Black Box Software Testing (Professional Seminar)

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Section:37
Learning Styles --- Teaching Testers

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Learning Styles

People learn in different ways. There are several models of learning styles. Different presentation methods work best for different styles of learners.

I'm not up to date on this literature. Back when I was a grad student in psychology, we talked about

- Visual vs. auditory learners. *Visual learners have more success in lectures if they have a copy of every slide*
- Active vs. passive learners. *Some people learn better in lecture or by reading / memorizing. Others learn better through exercises.*
- Individual vs. group learners. *Some people learn better on their own, others on project teams.*
- Concrete vs. conceptual learners. *Some people learn better from detailed stories, others from the formal presentation of the underlying principles.*

Learning Styles

I'm still thinking about how to develop a course that works well with the different styles. (I'm especially interested in this for building on-line courses that are worth teaching/taking).

For now, my approach involves:

- Lecture of key material
- Hard copies of every slide
- Many stories with rich detail to support key points
- Several assignments, which can be done by individuals or jointly
- Sample questions that can be studied by individuals or jointly.

And will soon involve

- Self-study drills
- A library of examples that students can read on their own.

Learning Styles

There's nothing magical about the division that I learned, and several others are more popular in the literature.

For a useful introduction and discussion of several style classifications, see R.M. Felder, *Matters of* Style, http://www2.ncsu.edu/unity/lockers/users/f/felder/public/Papers/LS-Prism.htm

Felder makes the point that the basic lessons for instructional design end up being pretty similar across the different classification schemes. The next slides, taken verbatim from his paper, show his advice to chemistry teachers:

Examples from Felder's Matter of Style

"Here are some strategies to ensure that your courses present information that appeals to a range of learning styles. These suggestions are based on the Felder-Silverman model.

- ***Teach theoretical material by first presenting phenomena and problems that relate to the theory*** **(sensing, inductive, global). For example, don't jump directly into free-body diagrams and force balances on the first day of a statics course. First describe problems associated with the design of buildings and bridges and artificial limbs, and perhaps give the students some of those problems and see how far they can go before they get all the tools for solving them.**
- ***Balance conceptual information*** **(intuitive)** ***with concrete information*** **(sensing). Intuitors favor conceptual information--theories, mathematical models, and material that emphasizes fundamental understanding. Sensors prefer concrete information such as descriptions of physical phenomena, results from real and simulated experiments, demonstrations, and problem-solving algorithms. For example, when covering concepts of vapor-liquid equilibria, explain Raoult's and Henry's Law calculations and nonideal solution behavior, but also explain how these concepts relate to barometric pressure and the manufacture of carbonated beverages.**

Examples from Felder's Matter of Style

- ***Make extensive use of sketches, plots, schematics, vector diagrams, computer graphics, and physical demonstrations*** **(visual)** ***in addition to oral and written explanations and derivations*** **(verbal)** ***in lectures and readings*****. For example, show flow charts of the reaction and transport processes that occur in particle accelerators, test tubes, and biological cells before presenting the relevant theories, and sketch or demonstrate the experiments used to validate the theories.**
- ***To illustrate an abstract concept or problem-solving algorithm, use at least one numerical example*** **(sensing)** ***to supplement the usual algebraic example*** **(intuitive). For example, when presenting Euler's method for numerical integration, instead of simply giving the formulas for successive steps, use the algorithm to integrate a simple function like $y = x^2$ and work out the first few steps on the chalkboard with a hand calculator.**
- ***Use physical analogies and demonstrations to illustrate the magnitudes of calculated quantities*** **(sensing, global). For example, tell your students to think of 100 microns is about the thickness of a sheet of paper and to think of a mole as a very large dozen molecules. Have them pick up a 100 ml. bottle of water and a 100 ml. bottle of mercury before talking about density.**

Examples from Felder's Matter of Style

- ***Occasionally give some experimental observations before presenting the general principle, and have the students (preferably working in groups) see how far they can get toward inferring the latter* (inductive). For example, rather than giving the students Ohm's or Kirchoff's Law up front and asking them to solve for an unknown, give them experimental voltage/current/resistance data for several circuits and let them try to figure out the laws for themselves.**
- ***Provide class time for students to think about the material being presented* (reflective) *and for active student participation* (active). Occasionally pause during a lecture to allow time for thinking and formulating questions. Assign "one-minute papers" near the end of a lecture period, having students write on index cards the lecture's most important point and the single most pressing unanswered question. Assign brief group problem-solving exercises in class that require students to work in groups of three or four.**
- ***Encourage or mandate cooperation on homework* (every style category). Hundreds of research studies show that students who participate in cooperative learning experiences tend to earn better grades, display more enthusiasm for their chosen field, and improve their chances for graduation in that field relative to their counterparts in more traditional competitive class settings.**

Examples from Felder's Matter of Style

- ***Demonstrate the logical flow of individual course topics* (sequential), *but also point out connections between the current material and other relevant material in the same course, in other courses in the same discipline, in other disciplines, and in everyday experience* (global). For example, before discussing cell metabolism chemistry in detail, describe energy release by glucose oxidation and relate it to energy release by nuclear fission, electron orbit decay, waterfalls, and combustion in fireplaces, power plant boilers, and automobiles. Discuss where the energy comes from and where it goes in each of these processes and how cell metabolism differs. Then consider the photosynthetic origins of the energy stored in C-H bonds and the conditions under which the earth's supply of usable energy might run out."**

Blooms Taxonomy Slides

"Bloom's Taxonomy, created in 1956 by Dr. Benjamin Bloom of the University of Chicago and his group of educational psychologists, is a categorization of verbs describing cognitive skills verbs into six classes (knowledge, comprehension, application, analysis, synthesis, and evaluation). The classes are ranked from least complex (knowledge) to most complex (evaluation) in terms of the level of thinking required for students to achieve these objectives. In general, critical thinking **skills encompass only the three most complex categories (analysis, synthesis, and evaluation)."**

(From Michael Bowen's web page, http://207.233.105.16/curriculum/bloomtax.htm, to be distributed in class.)

Testing Training

- It is easy to teach to the first few levels (tests would have students recall what was taught, define terms, make simple applications).
- It is much tougher to teach the underlying skills of testing.
- Putting students through tests, exercises and exams has been eye-opening in terms of how much they can learn with personal involvement and how little they get from traditional lectures.

Example of a Task Breakdown

Bug Reporting

- Reproduce the bug
- Simplify the bug
- Follow-up testing
- Describe the screen
- Describe the sequence
- Determine customer impact
- Determine technical impact

What sub-tasks and skills are involved in each of these?

Closing Notes

Given a group of motivated, bright people who have appropriate background knowledge and belong to your testing group or your testing class:

- Only some testers will learn well in lectures
- Only some testers will learn well by being thrown into a project and being told to figure it out
- Only some testers will learn well from books
- Only some testers will learn well or work well on their own and some will only learn well or work well on their own

Build training strategies to achieve the learning you want to convey, accommodate multiple learning styles, and push for mastery, not memory.