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Real Engineers Don't Write … Or Do They? Improving the Written Communication Skills of Engineering Students

Julie Marin Blair
University of Tennessee - Knoxville

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Appendix D -   **UNIVERSITY HONORS PROGRAM**
SENIOR PROJECT - APPROVAL

Name: _Julie M. Blair_

College: _Engineering_   Department: _MAES_

Faculty Mentor: _Dr. Elaine Seat_

PROJECT TITLE: _Real Engineers Don't Write... Or Do They?_

I have reviewed this completed senior honors thesis with this student and certify that it is a project commensurate with honors level undergraduate research in this field.

Signed: _Elaine Seat_ _____, Faculty Mentor

Date: _5/1/00_

Comments (Optional):

REAL ENGINEERS DON'T WRITE...
OR DO THEY?

**Improving the Written Communication Skills
of Engineering Students**

**A Senior Honors Project Completed by
Julie Marin Blair**

Presented to

**The University Honors Program
The University of Tennessee, Knoxville
Dr. Thomas W. Broadhead**

May 1, 2000

TABLE OF CONTENTS

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*   *   *

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ABSTRACT

The purpose of this project is to explore the unique cognitive style of engineers and the influence this style has on the manner in which engineers learn, particularly about writing. This report is divided into three main sections. The first section discusses the pressing need to improve the written communication skills of engineers. The second part of the report presents information about cognitive style theory and the cognitive style of engineers. The final portion of the report combines the results of the first two sections by examining the implications of applying cognitive style theory to the problem of poor technical communication among engineers.

PART ONE—THE RATIONALE

"The whole reason I got into engineering was to avoid writing papers."

"Psychology, sociology, child and family studies, most of those classes are okay...I mean, they're easy and not writing intensive. You want to stay away from those courses where you have to write."

"It's not like I'm going to spend a lot of time on this paper anyway. If the professor had thought it was important, he would have made it worth a lot more than 3%."

"As long as we can get the engineering part of the project done by tonight, I don't think we'll have any problems getting the project write-up finished by tomorrow. It doesn't have to be perfect—I mean, it's not like our professor is actually going to read it anyway."

"I need your completed design reports by the end of this week. I can't promise that I'll read them because I have so many finals to grade, but I'll probably at least flip through them."

"All I know is this—I can't wait to get an engineering job in the real world where I don't have to write reports all the time."

*   *   *

On any given day, conversations like these can be overheard in places where engineering students gather—in classrooms, computer labs, and student lounges. Engineering majors make no secret of their negative feelings about writing. For many of these students, writing is not something they enjoy doing, and very few of them do it well. The traditional engineering curriculum does not afford engineering students many opportunities to improve their writing. This encourages the attitude of apathy toward writing that most engineering majors already exhibit. While today's engineering students graduate from their undergraduate education with extensive technical backgrounds, many of them have only a year of freshman composition to serve as their official communication training. As these graduates enter the workforce, they are quickly

1

confronted with the startling and often harsh reality that strong communication skills are as essential to their professional survival and success as the technical expertise or problem-solving abilities they possess.

Engineering students today might be surprised to learn that effective communication of information has always been considered one of the most important responsibilities of the engineer. Since the early days of engineering as an official profession in the beginning of the twentieth century, prominent engineers have been emphasizing the significance of publicizing engineering information, both to the engineering community and to the general public. John Waddell, a noted engineer and author of several textbooks on bridge construction, said in 1916 that "the preparation of reports…is one of the most important and responsible classes of work that an engineer is called upon to perform" (Petroski 421). Waddell was also recorded as saying that effective communication was one of the main ways the profession of engineering could "attain and maintain its proper recognition, influence, and eminence" (Petroski 421).

While communicating the results of engineering investigations has always been a primary responsibility of the engineer, it is more important now than ever. The face of the engineering profession is radically changing. Gone are the days when an engineer could sit behind a desk in solitude, working on projects independent of other people. Due to the increasingly interactive work environment, the engineer of the twenty-first century must be able to communicate effectively with his or her peers and clients. This line of thought was confirmed in an article published in the March 1996 issue of *IEEE Transactions on Professional Communication*. In the IEEE study, an investigation was conducted among practicing electrical engineers about the communication environment

2

in the modern engineering workplace. The engineers who responded to the survey said they spent a little over half (55%) of their typical workday in communication tasks. The majority of this communication took place among fellow engineers and other employees, while the remainder of the engineer's communication time was directed to customers and other individuals outside of the organization (Vest et al. 39).

Industry, national engineering groups, and practicing engineers have begun to recognize the need to address the disparity between the level of communication ability required to succeed in the work environment of the twenty-first century and the insufficient communication skills possessed by today's engineering students. The Society of Manufacturing Engineers' Manufacturing Education Plan (MEP), published annually since 1997, has identified major competency gaps experienced by graduating engineers upon their entrance to industry. The MEP listed engineering students' lack of communication skills as one of five areas specifically targeted for improvement (SME Home Page). In "Report on Surveys of Opinions by Engineering Deans and Employers of Engineering Graduates on the First Professional Degree," a study published in 1992 by the National Society of Professional Engineers, 60% of the respondents indicated that courses to improve communication skills should be added to the current engineering curriculum (Ostheimer et al. 189). Recent engineering graduates have also begun to express their views about the need to raise the standard of engineers' communication abilities. In the same IEEE study mentioned previously, most of the practicing engineers surveyed stated that the deficiencies in technical communication, particularly in technical writing, should be addressed by requiring engineering students to take courses in these areas outside of engineering departments (Vest et al. 41).

However, the problem is more complex than simply adding more writing-intensive classes to the engineering curriculum. Due to the large number of technical courses that engineers are currently required to take as part of their undergraduate education, any attempt to add extra writing or humanities classes to the schedule will cause major difficulties for engineering programs. For many schools, requiring extra courses simply for the sake of improving engineering students' writing ability will cause them to add a fifth year to their undergraduate degree program or to reduce the number of technical courses their students can take (Kramberg-Walker 131). For this reason, engineering education specialists are looking for innovative ways to improve the writing of engineering students. Many have adopted a philosophy similar to the one attributed to Frank L. Splitt, Vice President of Technology Planning at Northern Telecomm Inc., in a recent issue of *Prism*: "To broaden the general knowledge of engineers who will be addressing the needs of the twenty-first century, we certainly need ways to improve writing and speaking. This does not necessarily mean more courses, but rather new thinking on how we teach the courses we already have" (Ostheimer et al. 189).

*   *   *

Up to this point, it has been established that technical communication skills are essential to the professional success of engineers. It has also been determined that simply adding more writing-intensive classes to the existing engineering curriculum is not a feasible option for improving engineers' writing abilities. If these statements are true, how can the importance of written communication skills be instilled in engineering

4

students, and how can these students be encouraged to improve their writing abilities? The answer to these questions may be found not by increasing the number of writing classes engineers take, but by exploring something much more fundamental—the ways these students are taught about writing and the ways they learn about it.

The purpose of this project is to explore the unique cognitive style of engineers and the influence this style has on the manner in which engineers learn, particularly about writing. After a brief explanation of the engineer's cognitive style, suggestions are made for ways to implement changes in writing pedagogy based on this cognitive style. The implications of implementing this style are also discussed.

PART TWO—THE BASIS

Cognitive style theory has its origins in research done by Herman Witkin and his colleagues in the late 1940s and early 1950s. The initial purpose of Witkin's research was to determine the ways that individuals process divergent sources of information. In order to accomplish this goal, Witkin examined the capacity of individuals to perceive the true vertical direction while being deliberately disoriented in a testing environment. Witkin created a battery of tests to investigate this phenomenon, including the Rotating Room Test (RRT), the Rod and Frame Test (RFT), and the Body Adjustment Test (BAT).

From his tests, Witkin came to the surprising conclusion that his subjects would consistently exhibit one of two modes of behavior when determining the true upright. One group would always refer to the external environment in order to choose the upright position, whether or not the external environment reflected the true vertical position. The other group of individuals would arrive at a decision on their own sense of the upright and not on external referents. Witkin labeled the first group as field dependent and the second group as field independent, based on their ability to discern the upright with or without assistance from the surrounding environment. Some years later, this perceptual ability to separate an item from an organized field was formally termed "disembedding."

Since this research was initially performed, other studies have been able to show a correlation between field independence in perception of the upright and numerous other dimensions of cognitive functioning (Witkin and Goodenough 23). The results of these studies have helped researchers to put together profiles of the field independent and field dependent styles. Field independent individuals possess strong cognitive restructuring

abilities and high levels of personal autonomy. Field independent individuals are natural problem solvers, due to their ability to disembed essential information from problems. Field dependent individuals are weaker tasks and are more dependent on environmental cues to assist them in cognitive restructuring processes. However, due to a greater level of dependence on their surroundings, field dependent persons possess strong social abilities. Field independent persons tend to favor less social environments and more impersonal situations (Witkin et al. 198).

Because of the similarities between the personality of the stereotypical engineer and the profile of the field independent individual, engineers were an almost automatic choice for further field independence studies. In the late 1960s, two psychologists designed a study to determine whether engineers were more field independent than the normal population. The researchers formed this hypothesis based on engineers' tendencies to be "analytical, logical, and capable of abstracting the various aspects of a problem for analysis" (Barrett and Thornton 789). As expected, the study showed that the engineers exhibited a stronger propensity toward field independence than a pool of typical male college students (Barrett and Thornton 791).

*   *   *

The study of cognitive style theory holds great promise as a means to understand more about personality and perceptual differences. Witkin and his colleagues were particularly intrigued with the effect of the field independence/dependence construct in the classroom. By knowing and understanding different cognitive styles, teachers at all

levels possess the potential to make learning more accessible to different groups of students by tailoring their instructional styles to the learning styles of their students. This could prove important in the attempts to make writing skills more accessible to engineering students.

Late in his career, Herman Witkin devoted his main efforts to developing profiles for both the field independent and field dependent student. In a 1977 review, Witkin and his colleagues outlined four main characteristics of field independent learners. These qualities included a high use of analyzing and structuring processes, a proactive role in learning, an ability to look for less obvious learning cues, and an intrinsic, task-oriented form of motivation (Davis 150). Since engineers are perhaps one of the most extreme examples of the field independent style, his work in this area is especially valuable to consider when developing need-specific classes for students, such as writing programs for engineers.

PART THREE—THE IMPLICATIONS

It is very possible that one of the reasons engineers fail to become better writers is due to the fact that writing is not taught to them in a way that satisfies their cognitive style preferences. Field independent learners thrive on very concrete and goal-oriented instruction, and they desire to take a proactive role in any learning endeavor. Even under the best circumstances, writing can seem like a very vague and unstructured task to a field-independent learner, with its subjective criteria for judgment and lack of specific goals. In addition, it is often necessary to teach some aspects of writing, such as principles of grammar, in a manner that is not conducive to the interactive style of learning field independents prefer. However, as the need for technical communication skills among engineers grows, it has become necessary to suggest new ways to teach engineers about writing. With Witkin's profile of the field independent learner as a model, a helpful set of criteria can be developed for integrating writing into the engineer's communication repertoire. These criteria capitalize on the elements of writing processes that can be modified to the field independent cognitive style and hopefully present writing principles in a manner in which engineers can find meaningful, memorable, and useful.

- *Writing tasks should be integrated into the general engineering curriculum.* Due to the problems associated with requiring engineering students to take more writing-intensive courses, it is vitally important that the teaching of writing be incorporated as a part of the general engineering curriculum. One possible solution to this problem would be to develop separate sections of freshman composition tailored to the needs of engineering students. A more

feasible solution would be to combine writing assignments with the existing first- and second-year curriculum. By developing self-taught modules that coincide with current classes, the engineering student can gain valuable knowledge about writing while simultaneously learning principles of engineering. Not only does this method prevent engineering programs from having to make major changes to their curricula, it also capitalizes on the desire of field independent students to exercise autonomy by allowing them to study about a new topic independently.

- *Writing tasks should provide engineering students with real life experiences.*
  The writing preparation engineering students currently receive often does not prepare them for writing tasks in the workforce. Because writing assignments in the classroom are often limited to such projects as essays or lab reports, students do not get adequate exposure to the types of documents that are used daily in industry, such as memos and progress reports. The writing assignments given to engineering students should reflect the types of documents used in the world of work, so that these students can better meet the requirements of industry (Winsor 20, 98). These assignments should also reflect the unique writing environments that often occur in a typical work situation, such as group writing and writing for a wide audience (Selzer 185).

- *Writing should be presented as a process with a definite methodology and concrete goals.*
  One of the main problems engineers express about writing tasks is that there is no set of rules, aside from grammar, to guide their composing process. This

10

can be directly related to the field independent learner's need for structure and defined objectives in their educational endeavors. Technical writing professionals have already developed many processes that can direct students in ways of developing, selecting, and arranging content (Selzer 184-185). These principles can be easily exported and utilized to assist engineers in their writing process.

<p style="text-align:center">*   *   *</p>

Hopefully, implementation of these simple criteria will be the first step in the process to advance the communication abilities of engineering students. By informing engineering majors about the importance of strong communication skills, these students will be more apt to improve their writing abilities. By teaching engineers writing based on their cognitive style, engineering students will discover concrete ways to improve their writing skills and will hopefully implement them in their work. By fostering a sense of the importance of writing and by teaching engineers that they have the potential to be successful writers, the engineering community will encourage and support efforts to make engineers better communicators.

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