Promoting Understanding in the Classroom: Comparison of the Strength Deployment Inventory, Learning Styles Inventory, and Myers-Briggs

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Abstract - Given the importance of teamwork in engineering, engineering educators have explored using many different assessment tools to help individuals understand themselves and others. Among the most popular of these assessments are the Myers-Briggs Type Indicator (MBTI)® and the Index of Learning Styles (ILS). Another potentially powerful assessment tool is the Strength Deployment Inventory (SDI). Whereas other tools measure behavior, the SDI provides insight into one's underlying motivations both when things are going well and in conflict. In this study, we gave the SDI as well as the ILS and the MBTI assessment to twenty-five undergraduate engineering students. Here we present the results of these assessments and explore comparisons between the three assessment tools. For the students in our sample, we showed that Extroverts on the MBTI tend to be more “Red” or Assertive on the SDI while Introverts on the MBTI tend to be more “Green” or Analytical on the SDI. Also, when under conflict, such as may arise on a team project, students’ behavior changes and is influenced by their MBTI type. This information might help instructors enhance students’ team experiences.

Index Terms – Strength Deployment Inventory, Learning Styles Inventory, Myers-Briggs, teamwork

INTRODUCTION

As educators, we strive to inspire our students to learn and enjoy their learning experience. However, we are often confronted with students’ apparent lack of motivation. What could be seen as a lack of motivation might actually be the students’ inability to capture the information due to differences in personality, motivation style, or learning style. As educators, we have to create a balance to ensure that we are reaching our students. This is particularly important for effective teamwork. Given the importance of teamwork in engineering, engineering educators have explored using many different assessment tools to help individuals understand themselves and others. One of the most popular of these assessments is the Myers-Briggs Type Indicator (MBTI)®.[1] The essence of this approach is that much seemingly random variation in behavior is actually orderly and consistent, being due to basic differences in the ways individuals prefer to use their perception and judgment. Another tool that has been successfully used in engineering education is the Index of Learning Styles (ILS).[2] This instrument assesses preferences on four dimensions of a learning style model formulated by R. M. Felder and L. K. Silverman. The ILS results provide an indication of possible strengths and habits that might lead to difficulty in academic settings.

Another potentially powerful assessment tool is the Strength Deployment Inventory (SDI).[3] Whereas many other tools measure behavior, the SDI provides insight into one's underlying motivations both when things are going well and when one has encountered conflict or opposition. SDI is based on the Relative Awareness Theory of Dr. Elias Porter that behavior is based on motivation, but motivation changes during conflict. Preliminary work with SDI concluded that administering the SDI assessment prior to team activities would increase their individual team survey assessment score at the end of the project and ultimately have a positive effect on students and their teams.[4] Students that received the assessment reported a more positive experience, higher team cohesiveness, and looked forward to future team projects more than those who did not receive the SDI assessment. These differences were determined to be statistically significant.

We gave the SDI as well as the ILS and the MBTI assessment to undergraduate engineering students. In this paper, we present the results of these assessments and explore comparisons among the three assessment tools. Comparisons have been done between the ILS and MBTI [5, 6] but we are not aware of any comparisons which include the SDI assessment tool. This information might help when instructors are trying to help students work in teams or develop materials to enhance student learning. By knowing student motivation styles, learning material can be developed to address their preferred method of communication, which might increase their understanding and retention of course material. This concept of learning material development including the SDI assessment will be explored in more depth as part of an NSF CCLI grant awarded to one of the authors for the redevelopment of a manufacturing systems course. [7]

STRENGTH DEPLOYMENT INVENTORY (SDI)

The SDI, the cornerstone tool of Relationship Awareness Theory, is an established tool for improving team...
Dr. Elias Porter’s Relationship Awareness Theory gives organizations and individuals a framework for building more effective personal and professional relationships. It helps them to sustain those relationships through understanding the underlying motivational value systems of themselves and others—not just when things are going well, but also when they are managing conflict. Relationship Awareness Theory helps people to recognize that they can choose their behaviors to accommodate their underlying values, while also taking into account the values of others. It is a dynamic and powerful way of looking at human relationships that aids in building communication, trust, empathy, and effective, productive relationships. [3]

Relationship Awareness Theory is a Motivational Theory which addresses the motives behind everyday behavior in relationships. By shifting our focus from only looking at behavior to looking at the motive behind the behavior, we can gain a clearer understanding of ourselves and others. [3]

Relationship Awareness Theory looks at behavior in the following ways:

1. Behaviors are tools used to achieve a result or confirm our sense of self-worth. These tools are also used to ward off things we do not want.
2. Motives come from our wish to feel a strong sense of self-worth or self-value.
3. Our individual Motivational Value System is consistent throughout our life and underpins all of our behaviors.

Traditionally, motivation is described as something that can be inspired in others. However, in Relationship Awareness Theory, motives are considered already present in every person and readily available to be tapped. Thus, in Relationship Awareness Theory, we look at motives as a basic antecedent of behavior. In other words, motives are the “why” of what we do. People are born with a predisposition for a particular motive set. Throughout childhood and adolescence a person may receive positive or negative feedback regarding their Valued Relating Style. The degree of finesse that a person has with their Valued Relating Style is then, a function of the opportunities they have had to use and refine their use of their personal strengths, thus consolidating their Valued Relating Style by late adolescence or early adulthood. The Motivational Value System is seen as unchanging over the course of a lifetime. People either use their Valued Relating Style and feel empowered and rewarded, or use a non-preferred style and feel devalued and unrewarded. If the environment provides opportunities for an individual to use their Valued Relating Style and rewards the subsequent behavior, the individual usually reports feeling good about himself or herself and good about their relationships. Their sense of self-esteem rises and their sense of well-being is enhanced. If, on the other hand, the person is consistently denied the opportunity to use their Valued Relating Style, there can be adverse consequences. [10]

Relationship Awareness Theory identifies seven styles of relating to others or clusters of motives known as Motivational Value Systems. These systems are described in terms of characteristic behaviors as well as colors (red, green, blue or a combination). The term “hub” is used to refer to the balance or combination of all three colors. Four of these are primary types of strengths and three are blends of the primary types of strengths.[3]

- Altruistic-Nurturing (Blues) – concern for the protection, growth and welfare of others.
- Assertive-Directing (Reds) – concern for task accomplishment and organization of resources to achieve results.
- Analytic-Autonomizing (Greens) – concern for well-thought out approaches, order, individualism, and self-reliance.
- Flexible-Cohering (Hubs) – concern for flexibility, group welfare, and team members.
- Assertive-Nurturing (Red-Blues and Blue-Reds) - concern for the protection, growth and welfare of others through task accomplishment and leadership.
- Judicious-Competing (Red-Greens and Green-Reds) – concern for intelligent assertiveness, justice, leadership, order and fairness in competition.
- Cautious-Supporting (Blue-Greens and Green-Blues) – concern for affirming and developing self-sufficiency in self and others, concern for thoughtful helpfulness with regard to justice.

Note that the behaviors are not unique to any particular cluster. For example, people who are motivated by a desire to be “altruistic-nurturing” tend to exhibit behaviors that are seen by others as helpful. However, helpful behavior can also be exhibited by people who have other motivational value systems. The difference is one of frequency. People who are motivated by a desire to be altruistic and nurturing are likely to behave more frequently in ways that are helpful to others than people who have other motive clusters.

To complete the SDI assessment, an individual answers 20 multiple-choice self reporting questions. Then the relative importance of the separate value systems in an individual is calculated. Ten of the questions are used to determine the individual’s Motivational Values System when things are going well. The other ten questions determine the individual’s conflict sequence. The conflict sequence consists of three stages and behavior changes that one goes through when in conflict. For example, if an individual’s Motivational Value Style is Red, they do not necessarily exhibit Red behavior during the first stage.

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Instead, they might go from Blue to Red to Green or any other combination. The three stages of conflict are:

Stage 1 – Focus on self, problem and others
Stage 2 – Focus on self and problem
Stage 3 – Focus on self

The results of the assessment are presented as a score for each color for when things are going well (“normal”) with the scores adding up to 100, scores for each color in conflict, and a graphical presentation on a tricolored MVS triangle with a dot that represents “normal” and an arrow to indicate movement during conflict. For example, a person whose “normal” MVS is “Blue” might score 50-37-13 for Blue-Red-Green. In conflict, if their scores were 42-30-28 for Blue-Red-Green, their Stage 1 response would be characterized as Blue, Stage 2 as Red, and Stage 3 as Green. (See Figure 3 later in the paper for more examples of the graphical representation.)

Understanding these styles helps anticipate others’ reactions to difficult situations to provide strategies for altering traditional approaches. This is vital information because it means we can understand why certain people have the impact on us they do and how we may be impacting them! Furthermore, we learn how to recognize the real issues in relationships and how to tailor our language accordingly to communicate in more flexible and effective ways.

The SDI when used with intact or newly formed teams gives the teams a picture of how everyone on the team is motivated - both when things are going well and during conflict. Teams could use this information to allocate tasks, identify and resolve conflict, improve communication, and work more productively together. Teams could gain a greater sense of understanding, acceptance, and appreciation of each other. For example, a student with a Red MVS would like to know what needs to be done and will take on the tasks to make it happen. A student with a Green MVS, however, will need detailed explanation on what needs to be done, the steps to follow, and the reasons for the task.

MYERS-BRIGGS

The Myers-Briggs Type Indicator® (MBTI) personality inventory is well-known with a comprehensive website and numerous references available in the literature. [1, 11] The MBTI was developed in the 1940s by Isabel Briggs Myers and her mother Katharine Cook Briggs to make the theory of psychological types described by C. G. Jung understandable and useful in people’s lives. The essence of the theory is that much seemingly random variation in the behavior is actually quite orderly and consistent, being due to basic differences in the ways individuals prefer to use their perception and judgment. Based on Jung’s theory, the MBTI characterizes people using one of 16 distinctive personality types arising from four different preferences. These are described by personality type and expressed as an MBTI code of four letters based on these descriptions [1]:

- **Favorite world**: Do you prefer to focus on the outer world or on your own inner world? This is called Extraversion (E) or Introversion (I).
- **Information**: Do you prefer to focus on the basic information you take in or do you prefer to interpret and add meaning? This is called Sensing (S) or Intuition (N).
- **Decisions**: When making decisions, do you prefer to first look at logic and consistency or first look at the people and special circumstances? This is called Thinking (T) or Feeling (F).
- **Structure**: In dealing with the outside world, do you prefer to get things decided or do you prefer to stay open to new information and options? This is called Judging (J) or Perceiving (P).

For example, someone whose preferences are for introversion, sensing, feeling, and perceiving would be known as an “ISFP”.

As engineering professors we need to be aware of the different personality types. As mentioned by Felder, “Engineering professors usually orient their courses toward introverts (by presenting lectures and requiring individual assignments rather than emphasizing active class involvement and cooperative learning), intuitors (by focusing on engineering science rather than design and operations), thinkers (by stressing abstract analysis and neglecting interpersonal considerations), and judges (by concentrating on following the syllabus and meeting assignment deadlines rather than on exploring ideas and solving problems creatively).”[12]

**INVENTORY OF LEARNING STYLES**

The Index of Learning Styles (ILS) is a 44-question instrument used to assess preferences on four dimensions (active/reflective, sensing/intuitive, visual/verbal, and sequential/global) of a learning style model developed by Richard M. Felder and Linda K. Silverman in 1988. [13]

- **Sensing** (S) (concrete thinker, practical, oriented toward the facts and procedures) or **Intuitive** (I) (abstract thinker, innovative, oriented toward theories and underlying meanings)
- **Visual** (V) (prefer visual representations of presented material, such as pictures, graphs, charts) or **Verbal** (Vr) (prefer written and spoken explanations)
- **Active** (A) (learn by doing, trying things out, enjoy working in groups) or **Reflective** (R) (learns by thinking things through, prefer working alone or with a single familiar partner)
- **Sequential** (Sl) (linear thinking process, learn in small incremental steps) or **Global** (G) (holistic thinking process, learn in large steps)
Based on the four dimensions, there are 32 [2] learning styles. The impact on ILS for engineering educators is summarized as

“Students learn in many ways—by seeing and hearing; reflecting and acting; reasoning logically and intuitively; memorizing and visualizing and drawing analogies and building mathematical models; steadily and in fits and starts. Teaching methods also vary. Some instructors lecture, others demonstrate or discuss; some focus on principles and others on applications; some emphasize memory and others understanding. How much a given student learns in a class is governed in part by that student’s native ability and prior preparation but also by the compatibility of his or her learning style and the instructor’s teaching style. Mismatches exist between common learning styles of engineering students and traditional teaching styles of engineering professors. In consequence, students become bored and inattentive in class, do poorly on tests, get discouraged about the courses, the curriculum, and themselves, and in some cases change to other curricula or drop out of school.”[2]

In their work, Felder and Silverman examined the learning styles of engineering students and provided suggestions to educators to effectively approach students based on their learning style. [2, 14]

**OUR STUDY**

After obtaining institutional review board approval, we gave the SDI, ILS and MBTI assessments to first year engineering students in a first-semester *Introduction to Engineering* course and senior Industrial and Systems (ISyE) students at the University of San Diego (USD). USD is a private Roman Catholic institution with a small engineering program offering a B.S./B.A. in Electrical Engineering, Industrial and Systems Engineering, and Mechanical Engineering. Typical class sizes are 15 students. The first year curriculum is identical for all engineering majors. Thus most first year engineering students have not declared a specific major. In addition, only the SDI was given to another 45 first year engineering students in a second-semester *Introduction to Engineering Design and Practice* course.

**RESULTS AND ANALYSIS**

The results of the survey assessments are shown in Table I for the 25 USD Engineering students who took all three assessments. The SDI results from these 25 students as well as the additional 45 students who took only the SDI are shown in Figure 1. Initially, we compared our results to a sample of 25,000 from the general population [15]. When comparing the USD Engineering student distribution shown in Figure 1 to the general population shown in Figure 2, we see that the shapes of the distributions are similar with the majority of participants falling into the “Hub” category.

<table>
<thead>
<tr>
<th>USD ENGINEERING STUDENTS’ ASSESSMENT RESULTS</th>
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<tbody>
<tr>
<td><strong>Student</strong></td>
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**TABLE I**

**RESULTS OF SDI ASSESSMENT FOR 70 USD ENGINEERING STUDENTS**

**RESULTS OF SDI ASSESSMENT FOR GENERAL POPULATION OF 25,000 PARTICIPANTS**

Our engineering sample does show a larger percentage of “Hubs” than the general population (39% vs. 57%) and a smaller percentage of “Greens” (6% vs 3%).
Given the analytic behavior of “Green”, we were surprised to find only 3% greens in our engineering student sample. Thus, we continued to investigate the data. We discovered an interesting relationship when viewing the SDI results for the three stages of conflict. Although USD Engineering students score highest for “Blue” initially, as conflict arises, which could occur when presented with a problem or in a project, the students “Red” and “Blue” Motivational Value Systems increase by 6.1% and 12.3% respectively. This would imply that as students are faced with adversity, their Analytical and Assertive strengths start to take effect. This can be seen in Table II which shows the average SDI score in each color for our sample when students are acting according to their own MVS (shown as “normal”) and when students are in conflict. (Note that all of these scores would still lie within the “Hub” region on the MVS triangle.)

<table>
<thead>
<tr>
<th></th>
<th>Blue</th>
<th>Red</th>
<th>Green</th>
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<tbody>
<tr>
<td>Normal</td>
<td>36.8</td>
<td>31.9</td>
<td>31.3</td>
</tr>
<tr>
<td>Conflict</td>
<td>30.5</td>
<td>34.0</td>
<td>35.7</td>
</tr>
<tr>
<td>% Change</td>
<td>-20.6%</td>
<td>6.1%</td>
<td>12.3%</td>
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</table>

To study the students’ results further, the average scores for all the questions were subdivided by the MBTI categories and plotted on the SDI MVS triangle as shown in Figure 3. Each dot which represents the “normal” MVS is labeled with a letter which is linked to the MBTI and Blue-Red-Green scores as shown in the legends outside of the triangle. As expected, most of the dots are located in the center circle which is called the “Hub”, however, the “arrowheads” which represent the conflict sequence are more spread out over the other regions. The arrowheads are also visually towards the Red and Green regions supporting the conclusion that the students’ behavior becomes more “Green” (Analytical) and “Red” (Assertive) as conflict arises. For example, the dot labeled C corresponds to an MBTI of ESFJ. This group starts out near the Blue edge of the “Hub” with scores of 40-33-27 when things are going well but moves toward the Red and Green areas under conflict with scores of 32-37-31 for Blue-Red-Green. The INFJ group labeled G moves more dramatically from “Hub” to “Green” under conflict. This is seen by the longer arrow for this representation compared to that for the ESFJ group.

Finally, we also investigated two additional hypotheses; Extroverts are primarily “Red” and Introverts primarily “Green”. To validate this inquiry, a two sample t-test was performed on the results from the sample of 70 USD Engineering students. The statistical results showed that the “Red” scores for Extroverts are significantly greater than those of Introverts based on an alpha value of 0.05. In addition, the “Green” scores for Introverts are statistically greater than for Extroverts based on an alpha value of 0.05.
CONCLUSIONS
We explored the relationships among the SDI, MBTI, and ILS assessments for a sample of 25 undergraduate engineering students. Our analysis shows that, like the general population, our engineering student sample has a large percentage of “Hubs” or people who are relatively balanced when things are going well. However, when faced with conflict such as may be the case when working on a team project, students’ behavior changes to become more analytical or more assertive. We showed that these changes are influenced by their Myers-Briggs type (MBTI). An awareness of these factors could be helpful to engineering instructors in enhancing students’ experiences within teams. Our results also show that Extroverts are more likely to score high as “Red” or analytical on the SDI while Introverts are more likely to score high as “Green” or analytical on the SDI. Further study on larger populations would be useful to determine the generalization of these findings.

ACKNOWLEDGMENT
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