An Exploration of Matching Teaching to the Learning Preferences of Systems Engineering Graduate Students

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Abstract. This paper provides an exploratory study on the relationship between learning preferences of systems engineering graduate students and delivery methods of systems engineering coursework. We begin by providing an overview of learning in the systems engineering context, followed by two central research questions that guide the rest of the paper. Our study is focused on measuring learning preferences based on a previously developed survey instrument called VARK. We provide a detailed description of VARK and some insight into the existing database that sheds light on the typical distribution of learning preferences across disciplines. We provide some preliminary results and discuss their implications on systems engineering curriculum development and delivery. Finally, we discuss additional questions that remain to be explored as we strive to understand the learning preferences of systems engineering graduate students.

Introduction

Postgraduate students in systems engineering (SE) are typically mature-age and studying part time (Rhodes & Valerdi 2007). They often cannot take classes on a full-time study, or regular attendance on campus basis (Kasser 2008). A literature review on systems engineering education and curriculum design (Asbjornsen 2000, Peppen 2000, Sage 2000, Brown 2000, Thissen 1997, Jain 2007, Ratcliff 1997) found that publications focused on the SE body of knowledge and did not give much attention to other pedagogical issues such as learning and teaching styles (Kasser 2008). These factors form a context for SE education and are part of what must be considered in curriculum design.

Learning Styles is a concept originating in the educational literature to refer to the manner in which the student prefers to receive educational input with a view to developing learning from that input. The term *learning style* is now used loosely to describe almost any attribute or characteristic of learning but specifically refers to the preference for mode of presentation or activity through which the student learns. Some inventories report on a number of components in a style (motivation, surface/deep approaches to learning, social, physical and environmental elements) all of which are part of curriculum (Ratcliff 1997) and some personality inventories have learning characteristics as a part of their wider descriptions (Felder & Brent 2005).

Interest in understanding how students learn has been driven at least some employers and educators in SE to match the pedagogy with the multi-disciplinary content and personal development objectives necessary for SE practice. The underlying assumption behind interest in learning styles is that student achievement in learning tasks is dependent, at least in part, on the match between the teaching pedagogy and learning experience presented to the student and the student's preferred learning style (Felder & Brent 2005). These styles and their preference among individual learners form the basis of distinction of different learning inputs of particular forms. One such distinction is proposed by a popular methodology called Visual, Aural/Auditory, Read/Write, and Kinesthetic (VARK) developed by Fleming (2001). The VARK instrument divides learning preferences in response to the input forms of 'visual', 'aural/auditory', 'read/write' and 'kinesthetic' forms. These forms will be described later in this paper

The work proposed by the authors is intended to identify the learning preferences of graduate level students of SE with a view to enabling informed curriculum and pedagogy planning, particularly with respect to developing teaching methods which are cognizant of student differences and preferences for learning. The authors' interest is to provide a basis for development of educational methods which will facilitate students' learning of the content, skills and behaviors appropriate for systems engineering practice, and which will engage the students for most effective learning.

This work is motivated by a desire to understand the role of learning preferences in SE education. The authors have been involved in research on the competencies and skills required by systems engineers to perform their role, contrasting it with that required in other engineering roles. This difference may attract different kinds of people to SE than to other fields. This difference may be reflected in a bias towards certain learning approaches. Regardless of whether there is a difference in learning preferences of graduate students in systems engineering and other engineering fields, the differences in the kind of work require graduates to have different skills and behaviors as well as different content knowledge, indicating that awareness of learning preferences will be important for improving the effectiveness of SE education. Such awareness when passed on to the students should also help them when communicating with other engineers.

A further question which the authors plan to address is whether learning preferences are situationally determined. We believe it is plausible that students may prefer different learning styles depending on the content and the kind of assessment expectations which are placed upon them with respect to the abilities that they will be able to demonstrate as a result of the study. In an extreme example, assessment based on declarative knowledge when contrasted with demonstration of competence of a skill or action (procedural knowledge) may result in students seeking to develop in different ways and holding a different perception of the best pathway to that different outcome (Biggs 1999).

The considerations discussed above have led the authors to the following two research questions:

1. Do systems engineering graduate students collectively have certain learning preferences?
2. Do most systems engineering graduate students predominantly prefer kinesthetic and read/write learning?

Systems Engineering Education: Teaching Methods and Learning Approaches

Most of the SE curriculum work has tended to focus on content topics to be taught with little consideration for learning preferences of students and teaching styles of instructors. However, teaching is only effective when there is a match between learning and teaching styles. This paper addresses the concept of learning preferences, previously addressed in (Kasser 2008) which discussed pedagogy from the perspective of cognitive psychology. One unique teaching approach for the development of SEs is experiential learning (Davidz & Nightingale 2008).

Traditionally engineering education has been mostly concerned with the acquisition of knowledge (in the humanities, management, the sciences, etc.) and analytical techniques and skills in engineering, usually within a specific discipline or domain (e.g. mechanical, electrical, etc.). The rigorous application of such domain/discipline specific skills and knowledge to engineering elements is what is usually sought in engineering student projects. But in today's world, industry is concerned with an engineering perspective that understands the system as a whole total design: the integration of numerous technical and non technical disciplines toward the development of new products, systems and services. In this regard, a misdirected engineering rigor, overtly focused on a discipline, will always give rise to sub-optimal systems. It is SE education that uses multi-disciplinary student teams to make the students understand and appreciate how their individual partial contributions fit into the whole system (Jain et.al, 2006, 2007, 2008).

Generally, graduate SE courses are based on Inductive Student-Centered Teaching Methods that have been demonstrated to facilitate intellectual growth and student engagement (Felder 1988). An example of this approach is the use of project-based collaborative learning methodologies (Felder 2005, Pimmel 2001). Extensive evidence supports the benefits of student engagement (National Survey of Student Engagement 2003, Prince 2004). The most important student engagement criterion was interaction among students and between faculty and students.

Felder (1988) makes a distinction between student learning approaches, namely, surface, strategic, and deep approaches. In the surface approach students memorize facts but do not try to fit them into the larger context and follow routine solution procedures without trying to understand their origins and limitations. In the deep approach students focus on understanding the course material. They analyze, understand and try to fit it into a coherent body of knowledge. In the strategic approach students do whatever it takes to get the top grade. They are well organized, efficient and assess the level of effort needed. SE education generally tends to follow Felder's deep approach to learning. A pedagogy designed on Felder's instructional conditions has been found to facilitate intellectual growth. Such a pedagogy is based on providing a variety, and choice, of learning tasks, explicit communication and explanation of expectations, modeling, practice, and constructive feedback on high-level tasks, a student-centered instructional environment, and respect for students at all levels of development (Felder & Brent 2004, Smith, et al 2005).

Another aspect of student learning focuses on the teaching approach – whether it is based on student-centered methods. These methods take into account and provide for the variations in the learning abilities of individual students. When properly implemented student-centered methods lead to better learning, longer retention, greater skill development, and higher self-confidence for most students relative to more traditional teacher-centered methods (Felder & Brent 2004). A student-centered teaching approach includes class-room exercises which involve students during the setting up of the agenda in order to promote them to adopt the deep approach. Such an approach will ensure that students are assigned high-level problems relating to their backgrounds, interests, concerns, and career goals.

Measuring Student Learning Preferences: VARK

Learning styles vs. learning preferences. The acronym VARK stands for Visual, Aural/Auditory, Read/Write, and Kinesthetic sensory modalities that are used for learning information. Fleming and Mills (1992) suggested four categories that seemed to reflect the experiences of the students and teachers. VARK is about *preferences* which are a part of the Myers-Briggs Personality Type Indicator and VARK is structured specifically to improve learning and teaching. David Kolb's (1984) Experiential Cycle is a model of cognitive processing – how we process learning in the brain – whereas VARK is about our preferences for taking information into the brain and communicating them "outside". Gardner's Multiple Intelligences Theory (Gardner & Hatch 1989) is another cognitive model which includes some of the VARK modalities as "intelligences" and extends that list to at least five other dimensions. Sometimes the link between VARK and these theories appears to be quite strong but VARK has its own focus, rationale and strategies.

VARK deals with only one dimension of the complex amalgam of preferences that make up a learning style. The VARK questions and their results focus on the ways in which people like to receive and deliver information. The questions are based on situations where there are choices and decisions about how that communication might take place.

It is important to say what VARK is not, so that other components are not perceived as being a part of it. VARK has little to say about personality, motivation, social preferences, physical environments, or intraversion-extraversion. The choice to limit VARK to modal preferences was made because that is where Neil Fleming, the developer of VARK, had most success in assisting students with their learning. Of course, changing the other dimensions affected learning, but it was the modal preferences that had the most direct application learning effectiveness.

Learning Preferences. Despite the apparent similarities between learning styles and learning preferences, VARK is not a learning style. Learning styles have 18+ dimensions (preferences for temperature, light, food intake, biorhythms, working with others, deep and surface approaches, etc.). VARK is about one preference – our preference for receiving, and delivering information in a learning context. Although it is a part of learning style we consider it an important part because people can do something about it. Some other dimensions of learning styles are not open to change and therefore are less helpful in teaching settings.

The VARK Categories

The focus of VARK is to obtain a profile of the learning preferences of individual students and from this determine the collective preferences of a particular group of students in a classroom. Although there is some overlap between the four VARK categories, they were designed to capture unique dimensions that describe student learning.

Visual (V): This preference includes the depiction of information in maps, spider diagrams, charts, graphs, flow charts, labeled diagrams, and all the symbolic arrows, circles, hierarchies and other devices, that instructors use to represent what could have been presented in words. It could have been called Graphic (G) as that better explains what it covers. It does NOT include movies, videos or PowerPoint. It does include designs, whitespace, patterns, shapes and the different formats that are used to highlight and convey information.

Aural/Auditory (A): This perceptual mode describes a preference for information that is "heard or spoken." Students with this modality report that they learn best from lectures, tutorials, tapes, group discussion, email, using mobile phones, speaking, web chat and talking things through. It includes talking out loud as well as talking to yourself. Often people with this preference want to sort things out by speaking, rather than sorting things out and then speaking.

Read/Write (R): This preference is for information displayed as words. Not surprisingly, many academics have a strong preference for this modality. This preference emphasizes text-based input and output - reading and writing in all its forms. People who prefer this modality are often addicted to PowerPoint, the Internet, lists, filofaxes, dictionaries, thesauri, quotations and words, words, words...

Kinesthetic (K): By definition, this modality refers to the "perceptual preference related to the use of experience and practice (simulated or real)." Although such an experience may invoke other modalities, the key is that people who prefer this mode are connected to reality, "either through concrete personal experiences, examples, practice or simulation" (See Fleming & Mills, 1992, pp. 140-141). It includes demonstrations, simulations, videos and movies of "real" things, as well as case studies, practice and applications.

There are seldom instances where one mode is used, or is sufficient; therefore there are four parts to the VARK profile. Students who prefer more than one mode almost equally are of two types. There are also those who are context specific who choose a single mode to suit the occasion or situation. There are others who are not satisfied until they have had input (or output) in all of their preferred modes. They take longer to gather information from each mode and, as a result, they often have a deeper and broader understanding.

VARK Database

VARK was chosen to gain the following benefits of using a pre-established measurement learning preferences instrument:

1. VARK has been documented by researchers outside of the group that originated it, providing valuable information and lessons learned from applying it to measure learning preferences in different disciplines; and
2. the VARK instrument has been validated by other researchers (Leite, Svinicki & Shi 2008); and
3. VARK has gone through several iterations of improvements (currently in version 7) which capture several years of experience and analysis; and
4. VARK provides benchmarking opportunities between existing data and newly collected data. This is particularly helpful when comparing across gender, students/teachers, and fields of study.

The developers of VARK maintain an on-line version of the survey that enables the collection of data from anyone with internet access. As of September 2008, nearly sixty thousand people have taken the VARK questionnaire online. The profile of learning preferences is shown in Figure 1.

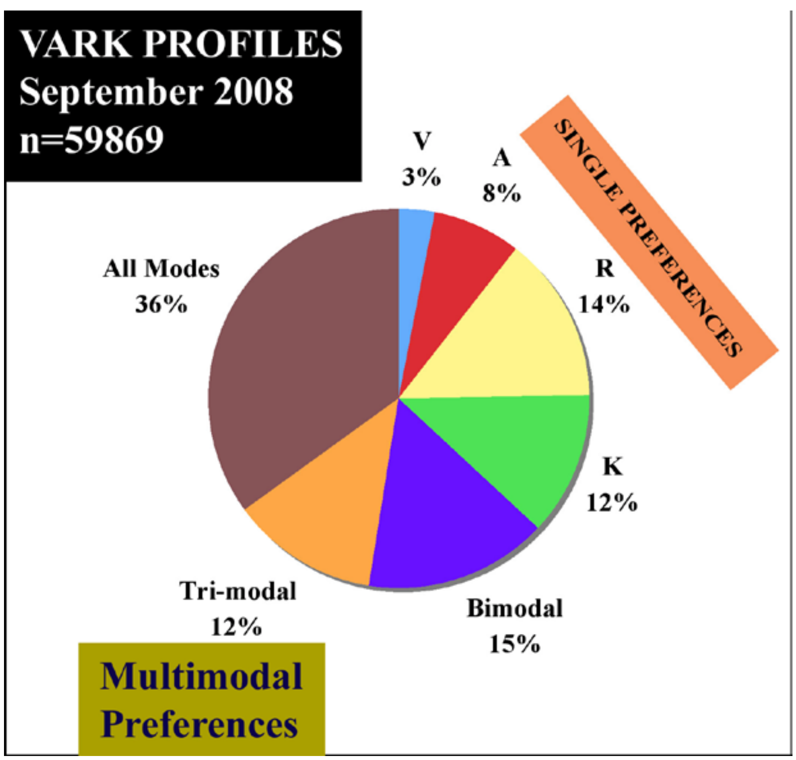

Figure 1. Reported Learning Preferences in VARK Database Results September 2008 (n= 59,869) (VARK website)

Multimodality was the expectation in the VARK questionnaire design because the modal preferences of people are seldom singular. The majority of people report preferences for multiple modes and use strategies associated with their preferences depending on the context or situation. For example they may choose a Read/write response because the situation is biased towards it. Intuitively this makes sense, as we seldom act on the basis of input or output from only one mode. For that reason, multimodality (bi-, tri- or quad-) is likely to be the “normal” condition and single-preferences are likely to be less common. Students who have a mild, strong or very strong preference for one mode are still multimodal – it is just that one of their preferences is a little stronger than the others. For example a student with VARK scores of 6-3-3-3 is said to have a single preference for Visual but is, in fact, still multimodal, though not categorized as such by the VARK algorithm. Some modes, notably Kinesthetic, are themselves an amalgam of senses and could be said to be multimodal in the broadest sense of the term.

If multimodality is the expectation in life situations, it should be allowed in the structure of the VARK questionnaire. But clearly if everyone chose every answer for every question then VARK would provide few insights into their strategies for learning. Allowing for multiple choices, however, reduces the discrimination of VARK. So on one hand multimodality is the norm but on the other hand we are interested in the relative strengths of particular modes within individuals. VARK provides the flexibility to allow multiple choices, yet point out a person’s established preferences in their profile.

Learning Preferences by Discipline

There are differences in the VARK preferences of students across different disciplines. For example, law students and faculty usually have larger proportions of Read/Write than, say, nursing, where students are more likely to have kinesthetic preferences. Graphic designers, performing arts and computer systems students are stronger on the Visual dimension. Performing arts and applied science students have more single preference Visual profiles than other disciplines. Understandably, students in the humanities choose more Read/write options in the VARK questionnaire. Science students are more multimodal as shown by the results in Table 1.

We suspect there would be differences of VARK preferences across different cultures. Polynesian cultures had no written language but had a strong set of traditions based on storytelling and genealogy handed down from elders to novices. This may indicate a stronger aural preference. Aboriginals (Australian) and Native Americans had strong symbolic representations and drawings to depict their views on reality and history that might indicate a stronger set of preferences for the V mode. A selected subset of the VARK data is provided in Table 1.

Since this paper is focused on the learning preferences of systems engineers, we will compare our results to the engineering population in the VARK database (2,819 samples) which report a distribution of learning preferences for engineering students and teachers across the four dimensions is 22% (Visual), 25% (Aural/Auditory), 25% (Read/Write), and 28% (Kinesthetic). A more detailed breakdown of the learning preferences of engineers is provided in Table 2.

Table 1. Distribution of VARK Scores in 2008 Database (VARK website)

	Visual (%)	**Aural/Auditory (%)**	**Read/Write (%)**	**Kinesthetic (%)**	**Total (n)**
Total	***20.6***	***25.2***	***26.2***	***27.8***	***59,839***
Females %	20.6	24.8	27.1	27.5	36,749
Males %	20.7	25.9	25.0	28.4	23,120
Students	20.6	25.4	26.1	27.9	55,162
Teachers	20.9	22.9	28.8	27.4	3,472
Applied Science	20.7	23.9	27.3	28.0	1,384
Architecture	23.6	24.9	22.9	28.6	355
Art	23.1	24.9	23.8	28.1	1,987
Business	20.6	25.8	26.3	27.3	7,343
Education	20.4	25.0	26.4	28.1	5,416
Engineering	21.6	25.1	24.9	28.4	2,819

Table 2. Learning Preferences of Engineers, n = 2,775 (VARK website)

Profile	Student (n)	Teacher (n)	Total (n)
A mild	142	3	145
A strong	48	2	50
A very strong	11	0	11
AK	141	5	146
AR	62	3	65
ARK	134	6	140
K mild	225	8	233
K strong	95	5	100
K very strong	36	3	39
R mild	167	8	175
R strong	79	5	84
R very strong	31	3	34
RK	85	5	90
V mild	63	1	64
V strong	18	1	19
V very strong	4	0	4
VA	17	0	17
VAK	93	2	95
VAR	28	0	28
VARK	1,033	30	1,063
VK	68	4	72
VR	30	0	30
VRK	66	5	71
Total	**2,676**	**99**	**2,775**

These results suggest a strong bias towards multimodal learning preferences among engineering students with only 34% (919 out of 2,676) indicating only one learning preference. This means the other 66% of the population has at least two learning preferences.

This finding presents several questions for SE educators. The first two are:

1. Does this trend of multi-modal learning preferences exist in the population of SE graduate students?
2. If so, how can graduate systems engineering curricula be adapted to address the diversity in learning preferences?

In the remainder of this paper we explore the first question and provide some preliminary thoughts on the second.

Research Method and Experimental Considerations

In order to obtain data specific to the population of systems engineering graduate students, we developed our own version of the VARK survey focused on our sample population. This section provides a description of the sample population, the data collection approach, scoring method, and issues related to survey validity and reliability.

Description of sample population. Our target population is students enrolled in graduate programs in systems engineering. This population is spread throughout the world but concentrated in countries such as the United States, United Kingdom, Australia, Singapore, etc. Since the only available version of the survey is in the English language we are unable to collect data from countries where English is not spoken.

Most countries have policies having to do with the use of humans as experimental subjects. We will comply with these regulations in the U.S. and wherever necessary.

The target sample size for the different VARK categories will be calculated using the categorical data method (Bartlett, Kotrlik & Higgins 2001) once the population size is determined.

Data collection approach. We have maintained the integrity of the original sixteen questions from version 7 of the VARK survey (Appendix A) and will supplement the questionnaire to include additional demographic information that will be helpful in classifying the data for further analysis and answering our research questions with the following items:

- Gender
- Name of institution
- Degree objective (i.e., Masters, PhD)
- Name of degree program (i.e., Industrial & Systems Engineering)
- Country of educational origin (where you completed most of your education)
- Undergraduate field of study (i.e., aerospace engineering, physics, computer science, etc.)

The instructions provided to survey respondents is to fill out the questionnaire by making a selection (a, b, c or d) for each question, but they may omit a question if they are unsure of their preference or they may choose more than one option if there are multiple preferences. Some may contest the meaning of words in the questionnaire and others may ask for additional contextual or situational information before they choose their answers. We will avoid giving that information, as it may bias responses to the questions and we cannot ensure that everyone taking the survey will receive the same instructions. We will encourage them to choose more than one response if they think the context is not clear.

We will emphasize that the results indicate their preferences but are not necessarily their strengths. This reduces the anxiety for respondents who may express the view that the questionnaire says they are not good readers or not visually strong.

Before students complete the questionnaire it may be helpful to tell them that they are to answer the questions for themselves (not for others) and their responses should be focused on their current learning preference rather than what they hope their learning preference should be.

Scoring method. The free VARK questionnaire (www.vark-learn.com) offers sixteen statements that describe a situation and asks the respondent to pick one or more of four actions that the respondent would take. Each action corresponds with a VARK learning preference. The total of all four scores ranges from 16 to 64, with individuals having a preference for one, two, three, or all four of the learning modes. Students and faculty can self-administer, self-score, and self-interpret the VARK Inventory by using the answer key provided in Appendix B.

Survey validity and reliability. We will discuss measurement reliability, threats to internal & external validity, known issues with VARK items (Leite, Svinicki & Shi 2009). It is known that work and life experiences may blur differences between preferences as people learn to use aural, visual, read/write and kinesthetic modes in new situations and preferences may also be masked by experiences.

Preliminary Results

In order to pilot the VARK survey we obtained preliminary data from systems engineering graduate students from one academic institution in the U.S. This pilot study provided an initial validation of the survey within the desired population and led to additional improvements for subsequent data collection activities.

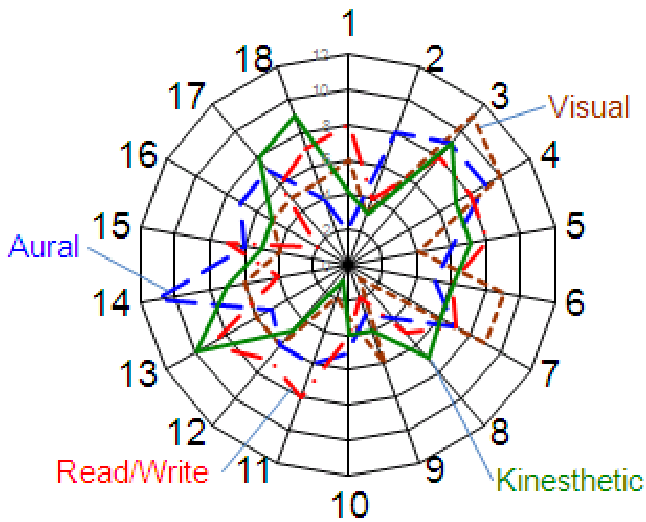

Figure 2. VARK Composition by Student (n = 18)

The results of this initial pilot of 18 participants, shown in Figure 2, confirmed the hypothesis that systems engineers have multiple learning preferences. Further data collected will provide higher statistical significant and the ability to categorize the data by institution, experience and undergraduate degree of study.

Understanding the Results from VARK Survey

The results provided by the VARK survey indicate a 'rule of thumb' and should not be rigidly applied. The questionnaire is not intended to 'box' respondents into a mindset that they have been diagnosed. Rather, it is designed to initiate discussion about, and reflection upon, learning preferences.

It is not expected that any one preference will be dominant or that all participants will be multimodal. Approximately 50% of faculty seem to be multi-modal, although they usually show preferences for Read/Write as one mode. Correspondingly, there will be some students or faculty that have a strong or very strong preference that stands out from others. The most consistent finding from the VARK database results2 is that classrooms are very diverse. With this in mind, the creators of VARK provide the following cautions:

- Preferences are not the same as strengths.
- VARK is about learning not leisure.
- If you have completed the questionnaire with empathy you will have indicated the preferences of others, not your own learning preferences. Redo it for yourself.
- Teachers, your VARK scores indicate how you learn. They may not indicate how you teach.

Implications for teaching systems engineering

Fleming (2001) offers extensive suggestions for classroom approaches for matching teaching approaches and learning preferences, some of which are supported in the literature (Brown 2000, Bruning 2004, Felder & Silverman 1988, Thissen 1997). Table 3 summarizes a number of learning activities that can be incorporated into a course to support each learning preference.

Table 3: Activities that accommodate VARK learning preferences (Fleming 2001)

Visual	**Aural/Auditory**	**Read/Write**	**Kinesthetic**
Diagrams	Debates, Arguments	Books, Texts	Real-Life Examples
Graphs	Discussions	Handouts	Examples
Colors	Conversations	Reading	Guest Lecturers
Charts	Audio Tapes	Written Feedback	Demonstrations
Written Texts	Video+Audio	Note Taking	Physical Activity
Different Fonts	Seminars	Essays	Constructing
Spatial Arrangement	Music	Multiple Choice	Role Play
Designs	Drama	Bibliographies	Working Models

No single mode is superior and there is no superior profile of VARK scores. Although our academic institutions may be strongly Read/Write, life is much more varied. Students can be successful with almost any combination. The key is to understand one's own learning preferences and take advantage of them.

Because of our Westernized systems of education, we may have to ultimately deliver in Read/Write mode. Although there are a great variety of learning preferences and VARK profiles, high schools, colleges and universities still insist that their students present evidence of their learning in reading and writing. Some researchers argue that the increased emphasis on linguistic and logical skills make standardized tests limited which served as the motivation for the theory of multiple intelligences (Gardner & Hatch 1989). In this spirit, VARK provides students with strategies to learn and suggests that they use their strengths even though they may not be linguistic or logical ones. Course material may still have to be presented in written form (tests, assignments, examinations) but student learning should be in a format that suits student preferences.

Those with a multimodal set of VARK preferences need to process information in more than one mode in order to get enough understanding. Students should be encouraged to try new study strategies listed under their preferences. Research shows that many people become much more successful if they develop a range of learning strategies based upon their preferences (Fleming 2001). It is clearly not helpful to use strategies that lie outside of one's preferences (e.g. using mind-maps may not help if you do not have some Visual preference. Mnemonics may not help if you have a low VARK score for Read/write.)

Simply knowing one's learning preference does not contribute to improved learning in the same way that knowing you have a disease does not cure the disease or weighing yourself does not fix obesity. It is the next step that is important; when students make changes to their study methods based on their VARK preferences, their learning will be enhanced, that is, when they use strategies that align with their preferences. It is what they do after they learn their preferences that has the potential to make a difference. But the question remains:

How should teachers adapt existing delivery methods and curricula to cater to all four learning preferences?

As discussed earlier, teachers do not teach in the same way they learn. The VARK questionnaire indicates how teachers learn, but not how they teach. Many teachers use their empathy to recognize that students are struggling and they use VARK modes other than their own preferred ones to "reach" them. That is why it is important for teachers to complete the questionnaire as learners rather than teachers.

Next steps

The authors are engaging a larger network of systems engineering educators to study the learning preferences across a cross-section of the population. This will help in understanding if some of the learning preferences can be attributed to demographics such as experience, cultural background, academic background, and geography. Moreover, by demonstrating the reliability and validity of VARK for systems engineering teachers can improve their delivery approach and improve systems engineering education as a whole. The engagement of systems engineering educators in the data collection, analysis and discussion has already led to new questions for consideration:

> Is VARK the best instrument for assessing learning preference of systems engineering graduate students?
>
> How should specific systems engineering principles (i.e., requirements decomposition, tradeoffs, verification & validation, etc.) be taught in light of the learning preferences of graduate students?
>
> How can geographic, gender or discipline specific learning preferences be reconciled in an increasingly diverse population of systems engineering graduate students?
>
> Is systems engineering graduate education uniquely different that other engineering disciplines (in terms of content)?

These questions, among others, will be explored as more data are collected and more studies in engineering education are examined for their applicability to our field.

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Appendix A. VARK Questionnaire (Version 7.0)

Choose the answer which best explains your preference and circle the letter(s) next to it.
Please circle more than one if a single answer does not match your perception.
Leave blank any question that does not apply.

1. You are helping someone who wants to go to your airport, town centre or railway station. You would:
    a. go with her.
    b. tell her the directions.
    c. write down the directions (without a map).
    d. draw, or give her a map.

2. You are not sure whether a word should be spelled `dependent' or `dependant'. You would:
    a. see the words in your mind and choose by the way they look.
    b. think about how each word sounds and choose one.
    c. find it in a dictionary.
    d. write both words on paper and choose one.

3. You are planning a holiday for a group. You want some feedback from them about the plan. You would:
    a. describe some of the highlights.
    b. use a map or website to show them the places.
    c. give them a copy of the printed itinerary.
    d. phone, text or email them.

4. You are going to cook something as a special treat for your family. You would:
    a. cook something you know without the need for instructions.
    b. ask friends for suggestions.
    c. look through the cookbook for ideas from the pictures.
    d. use a cookbook where you know there is a good recipe.

5. A group of tourists want to learn about the parks or wildlife reserves in your area. You would:
    a. talk about, or arrange a talk for them about parks or wildlife reserves.
    b. show them internet pictures, photographs or picture books.
    c. take them to a park or wildlife reserve and walk with them.
    d. give them a book or pamphlets about the parks or wildlife reserves.

6. You are about to purchase a digital camera or mobile phone. Other than price, what would most influence your decision?
    a. Trying or testing it.
    b. Reading the details about its features.
    c. It is a modern design and looks good.
    d. The salesperson telling me about its features.

7. Remember a time when you learned how to do something new. Try to avoid choosing a physical skill, eg. riding a bike. You learned best by:
    a. watching a demonstration.
    b. listening to somebody explaining it and asking questions.
    c. diagrams and charts - visual clues.
    d. written instructions – e.g. a manual or textbook.

8. You have a problem with your knee. You would prefer that the doctor:
    a. gave you a web address or something to read about it.
    b. used a plastic model of a knee to show what was wrong.

c. described what was wrong.
d. showed you a diagram of what was wrong.

9. You want to learn a new program, skill or game on a computer. You would:
   a. read the written instructions that came with the program.
   b. talk with people who know about the program.
   c. use the controls or keyboard.
   d. follow the diagrams in the book that came with it.

10. I like websites that have:
    a. things I can click on, shift or try.
    b. interesting design and visual features.
    c. interesting written descriptions, lists and explanations.
    d. audio channels where I can hear music, radio programs or interviews.

11. Other than price, what would most influence your decision to buy a new non-fiction book?
    a. The way it looks is appealing.
    b. Quickly reading parts of it.
    c. A friend talks about it and recommends it.
    d. It has real-life stories, experiences and examples.

12. You are using a book, CD or website to learn how to take photos with your new digital camera. You would like to have:
    a. a chance to ask questions and talk about the camera and its features.
    b. clear written instructions with lists and bullet points about what to do.
    c. diagrams showing the camera and what each part does.
    d. many examples of good and poor photos and how to improve them.

13. Do you prefer a teacher or a presenter who uses:
    a. demonstrations, models or practical sessions.
    b. question and answer, talk, group discussion, or guest speakers.
    c. handouts, books, or readings.
    d. diagrams, charts or graphs.

14. You have finished a competition or test and would like some feedback. You would like to have feedback:
    a. using examples from what you have done.
    b. using a written description of your results.
    c. from somebody who talks it through with you.
    d. using graphs showing what you had achieved.

15. You are going to choose food at a restaurant or cafe. You would:
    a. choose something that you have had there before.
    b. listen to the waiter or ask friends to recommend choices.
    c. choose from the descriptions in the menu.
    d. look at what others are eating or look at pictures of each dish.

16. You have to make an important speech at a conference or special occasion. You would:
    a. make diagrams or get graphs to help explain things.
    b. write a few key words and practice saying your speech over and over.
    c. write out your speech and learn from reading it over several times.
    d. gather many examples and stories to make the talk real and practical

Appendix B. Calculating VARK scores

Question	**a** category	**b** category	**c** category	**d** category
1	K	A	R	V
2	V	A	R	K
3	K	V	R	A
4	K	A	V	R
5	A	V	R	K
6	K	R	V	A
7	K	A	V	R
8	R	K	A	V
9	R	A	K	V
10	K	V	R	A
11	V	R	A	K
12	A	R	V	K
13	K	A	R	V
14	K	R	A	V
15	K	A	R	V
16	V	A	R	K

Count the number of each of the VARK letters you have circled to get your score for each VARK category.
Total number of **V**s circled =
Total number of **A**s circled =
Total number of **R**s circled =
Total number of **K**s circled =