PERSONALITY AND LEARNING STYLE DIFFERENCES IN GRADUATE SCIENCE PROGRAMS INCORPORATING BUSINESS SKILLS TRAINING

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ABSTRACT

To address the need for employees in the science and engineering industry to have business-related skills in addition to their technical skills, a multidisciplinary science graduate program was developed at the University of Arkansas. It was hypothesized that business and soft skill training, a diverse academic course selection, and a cohort methodological approach to learning may attract different types of students than traditional science and engineering programs. Students not as commonly attracted to traditional engineering programs (extraverts, active and sensory learners, and members of underrepresented ethnic groups) may be more interested in an interactive team environment that incorporates real world issues. Multidisciplinary graduate students were compared with traditional engineering students to investigate demographic, personality, and learning style differences. Students in the multidisciplinary group were slightly more extraverted, had a slightly greater preference toward active learning, and had a greater preference toward thinking personality types than students in traditional programs. Additionally, a larger percentage of African-American students enrolled in the multidisciplinary program. Specific recruiting efforts and self evaluation of psychosocial characteristics may help students evaluate their academic and career goals.

I. INTRODUCTION

Leaders in the science and engineering industry (e.g., Committee on Science, Engineering, & Public Policy, 1995; Horwitz-Bennett, 2003; Stevens & Burley, 2003; Weiss, 1998) have stated that there is a need for employees to have business-related skills such as project management, team-building, communications, problem-solving, creativity, entrepreneurship, and an understanding of business ethics, in addition to their technical skills. In conjunction with academic preparation, it has been strongly recommended that science and engineering students participate in internships to obtain pragmatic experience in skills needed in the business and industry arenas. The National Science Foundation (NSF) has supported the concept of joining traditional science and engineering training with business-related education by funding the development of a number of multidisciplinary degree programs in these fields.

Interestingly, the inclusion of business skills training that introduces concepts such as team-building, collaborative activities, project management, and creativity can change the instructional environment of traditional science and engineering programs and can influence the types of students both attracted to and successful in the programs. Researchers (Felder, Felder, & Dietz, 2002; Godleski, 1984; Rosati, 1997) have provided data indicating that personality and learning types are related to academic performance in science and engineering courses. The types of students successful in engineering programs employing non-traditional instructional strategies have been identified as being different from the students that have the highest probability of success in traditional science and engineering programs. Further research has identified personality characteristics associated with successful employees in the science and engineering industry (Stevens & Burley, 2003). If there are differences in the educational focus and learning environments of traditional science and engineering programs as compared to alternative science and engineering programs such as those with a multidisciplinary business and technology focus, would it be reasonable to expect different types of students to be attracted to each of these programs? More specifically, would the students who select a business-model engineering program be more likely to have personality and learning characteristics that would align with the most successful types of employees in the business industry? In this study, personality and learning style characteristics for students in two types of graduate engineering programs were compared to identify differences in the types of students selecting a multidisciplinary business-modeled engineering program compared to traditional engineering programs.

II. Literature Review

National Focus on Business-Related Skills Training

In 1997, the National Science Foundation developed the Integrative Graduate Education and Research Training (IGERT) program to fund the development and support of multidisciplinary academic programs connected with the fields of science, technology, engineering, and mathematics (NSF, 2002). The emphasis of IGERT is to enhance graduate education by developing innovative models to encourage collaborative research across departments and institutions, to facilitate diversity, and to integrate research and education. One of the goals of IGERT is to increase student focus on problem-oriented rather than just discipline-oriented research, which may better prepare students to address issues such as scientific, business, social, and ethical challenges in academic and industry careers.

An environmental component of the business workforce includes working on novel and complex problems with professionals having diverse areas of expertise. Researchers suggest there are benefits to having students attempt unique pragmatic projects that would be commonly found in the industry sector rather than simply replicating experiments in which the results have already been determined (O'Connor, Sibray, & Forinash, 2001). This type of training aids in the preparation of students to solve "real world" problems. O'Connor et al. also claimed that collaboration with students across departments created a more stimulating environment in which groups of students were able to obtain and share feedback to better understand how their work was valuable to people in other fields. A number of multidisciplinary science and engineering programs have included business skills training to assist graduates entering the industry sector in adapting to collaborative work environments (McKeage, Skinner, Seymour, Donahue, & Christensen, 1999).

Multidisciplinary Engineering Program including Business Skills Training

A multidisciplinary science and engineering graduate program was developed in 1998-1999 at the University of Arkansas with a focus on three primary elements: a) broadening academic core competency knowledge to develop professionals who can more effectively interact with experts from a broad range of disciplinary specializations, b) developing specialized research and laboratory skills utilizing an interdisciplinary state-of-the-art research laboratory, and c) developing business-related interpersonal skills in areas such as team-working, communication, project management, and project development for increasing success in diverse types of industry and academic job settings. The faculty who support the multidisciplinary microelectronics-photonics (MEP) degree program utilize a cohort methodology to address the business-related issues of team-building and interactive learning through training within collaborative groups of students with diverse areas of expertise.

Multidisciplinary programs incorporating business and soft skill training may attract a different type of student than those who select traditional natural science fields. Multidisciplinary programs tend to have more diverse academic course selection options in addition to a more diverse set of required coursework, which may attract students less satisfied with traditional program course requirements. The microelectronics-photonics' cohort methodological approach to learning adopted by the faculty fosters collaborative work and an academic and social support system for students through the involvement in cohort meetings, summer camps, interactive training workshops and organized social events. It is hypothesized that students not as commonly attracted to traditional engineering programs (extraverts and active learners) may be more intrigued by the interactive and supportive group environment of the multidisciplinary cohort program. Additionally, students from underrepresented groups who could feel isolated in traditional programs may appreciate the supportive team approach.

Learning Styles and Personality

An understanding of the types of students who select a program can be useful for faculty at the recruitment level, whereas an understanding of student preferences at the classroom level can facilitate the creation of educational activities. One component in developing an effective pedagogical style is identifying how the effectiveness of instructional delivery can be enhanced by assessing interactions of student and instructor learning styles. Learning styles are the ways in which an individual characteristically acquires and processes information (Felder & Silverman, 1988). Although researchers have proposed different models, most agree students learn differently based upon their learning styles (Honey & Mumford, 1992; Felder, 1996; Sternberg & Grigorenko, 1997). Similarly, instructors tend to teach using processes and methods they prefer for learning (Ebeling, 2001). Understanding similarities and differences between instructor and student styles may provide information for developing instructional strategies to accommodate all styles. Ultimately, more students will benefit from a teacher using a variety of teaching styles (Zhang & Sternberg, 2000). When the teacher uses styles to which the student can best relate, the student may have a more positive attitude and show higher academic achievement (Dunn & Dunn, 1978; Felder & Silverman).

Sternberg and Grigorenko (1997) recommended studying learning styles as a function of cognitive styles, which are based on cognition, personality, or activity, and which bridge cognition and personality. A common personality inventory used with scientists and engineers is the Myers-Briggs Type Indicator (MBTI), which evaluates an individual's preferences on four dichotomies related to personality. The design of the MBTI was based upon Carl Jung's theories of psychological types (Felder, 1996; Finley Snyder, 1999: Silver, Strong, & Perini, 1997; Sternberg & Grigorenko, 1997). Jung characterized individuals in terms of attitudes (extraversion and introversion), perceptual functions (intuition and sensing), and judgment functions (thinking and feeling). A distinction between judgment and perception was also eventually added to the MBTI classifications. An individual may be classified as any one of 16 combinations of the 4 categories (Briggs & Briggs-Meyers, 1998).

The academic performance of students in engineering courses has been linked to the interaction of instructional styles and student personality characteristics (Felder et al. 2002; McCaulley, Godleski, Yokomoto, Harrisberger, & Sloan, 1983; Rosati, 1997, 1999). For instance, people classified as extraverts on the MBTI seem to flourish in environments that allow for group work and interactive activities. Introverts prefer to process information internally. Sensors like to work with concrete ideas and processes, whereas intuitors attempt to understand things conceptually. Intuitors also tend to not like memorizing facts and learning through repetition. Thinkers prefer objective conclusions based on concrete evidence. Feelers may be more likely to consider conditional, more subjective, factors in making judgments or developing conclusions. Judgers like planned, organized information, whereas perceivers are more receptive of spontaneous changes and variability in their work and learning environments. Detailed descriptions of the four personality scales are provided in Briggs and Briggs-Myers (1998).

Learning style preferences are interrelated to personality characteristics in the academic environment. Felder and Silverman (1988) have provided for the differentiation of students on four learning style scales: active-reflective, sensing-intuitive, visual-verbal, and sequential-global. Active learners tend to prefer hands-on activities or active discussions of materials whereas reflective learners enjoy thinking about the relationships between constructs and ideas first. Sensors prefer the study of factual information and prefer learning through straight-forward, consistent procedures. They also prefer the use of pragmatic and/or "real world" examples. Intuitors tend to enjoy the use of innovative and varying instructional procedures and dislike the use of repetitive learning processes. Verbal learners prefer learning with the use of the written or spoken word, whereas visual learners prefer diagrams, demonstrations, and other visual aids. The final classification differentiates between sequential learners who prefer the step-by-step process as compared to global learners who tend to learn by eventually understanding the "big picture".

Relationships Among Psychosocial Characteristics, Academic Performance, Retention, and Employment Goals in Engineering

In studies using MBTI profiles of engineering students, researchers have found that introverts, intuitors, thinkers, and judgers had higher first-year grade point averages (GPA) and were more likely to graduate from a traditional engineering program in four years (McCaulley et al. 1983; Rosati, 1997) leading to the conclusion that traditional forms of instruction in the engineering curriculum may best serve these types of students. In addition to supporting this previous research, Felder et. al (2002) also found that extraverts significantly outperformed introverts in chemical engineering classes using active and cooperative learning methods. There also seemed to be an interaction between the introversion – extraversion scale and the sensing – intuitive scale in terms of student performance and retention. Most notably, introverted sensors had the highest risk of attrition at 62% after five years, whereas extraverted sensors had the lowest 5-year attrition rate at 11%. A combination of either extraversion or introversion with intuition resulted in attrition rates of 25% and 27%, respectively. Results provide support for Godleski's (1984) conclusion that the sensing – intuitive scale is one of the most highly related to academic success in engineering, but there is the need for study of the interaction effect between the sensing-intuitive and extravert-introvert scales. Felder, Felder, and Dietz (2002) hypothesized that broader implementation of application and pragmatic activities in the experimental courses, in addition to cooperative learning, might have aided in the reduction of attrition rates for extravert sensors. Follow-up questionnaires administered to the students indicated that the majority of sensors (82%) and 62% of the intuitors found the experimental courses to be "more instructive" than the traditional courses. Retention was not significantly different for judgers and perceivers, but the attention to detail and task management abilities of the judgers seemed to contribute to significantly higher course grades in chemical engineering.

Interestingly, in the Felder et al. (2002) study, the majority of intuitors indicated the desire to work in a university or research setting, a small firm, or in public service. The majority of sensors stated a preference for working at a large corporation. Additionally, sensors had a greater concern than intuitors for meeting or exceeding employers' expectations. Of interest is whether the traditional university engineering curriculum is as sufficiently preparing students to enter the field of business and industry as it is preparing them to enter the world of academe.

Stevens and Burley (2003) conducted a 10-year study to investigate the relationship between personality characteristics and job performance in a Fortune 500 chemical company. They utilized the MBTI personality scales and the MBTI creativity index (a combination of the four scales into a single score in which the classifications of extraversion, intuition, thinking, and perceiving are positively related to creativity [Myers & McCaulley, 1998]) to investigate the relationship between personality, creativity and performance. The results from the MBTI were significantly related to performance and profitability. They classified 69 new business development (NBD) analysts using the MBTI-CI into two groups and followed the success rate of their 267 NBD projects over 10 years. The analysts in the high creativity group had 1.4 times as many products released, approximately 2.7 times as many products altered or readjusted during the developmental process, 2.3 times more positive recommendations, and projects that were approximately 9 times more profitable. The total profit of the NBD group with the higher MBTI-CI scores was $197.5 million as compared to $15.2 million for the low creativity group. Further, Stevens and Burley identified that the two most important subscales of the MBTI appeared to be the Sensing-Intuitive scale and the Thinking-Feeling scale and created the Rainmaker Index to identify people with the highest concentration of these two characteristics. After computing the Rainmaker Indexes for the 69 analysts and dividing them into three groups based on the scores, they reported that the top group developed 1.62 and 2.13 times the number of products of the middle and low groups. Additionally, the profitability of the products for the top group was approximately 9 times greater than that of the middle group and 95 times greater than that of the low group. Thus, they concluded that certain personality characteristics, in combination with training, may be an important consideration in the hiring and training process for certain industry job positions.

Importance of Facilitating the Success of Diverse Learners in Engineering

Research results such as the decreased success of the sensor at the early educational stages in traditional science and engineering programs, the lower retention of intuitors during their academic careers, and the lower academic success rates of extraverts support the need for further assessment into the success of students of varying personality and learning styles when enrolled in non-traditional degree programs. Further, the belief that extraverted, sensing, and judging thinkers might be one of the more common personality types of successful business executives (Briggs Myers, 1974) and evidence that intuitive thinkers may be some of the most creative and profitable product development employees, leads to the importance of identifying learning environments that can maximize the success of students identified as having high potential in business and industry.

The cohort methodology, business skills training, and multidisciplinary research collaboration incorporated in the University of Arkansas multidisciplinary MEP program may align with the interests of extraverts who prefer to interact with colleagues in a team environment, and sensors who prefer to work in an applied setting learning skills needed in a business and industry. The inclusion of state-of-the-art research facilities that provide for collaborative research among faculty and students of multiple disciplines is hoped to also stimulate the innovative, conceptual abilities of the intuitors. Weekly meetings encouraging group collaboration are contrary to traditional learning environments that typically encourage individual work. The use of instructional activities such as summer camps and interactive creativity training might be expected to attract active learners who enjoy hands-on construction and problem-solving exercises requiring creative thought. This study investigated the differences between a) students who chose to enroll in a multidisciplinary engineering program with a cohort methodology including business skill coursework and b) students who chose to enroll in more traditional types of science or engineering programs.

III. METHOD

Participants

Four years of data collected from students in a multidisciplinary graduate engineering program were compared with data collected from students in traditional engineering programs.

Data from the students' first year in the program were used to investigate potential demographic, personality, and learning style differences of students self-selected to two kinds of graduate degree programs. Participants included 42 students in the multidisciplinary graduate program and 21 students in the traditional science graduate programs, consisting of chemical engineering, electrical engineering, and mechanical engineering. Students were volunteers for the project, as required by human subjects' research guidelines.

Instrumentation

Index of Learning Styles. Students provided demographic information and completed the Index of Learning Styles (ILS; Soloman & Felder, n.d.) and the Myers-Briggs Type Indicator (MBTI; Briggs & Briggs Myers, 1998) personality measure. There are four learning preference scales on the ILS: active-reflective, sensing-intuitive, visual-verbal, and sequential-global. Each of these four scales has a range of -11 to 11, where positive values indicate a greater preference toward the first characteristics stated by the scales (e.g. active, sensing, visual, sequential), and negative values indicate a greater preference for the second characteristic identified by the scales (e.g. reflective, intuitive, verbal, and global). A verbal preference score close to 0 (e.g., 1 or 2) is indicative of relatively no preference between visual and verbal learning styles. Conversely, a visual-verbal ILS score of 9 would indicate a fairly strong preference toward visual presentation of information.

Validity and reliability information for the ILS is limited, thus assessments were conducted on the data obtained in the study. The internal consistency values for the four scales were .58, .72, .61, and .55 for the active-reflective, sensing-intuitive, visual-verbal, and sequential-global scales, respectively. At the beginning of our study, there had not been a published report on the validity of the ILS. A validity study was published after the current data collection project began, and unfortunately the low reliability estimates found with our dataset were similar to the ILS validation study. A principal components analysis using a four factor model indicated that 31 of the 44 items loaded as hypothesized, whereas only 26 of the 44 items had loadings larger than .40 on the primary components and loadings smaller than .30 on the remaining components. The decision was made to maintain the original scales for this study for comparison to previous science and engineering studies using the ILS.

Myers-Briggs Type Indicator. The MBTI contains four personality type scales: extravert-introvert, sensing-intuitive, thinking-feeling, and judging-perceiving. Each scale of the

MBTI was linearly transformed to produce scale ranges similar to the ILS for interpretation purposes. After transformation, the ranges of the raw scores on the MBTI were -21 to 21 for the extravert-introvert scale, -26 to 26 for the sensing-intuitive scale, -24 to 24 for the thinking-feeling scale, and -22 to 22 for the judging-perceiving scale. A positive score value indicates a preference toward the first characteristic, and a negative score value represents a preference for the second characteristic. The range of the scores is important to consider because a student with an extroversion preference score close to 0 (e.g., 1, 2, 3, or 4) is actually indicative of relatively no preference between extraversion and introversion personality styles. An extraversion-introversion MBTI score of -19 would indicate a strong preference toward introversion.

Reliability and validity data for the MBTI have been broadly disseminated, and thus are not reported here. Internal consistency reliability estimates were computed for comparison of the sample group to the norming population. Coefficient alpha values of the sample group mirrored those of the general adult national norm group with a range of .88 to .93 for the four scales.

Data Analysis

Data are provided using frequency tables that represent the proportion of students in each of the learning styles and personality type categories. Because of the uniqueness of the scale definitions on the ILS and the MBTI inventories and the moderate sample sizes, the eight scales were analyzed using univariate one-way analysis of variance estimates. Due to the exploratory nature of the study in combination with the need for sufficient power to identify moderate effect sizes, a liberal alpha level of .03 was selected for each of the eight analyses. The power of this study was somewhat limited due to the small number of graduate students admitted to a science or engineering program in any given year, so the larger allowance for a family-wise error rate of approximately .22 was selected. Effect size estimates are provided as a framework for interpreting the magnitude of the group differences.

IV. RESULTS

Demographics. Due to the nature of a self-selected sample resulting from a volunteer study, demographic characteristics for the population of students enrolled in the multidisciplinary (MEP) and traditional (TRAD) programs from 1998 – 2003 were compared to the demographic characteristics of the participants in the study. Self-selection into the two program areas for the entire population of engineering graduate students resulted in a slightly higher percentage of females in the multidisciplinary program than in the traditional engineering programs. The multidisciplinary group consisted of 20% females and 80% males, and the traditional group was made up of 15% females and 85% males (see Table 1). In comparison, the proportion of females volunteering for the study was slightly greater, with 28% of the multidisciplinary participants and 24% of the traditional participants being female. In terms of ethnicity, both groups had similar distributions of white, Asian, Hispanic, and Native American students (see Table 2). However, only 1% of the traditional group identified themselves as black students, as compared to 10% of the multidisciplinary group identifying themselves as black. One of the notable differences between the racial/ethnic distributions of the population and the sample was that a smaller proportion of the international students from both engineering groups participated in the study. While over one half of the general engineering graduate student population is classified as international students, only one third of the sample participants were international students.

Table 1
Gender of Graduate Students Enrolled from 1998-2003

		Male		*Female*	
Program	*N*	*N*	*(%)*	*N*	*(%)*
Population					
Multidisciplinary	70	56	(80)	14	(20)
Traditional	411	348	(85)	63	(15)
Study Participants					
Multidisciplinary	42	31	(73)	11	(28)
Traditional	21	16	(76)	5	(24)

Table 2
Ethnicity of Graduate Students Enrolled from 1998 - 2003

Program	White *N (%)*	Asian *N (%)*	Black *N (%)*	Hispanic *N (%)*	Native Amer *N (%)*	International *N (%)*
Population*						
Multidisciplinary	20 (29)	4 (6)	7 (10)	2 (3)	0 (0)	37 (53)
Traditional	127 (31)	30 (7)	5 (1)	3 (1)	3 (1)	241 (59)
Study Participants						
Multidisciplinary	15 (36)	7 (18)	7 (18)	1 (3)	0 (0)	12 (29)
Traditional	10 (48)	2 (10)	1 (5)	1 (5)	0 (0)	7 (33)

** The population data were obtained from the university mainframe in which the most recent cohort of students may not have been completely entered. The sample participants include recent admissions, thus the number of students in a participant category may be larger than that of the population.*

Personality and Learning Differences Based on Initial Program Admission

ILS. A comparison of the percentage of students from the two engineering groups, in each of the four learning styles categories, indicates that a larger proportion of the students in the multidisciplinary program were classified as active learners (60%) than the traditional program (43%). The percentage of students preferring the sensing and sequential styles of learning were approximately equal for both engineering programs (see Figure 1). For example, 55% of the traditional group were classified as sequential learners, and 45% were global learners. Similarly, 48% of the multidisciplinary group preferred sequential learning, and 52% preferred global learning. Students in both engineering programs typically consider themselves visual rather than verbal learners (88% and 86%, respectively for the multidisciplinary and traditional programs).

One-way ANOVAs on the ILS indicated no statistically significant differences between multidisciplinary and traditional groups on any of the four subscales based on students' initial selection to either program (see Table 3). The multidisciplinary and traditional groups' averages were both near zero on all subscales other than the visual-verbal subscale where the mean was 5.33 for the multidisciplinary engineering group and 4.14 for the traditional engineering group. Both groups were primarily composed of visual rather than verbal learners. Effect size differences were moderate with values ranging from .22 to .44.

MBTI. A substantially larger percent of the students in the traditional program showed a preference toward an introvert personality type (67%) as compared to the multidisciplinary group

(46%; see Figure 2). Both groups were more often classified as intuitive rather than sensing (69% of the multidisciplinary students and 87% of the traditional students). The multidisciplinary group classified themselves as thinkers (77%), whereas the traditional group tended toward the feeling personality style (53%). Both groups had slightly larger proportions of judgers than perceivers (69% and 60% in the multidisciplinary and traditional groups, respectively).

MBTI results were also analyzed using one-way ANOVA, between-groups designs. These analyses yielded statistically significant differences on the thinking-feeling subscale, $F(1,52) = 5.50$, $p<.03$ (see Table 3). The multidisciplinary group perceived themselves as having a more thinking than feeling personality style ($M = 6.36$, $SD = 10.45$), whereas the traditional group, overall, had no clear preference for either one, with an average score close to the center of the scale ($M = -0.80$, $SD = 8.84$). The effect size was large, $d = .71$. There were no statistically significant differences on the introversion-extroversion, sensing-intuitive, and judging-perceiving scales. However, on average, the multidisciplinary group was more extraverted ($M = 1.31$, $SD = 10.33$), and the traditional group was more introverted ($M = -2.33$, $SD = 13.06$). Both groups were more intuitive than sensing, but the traditional group was substantially more intuitive than the multidisciplinary group ($M = -10.40$, $SD = 8.01$ and $M = -5.08$, $SD = 10.66$, respectively). Differences were marginally significant $F(1,52) = 3.06$, $p = .09$, with a moderate effect size of $d = .53$. The groups were similar on the judging-perceiving subscale, both perceived as more judging than perceiving ($M = 4.72$, $SD = 13.82$ and $M = 4.00$, $SD = 13.29$, respectively).

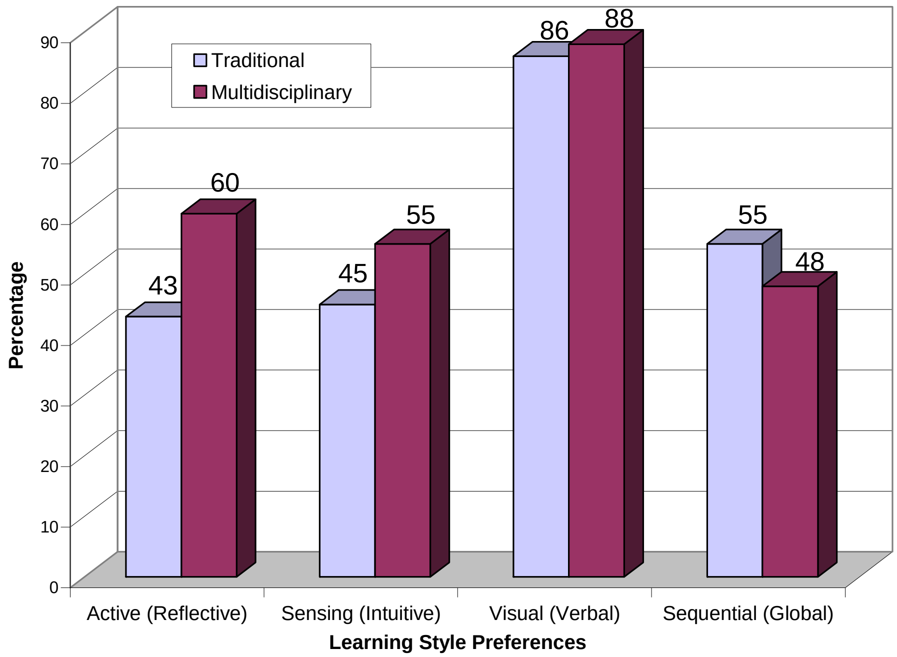

Figure 1. Learning style preferences of students in traditional and multidisciplinary science and engineering graduate programs.

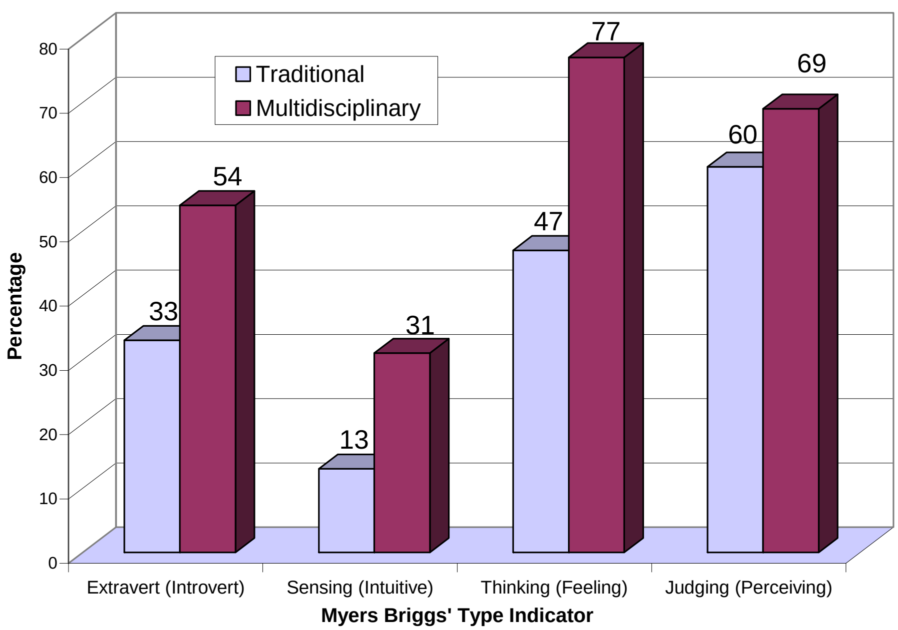

Figure 2. Personality type indicators for students in traditional and multidisciplinary science and engineering graduate programs.

Table 3
MBTI and ILS Scores of Graduate Students Selecting Traditional or Multidisciplinary Programs

	Traditional			Multidisciplinary				
	n	*M*	*(SD)*	*n*	*M*	*(SD)*	*F*	*d*
ILS[ŧ]								
Active-Reflective	21	-0.81	(4.56)	42	0.71	(4.30)	1.69	.35
Sensing-Intuitive	20	-1.40	(5.01)	42	0.88	(5.34)	2.57	.44
Visual-Verbal	21	4.14	(3.55)	42	5.33	(4.35)	1.18	.29
Sequential-Global	20	1.00	(4.00)	42	0.10	(4.08)	0.68	.22
MBTI								
Extravert-Introvert	15	-2.33	(13.06)	39	1.31	(10.33)	1.16	.33
Sensing-Intuitive	15	-10.40	(8.01)	39	-5.08	(10.66)	3.06	.53
Thinking-Feeling	15	-0.80	(8.84)	39	6.36	(10.45)	5.50*	.71
Judging-Perceiving	15	4.00	(13.29)	39	4.72	(13.82)	0.03	.05

* $p < .03$
[ŧ] On the ILS and MBTI positive values are representative of a preference toward the first characteristic stated by the subscale; negative values are representative of the second end of the scale listed. For example, positive values on the active-reflective scale indicate a preference for active learning; negative values represent a preference for reflective learning.
** Scores were only computed for participants who answered all items on a scale.

V. DISCUSSION

Learning Styles and Personality Types

There were no significant differences between the learning styles of the students in the two engineering programs. The frequency distributions and group means indicate that students in the multidisciplinary program had slightly larger preferences toward active and sensory learning as hypothesized, which indicates they have a preference toward the use of “straight-forward” real world examples and interacting with their environment in order to develop a greater understanding of the concepts being studied. The traditional group had a slight preference for reflective and intuitive learning, which is a preference for the use of varied and innovative instructional procedures and the process of thinking through ideas and concepts to obtain a greater understanding rather than “jumping in” and interacting with their environment. There was one learning styles scale that indicated a clear preference toward a particular style for both the traditional and the multidisciplinary groups. The majority of students clearly preferred visual learning to verbal presentation. This provides further feedback to our university professors on the importance of not primarily relying on the traditional lecture method of instructional delivery if the goal is to maximize student interest and involvement as active learners.

On the MBTI, students in both programs identified themselves as being more intuitive than sensing in personality type, although the traditional group was noticeably more intuitive with only 2 of the 15 students being classified as sensors. Intuitors have a greater desire to understand things conceptually rather than through the passive presentation of factual information. Results indicated that students in traditional programs tended to be more introverted than extraverted, whereas students in the multidisciplinary program were approximately equally distributed. It is of interest whether students who perceive themselves as more extraverted, as a whole, are more attracted to this multi-disciplinary program because of its business and industry orientation, the flexibility of the coursework, and/or the type of interactive cohort methodology used for facilitating the academic progression of students in this program.

Both groups classified themselves as more judging than perceiving. The one significant difference was on the thinking-feeling scale where the multidisciplinary group clearly saw themselves as having the thinking personality type, and the traditional group had approximately equal numbers of thinkers and feelers. Thus, the multidisciplinary group had a preference for making conclusions based on concrete results or information, and students in the traditional engineering program may be more likely to accept subjective data as a component to making decisions.

Demographic Group Comparisons

Differences in the demographic composition of the groups provide evidence of successful recruiting efforts and information on students who could be targeted in the future. A substantially larger proportion of black students chose to enroll in the multidisciplinary program. Admittedly, this has been one of the program goals. It will be interesting to follow the progress of the program to evaluate if more Hispanic students choose to enroll in the program after the faculty spends more time and effort actively recruiting this population.

Conclusions

Results provide information to instructors in both the traditional and multidisciplinary programs regarding the value in using a variety of teaching methods in the classroom. As students advance through the academic system, they may become adept at adjusting to specific teaching styles of instructors. It has even been theorized that students' preferences may become less pronounced as their educational levels increase. However, large variability in scores on each of the learning styles scales indicates students have distinct preferences toward particular learning styles and do not necessarily migrate toward the mean with advanced academic training. With the exception of the visual-verbal learning style, the multidisciplinary and traditional students have myriad learning style preferences and thus, instructors may be most successful by including a variety of instructional techniques in the classroom for optimal interaction.

The weakness of the validity of the ILS is a substantial limitation to this study. Future research will need to refine the ILS instrument or incorporate the use of other measures for assessing learning styles. Yet even with the low internal consistency of the scale items, differences between the two engineering groups were in the direction hypothesized. A combination of the ILS and MBTI results indicates that students preferring a more interactive, real world type of learning experience with the use of concrete examples supported by factual information may be more interested in a program like the multidisciplinary engineering program that uses an interactive cohort methodology to incorporate practical business skills training.

A second major limitation to the study is that the sample is voluntary based on human subjects requirements, and thus is not directly generalizable to the population of traditional and multidisciplinary science and engineering students on the campus where the study was conducted. The data are reported for informational purposes to help direct faculty on types of personal and career goal-oriented questions that may provide additional guidance in the advising process. For students entering graduate science and engineering programs, advisors may be better able to help them adjust to courses and career goals that fit with their interests and personality types. For example, introverts may prefer the coursework and academic career outcomes often related to a traditional graduate program. Extraverts may enjoy the cohort methodology and collaborative environment of the multidisciplinary program. Previous research has examined undergraduate engineering students with respect to personality and learning style type, but little has been done to further differentiate graduate engineering and science students, particularly those with an interest in business and industry. Future research for this study will focus on the success rate of the different types of students in terms of classroom performance, completion rates and time to graduation. Additionally, the results offer faculty of the multidisciplinary program empirical support of their efforts to recruit members of underrepresented groups to this type of program.

VI. References

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