RESEARCH ARTICLE

# Enhancing Students Learning in an Undergraduate Engineering Economics Course During the COVID-19 Pandemic

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## Abstract

As the COVID 19 Pandemic greatly impacted teaching and learning, academic institutions switched from in-person to online classes. This shift prompted an examination of students' learning styles to accommodate their learning in virtual environment. The VARK (Visual-Aural-Read/Write-Kinesthetic) instrument was used to assess effectiveness of teaching and students' learning in U.S. Coast Guard Academy (CGA) undergraduate engineering course. The VARK instrument was used to facilitate effective virtual classroom activities to engineering students during the COVID-19 pandemic. This paper argues that students have different learning strengths and styles. Some students may learn best by watching and listening, others by thinking, and others by doing or by doing, touching, and feeling. Our results indicate that engineering students demonstrate a strong preference for at least two learning styles and the learning styles differ between male and female students. Females are not kinesthetic learners, but their preferable mode of learning is verbal or reading. Male students preferred aural style and African Americans kinesthetic learning style. This research was conducted to improve our teaching and provide students with safe learning environment during challenging time of the COVID-19 pandemic. The paper finds that learning styles are important across all majors during virtual learning and teaching. The VARK instrument can be used to indicate cadets' learning styles to facilitate effective learning and teaching in virtual environment during the COVID-19 pandemic.

Open Access

**Citation:** Zapalska, A. Enhancing Students Learning in an Undergraduate Engineering Economics Course During the COVID-19 Pandemic. *Interdisciplinary Education and Psychology.* 2022; 3(1):2.

Received: September 03, 2021
Accepted: January 31, 2022
Published: February 09, 2022



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## Keywords

Learning styles, teaching styles, learning styles assessment instruments, COVID-19 pandemic, effectiveness of learning, virtual classroom

## Introduction

Both students and teachers have different learning styles. When teachers reflect on their teaching, they recognize that their teaching styles are a blend of their learning styles and the ways in which we were taught most successfully. Therefore, the strategies that instructors use involve those strategies that they find most comfortable in their learning process. If the instructor tends to perceive information in an auditory manner, his or her teaching strategies are likely to emphasize listening and oral delivery. If the teacher perceives things in a kinesthetic way, his or her teaching strategies naturally would appeal to the touch, movement and doing. However, what works for the teachers may not work for all their students. A visual style of teaching creates a learning environment for visual learners, but the auditory or kinesthetic learners would probably have a less positive attitude toward this instruction than that of the visual learner.

Although there are numerous research publications and formal instructional programs designed to improve teaching and learning strategies, one key aspect is to identify teachers' and students' learning styles. The purpose of this paper is to illustrate the effectiveness of the VARK instrument that faculty can use to identify their own teaching strategies as well as to help their students become aware of their own learning strategies. Moreover, the information generated by the VARK learning style instrument can inform faculty about the cognitive and motivational

characteristics of their students. This information can be used in course planning and teaching to enhance teaching effectiveness and students learning. The VARK instrument can be used to increase effectiveness in remote learning environment caused by the COVID-19 pandemic. This study examines the learning styles of the CGA cadets who enrolled in an engineering economics course during the COVID-19 pandemic. In particular, the following questions are addressed in this paper: Do students in engineering discipline differ in their style of learning?; What are the most common learning and motivational styles of our students?; How do our students perceive and process information?; Does our teaching style match the learning styles of our students?; Do male and female students differ in learning styles within the disciplines?; and How can we use this information to improve our teaching and our students learning specially during the COVID-19 pandemic?

The data for this paper was collected online during the COVID-19 pandemic over three semesters, including Spring 2020, Fall 2020, and Spring 2021. Using the VARK instrument, the author collected data on students' learning styles in the Essential of Economics course. During the COVID-19 pandemic, when learning and teaching challenges amplified, it was critical to identify our students' learning styles to accommodate their learning at the time where all classes were unexpectedly held virtually on Microsoft Teams. This paper argues that students have different learning strengths and styles. Some students may learn best by watching and listening, others by thinking, and others by doing or by feeling. This paper is organized in the following order. In the second section, the authors present literature review followed by a section in which learning style is defined. Next section presents research methods and discusses how to identify learning styles. The author presents the VARK instrument and how it was used to identify learning styles. Section five examines the data and discusses the data research results. Conclusions, references, and appendices are provided at the end of the paper.

## Literature Review

Research on learning styles has its foundations in the late 19th century. This original research focused on documenting that there were style differences among learners and developing instruments that accurately assess those differences in both adults and children (Dunn et al., 1989). Most of that early research was on the relationship between memory and oral or visual teaching methods and those findings were conflicting because of the differences in the populations, learning materials, research methods, and test instrumentation that were utilized (Keefe 1987). Later researchers began to recognize that learners had different cognitive styles that determine a learner's typical mode of perceiving, remembering, thinking, and problem solving (Messick, 1976) and to demonstrate how to utilize the diagnostic instruments to match instruction to the style of individual students (Galloway, 1984).

More recent studies on learning styles recognize not only cognitive styles but also affective and physiological aspects. Researchers have attempted to identify and isolate specific traits of learners in each of these areas to describe the unique processes of learning (Kolb et al., 2008; Hawk and Shah, 2007; Cekiso, 2011). This growing number of research underlines the central theme that variations in student learning styles have important implications for the instructional process. In this context, researchers are attempting to assess learning styles to improve the efficiency and effectiveness of instructional materials and methods (Corbin, 2017; Collin, 2007; Hawk and Shah, 2007). Williamson and Watson (2007) argued that students need to understand how they learn and that teaching with an emphasis on learning styles can assist students and provide effective learning environment. Gilakjani (2012) contended that with instructor's assistance, students may develop a different learning style, but they still tend to maintain a preference for a particular learning style. There is no learning style that is inferior to another, but learning styles have different attributes and require different teaching instruments.

Dunn (1991) indicated that the achievement of college students could be improved by providing initial instruction in a manner consistent with each student's learning style. Dalmolin (et al., 2018), Fatemeh and Camellia (2018), and Gregoric (1988) stressed that the potential for both style "match" and "clash" between teacher and learner must be considered, arguing that when students have a strong preference the way new material is presented, it is difficult or impossible to learn when educators fail to present material in their preferred way. Miller

(2001) argued that to improve student motivation and performance it is critical to adapt teaching approaches to meet the different learning style preferences of our students. The learning style can be influenced by individual characteristics such as age, gender, cognitive styles, personality, sensory processes, intellectual ability, academic achievement, cultural background, temperament, and critical thinking skills development (Kausar, et al., 2019).

Research on learning styles theories and models in various disciplines has also been reported (Bacon, 2004; Boström, 2011). Biberman and Buchanan (1986) examined learning styles within the area of business indicating that learning styles of accounting/economics/finance majors were different from those in the marketing/management/leadership majors. Almeida and Mendes (2010) used the Kolb (1984 and 1999) instrument to argue that education major students do not possess a dominant learning style but a three-mode pattern where one of the learning modes, abstract conceptualization, is underdeveloped. The most consistent findings on gender differences in learning style indicate that students are not limited to one type of preference. Some studies indicate that males are more visually and kinesthetically oriented than females (Eid at al., 2021, Heffler, 2001). Study conducted by Wehrwein (et al. 2007) focused on analyzing learning styles between females and males indicating that female students were more kinesthetic learners relative to their male counterparts. The author used the visual-arial-reading-kinesthetic (VARK) questionnaire developed by Neil Fleming to assess learning styles among undergraduate psychology majors at Michigan State University. Other researcher studies compared learning styles of students across different majors. For example, a study conducted by Tindal and Hamil (2003) stated that STEM courses fail to accommodate learning styles while Kulturel-Knal (et al., 2011) contradicted this statement while stating that in STEM education females prefer hands-on learning experiences as they demonstrate intuitive or feeling based judgements.

This paper was written to contribute to the existing literature on students' learning styles. The VARK results in this study were used to indicate learning preferences among engineering majors as well as to illustrate that the learning styles percentages were different between male and female students; majority of female students were multimodal in contrast to only one third of male students. This study also focused on kinesthetic learning as preferable mode of learning to indicate that majority of male students exhibited this learning style as dominant and preferable. Our results indicate that women were also more oriented toward reading and verbal modes of learning, while males preferred aural style. The results of this study also contributed to the research results of Kolb (1984) that engineering students prefer abstract-active learning. In addition, this research contributed to the study on African American students' styles, indicating that this group of students exhibits kinesthetic style of learning which is supported by research conducted by Ewing and Yong (1992).

Moreover, this study also was conducted to conform whether our learners become more receptive to the learning experience when their learning styles were taken into consideration. Successful learning experiences contribute to the students' abilities to enter into further exploration of learning in their given field of study. Past students' learning experiences contribute to creating a framework for future learning. This study was also conducted to indicate if students' awareness of learning styles and choice of study strategy can be positively corelated to students' achievement as recommended by studies conducted by Hendry (et al., 2005) and Graf (et al., 2009).

## Definition of Learning Style

The concept of "learning style" has been analyzed and understood in various ways and the area of learning style is complex. Accordingly, it is defined as (1) a certain specified pattern of behavior and/or performance according to which the individual approaches the learning experience; (2) a way in which the individual takes in new information and develops new skills; (3) the process by which the individual retains new information or new skills (Kolb and Kolb, 2008; Hawk and Shah, 2007), and (4) "…the manner in which and the conditions under which learners most efficiently and effectively perceive, process, store, and recall what they are attesting to learn… " (Kaisar et al., 2019; page 62). Gregoric (1988) defines learning as the way the learner mentally orders the concrete and abstract perceptions of his or her environment. Kolb (1984) identified four learning styles with specific characteristics: accommodating, diverging, assimilating, and converging, stating that each learning style

presents its own strengths and weaknesses. Figure 1 demonstrates Kolb's four learning styles within the process of the experiential learning cycle. Kolb's learning styles and their particular characteristics have been considered a foundation to learning; the theories associated with each learning style allow to distinguish specific characteristics as well as assess their specificity.

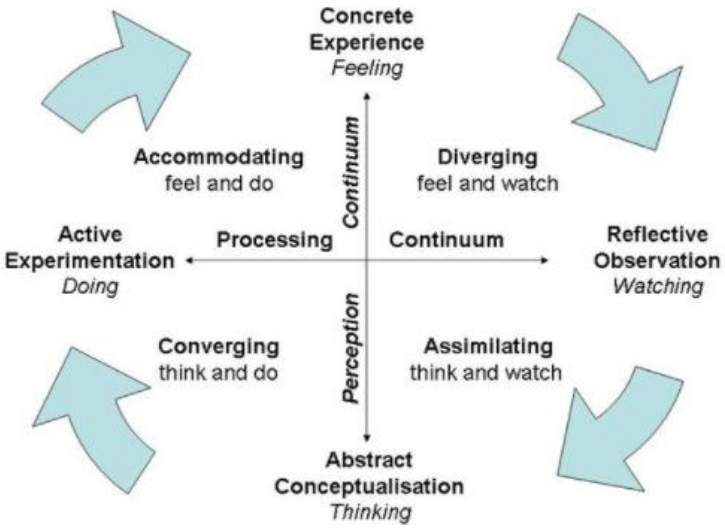


**Figure 1**. Kolb's Learning Styles and the Experiential Learning Cycle

Source: Kolb, A. Y., and Kolb, D. A. (2008)

Gregoric (1988) and Butler (1988) use a theory that identifies learning style in terms of the following modes: concrete, abstract, sequential, and random. Concrete learners need to be involved in learning a concept in a real way, where concrete objects are used. It is critical for those learners to be physically involved with a new concept or new information. Abstract learners tend to be precise and attentive to specific details. They take pieces of information and data to synthesize them together to understand concepts. Sequential learners are structured and ordered; their learning process must be clear and precise, specific details need to be delineated and concrete steps must be specifically outlined. Random learners are holistic by nature and not ordered or structured. They cannot operate in a structural way in learning situations but prefer to be "all over the place" in their attempt to understand something new. Table 1 summarizes more examples of different learning styles frequently discussed in literature.

**Table 1**. Characteristics of Learners

| **Theorist** | **Characteristics of Learners** | | |
|---|---|---|---|
| Sarasin (1998) | *Auditory* | *Visual* | *Tactile/Kinesthetic* |
| Gregoric/Butler (1988/1988) | *Abstract/Sequential* | *Random/Concrete* | *Concrete* |
| Sims & Sims (1995) | *Cognitive* | *Perceptual* | *Behavioral Affective* |
| McCarthy (1990) | *Analytic* | *Imaginative* | *Dynamic* |
| Harb (et al., 1993) | *Abstract/Reflective* | *Concrete* | *Active/Concrete* |

Based upon the above context, in this paper a learning style is defined as *the preference or predisposition of an individual to perceive and process information in a particular way or combination of ways.*

## Research Methodology

The first step in understanding students' learning is to do a preliminary analysis of their learning styles. The instructor should gain some understanding of the learning styles of the students through brief and personal conversations with them and discussions about how they remember simple things in their lives. Then, the instructor formally observes and documents their specific behaviors and approaches while they are completing their tasks in the classroom. However, this approach was not possible during the remote learning that took place during the COVID–19 pandemic. The in-depth personal interviews proved to be an excellent way to find out about our students' experiences as learners. Their narratives proved to be a rich source of information about attitudes toward teaching and learning, learning

processes, and preferences for instructional techniques. Through the one-on-one interviews using the Microsoft Teams, the author was able to trace the evolution in our students' understanding of their learning skills and personal responsibilities in learning process.

The next step was to help students understand how they learn best. Interviews yielded a great deal of information about learning styles, we needed to acquire more detailed information on how our students learn and what are their preferable learning styles. We used checklists, and the VARK questionnaire (VARK | a guide to learning styles (vark-learn.com). An ideal post-Covid goal would be to observe each student throughout the semester to have the most complete picture of how he or she learns, and then both modify our teaching strategies and develop more diversified teaching and learning strategies whenever necessary.

The composition of classes at the CGA is diverse as classes include men and women, students of different color and those from varying ethnic and socio-economic backgrounds. As a result, the CGA instructor should keep in mind that even students learn best in their preferable way based on their learning styles, students should be exposed to a variety of learning experiences to become more versatile learners and to be better prepared for the "real world." As our students tried to identify their styles, they started to examine their styles in the context of their learning experiences and to the extent to which certain strategies helped them succeed or fail. There are several assessment tools that can be used to categorize learners' learning styles (Gilakjani, 2012; Dunn et al., 1989; Oltman et al., 1971). These instruments vary in length, format, and complexity. Some require special training to administer and interpret, whereas others can be given by following a few simple directions. They can also measure one dimension of style, whereas others measure two, three or more.

In order to assess students' learning styles, the authors adopted and used the VARK questionnaire for several reasons. This instrument, developed and used at Lincoln University, Canterbury, New Zealand, in 1995, alerts students and teachers about the variety of different teaching and learning approaches while stressing four modal preferences for learners and teachers. It also provides ideas for developing teaching/learning strategies that are tailored for individuals at the college while not defining the strengths of individuals, but their preferences for the ways in which they like to receive and process new information. The authors also selected the VARK instrument as it overcomes the predisposition of many educators to treat all students in a similar way. According to the author of the VARK questionnaire, Neil D. Fleming (1992), the use of this tool allows teachers to reach more students; there is a better match that can be reached between teacher and learner's styles. It also avoids diagnostic "labelling" but provides a basis for selecting practical strategies that both students and teachers can use.

The VARK instrument is simple to use and outlines four styles of learning. According to Fleming (1992), the most common mode for information exchange is speech that arrives at the learner's ear: aural (A) in the questionnaire. Some students reveal preferences for accessing information from printed words: read/writers (R) since reading and writing are their preferred modes for receiving in information. The third group of students is visual (V) since those students like information to arrive in the form of graphs, charts, and flow diagrams. They prefer to learn by picturing information or enhancing it via colors and layout. The last group of students likes to experience their learning by using all their senses, including touch, hearing, taste, smell, and sight: kinesthetic (K). Learners from this group like concrete, multi-sensory experiences in their learning. Learning by doing is strongly preferable, and an abstract material must be is presented to them via suitable analogies, real life examples, or metaphors. However, no student or teacher is restricted to only one of the four modes: V, A, R, or K. Although, both students and teachers may exhibit a strong preference for one mode, they, at the same time, may have a relative weakness or strength in some other modes.

## Data Analysis and Results

The data presented in this paper is based on the number of students who took the Essential of Economics in one of the three semesters covered in this study. At the beginning of the fall semester of 2020 and the spring semesters of 2020 and 2021, engineering majors from the Essentials of Economics course answered the VARK questionnaire. Percentages were computed to show the proportion of students in the four learning topologies. Table 2 summarizes the learning preferences for the CGA engineering students. During those three

semesters, we had 110 male students and 31 female students enrolled in our course. Those three semesters were offered during the COVID-19 pandemic. The VARK results in total numbers and in percentages in total and by gender are being presented in Table 2. The results have been reported based on number of learning styles: uni- (one style), bi- (two styles), tri- (three styles) and multi-modal (four styles).

**Table 2**. The VARK Learning Styles Results of Engineering Majors Over Three Semesters During the COVID-19 Pandemic

| **Total Number of Students** | **Unimodal Number** | **Bimodal Number** | **Trimodal Number** | **Multimodal Number** |
|---|---|---|---|---|
| Both genders<br>Males<br>Females | | 10 both genders<br>10 males<br>0 females | 85 both genders<br>57 males<br>3 females | 46 both genders<br>43 males<br>28 females |
| **Percentage of Students** | **Unimodal Number** | **Bimodal Number** | **Trimodal Number** | **Multimodal Number** |
| Both genders<br>Males<br>Females | | 7% both genders<br>9.1% males<br>0 % females | 60% both genders<br>51.8% males<br>9.7% females | 33% both genders<br>39.1% males<br>90.3% females |

The VARK results in this study, indicate that majority of our students, similarly to the work presented by Gregoric (1988), have a preference regarding learning style. However, all engineering students in this study indicated that they demonstrate a strong preference for at least two learning styles. The results presented in Table 3, indicate that 7% of our students were bimodal, 60% were trimodal, and 33% students were multimodal. The learning styles percentages were different between male and female students. There were 0% female students who were bimodal in contrast to 9.1% of males. Moreover, 90.3% of female students were multimodal in contrast to only 31% of males who were multimodal. Males were characterized by 51.8% of trimodal and women only 9.7% trimodal. 90.3% of females and 39,1 % of males were multi-modal learning preferences as presented in Table 2. Our results confirm the results presented by (Kausar, et al., 2019) that students have multimodal learning preferences while using VARK questionnaire to access learning preferences of students.

Moreover, our VARK results also indicated that 60% of female students did not indicate kinesthetic (K) learning as their preferable mode of learning, while 99% percent of male students had this learning style dominant and preferable. Those results did not support the work conducted by Wehrwein (et al. 2007) where female students were more kinesthetic learners relative to their male counterparts. Our results indicate that women were also more oriented toward reading (R) and verbal (V) modes of learning, while males preferred aural (A) style. From the pre-VARK survey, we learned that both female and male students supported active experimentation and abstract theory. This result supports the research results of Kolb (1984) that engineering students prefer abstract-active learning. We also observed that African American students preferred kinesthetic style of learning which is supported by research conducted by Ewing and Yong (1992). Overall, our results indicated that 85% of our students were not surprised about their learning style while indicating that having all different modes of learning during the COVID-19 pandemic allowed them to be successful in the course.

As most of our students possessed abstract conceptualization and active experimentation preferences, they were motivated to discover and experiment. In this case, application and usefulness of information is increased by understanding detailed information about the systems, concepts, and operations. Kolb (1999) defines those learners as “convergers” and recommends problems- and exploration-based activities as well as interactive instructional methods.

Table 3 identifies types of learners based on learning styles and provides descriptors, pre-instructional strategies, teaching strategies, and behaviors for four types of learning styles that are recommended to be adopted based on the VARK instrument. Some of the methods presented in Table 3 might not be possible in the engineering courses but based on our experience alternatives can be adopted to provide all possible modes of learning for students who have multimodal learning styles.

**Table 3**. Types of Learners, Their Characteristics, Instructional Strategies and Behavior

| Type of Learner | Teaching Strategies | Behaviors |
|---|---|---|
| **Auditory Learners:** Abstract & concrete, analytic, sequential, reflective, independent, achievement-oriented, memory-oriented competitive, perceptual, conceptual, skill-oriented; | Lecture, oral directions, discussions, independent tasks, oral & objective presentations, and practice, programmed instruction, tasks with specific answers, memorization, verbal sorting, sequential presentation, think time, verbal questioning, focused/directive questions, continued verbal sharing, verbal rewording; | Need ample process time, Interact with information orally, request oral repetitions, rephrase, and expand on topics, request additional information, first must understand the facts and then understand the whole concept. |
| **Visual learners:** Abstract & concrete random, concrete, active, effective, field-sensitive, field-dependent, concept-oriented holistic, perceptual, and imaginative; | Visual formats, environmental influences, group learning, graphic organizers, modeling, demonstrations, role-playing, student presentations, field trips, motivational accounts or stories, computer-aided instruction, activities that allow freedom & emphasize creativity, open-ended questions, teaching to senses; | Prefer to learn about a concept before trying to understand its parts, repetition, visual imaging, not paying attention, wait time, outlining, require visual aids (charts, diagrams, drawings, and outlines) in order to make sense of something new; |
| **Kinesthetic learners:** Dependent (collaborative) & independent (individual), concrete sequential, concrete random, creative, behavioral, need for interaction, hands-on, physical by nature, sensory, learns by doing, active, concrete; | Supplementing commercial materials with manipulative components, focusing techniques that include interaction with objects, questioning based on physical interactions with objects; Internship, field trips, direct contact, experiential learning, simulation, games demonstrations | Like learning by doing, need to something to understand and master, rely on physical interaction during learning process, like to be active and dynamic participants to fully understand and learn, require exploration & experimentation time, interaction with resources & materials, preparation in advance, application of concept, first-hand experience, participation; |
| **Read/Write Learners:** Abstract & concrete random, concrete, active, effective, field-sensitive, field-dependent, concept-oriented; | Focusing techniques in writing, focus questions in writing, visual stimuli, diagrams and charts; Visual formats, modeling, demonstrations, role-playing, computer-aided | Prefer to take information most efficiently from reading headings, lists, definition, lecture-notes and textbook, like to write ideas and principles into other worlds, write out the |

| | | |
|---|---|---|
| | instruction, activities that allow freedom & emphasize creativity, open-ended questions, teaching to senses; | words again and again, organize and turn any diagram, chart, and graph, game and simulation into words. |

Based on the above table and learning style results for our groups of students, the following list represents a mix of strategies that can be used in the classroom to accommodate a variety of learning styles:

1. Use written problem-based assignments.
2. Combine individual assignments with some group assignments so that students can explore together.
3. Provide step-by-step instructions and directions whenever they are needed in an oral (in class or/and by recording posted on the Microsoft-teams and written form).
4. Provide oral (during class on the Microsoft-teams) and written comments on homework assignments.
5. Engage students in conversation about the subject and concepts and ask students for oral summaries of material.
6. Allow students to work in groups and help each other to discuss, analyze and solve problems
7. Provide some oral assignments.
8. Use some video and computer assignments in combination with other teaching techniques.
9. Use games, simulations and/or active learning in combination with lecturing in the post COVID-19 pandemic (not all games can be used in a virtual classroom).

This paper's results indicate that after using the VARK instruments the grade point average increased by 1 point, 1,5 points and 1.2 points over the three semesters during the COVID pandemic. This study results support the argument of Dalmolin (et al., 2018) and Fatemeh and Camellia (2018) that there is a positive relationship between students' learning styles and their academic performance. To teach more effectively, instructors need to know learning styles of their students to ensure that their methods, materials, and resources fit the ways in which their students learn and thus maximize the learning potential of each student. By sharing information about learning styles, the students can gain power and control over their personal learning styles and the learning process. Through this process students' grades improve reflecting effective students' learning.

The students were also asked to report their experience with the VARK and the teaching method that was used on Microsoft Teams during the COVID-19 pandemic on their course assessment open-end portion where students were asked about their satisfaction with the VARK instrument and learning about their dominant learning styles. As the assessment process indicated, 90 % of students were thrilled to learn about their learning styles, and some of their comments included:

*"… I like the VARK as it showed me how I learn. It was the first time I was told about the learning style. It seems someone cares about our learning, and this was good during pandemic. …"*

*"… The learning style survey we used in our economics class helped me to learn more effectively as I was able to communicate with my teacher how I learn. Hope we can use this instrument in other classes. Economics was difficult but my teacher used different techniques and instruments to teach and assess my knowledge in her class. …"*

*"… I was surprised to see the VARK survey to be used at the beginning of our class. Once the instructor explained why she used it, it made sense. I was happy to know that my teacher cared about how I learn. Th class was difficult and the Covid did not make it easier on all of us in all classes. But the VARK helped us to communicate with our teacher how we learn, study, and master concepts. I also was happy to learn how I learn and what learning techniques help me to be better in learning…."*

*"... I wish all instructors used this VARK assessment tool as I am learning by doing and many courses do not use "doing". There might be a lot of discussion, but I am not an oral learner. I like hands on in class, outside of class and in group learning. …"*

*"… What a great tool. I found the VARK instrument to be helpful and an opportunity to communicate with the instructor how I learn motivated me to work harder. Hope we have this tool available to all other students beyond the pandemic. We used a lot of hands-on exercises as so many of us in class learning by doing. Lectures that were recorded and posted on teams facilitated effective learning for oral students and some discussion on topics covered in class toward the end of each session allowed everyone to benefit. …"*

## Conclusions

Knowledge of students learning style is important but cannot be considered as the only factor utilized for their effective learning practices. Awareness into the specific learning preferences of students can help instructors tailor their teaching and assessment of learning techniques. To help our students to learn effectively, teachers must understand how their students learn, how they perceive, and how they process information. Learning styles of students must be identified so that the instructor can plan appropriate teaching strategies to accommodate individual strengths and needs. Student learning style preferences can be determined using the Kolb or the VARK questionnaires, which can assist both the learner and educator in identifying individual student preferences in the way information is presented. Instructors need to assess and understand how students learn and retain knowledge. Students must be self-aware of their preferences to adjust their study techniques to best fit their individual styles, specifically when the information and instruction provided does not match their preferred style.

The purpose of the study was to assess students' learning styles and gender differences in learning style preferences among undergraduate engineering students and to determine if they were uni, bi, trio, or multi-modal learners and what were their learning style preferences. This paper also looked at the learning differences between male and female students. Our results differed from the results presented by Wehrwein (et al., 2007), Slavin (2010), Onasanya and Adegbiya (2007), and Idris (2015) who stated that their students were primary audio-visual learners. Moreover, this study differentiated the learning preferences between male and female students. Our students were multi-modal learners with male students strongly preferring kinesthetic learning.

The results of this study are in support of research conducted by Dunn (1979 and 1991) on learning style indicating that males favored kinesthetic instruction, such as experiential, active, and hands-on as well as auditory and visually oriented techniques, while females were strongly skewed toward reading and verbal styles. Based on the results from the VARK instrument as well as our open-question survey, that this paper supports the research conducted by Njal (et al., 2019) which states that (i) teachers vary their teaching methods and strategies to pave way for students to use different learning styles; (ii) students should endeavor to identify their unique learning styles and use them; and (iii) school administrators should provide learning resources that covers all the learning styles.

This study has several limitations, one of them related to the sample size. One of our aims is to conduct a similar study with a larger sample as well as include more students from other academic disciplines and majors, such as Management, Science, Government, and Mathematics, and expand the results obtained in this study. There is also a need to examine the effect of gender, age year of study, and cultural background on learning style.

Individuals learn in different ways using several learning styles, but lecturers may not always share material and learning experiences that match students' learning preferences. Discrepancies between learning and teaching styles can lead to disappointment with students who are taking our courses. In this context, each course should accommodate all types of learners. It is necessary to provide several different learning options that consider or cater for different learning styles. Combining a mixture of approaches and teaching methods allows students to choose the instructional style that best fits their individual learning styles. Effective teaching arises when teachers reach those students who are mismatched with their

own learning/teaching style. The VARK instrument allowed the author of this paper to overcome this problem. Effective use of the VARK instrument and a proper course design resulted in a learning experience that was appropriate for all students with different learning styles. Effective teaching arises when teachers reach those students who are mismatched with their own learning/teaching style. The VARK instrument allowed us to overcome this problem especially this during challenging time of the COVID-19 pandemic.

This research focused on raising student achievement through guided instruction in learning styles and competencies. The findings of this study illustrate a need for students to gain an understanding of how they learn and how to apply that understanding into improving of their learning that will contribute into development of problem solving and critical thinking skills. Future research into student self-awareness and self-efficacy in learning styles as well as the impact on student potential achievement from designing coursework that is based on students learning preferences could substantially contribute to educational effectiveness. Those approaches are critical especially during unprecedented times of the COVID -19 pandemic which led to full remote learning and teaching environment. Further research examining other factors that impact student learning experiences through learning styles may contribute to the more innovative solutions to building the optimal student experiences in undergraduate learning environments.

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