



# Determining Learning Styles of Engineering Students and the Impact on Their Academic Achievement

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**Abstract.** The purpose of this research is twofold. Firstly, it aims to identify the learning style preferences of two classes in their fourth year of engineering studying at National School of Applied Sciences of Fez during the 2018–2019 academic year. Secondly, it investigates the relationship between learning styles and the academic achievement of these students. A VARK questionnaire was administrated to the students and the collected data were analyzed by using statistical methods (Pearson correlation).

The findings of this study showed that for the industrial engineering class, the most preferred learning style of students were Kinesthetic with a percentage of 41.17%. This is followed by a multimodal style (23.52%), visual style (20.58%), auditory style (8.82%) and Reading/Writing style (5.88%). For the mechanical and automated systems engineering class, the most preferred learning style of students were visual style and kinesthetic style with the same percentage of 31.57%. This is followed by a multimodal style (18.42%), Reading/Writing style (10.52%) and auditory style (7.89%).

This study will be helpful for instructors in determining appropriate teaching approaches to accommodate the diverse learning styles.

**Keywords:** Learning styles · VARK model · Pearson correlation

## 1 Introduction

Learning styles are various strategies or ways of learning [1]. Their concept owes its evolution in psychology [2]. There are several definitions and models of learning styles. According to [3], learning style as a complex manner in which learners most efficiently and most effectively perceive, process, store, and recall what they are attempting to learn [4]. Another definition of learning style is by Dunn in the paper [5] who described the latter as the way each learner begins to concentrate, process, and retain new and difficult information [1].

The main models of learning styles are: David Kolb's model, Felder's model and Neil Fleming's VARK model.

David Kolb's model classified the learning styles as: convergent (good at problem solving and practical application of ideas); divergent (good imaginative ability and awareness of meaning and values); assimilative (good at inductive reasoning); accommodative (efficient in carrying out plans and like getting involved in new experiences) [2].

The Felder-Silverman Learning Style Model was introduced by Richard Felder and Linda Silverman in 1988 and classified learning styles into four dimensions: active-reflective (processing information), sensing-intuitive (perceiving information), visual-verbal (inputting information) and sequential-global (understanding information). The Index of Learning Styles (ILS) instrument, developed by Felder and Soloman in 1991, comprises 44 questions, 11 for each of the four previously described dimensions [1].

The VARK model was introduced by Neil Fleming in 1987 and has four categories of learners: visual, auditory, reading/writing and kinesthetic [1, 6, 7] and the VARK questionnaire developed by Flemming is used to assess the sensory modalities. Visual learners prefer the use of diagrams and symbolic devices. Read-write learners prefer printed words and texts. Auditory prefer heard information. Kinesthetic learners have to feel or live the experience to learn; they prefer simulations of real practice and experiences [8, 9].

By identifying the learning styles of students, teachers can use different methods and regulate their courses appropriately and according to the conditions in order to match students' learning styles which is the most successful strategy [10–13].

This paper aims to identify the learning style preferences of the industrial engineering class (IE) and the mechanical and automated systems engineering (MASE) class in their fourth year of studying at National School of Applied Sciences of Fez during the 2018–2019 academic year. Also, it investigates the relationship between learning styles and the academic achievement of these students.

## 2 Method

In order to assess the preferred learning styles of the industrial engineering (IE) class and the mechanical and automated systems engineering class (MASE) in their fourth year of studying at National School of Applied Sciences of Fez during the 2018–2019 academic year, the Neil Fleming's VARK model was used.

The VARK questionnaire is consisting of The VARK questionnaire of 16 multiple choice questions, each having four choices. All choices correspond to the four sensory modalities which are measured by VARK (visual, aural/auditory, read/write, and kinesthetic). The students can select one or more choices, based on the sensory modalities which are preferred by them, to take in new information [14].

The questionnaire was administrated to the IE class consisting of 34 students and to MASE class consisting of 38 students. This study has paid special attention to assure respondents confidentiality and right to respond or reject the questionnaire.

And in order to determine if there is any relationship between learning styles of students and their academic achievement (final exam's scores), the descriptive method (Pearson correlation) was used using SPSS software.

## 3 Results and Discussion

The learning styles of all 34 students of IE class and of all 38 students of MASE class responses are shown in the following Tables 1 and 2.

**Table 1.** Students' learning styles frequencies of IE class

	Visual	Auditory	Read/Write	Kinesthetic	Multimodal
Students number	7	3	2	14	8
Percentage	20.58	8.82	5.88	41.17	23.52

**Table 2.** Students' learning styles frequencies of MASE class

	Visual	Auditory	Read/Write	Kinesthetic	Multimodal
Students number	12	3	4	12	7
Percentage	31.57	7.89	10.52	31.57	18.42

The Table 1 above clarifies that most of students of IE class are kinesthetic learners with a percentage of 41.17%. The kinesthetic learners prefer simulation and hand-on experiences. The table also shows that 23.52% of students prefer a multimodal learning style. This is followed by visual learning style with a frequency of 20.58%. These learners prefer the use of diagrams, symbolic devices and printed information. The least preferred learning styles are Auditory and reading/writing styles with the frequencies 8.82% and 5.88% respectively.

Also, the Table 2 above clarifies that most of students of MASE class are kinesthetic learners with a percentage of 31.57% and visual learners with the same frequency. The table also shows that 18.42% of students prefer a multimodal learning style. This is followed by read/write learning style with a frequency of 10.52%. The least preferred learning style is auditory style with the frequency 7.89%.

So, the best teaching strategy for these students is the use a lot of laboratory applications as possible and to use visuals like PowerPoint slides with images, videos and colours.

In order to investigate the relationship between learning styles and academic achievement of these students based on final exam's scores, we use a descriptive method (Pearson correlation) where the independent variables are learning styles and the dependent variables are academic achievement. Collected data was analyzed using SPSS software. The Tables 3 and 4 below show the results of this analysis.

**Table 3.** Pearson correlation of different learning styles for IE class

	Academic achievement	
<i>Learning styles</i>		
Visual style	Pearson correlation	0.83
	Signification	0.021
Auditory style	Pearson correlation	0.023
	Signification	0.39
Reading/Writing style	Pearson correlation	-0.36
	Signification	0.43
Kinesthetic style	Pearson correlation	0.87
	Signification	0.012

**Table 4.** Pearson correlation of different learning styles for MASE class

	Academic achievement	
<i>Learning style</i>		
Visual style	Pearson correlation	0.91
	Signification	0.049
Auditory style	Pearson correlation	-0.54
	Signification	0.39
Reading/Writing style	Pearson correlation	0.18
	Signification	0.031
Kinesthetic style	Pearson correlation	0.61
	Signification	0.032

From the results of the Table 3 above, the visual learning style shows a strong correlation with the academic achievement of the IE students because the Pearson correlation is equal to 0.83 which is higher than 0.8 and we can also conclude that this correlation is highly significant (because the coefficient signification is less than 0.05). The same results for the Kinesthetic learning style (Pearson correlation is equal to 0.87 which is higher than 0.8 and the signification is equal to 0.012). In the other hand, the auditory learning style shows a very weak correlation equal to 0.023. Reading/Writing style shows a negative and weak correlation. We can conclude that visual and kinesthetic style influence the academic achievement for IE class.

For the MASE class as shown in the Table 4, we can conclude that the visual learning style shows a very strong correlation with the academic achievement of the MASE students because the Pearson correlation is equal to 0.91 (very near of 1) which is higher than 0.8 and this correlation is highly significant (because the coefficient signification is less than 0.05). Also, we can admit that there is a correlation between kinesthetic learning style (Pearson correlation is equal to 0.61 and the signification is equal to 0.032). In the other hand, the Reading/Writing learning style shows a very weak correlation equal to 0.18 which is highly significant (signification equal to 0.031). Auditory style shows a negative correlation which is not significant. We can conclude that visual and kinesthetic style influence the academic achievement for MASE class.

So, we can conclude that the same learning styles influence the academic achievement for both classes. Therefore, including practice and visual aids in the teaching strategy is very necessary.

## 4 Conclusion

This research is carried out to determine the learning styles of two classes at National school of applied sciences of Fez, Morocco and to investigate if the learning style Influences students Academic Performance. Based on the VARK questionnaire, the findings show that the most preferred learning styles for both alos, by using the statistical method, the findings showed that only visual learning and kinesthetic learning are the only styles that have a significant impact on the academic performance of the

students of both classes while the other two styles are not significant drivers in impacting the academic performance.

So, in order to find appropriate teaching methods and to achieve educational goals, the teaching strategy must integrate practice and use visual aids.

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