Thinking Preferences of Engineering Students: Implications for Curriculum Restructuring

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ABSTRACT

The thinking preferences of engineering students at the University of Toledo have been assessed in a longitudinal study, using the Herrmann Brain Dominance Instrument (HBDI). The scores and profiles reveal thinking preferences in four different ways of thinking and "knowing": A = analytical-logical-quantitative, B = sequential-organized-detailed, C = interpersonal-sensory-kinesthetic, and D = innovative-holistic-conceptual thinking. With the HBDI, we have a tool that can assess the effects of curriculum restructuring. Data from 1990-1993 fall freshmen classes and 1991-1994 spring senior classes have been evaluated, where the 1994 seniors are the first group for which freshmen data are available. Conclusions drawn from the results are: 1) Overall, there has been a shift from "plug-and-chug" quadrant B thinking to increased "creative" quadrant D thinking, because more students with strong quadrant D preferences are being developed and retained, primarily due to the new creative problem solving course. 2) Avoidance of quadrant C thinking (teamwork skills) is persisting and creates classroom climates that are uncomfortable for some students, a high percentage being females. Students are not developing the teamwork and interpersonal thinking skills demanded by industry. 3) A majority of students are still being cloned in the A-dominant profile of the faculty. Students who have developed independent ways of practicing right-brain thinking and all students who were involved in creative problem solving as class assistants became more whole-brained or right-brained. Quadrant C and D thinking activities must be integrated into the curriculum each term for students to develop their full potential and reinforce the whole-brain thinking skills introduced in the first-year creative problem solving course.

I. BACKGROUND

We introduced an emphasis on creativity into the College of Engineering at the University of Toledo with the fall term of 1990. The keynote speaker of the two-day faculty seminar for teaching excellence was Ned Herrmann, the father of brain dominance technology and inventor of the Herrmann Brain Dominance Instrument (HBDI). At the same time, creative problem solving was instituted as a required one-credit hour course for all first-year engineering students. The innovations that we emphasized in this new course included the philosophy of zero defects (this means no grading on a curve), writing and sketching as thinking tools; teamwork; and applying the creative problem solving process to a design project while introducing students to the Pugh method of design concept evaluation. Over the following three years, almost three dozen faculty members volunteered to teach this innovative course, many of them several times. This course not only encourages students to become aware of and appreciate different thinking strategies, it constitutes a teaching laboratory for the instructors for trying out new techniques to address different learning styles. This approach formed the basis of the curriculum restructuring efforts in the College.

Figure 1 gives a brief overview of the Herrmann model of thinking preferences. A sample Herrmann Brain Dominance profile is shown and discussed in Appendix A (to provide an introduction to the terminology and format of the HBDI results and their interpretation for those not familiar with this instrument). Each quadrant in the Herrmann model represents a cluster of distinct thinking abilities and ways of "knowing." Each person embodies a coalition of these abilities in various proportions. Differences in thinking preferences are expressed in different vocabularies and in different problem solving outcomes. However, thinking preference does not mean competence. We can learn to use our primary and secondary preferred modes more effectively through training, motivation, and practice, and we can learn to strengthen less preferred modes.

To assess the effects of the changes being introduced into the curriculum, we designed a longitudinal study in cooperation with Ned Herrmann. During the first week of the creative problem solving course (in the fall term for most students), the students completed the HBDI survey. These students were then reassessed again in the spring of their fourth year. Starting in early 1991, we also made the HBDI available to all seniors on a volunteer basis to collect data for comparison. The average engineering faculty profile obtained in 1990 at Toledo (Figure 2) is typical of engineering faculty at several institutions that have been surveyed with the HBDI. When we analyzed the HBDI results after the first year of our study, we found that

*At Michigan Tech, creative problem solving is a three credit-hour course taught by an instructional team of two faculty (preferably interdisciplinary) and two undergraduate assistants (sophomores).

**Some of these faculty members applied what they learned in other courses; others remained relatively unchanged, and a few became hostile to the creativity course.

The Ned Herrmann model is occasionally mistaken for the 4MAT system based on the Kolb learning cycle. A comparison of the two models is given in Reference 4, pp.108-111. The 4MAT system values each of its four styles of learning equally, and instructors are encouraged to use all segments of the cycle, even though they themselves may have preferences for particular modes. We have found that the 4MAT system addresses all four thinking quadrants in the Herrmann model. Using the creative problem-solving approach or the 4MAT system will make for better thinking and learning since both involve the whole brain.