --mainly because they didn't know how to conceptualize the overall problems, break it into steps, search for relevant information and then “do the math”. Non-mathematical college students at Vandy were also quite terrible at this--although they were a little better than the sixth graders (remember that the latter were very high achieving given standard measures of math)

. A second group of students saw the same Jasper adventures and were asked to solve it. However, we structured our questions by asking a series of short sub-problems that were needed to solve to solve the overall adventure. Once we defined these sub problems for them they did MUCH better than the previous group. They knew “the math” But they could not define these sub problems on their own. After training in Jasper, there were large increases in students abilities to do “unprompted Problem solving” for complex tasks. (See CTGV, 1997).

Analogous issues in Bioengineering: Many problem solving tests that I have seen used in Bio engineering seem closer to the side of being “heavily prompted” rather than open ended. This is our (my) fault for not pointing out this issue sooner. It's is one of those things that is so taken for granted by our LS research team that we forgot to mention it. (It's a good example of the need for better “pedagogical content knowledge”

on our part). The issue of TAP surfaced when we had the chance to analyze actual BioEngineering tests that were being used. (Many thanks to those who shared these tests).

A sample test question in Bio Mechanics can (hopefully) serve to clarify the relevance of TAP issues for our work. On one test item, students are introduced to a woman who has had a hip replacement that is very sore, so she has to walk on a cane. The initial problem statement includes all kinds of specific data like her weight, the length of the cane, very helpful visual representations of the hip and angles of stress. But so much is specified that the problem essentially asks students to “do the math” without asking them to first frame the problem, decide what they further need to know, etc. These “highly specified” problems seem more analogous to the Jasper studies where we specified sub problems for students and they did quite well. But I think we can conjecture that too much specification misses the opportunity to measure important features of the concept of “adaptive expertise” --where people must start from scratch to define issues and decide what they further need to know.

How might we transform the question about the woman with the sore hip.? Here’s one possibility (I’m sure this needs to be tweaked because I need a better specification of exactly what we want students to know and be able to do at this point).

A physician asks a bioengineer to help alleviate a woman’s hip pain following hip surgery on her left hip. The woman is unable to put any pressure on one of her feet because it hurts too much. He finds similar problems with all his hip replacement patients (the problem typically lasts for about one month or so). He wants ideas about how to help his patients get around comfortably in a way that minimizes their pain.

As you approach this task, briefly write down your initial conjectures about the pain and why it occurs; additional data you would like to know, and additional questions you would like to ask.

-Some of my thoughts as a novice: As a novice (my fate in life it seems), a number of questions come to mind. For example, a cane or crutches might help. Certain kinds of shoes might help as well. Maybe the pain is the result of a poor method for hip replacement. I need to understand lots of things in order to proceed. To go through this process, I’ll use the IDEAL framework sketched in my thought paper on adaptive expertise (sent to the group a few days ago).

I - INVEST the Time to see Problems as Opportunities for Learning:

First, as a student I need to understand why it is useful to INVEST my time exploring this kind of open ended problem. If I don’t understand the value (I.e. This is going to prepare you for the kinds of things I’ll need to do to shine once you graduate), I’m going to be impatient and want the old style of problems. And I need more than just a mention that “trust me”, you’ll need this some day”. Ideally, students will have lots of formative assessments that let them see how their abilities to do this kind of thing are improving over time.

D, E, A - Develop, Explore, Act an Understanding of the Problem

There are a lot of issues here--especially for me as a novice. Here's a few.

if you have a hip replacement with pain on one side, does the cane go on the side of the replacement or the opposite side (e.g. To balance the body). If you use crutches, would you stay off the leg on the side of the sore part of the hip or stay off the other leg? If I had pain in my hip I could easily experiment and see what helped best to ease my pain. But as a bioengineer, I eventually need to understand why things work as they do.

As I thought through the preceding questions it eventually became clear to me that I need to know much more about hips and how they support weight and how and why they can be painful. And I need to understand weight distribution in my feet as a walk, and how that affects hips. So at this point in my exam I might ask for a diagram on hips, etc. and receive several representations--some of which are and are not helpful. (I might be given this information by asking orally & receiving it via paper, or eventually via computer). If I don't ask for it, I might eventually be given it anyway and prompted about how to use it (this would be noted as part of the assessment of my performance). Eventually, I would be asked to calculate various things and say how they impact my solution to the overall problem above.

Look and Learn: I might be asked to say what I learned from this exercise that will help me improve next time.

Linking Assessments with the Concept Of Adaptive Expertise and New Views of Transfer

At a general level, the approach sketched above relates to adaptive expertise and new theories of transfer and their implications for assessment.

In my earlier thought piece on "adaptive expertise" that was sent around, I argued that most assessments are inadvertently built on a "sequestered problem solving:" (SPS) model of transfer rather than on a "preparation for future learning" (PFL) perspective (see Bransford & Schwartz, 1999).

Arguably, people who are adaptive experts are well prepared for future learning. They have developed the knowledge, skills and attitudes that allow them to frame problems and identifying what else they need to know in order to solve them.. Most assessments, whether of memory or "transfer", do not assess critical aspects of problem framing and searching for additional information. Instead, the assessments really look only at the end products of problem solving (e.g., the ability to compute given a very well defined task).

The latter is very important, of course. But we also need to assess the “front end” of problem solving. And we need to teach it and help students understand WHY it is useful to them in their lives. It would be great to do some mini-studies on this issue so we can show data to NSF by next year.

Cheers.