

Connecting to engineering students in the classroom

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ABSTRACT: All of us have something to learn and to teach. Many teachers believe that being fair means treating all students equally. If this translates into using the same approach with every student or treating students identically, then problems are likely to arise for many students who may feel left out because of their teacher's choice of classroom activities biased by his/her own teaching style. Educators have been using the Myers-Briggs Type Indicator (MBTI) to develop teaching methods and to understand both individual learning styles and differences in motivation. In this investigation, the MBTI is used to infer not only in terms of type casting students, but also on how to better understand their learning differences, strengths and weaknesses. Once the natural and healthy differences that exist in students are fully understood, teachers can appreciate that being fair really means providing equal opportunities for each student to learn in the manner that best suits his/her own natural learning style. Adjusting instruction to accommodate the learning styles of different types of students can increase both achievement and the enjoyment of learning; therefore, this work can improve the degree of satisfaction and understanding among university teachers and students.

INTRODUCTION

The Swiss physician-psychologist Carl Jung had the insight that people could be identified by their different – and equally legitimate – preferences for functioning. Jung wrote in his memoir that he developed *psychological types* to explain how an individual functions within a society; it is precisely the interplay of inborn personality preferences with the temperament of a family or a nation that permeates his discussion of type. However, personality type does not explain everything when it comes to people and there are few simple answers in this regard.

Myers had the vision to apply that knowledge, determining how people take in information, make decisions, and communicate thoughts and feelings [1]. The Myers-Briggs Type Indicator (MBTI) is based on Jung's theory that people with different personality profiles organise information and perceive the world in different ways. The theory of psychological type has the power to transform human relationships, particularly the teacher-student interaction. In fact, it can help to improve interpersonal dynamics, avoid misunderstandings and explain motivation.

The MBTI is a personality-assessment tool that has been used for more than three decades to determine personality styles and preferences. Although neither this psychological instrument nor any other scheme yet developed is universally accepted by all psychologists, many educators and institutions are employing the MBTI inventory for a variety of purposes, including vocational counselling and career development.

The MBTI is a self-report instrument. It is an indicator of preferences, is based on theory, is professionally interpreted, is non-judgmental, and is a way to sort, not to measure. Among its benefits, the MBTI:

- Offers a logical model of consistent human behaviour.
- Emphasises the value of diversity.
- Builds an objective framework for examining emotional issues.
- Presents a way to improve communication patterns.
- Aids people in valuing their unique contributions.
- Helps reduce stress.
- Provides a dynamic theory on which one can build personal strategies.

It is this well-researched view of type theory that teachers would like to apply to discussions of teaching and learning styles. In order to do so, it is important to discuss several approaches to teaching and how type is related to each approach. This is deemed as the best way to improve teaching effectiveness because it explains why teachers are sometimes pressured to teach in a way that does not suit their personality styles and how students are forced to learn in environments that do not suit their learning styles. To understand this, it is necessary to look at a teacher's and student's preferred teaching and learning styles.

The MBTI is an instrument that is designed to measure four dimensions of an individual's personality: extraversion/introversion, sensing/intuitive, thinking/feeling, and judging/perceiving.

The indicator establishes these four parameters so as to assess personality types. We all have personality qualities of each scale or parameter but we simply prefer some qualities or are more comfortable with some styles than others. An example of this is how right-handers are more comfortable with the right hand, but sometimes use the left hand. Each respondent is forced to choose preferences; the higher the score on each preference, the stronger the preference is likely to be. No one has to excel at everything.

Extraversion (E) and Introversion (I)

The first scale represents complementary attitudes towards the outer world of people and action; or the inner world of ideas and private things. As a matter of fact, the extravert prefers looking outward, but the introvert looks inward. For example, strong extraverts are sometimes said to *talk to think*, whereas introverts *think to talk*. The implications of these terms go beyond the everyday caricatures of sociable versus shy.

Extraverts are talkative, initiators of conversation and outgoing; they like action and variety. In contrast, introverts are quiet, respondent to conversation and reserved, they like silence and time to consider things. To an extravert, the outside world is where interesting things happen, so *he who hesitates is lost*. Yet to an introvert, the hustle and bustle of the outside world can be distracting; the more interesting part of life is the world of thoughts and ideas, so *look before you leap*. Both orientations can be valuable, just as both can be costly, but neither is inherently better than the other; they are simply different.

Sensing (S) and Intuition (N)

The second scale of preference distinguishes the way we take in information from the environment. Whereas a strong sensing person (S) might need to assimilate a whole series of facts in linear fashion, the person who prefers intuition (N) can absorb the same information through abstraction and concepts that might not seem to be directly related in the first place, but that could establish a pattern.

S enjoys using skills already learned more than learning new ones, and dislikes new problems unless prior experience shows how to solve them; N likes using new skills more than practicing old ones, and dislikes doing the same thing over and over again. This scale indicates whether a person would rather understand the objects, events and details of the present moment (S) or imagine the possibilities of the future (N). The adjectives that describe a sensing person are realistic, practical, and fact-oriented, while those appropriate to an intuitive person are speculative, imaginative and creative. Of course, we all share both sets of qualities to some extent, but one set predominates.

Thinking (T) and Feeling (F)

The third mode of orientation in the MBTI classification are thinking and feeling; again these terms are more extensive than everyday usage indicates. This scale shows a person's preferred basis to make decisions: logical analysis (T) or personal values (F).

This scale of preferences identifies thinking as the analytical way of making a decision, while feeling describes the tendency to rely on values to make decisions. Whereas the T individual needs distance from a situation to make a decision, the F person must be immersed in the situation in order to gain empathy with people involved. Sometimes, a T may neglect and hurt other people's feelings without knowing it; that rarely happens to an F, who is usually very aware of other people's feelings. There is a gender difference in the general population regarding this scale, that is, the majority of women prefer F. Thinking people are principle-oriented, cool-headed and firm. Feeling people are emotion-oriented, warm-hearted and gentle.

Judging (J) and Perceiving (P)

The fourth scale differentiates between how we are oriented in our lifestyles and how we organise our world. It reveals whether a person favours organising and controlling events (J), or observing and adapting to them (P).

J identifies the tendency to be super organised. If a deadline is to be met, the J person usually finishes the task well in advance. At the other extreme, the person who prefers perceiving (P) appears to be very disorganised and seems to be distracted from completing a task until some little bell goes off at the last minute and tells this individual to get the task done. Often, it is said the easiest way to distinguish between these two preferences is to look at the person's desk. The desk of a J person is immaculately organised; the desk of a P individual appears to be in constant chaos even though the P person claims to know exactly where everything is located and that there are rules underlying the chaos. The words deadlines, punctual, schedule and routine apply to judging types, whereas open-ended, flexible, adaptable and spontaneous apply more to perceiving types.

The MBTI sorts these four sets of preferences, one from each dimension, to filter out a person's preferred type. Hence, a person's four preferences indicate which of the 16 personality types he/she fits, as shown in Figure 1. Philosophically, this system of classification places an equal value on all 16 types, respects the differences between people and explains their varying points of view. If the MBTI results show that a person is ISTP, then the terminology is to suggest that the person prefers ISTP, not that the person *is* an ISTP. No type is better than any other.

ISTJ	ISFJ	INFJ	INTJ
ISTP	ISFP	INFP	INTP
ESTP	ESFP	ENFP	ENTP
ESTJ	ESFJ	ENFJ	ENTJ

Figure 1: The 16 MBTI types.

TYPES AND LEARNING STYLES

This section addresses the issue of how a learning style should be used at higher-level education. There have been numerous attempts to classify the fundamental ways in which learning styles differ. Based on the work of several educators, Tennant observes that learning styles can be typically represented as polar opposites of a single dimension, so that a person is described as field dependent/independent, reflective/impulsive, convergent/divergent, analytic/holistic and so on [2]. These varied approaches to learning should not be seen as mutually exclusive; rather they support the reasonable expectation that people differ in their learning styles in a number of ways.

An ideal learner needs four different kinds of abilities: concrete experience abilities, reflective observation abilities, abstract conceptualisation abilities and active experimentation abilities. That is, the perfect learners must be able to involve themselves fully, openly and without bias in new concrete experiences, they must be able to reflect on and observe these experiences from many perspectives, they must be able to create concepts that integrate their observations into logically sound theories, and they must be able to use these theories to make decisions and solve problems. However, this model does not apply to

every learning situation, that is, not every learning opportunity demands a balanced integration of concrete experience, reflective observation, abstract conceptualisation and active experimentation.

Teachers tend to teach, as they themselves like to be taught; commonly teachers assume that their students can learn best by employing the same techniques that once were used on them as students. However, people differ significantly in the way in which they learn best and it is believed that these learning styles are related to personality types [3].

Learning style is a term that refers to an individual's characteristic and consistent approach to perceiving, organising and processing information. The idea that people have different learning styles is enticing for educators. First, it highlights the importance of learning processes, as well as teaching techniques. Second, it is an egalitarian concept because it focuses on people's strengths and weaknesses, that is, learners become *different* rather than bad, poor, average, good and excellent. Because of this, it would be naïve to expect that teachers could easily design and deliver a course to fit the learning style needs of all of their students.

As it turns out, there are very few ideal learners, and most of us develop a preference or strength in one of the poles of each dimension. For instance, in the classroom, extraverts are the ones likely to begin working on an assignment before the teacher has finished writing it on the board, because they tend to think while they speak rather than before they speak. In discussion, they may interrupt frequently, dumping their

thoughts quickly for consideration. They may have trouble sitting still for long periods of time, such as when listening to a lecture or writing a paper, and they usually work better when allowed to take frequent, active breaks.

However, introverts are likely to do well when given long, uninterrupted periods of study. They may even work better when they can get away from the distractions of the classroom. They are less likely than extraverts to contribute frequently to discussions. But when they say something, it has generally been well thought out. Because they like to rehearse their answer before speaking, they may be slow to respond to questions about new material.

Figure 2 contains a summary of findings that relate personality types to learning styles. For example, Figure 2 also indicates how the process of learning is fundamentally different for sensing and intuitive people. The findings shown here have implications for teacher training and the grouping of students.

It can be assumed that learning styles are stable in adulthood, as the MBTI is constant through adulthood. As the issue of the stability of learning preferences is likely to persist, it has implications for how best to provide advice and guidance to learners. If preferences are fixed, then it may be better to attempt to match teaching and learning styles, develop alternative learning activities for people with different styles, and guide people into those styles to which they are suited. The implication for teachers is that they should be aware of a learner's styles and apply corrective intervention where appropriate. On the other hand, intervention is also possible by

<p style="text-align: center;">Extraversion (E)</p> <p>E's usually learn best in an active environment, and have trouble sitting for long periods of time listening to a lecture or writing a paper. They often work best when they can interact in small groups, talk lessons over with a partner. E's tend to plunge into the activities without much forethought, relying on trial-and-error rather than anticipation to solve problems. E's like to talk their thoughts.</p>	<p style="text-align: center;">Introversion (I)</p> <p>I's usually learn best when working quietly and alone, read lessons over or write them out before discussion. They like to think through a problem before talking about it. I's should be given adequate time to formulate their responses before discussing it and are more comfortable when they can prepare their responses in advance, as they like to keep thoughts inside until they are polished.</p>
<p style="text-align: center;">Sensing (S)</p> <p>S's prefer the concrete to the abstract and tend to learn best in step-by-step progression. They follow clear, specific instruction and are often frustrated when given vague directions or unclear assignments, and are usually better at summarising material than analysing it. They like demonstrations, films and audiovisuals, and have practical examples and hands-on exercises, as this requires actively engaging the senses.</p>	<p style="text-align: center;">Intuition (N)</p> <p>N's prefer the abstract to the concrete and can become bored during drill or factual lectures. They thrive in classroom situations that place a premium on imagination, but are sometimes careless about details. They welcome opportunities for brainstorming, and are able to see the big picture. They work best if they can see global patterns, incorporate new approaches and demonstrate originality.</p>
<p style="text-align: center;">Thinking (T)</p> <p>T's prefer classrooms in which instructors provide a clear rationale for assignments. T's like topics that help them understand systems or cause-and-effect relationships, and develop logical criteria. T's tend to think syllogistically and analytically. T's work best if they can prepare outlines and state the objective first.</p>	<p style="text-align: center;">Feeling (F)</p> <p>F's prefer assignments in which they can find a human angle or have emotional investments. F's are less concerned with logic and more with values, and they like situations where helping people is the main activity. They see competition as disharmonious and like instruction with a feeling involvement.</p>
<p style="text-align: center;">Judging (J)</p> <p>J's tend to seek closure. They are comfortable making decisions and once a decision is made, they stick to it. J's tend to be well-organised, meet deadlines and usually prefer to work on one task at a time. They thrive in a structured classroom, with systematically organised lectures and exercises, and like to follow a study schedule.</p>	<p style="text-align: center;">Perceiving (P)</p> <p>P's tend to resist closure. They prefer spontaneity so that they can explore things without preplanning. P's like to work on multiple tasks simultaneously and often work right up to, and even beyond, deadlines. They work best if they have independence and autonomy to complete tasks.</p>

Figure 2: Types and learning styles.

assisting students to diversify their learning strategies and encourage optional choices outside a student's preferred style.

Fortunately, almost every class has at least some students of each type, so by accommodating every preference, each student can be exposed to other preferences. This helps students develop skill in their non-preferred areas. Such development is beneficial in creating the balance adults need to function effectively in the world. However, according to the MBTI model, people will be at their best when they have effective command of their preferred function. Therefore, students learn most effectively, especially when approaching new or difficult topics, when they are given opportunities to use their most effective learning style. Learning is most effective if different but complementary qualities are applied and combined; the integration of different techniques avoids burnout and boredom.

TYPES AND TEACHING STYLES

It is certainly not suggested that instructors must always adapt to the learning styles of their students. This is not only impossible in a diverse classroom setting, but also creates too much stress on the instructor. Certainly, an instructor can use an approach and modify it for those students who may feel disconnected. For example, an instructor who makes use of a lot of discussions in the classroom could be aware of the difficulty that introverts might have with the approach and be supportive rather than punitive when introvert students are slow to become involved in debates. Instructors can also use individual tutorials and other opportunities to individualise their advice in order to teach in a way that makes sense to a particular student. If instructors are careful to avoid reifying their approach by saying: *this is how I teach because it is related to who I am*, then their students can only benefit.

Figure 3 relates some aspects of personality traits to teaching. To give an example, extraverted teachers tend to be more activity-oriented, while introverted teachers usually like to allow more time for reflection. Extraverted teachers are generally more comfortable with noisy classrooms than their introverted counterparts, who like to maintain an atmosphere in which they (and their students) can *hear themselves to think*.

Effective teaching is achieved by combining explanation on basic principles, then their meanings with concrete facts and examples. This means that optimal acceptance is accomplished by balancing general description conducive to a proper understanding of the basic idea, providing an intuitive understanding; as well as by giving examples on its realisation and showing how the principle works, which is easily captured by a sensing person. Effective teaching is also significantly enhanced by the emotional strength of the teacher who is capable of captivating the feeling students. The ideal teacher, then, is one who can diagnose learning styles and select from an armoury of skill and techniques the appropriate strategy for enhancing learning.

DISCUSSION

It seems reasonable to expect that students encompass a variety of personality traits. Regarding learning styles, there is no one best combination of characteristics, since each preference has its own advantages and drawbacks. Therefore, it is a fallacy to think that professors can devise a single teaching technique that always appeals to all students.

A few teachers may conclude that the need for an appropriate match between student type and teaching style is more critical for students of below average intelligence. Yet all students can benefit tremendously if there is a match of learning and teaching styles. The combination of Figures 2 and 3 sets out some positive aspects of effective teaching and learning.

The majority of university faculty members that fall further along the scale towards the introvert side is more than the majority of university students. [4]. Additionally, the same survey shows that the majority (65%) of faculty in universities is found to be intuitive (N), although sensing (S) types dominate applied fields such as engineering and business.

In fact, INTJ and ISTJ are the most common types among university professors. Incidentally, the majority of elementary and high school teachers are ESFJ. As the E-I scale reflects natural interests and considering that most university students prefer E (although most university professors prefer I),

<p style="text-align: center;">Extraversion (E)</p> <p>E teachers give students choices and voice, are attuned to changes in students attention and are comfortable with noisy classrooms. E's tend to positively evaluate students who are active, energetic and enthusiastic.</p>	<p style="text-align: center;">Introverts (I)</p> <p>I teachers structure teaching activities, are attuned to the ideas they teach and comfortable with business-like atmosphere. I's tend to positively evaluate students who are thoughtful and introspective.</p>
<p style="text-align: center;">Sensing (S)</p> <p>S instructors emphasise facts, practical information and concrete skills, and usually ask for detailed and fact-oriented questions. S's are biased to students who are factual, practical and accurate.</p>	<p style="text-align: center;">Intuitive (N)</p> <p>N instructors emphasise concepts, the implications of facts, and their questions call for synthesis and meaning. N's are biased to students who are conceptual, creative and insightful.</p>
<p style="text-align: center;">Thinking (T)</p> <p>T educators talk from an objective base; they want students to focus on what he/she is doing or saying and they attend to the class as a whole. T's are inclined towards students who are logical, precise and critical of their own work.</p>	<p style="text-align: center;">Feeling (F)</p> <p>F educators seek dialogue and engagement, they encourage students to focus on interpersonal work and attend to individuals or small groups. F's are inclined towards students who are approachable.</p>
<p style="text-align: center;">Judging (J)</p> <p>J scholars are very orderly and stick to the class plan with organised lectures and like a well-arranged classroom. J's tend to positively evaluate students who are task-focused, timely and organised.</p>	<p style="text-align: center;">Perceiving (P)</p> <p>P scholars are lax and less organised, they like as much activity-oriented work as possible. P's tend to positively evaluate students who are spontaneous, adaptable and easygoing.</p>

Figure 3: Types and teaching styles.

extravert students respond better to discussion in order to learn and generate ideas than simply hearing a lecture on it. On the other hand, students who prefer I probably learn best by working alone, as they need solitude to think best and will benefit little from discussions. The I's need to mull over things before they talk and act.

With respect to the S-N preference scale, the S-N function also reflects basic learning difference with regard to taking in information. Sensing individuals focus on details, whereas intuitive people need to see the big picture. Sensing-type students deal easily with observing and memorising facts, but often need help in learning how to generalise from them. They often do well in courses that emphasise memorisation, but experience difficulty with tests that require hypothesising and problem solving. They can be helped to deal more successfully with abstract concepts if the educator begins with the concrete and moves step-by-step to the abstract, or if several specific applications of the theory are presented.

Sensing students are interested mostly in learning what is practical and can be put to direct use; they do best when the educator's directions are concise and to the point. In contrast, intuitive peers prefer to rely on their grasp and ability to apply general concepts and tend to shy away from the learning of facts *per se*; they deal well with abstractions and theory, and prefer open-ended projects.

The T-F preference correlates least with academic success, although as one might predict, most highly successful science and mathematics students and faculty members surveyed scored higher on the thinking scale, whereas those attracted to the liberal arts and to people-oriented fields, such as psychology and nursing, scored higher on the feeling side. This could be considered a surprise, since one would assume that thinking might have some kind of edge. Both thinking and feeling are valid preferences and processes. However, it is known that thinking types concentrate on the content of the lecture message; on the other hand, the feeling-oriented student is concerned with how the message is delivered.

Feeling people do their best with interpersonal domains requiring social skills, such as school teaching and the social and medical sciences. Thinking people do best with the analytical and impersonal domains such as mathematics, engineering, and technical and mechanical activities; this is associated with analytical thinking. It is also linked with better performance on tests of intelligence and other cognitive tests. These people are believed to structure material more effectively and form concepts more readily. They are more capable of dealing with a lack of clear direction (which is a feature of the adults as apposed to the child learner). Not surprisingly, students in the arts and social sciences tend to prefer feeling (F), whereas students in engineering and business are more likely to prefer thinking (T).

Similarly, the J-P difference is instructive for teaching and learning. Most educators tend to prefer judging (63%), whereas students are split 50:50 between judging and perceiving preferences. Judging types crave for closure: they want to make

a decision and go for it. Perceiving types tend to put off decisions, appear to waste time looking for all of the information; even after one decision is made, they might reopen the issue and reconsider it.

In general, perceiving types do better on aptitude tests while judging types tend to get higher grades in academic courses, presumably owing to their ability to focus themselves to a task. In terms of learning styles, judging types are considered to learn best in an orderly fashion through lectures and textbooks, and like meeting deadlines. Perceivers are found to prefer to cramming and doing things at the last moment, since they view learning as an open-ended activity.

CONCLUSION

In conclusion, good educators should be able to broaden their repertoire of effective teaching techniques, and so be able to reach all students at least some of the time. They should also consider varying their teaching styles on occasion to motivate and establish common ground with those few students who have different traits to their own. One suggestion is to view the teacher as a leader such that the goal of any leader is getting people to do what the leader needs and wants them to do. In the case of education, this means getting students to learn and to achieve by being aware of one's own personality styles and the wisdom and diversity of the various types. Therefore, the role of the instructor should be to:

- Help individuals understand themselves as learners through the identification of personality types.
- Encourage students to expand their learning strategies.
- Use a variety of instructional approaches so that learners are exposed to different methods of learning.
- Create an atmosphere in which diverse learning styles can thrive.
- Encourage collaboration and an exchange of experiences among students.

The MBTI is neither a measure of teaching performance nor learning competence, it is only an indicator of preferences. However, this objection does not preclude the possibility of using the MBTI to improve higher education practices. As a rule of thumb, the MBTI provides insights for effective teaching and learning, and it can be usefully employed as a guide to help understand learning styles and improve teaching skills.

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**Conference Proceedings of the
6th UICEE Annual Conference on Engineering Education
under the theme: *Educating for the Right Environment***

edited by Zenon J. Pudlowski

The 6th UICEE Annual Conference on Engineering Education, under the theme of *Educating for the Right Environment*, was organised by the UNESCO International Centre for Engineering Education (UICEE) and was held in Cairns, Australia, between 10 and 14 February 2003. This 6th Annual Conference of the UICEE was an academic activity that, basically, commenced the 10th year of the UICEE's operations.

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