LEARNING STYLES AND TEACHING STYLES*

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I have been invited to trace the history of my involvement with concepts of learning and teaching styles. This paper is my response to that invitation. It will be a personal retrospective and not a thorough historical or critical review of the subject. As personal retrospectives tend to do, it may give the appearance of self-aggrandizement or exaggerated self-importance. I hope it doesn't, because I am acutely conscious of the differences between my contributions and those of the real innovators whose shoulders I stood on. In case there is any doubt, however, let me make clear that I did not invent a single one of the ideas related to learning styles that have come to be associated with me. If I made any real contributions to the field, they would be that I made good decisions about what material to take from which experts and that I have made enough noise to raise awareness of the subject among my colleagues in engineering education.

For more than the first decade of my teaching career I basically taught as I had been taught. I prepared my notes, delivered them in lectures, and occasionally asked and answered questions. I was reasonably well organized and clear, and consistently collected good evaluations.

After about 13 years in the profession, it dawned on me that I might not be doing the best possible job I could be. (Some of us are slower learners than others.) I would be up there lecturing—and doing it brilliantly, I might add—and find myself more and more conscious of the glazed eyes and nodding heads and people reading newspapers, and I knew that something was not right. Or I would give a test on material that I had covered in my lectures and the average would come back 52 or something like that, and again, I knew that things were not working—I was putting the information out, but it was not being absorbed by many of the intended recipients.

In the Spring of 1982 I spent a sabbatical semester at the University of Colorado that changed the direction of my career. I became reacquainted with Linda Silverman, a childhood friend who was an educational psychologist then living in Boulder, and learned from her that educational psychology had a lot to tell me about what I was supposed to be doing for a living. In particular, I discovered and was fascinated by the Myers-Briggs Type Indicator and the fundamental differences between people that it revealed.

I continued to explore the MBTI and type theory during and after the sabbatical and found references on relations between type differences and learning styles, and suddenly behavior patterns I had been observing and worrying about in my own classes started to make sense. In particular, the sensing-intuitive learning style difference beautifully explained the chronic complaint of many undergraduate engineering students about lectures and courses that

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were "too theoretical" and bore no apparent connection to "the real world." I knew that many of the characteristics attributed to sensors—practical, methodical, observant, good at details, and comfortable with replicating their work—were also characteristics of excellent engineers and experimental scientists. I also knew that most engineering professors—including me—were fond of elegant theories and mathematical models and structured our lectures and courses accordingly. My idea of mismatches between engineering students' learning styles and engineering professors' teaching styles probably originated with this particular mismatch.

I learned that I was not the first to make the connection between the MBTI and engineering education when I heard Ed Godleski give a talk at a 1983 AIChE meeting summarizing type differences in retention and performance of engineering students, and then I found that a team that included Ed, Mary McCaulley, Charlie Yokomoto, Lee Harrisberger, and Dendy Sloan had been studying type effects in engineering since the 1970's. The results of their studies confirmed my suspicion that the current paradigm of engineering education was stacking the deck against sensors.

In the next few years I started reading everything about learning styles I could get my hands on, and found that models besides the MBTI highlighted additional mismatches between teaching and learning styles. I learned about visual, auditory, and kinesthetic learning modalities by reading the work of the Dunns, Barbe, Milone and Swassing, and the architects of neurolinguistic programming, Bandler and Grinder, and thought about how ineffective instruction based on lectures and assigned readings must be for visual and kinesthetic learners. I found out about the power of discovery learning by reading the work of Bruner and Taba and Gagne, and it occurred to me that the purely deductive teaching approach I (and everyone else I knew) had been using was not necessarily in the students' best interests, even though most of them liked this approach. I read the work of Kolb and McCarthy and Jim Stice's application of the Kolb model to engineering education, and I recognized that standard lectures do little to facilitate learning in either active or reflective learners and are particularly useless to the former. And from Linda Silverman I learned about the holistic mental processes and creative potential of global learners and how the strongly sequential nature of traditional instruction places many of them in academic jeopardy, and I then found that the sequential (serial)/global (holistic, random) dichotomy is a feature of a large number of learning style theories, including those of Gregorc and Pask.

I eventually came up with the idea of tying these threads together in a learning style model and a parallel teaching style model, and with Dr. Silverman I put together a presentation for the 1987 annual meeting of the American Institute of Chemical Engineers in New York. Of the many possible dimensions included in existing models, I wanted to include only those that are significantly affected by how instructors choose to teach. Thus, for example, I did not include the judging-perceiving preference from the MBTI, which has a profound effect on students' study habits and task commitments but is not strongly influenced by the instructor's choice of content or presentation style. The dimensions I settled on were sensing and intuitive (from the MBTI), visual and auditory (from modality theory and neurolinguistic programming), inductive and deductive (from various sources in cognitive and educational psychology), active and reflective (from Kolb and from the extravert/introvert preference on the MBTI), and

sequential and global (from Silverman, Gregorc, and Pask). We subsequently turned the presentation into a paper that appeared in the April 1988 issue of *Engineering Education*.[1]

The learning styles paper seemed to strike a nerve in many journal readers. In the months after it appeared I got a flood of reprint requests and expressions of thanks for shedding light on teaching problems the letter writers had been struggling with for years but never really understood. The paper was honored by the ASEE with the 1989 Wickenden Award and was honored even more by Phil Wankat, who once referred to it as a "classic" in something he wrote. (Regrettably I can't find that reference, which I was planning to have bronzed.)

I subsequently wrote a paper on the model for the *Journal of College Science Teaching*[2] in which I replaced the "auditory" category with "verbal." The motivation for the change was my growing concern about including written prose in the "visual" category, which is the only place to put it if the alternative is auditory. My suspicion, which was later confirmed by reading several cognitive science references, was that students process written words in much the same way as they process spoken words and much differently from how they process true visual information (pictures, diagrams, graphs, flow charts, demonstrations). The "verbal" category includes both spoken and written words and so is consistent with what I now understand about brain functioning. I recently wrote a paper for *ASEE Prism* on four different learning style models, including the Felder-Silverman model,[3] concluding that all of them lead to the same recommendations for good teaching practices and so which one is used to guide course planning and instruction is almost irrelevant. I have also written a number of "Meet Your Students" columns for *Chemical Engineering Education* that use capsule biographies of hypothetical students to describe learning style differences.[4]

The notion of learning and teaching style mismatches has profoundly influenced my own teaching, and when my wife and colleague Rebecca Brent and I give teaching workshops (which we do about 20 times a year), the first topic we discuss is learning and teaching styles. The concepts we develop in this part of the workshop serve as a unifying framework for subsequent discussions of lecturing, active and cooperative learning, testing and grading, and dealing with a variety of student-related problems. Applications of learning styles have become increasingly prominent in engineering education in the 1990's, with faculty and support staff using them to design courses, supplementary instruction and advising programs, and instructional software.[3]

In the late 1980's Barbara Soloman, the director of advising for the N.C. State University First-Year College, started using the Felder-Silverman model to help her freshman advisees understand problems they might encounter in their courses. In around 1994 she and I began to develop an instrument to assess preferences on each dimension of the model. We quickly dropped the inductive/deductive preference from the instrument, partly because we didn't think we could figure out a reliable way to assess it and partly because with this dimension, the instructional style many students prefer (deduction) is not necessarily the style that best facilitates their learning. The result of our efforts was the *Index of Learning Styles*.

The original version of the ILS was given to several hundred students, whose responses were subjected to factor analysis. Questions that did not correlate strongly with the appropriate factor or that correlated with several factors were dropped and replaced with others to produce a

second version, which I installed on my Web site (*http://www2.ncsu.edu/effective_teaching/)*. In its current state the instrument can by no means be taken to be fully validated, which would require additional factor analysis as well as comparison of the results with other assessment measures (including self-assessments). Someday I may link up with a test-and-measurement expert in an education or psychology department and do it, but given the current state of my things-to-do list it may be a while before that happens.

The response to the ILS has been as interesting as the response to the original learning styles paper. I have lost count of the number of requests Ms. Soloman and I have received to download and use the instrument and the explanatory material that accompanies it, despite our Web site warning that the instrument has not been validated. Various instructors have written *HTML* code to tabulate and analyze the results, and instructors at the University of Michigan and the U.S. Military Academy use the results to guide students to alternative pathways through multimedia instructional tutorials in chemical engineering and computer science courses.[3] Even if I never get to validate the instrument, it appears to have acquired a life of its own.

While assessing individual learning style preferences has a number of practical and interesting uses, in my opinion doing so is one of the least important applications of learning styles to teaching. Whether Joe is a sensor and Mary an intuitor or vice versa should make very little difference to their course instructor; what *is* important is that every course contains both Joes and Marys, and that to be effective the course instruction must meet the needs of all students, regardless of their learning style preferences. Techniques for doing that constitute the subject of all the papers I have written about learning styles, and this historical narrative is not the place to state them again. It may be appropriate, however, to review the advice that concluded the 1988 paper:

> *The idea…is not to use all the techniques in every class but rather to pick several that look feasible and try them; keep the ones that work; drop the others; and try a few more in the next course. In this way a teaching style that is both effective for students and comfortable for the professor will evolve naturally and relatively painlessly, with a potentially dramatic effect on the quality of learning that subsequently occurs.*

References

1. R.M. Felder and L.K. Silverman, "Learning and Teaching Styles in Engineering Education," *Engineering Education, 78*(7), 684-681 (1988).
2. R.M. Felder, "Reaching the Second Tier: Learning and Teaching Styles in College Science Education," *J. College Science Teaching, 23* (5), 286–290 (1993).
3. R.M. Felder, "Matters of Style," *ASEE Prism, 6*(4), 18–23 (1996).
4. These columns and other papers on learning styles may be viewed and downloaded at *http://www2.ncsu.edu/effective_teaching/*