

## **Comparative Analysis of Virginia Tech Engineering Students with Learning Disabilities**

**Mary L. Cummings**

**Virginia Polytechnic Institute and State University/University of Virginia**

### Abstract

From 1988 to 1998, the numbers of learning disabled students entering college almost tripled, significantly impacting the student population in colleges of engineering. This study compared the performance of Virginia Tech (VT) College of Engineering learning disabled students with two groups: VT students from all other colleges with learning disabilities and VT engineering students without learning disabilities. Results demonstrated that, in general, the GPAs of VT engineering males with learning disabilities are lower than both comparison groups. However, the GPAs of VT engineering females with learning disabilities were higher than both peer groups. In addition, this study addressed what can be done to facilitate the success of students with learning disabilities who desire to become engineers. Various factors affect these students' success, but studies show that external support services, internal coping skills, such as self-advocacy, and faculty support are all critical for the success of students with learning disabilities. Colleges of engineering should ensure their students with learning disabilities are aware of the support services available. In addition, engineering faculty need to be made more aware of the problems faced by students with learning disabilities and the importance of accommodating these students.

### I. Introduction

The demand for engineers in the U.S. workforce consistently outpaces the number of engineering graduates across the nation. There has been concerted effort both in industry and academia to attract more students to the fields of engineering. Some of the students who desire to become engineers come to college with diagnosed learning disabilities, and as the search for engineering students expands, the number of students with learning disabilities will increase in engineering programs. Even though the numbers of engineering students with learning disabilities are small, they are increasing. This rise is no doubt due in part to the increased efforts of primary and secondary educational systems to identify learning disabled students, but current research has not yet established the exact nature of the increase in learning disabled populations. Despite the ambiguity as to why the learning disabled population is increasing, colleges of engineering across the nation will have to address the fact that learning disabled (LD) students are a valuable resource and have talents highly desired by potential employers.

In 1998, a U.S. Department of Education statistical report on students with disabilities stated that approximately 4% of all freshman college applicants had a diagnosed learning disability, and 6% of these LD students hoped to obtain degrees in engineering (as compared to 8% for non-LD

students) <sup>1</sup>. Of all categories of students with self-reported disabilities in their freshman year in college, the learning disability category increased the fastest over the past decade. From 1988 to 1998, the numbers of learning disabled students entering college almost tripled <sup>1</sup>. While 16% of non-LD college bound males were interested in an engineering career, only 12% of LD males expressed the same interest. Interestingly, 2% of women with learning disabilities were interested in a career in engineering, which was the same percentage as the interested women without a learning disability.

The 1997 Individuals with Disabilities Education Act (IDEA) defines learning disabilities as “a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, which may manifest itself in imperfect ability to listen, think, speak, read, write, spell or do mathematical calculations...The term does not include a learning problem which is primarily the result of visual, hearing, or motor handicaps, of mental retardation, of emotional disturbance, or of environmental, cultural, or economic disadvantage” <sup>2</sup>. The most researched and well-known learning disability is dyslexia, but there are many others such as dyscalculia, dysgraphia, dysnomia, and aphasia. Learning disabilities are often comorbid with other conditions such as attention deficit disorders.

One of the most basic elements in diagnosing a learning disability is the existence of a clear discrepancy between what a child, adolescent, or adult is capable of achieving intellectually and the actual level of performance. By definition, children with learning disabilities (as well as adolescents and adults) are not of below average intelligence. In fact, many LD students have above average intelligence and often show signs of gifted intelligence in other skill areas. For example, a child struggling with dyslexia will sometimes excel in math and sciences. Unfortunately, due to the lack of understanding about learning disabilities by both the general population and faculty members of secondary and higher education, there is often a stigma attached to LD students. Students with learning disabilities are sometimes thought to be unable to handle difficult classes in the math and science fields. Because of this, they may receive real or perceived messages from parents and counselors that they cannot manage the academic rigors of demanding college majors like engineering. Unfortunately, very little previous research focuses on engineering students with learning disabilities, so the historical picture is not clear. The questions that this paper addresses are 1. How well are the engineering students with learning disabilities doing academically at Virginia Tech, and 2. What can be done to facilitate the learning of students with learning disabilities who desire to become engineers?

## II. Method

To investigate these research questions the Services for Students with Disabilities Office and the Engineering Fundamentals Division of Virginia Tech collaborated to gather historical data from the fall of 1999 for engineering students with learning disabilities. For the purposes of this study, a supplementary category was considered in addition to learning disabilities. Because learning disabilities sometimes coincide with attention deficit disorders (ADD), the ADD category was included as well.

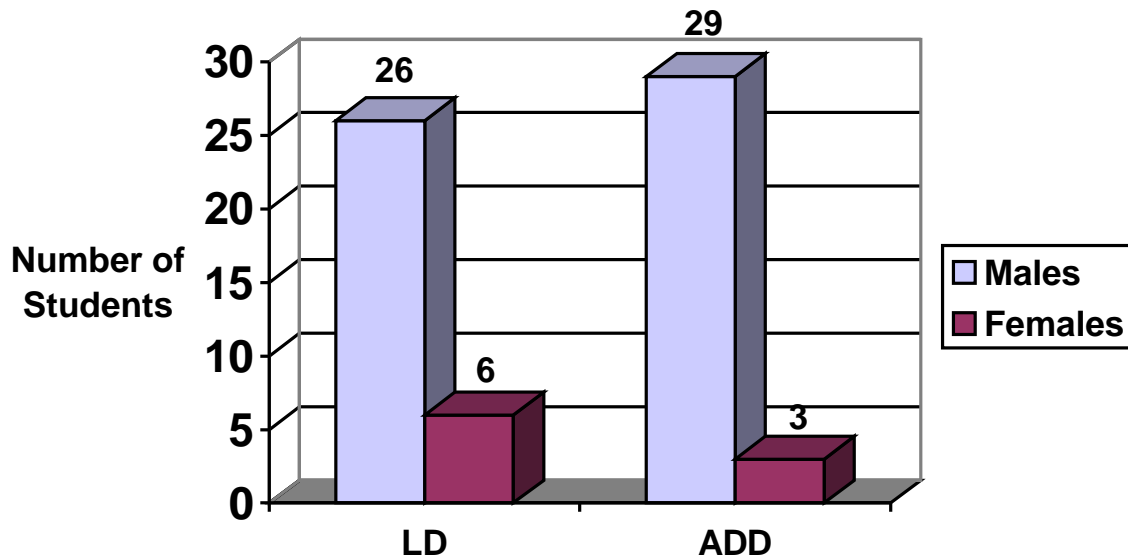


Figure 1. Breakdown of VT College of Engineering students with learning and attention deficit disabilities

In the fall of 1999 Virginia Tech, a state funded land grant university, enrolled 21,810 undergraduates, of whom 1.1% percent reported some type of learning and/or attention deficit disabilities. Of the 5181 College of Engineering undergraduate students, 64 or 1.2% of students self-identified as having learning disabilities and/or attention deficit disabilities. 14% of the engineering students with learning and attention deficit disabilities were female, and the population included students ranging from freshman to fifth year seniors. The typical SAT scores for entering VT freshman engineering students ranged from 1250-1300. Since federal law prohibits universities from inquiring as to whether or not a student has a disability, students with learning disabilities are admitted based on the same criteria as other non-disabled students. Therefore, learning disabled students' SAT scores, high school GPA's etc., are commensurate with their peers. Figure 1 represents the breakdown of the COE LD/ADD student population.

### III. Results

The results suggest some very interesting trends. Figure 2 displays the grade point averages (GPAs) for the LD/ADD engineering males and females as compared to all the self-identified LD/ADD students at Virginia Tech. Female engineering students with learning and attention deficit disabilities performed slightly above the overall VT female LD and ADD groups while the engineering males' scores were below both their female and male counterparts. However, VT engineering students of both genders with attention deficit disorders performed well above the ADD students from other colleges.

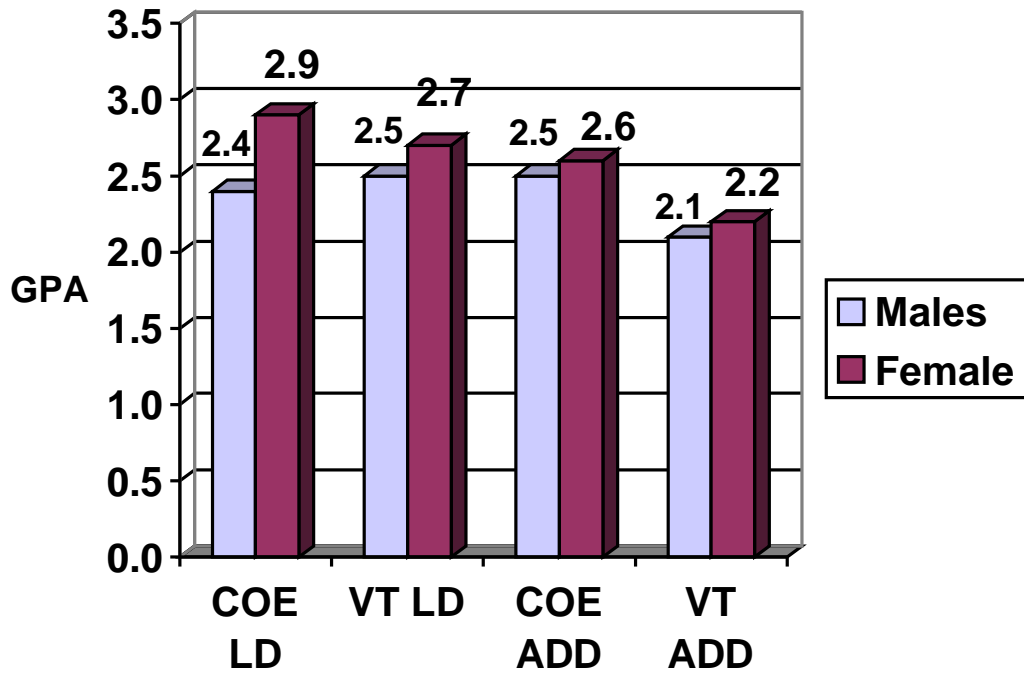


Figure 2. VT COE vs. other VT student GPAs with learning and attention deficit disabilities

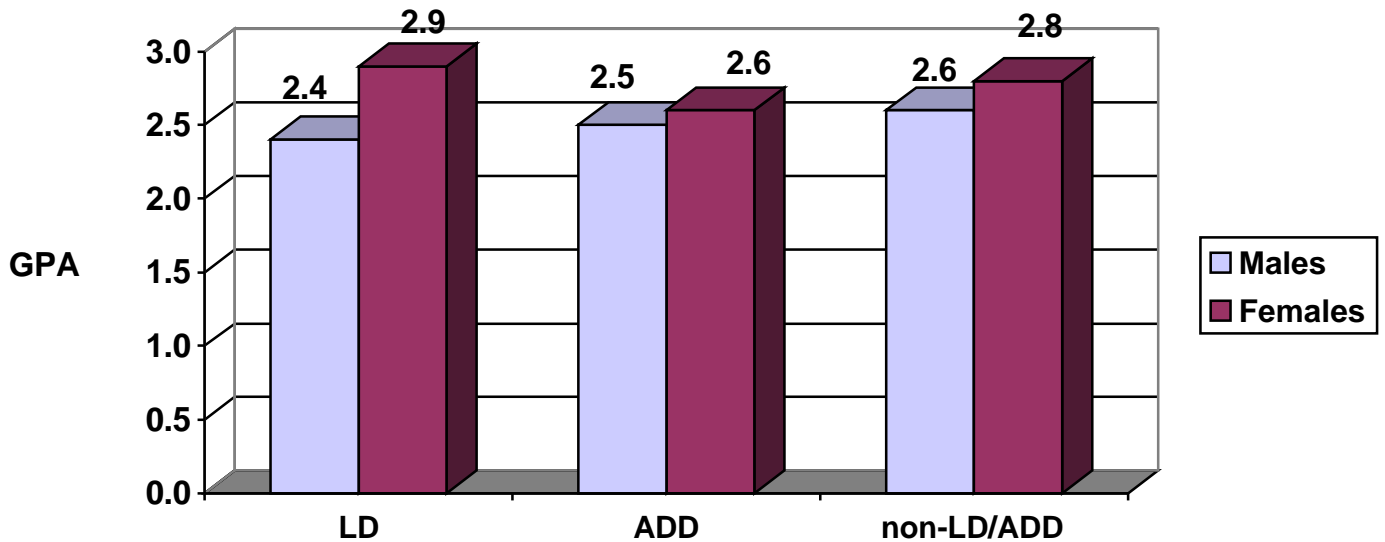


Figure 3. GPAs of VT COE LD/ADD vs. COE non-LD/ADD Students

Figure 3 demonstrates the overall GPA comparisons of male and female LD/ADD engineering students to that of engineering non-LD/ADD students. In all but one category, the engineering students with learning or attention deficit disorders did not achieve the same grades as their peers. The one exception was female engineering students with learning disabilities, who performed slightly above their peers, both male and female.

Figures 4 and 5 present the class breakdown of the GPAs of the VT learning disabled and ADD engineering students as compared to their engineering peers without disabilities. Similar to the overall GPA comparison of figure 3, the female engineering students with learning disabilities performed as well or better than their non-LD peers, with the exception of their sophomore year. While the male LD engineering students consistently performed below their peers, their GPAs did increase over the course of their studies. Interestingly, the female ADD students showed the same yearly trend, with the sophomore year clearly the most difficult.

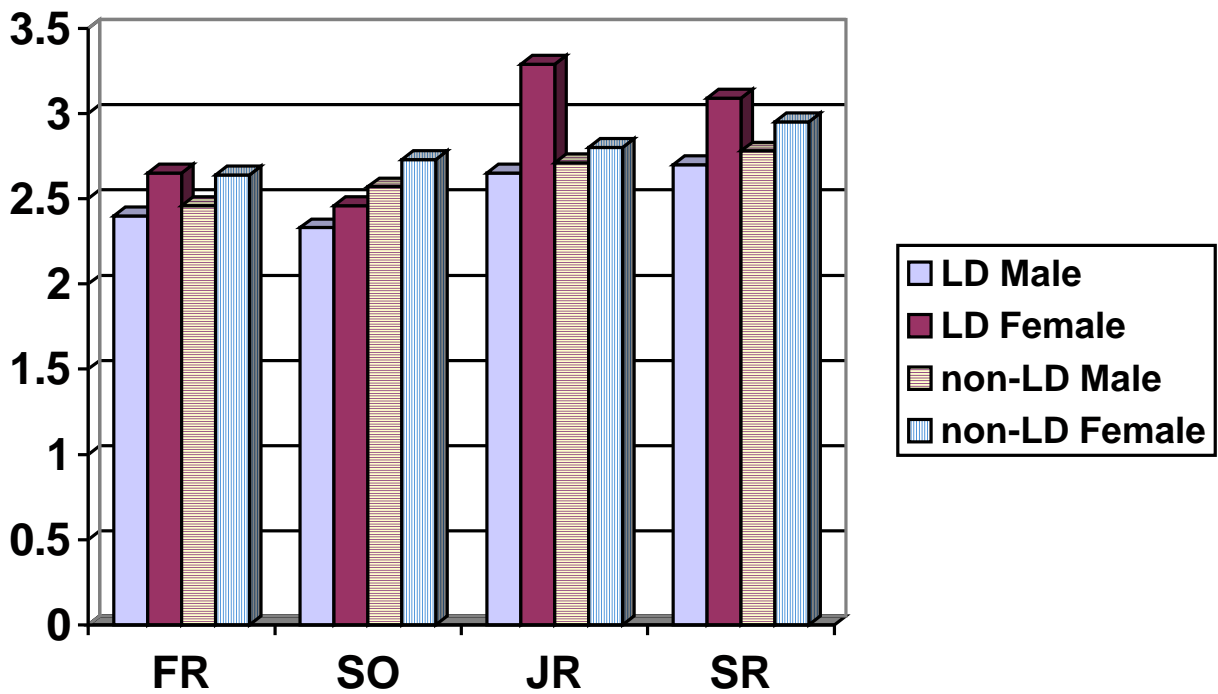


Figure 4. Four year VT COE non-LD & LD student GPAs

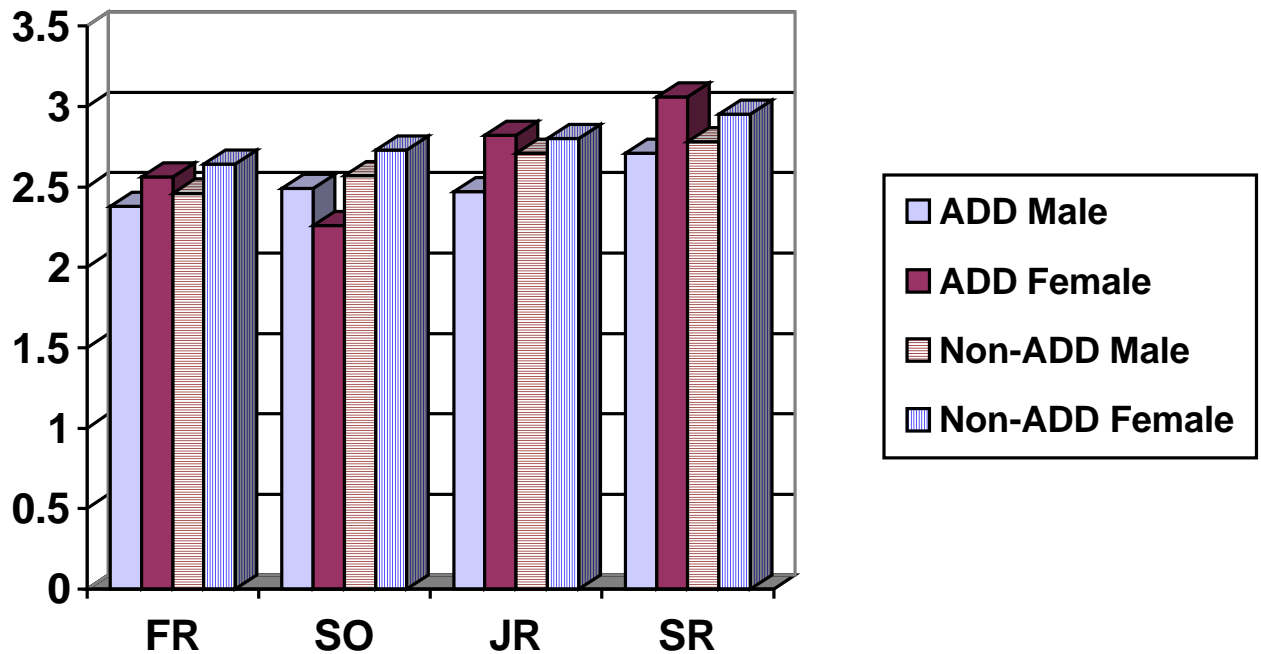


Figure 5. Four year VT COE non-ADD & ADD student GPAs

#### IV. Discussion

The finding that the GPAs of VT LD/ADD engineering students were lower than those engineering students without similar disabilities is not surprising. Previous research confirms that typically GPAs of LD students are significantly lower than non-LD students for every year of college completed.<sup>3</sup> The most striking result of the data analysis is the performance of the engineering females with learning disabilities. Virginia Tech COE females without learning disabilities historically outperform their male counterparts throughout the engineering curriculum, but it is unexpected to find essentially no difference between the LD and non-LD engineering females (2.9 vs. 2.8 GPA.) Even more noteworthy, the GPAs of the COE females with learning disabilities were well above those of the male COE LD students (2.9 vs. 2.4).

Nationwide in 1998, 58% of college students with learning disabilities surveyed in both public and private colleges and universities were men and 42% were women.<sup>1</sup> In the fall of 1999 at Virginia Tech, 77% of engineering LD students were males and 23% were females. Males are more often diagnosed as learning disabled, but some researchers contend that females with learning disabilities have greater difficulties in reading and math, and are more severely affected by their learning disability.<sup>4,5</sup> However, other education specialists disagree and hypothesize that LD females are more resilient than their male counterparts and show greater improvement with age.<sup>6,7</sup> In addition, women with learning disabilities are thought to develop better

compensatory strategies as they age.<sup>8</sup> Some studies have shown that women with learning disabilities have higher GPAs than their male peers, and that men with learning disabilities fail out of college at twice the rate of LD women.<sup>6,7</sup> The Virginia Tech COE data confirm the hypothesis that LD females outperform the male LD students, as does the data comparing all Virginia Tech LD students (figure 2). Surprisingly, the COE LD females also outperformed the engineering males without learning disabilities (figure 3). One limitation to this data set is the small number of women with learning and attention deficit disabilities in the COE. With a sample space of 9, they represent 0.2% of the COE. Unfortunately, since women only constitute 16% of the Virginia Tech COE, it will be difficult to obtain a larger data set.

Much research has been conducted to determine the effectiveness of various external coping strategies for LD students, including support programs conducted through university settings. In several studies, students with learning disabilities identified the following as critical factors for success in college: developing and using compensatory strategies, mentors, tutors, and counseling services<sup>3,9,10</sup>. In addition, a more recent study revealed that students placed a great deal of emphasis on examination and teaching accommodations, as well as the need to have a supportive staff that specialized in learning disabilities<sup>11</sup>.

Internal coping strategies are equally important success criteria for college LD students. Established support and counseling programs provided by a college or university are very important contributors to the success of LD students, but students must take responsibility for their learning disabilities to be successful. Internal factors that determine LD students' success are self-understanding, the level of acceptance and/or denial, motivation, clear goals, learning to cope with more course work, and taking responsibility for one's own learning<sup>9,10</sup>. The importance of self-advocacy and its significant role in the success of LD students cannot be understated. Self-advocacy includes acceptance and understanding of one's learning disability, as well as a functional comprehension of learning disability policies, including how they differ in the high school and college environment. Since colleges and universities cannot legally ask students if they are disabled, the first and most important step of self-identifying a learning disability is critical. Research findings reveal that those students who are motivated and act as self-advocates are the most successful LD students<sup>12</sup>.

Faculty support of LD students has been a topic of recent interest on college campuses, especially with increasing enrollment and the growing emphasis on innovative teaching and examination accommodations. A common faculty misunderstanding concerning learning disabilities is that these students are not capable of handling the mathematical rigors required in an engineering program. Recent research suggests that faculty need information about the definition and characteristics of LDs, strategies for teaching and evaluating LD students, what constitutes accommodations, and support services for LD students. However, the most important aspect of faculty interaction with LD students is a positive faculty attitude.<sup>13</sup> The perceived social and academic stigma of having a learning disability can be a major obstacle for students with learning disabilities. With these seemingly overwhelming obstacles to overcome, additional understanding and support from faculty is critical for the successful transition of an engineering LD student.

Currently Virginia Tech does not provide any additional support services to engineering students with learning disabilities beyond what is provided for all students with learning disabilities. Virginia Tech has established the Services for Students with Disabilities (SSD) unit, a group within the Dean of Students Office, which provides students with learning disabilities (and other disabilities as well) with support services. The SSD works to ensure that students with disabilities receive equal access to education and opportunities in the academic community. The SSD offers many services, which include accommodations, advocacy, assistive technology, auxiliary aids, faculty and staff awareness programs, a disability care team, and a networking group of students with disabilities. To augment the SSD's disability support programs, the Virginia Tech counseling center also offers various classes to students with disabilities such as sessions to advise students on how to manage their disabilities while in college.

Perhaps the most critical piece of information that any student with a disability, learning or otherwise, obtains upon arrival at Virginia Tech is the *Handbook for Students with Disabilities*, which is a pamphlet produced every new academic year. This handbook provides a series of checklists that advises a student with a disability what to do when applying to Virginia Tech, what to do once accepted, and lastly what to do upon arrival to ensure that the disability is fully addressed. The primary hurdle in the disability services information dissemination process is actually getting the information to the students who need it. Once a student with a learning disability is admitted to Virginia Tech, it is critical that they "self-identify." If a student with a learning disability does not go to the Dean of Students Office and let someone know they have a diagnosed disability, then the university cannot provide any support services. Because universities are not permitted to inquire about a disability, there is no definite way of knowing how many students, engineering and otherwise, are slipping through the cracks and not receiving assistance.

## V. Recommendations

The fall 1999 COE data set is just a single snapshot of the status of the Virginia Tech engineering LD students, but these data clearly indicate the need for a more longitudinal study in this area. Although not ideal, this preliminary data set indicates that women with learning disabilities in the Virginia Tech COE are performing above their male counterparts, with or without learning disabilities. The male students with learning disabilities are not reaching their potential, and the COE is potentially losing many valuable promising engineers. A high school LD student who gains admission to the Virginia Tech COE has already successfully negotiated many difficult academic obstacles, so he or she must have had some previous success in compensating for the learning disability. It appears the COE LD women are successfully dealing with their learning disabilities and excelling while the LD males are struggling just to remain enrolled in engineering. One additional area for further study would be to survey the COE LD students to discover what the different gender approaches might be in an attempt to determine why the COE women perform significantly better academically than the men with learning disabilities. In addition, other areas for future inquiry would include a retention study for engineering students with learning disabilities, a sophomore-year analysis to find out why it provided more difficulties than other years, and comparison of results with other large engineering universities.



Learning disability support services and colleges of engineering need to ensure they are reaching out to students with learning disabilities, to increase awareness of the support services that are available to them. In addition, engineering faculty need to be more aware of the problems faced by students with learning disabilities, and the importance of accommodating these students. Often the best teaching strategies for students with learning disabilities, like hands-on learning and collaborative environments, benefit all students. In essence, promoting faculty awareness, student self-advocacy awareness, and understanding of learning disabilities will improve the learning environment for all students.

## VI. Acknowledgments

I would like to extend a special thanks to Dr. Cherry Houck and Dr. Susan Angle for their technical support.

## Bibliography

1. Henderson, C. 46 (American Council of Education, Washington DC, HEATH Resource Center, 1999).
2. IDEA. (1997).
3. Vogel, S. A. & Adelman, P. B. Extrinsic and intrinsic factors in graduation and academic failure among LD college students. *Annals of Dyslexia* 40, 119-137 (1990).
4. Lerner, J. W. *Learning Disabilities: Theories, Diagnosis, and Teaching Strategies* (Houghton Mifflin Company, Boston, 2000).
5. Gottlieb, B. (1987).
6. Leonard, F. C. Using Wechsler Data to Predict Success for Learning Disabled College Students. *Learning Disabilities Research & Practice* 6, 17-24 (1991).
7. Vogel, S. A. & Hruby, P. J. Educational and Psychological Factors in Successful and Unsuccessful College Students With Learning Disabilities. *Learning Disabilities Research & Practice* 8, 35-43 (1993).
8. Nass, R. D. Sex Differences in Learning Abilities and Disabilities. *Annals of Dyslexia* 43, 61-77 (1993).
9. Vogel, S. A. & Adelman, P. B. The Success of College Students with Learning Disabilities: Factors Related to Educational Attainment. *Journal of Learning Disabilities* 25, 430-41 (1992).
10. Strasburger, R., Turner, M. & Walls, R. T. Factors Relating to the Postsecondary Success of Students with Learning Disabilities. *Journal of the Freshman Year Experience* 11, 63-76 (1999).
11. Finn, L. L. Students' perceptions of beneficial LD accommodations and services at the postsecondary level. *Journal of Postsecondary Education and Disability* 13, 46-67 (1998).
12. Hicks-Coolick, A. & Kurtz, P. D. Preparing Students with Learning Disabilities for Success in Postsecondary Education: Needs and Services. *Social Work in Education* 19, 31-42 (1997).
13. Vogel, S. A., Leyser, Y., Wylans, S. & Brulle, A. Students with Learning Disabilities in Higher Education: Faculty Attitude and Practices. *Learning Disabilities Research & Practice* 14, 173-86 (1999).

## MARY L. CUMMINGS

Mary (Missy) Cummings received her B.S. in Mathematics from the U.S. Naval Academy in 1988 and her M.S. in Space Systems Engineering from the Naval Postgraduate School in 1994. While in the Navy, she was one of the Navy's first female fighter pilots, and also worked as an assistant program manager in a Navy industrial engineering plant. Her previous teaching experience includes instructing for the U.S. Navy at Pennsylvania State University, and most recently as an assistant professor for the Virginia Tech Engineering Fundamentals Division. She is now a doctoral student in the University of Virginia Systems Engineering department.