AC 2011-1619: AN EXAMINATION OF LEARNING STYLES AND IT'S IMPACT ON CURRICULUM DEVELOPMENT

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An Examination of Student Learning Styles in an Electrical Engineering Technology Program

Examinations of student learning styles have provided direction and focus to curriculum design and revision in a broad range of disciplines for some time. Educators have noted successes when implementing curricular revisions to better match the learning preferences of students; reporting increased rates of learning and improved comprehension [1, 2]. Additional studies have explored the relationship between student learning styles and student retention rates [3].

While learning styles data has been routinely published for students in many fields; there is little data on students in Electrical Engineering Technology programs. This study examines the learning styles of two groups of incoming students (n = 154) in a four year Electrical Engineering Technology program. Data for this study was obtained using the Felder-Solomon Index of Learning Styles (ILS), a freely-available instrument used in the assessment of learning styles in a range of fields.

Students in this study exhibit a distinct preference for visual learning over verbal learning. This preference correlates with anecdotal evidence of a strong visual link and supports research efforts seeking to effectively incorporate visual learning tools and methods in Engineering Technology curriculum. Additionally, slight preferences for active, sensing and sequential learning styles were present in both sample groups.

Felder-Soloman Index of Learning Styles (ILS)

The Felder-Soloman Index of Learning Styles examines learning styles in eight areas using four contrasting scales. It was selected for this study as it specifically examines visual learning styles, a commonly appearing theme in recent STEM research. Additionally, the reliability and validity of the instrument has been assessed in a number of studies [4, 5]. The instrument is freely available from the author's website, which also contains data from groups covering a wide range of disciplines.

The four scales of the ILS are each composed of two contrasting learning style preferences (Table 1) which can have a magnitude ranging from 1 (slight) to 11 (strong). The design of the ILS prevents scores of zero or any even number. Scores appearing on the left side of the four scales were assigned a negative magnitude for the purposes of data analysis.

Table 1- ILS Scales

Scale	*Negative Polarity*	*Positive Polarity*
Active-Reflective (AR)	Active	Reflective
Sensing - Intuitive (SI)	Sensing	Intuitive
Visual – Verbal (VV)	Visual	Verbal
Sequential – Global (SG)	Sequential	Global

Population and Sampling

Learning styles are dynamic and can be influenced by learning experiences. The sample for this study was derived early in an introductory ECET course to reduce the likelihood that program curriculum would be an influencing factor. The sample is reflective of the population as students were required to complete the ILS as part of normal classroom activities but were not required to participate in this study. Less than ten percent of the population chose not to participate.

Data Analysis

Scores from the ILS instrument were collected from students in two offerings (Fall 2009 and Fall 2010) of a required freshman course in an Electrical Engineering Technology program. This study only analyzes total scores for each scale reported by an online assessment instrument [6]. As students' responses to individual items on the assessment were not collected, a test of internal validity was not possible. The distribution of scores from each group by scale appears in Figure 1.

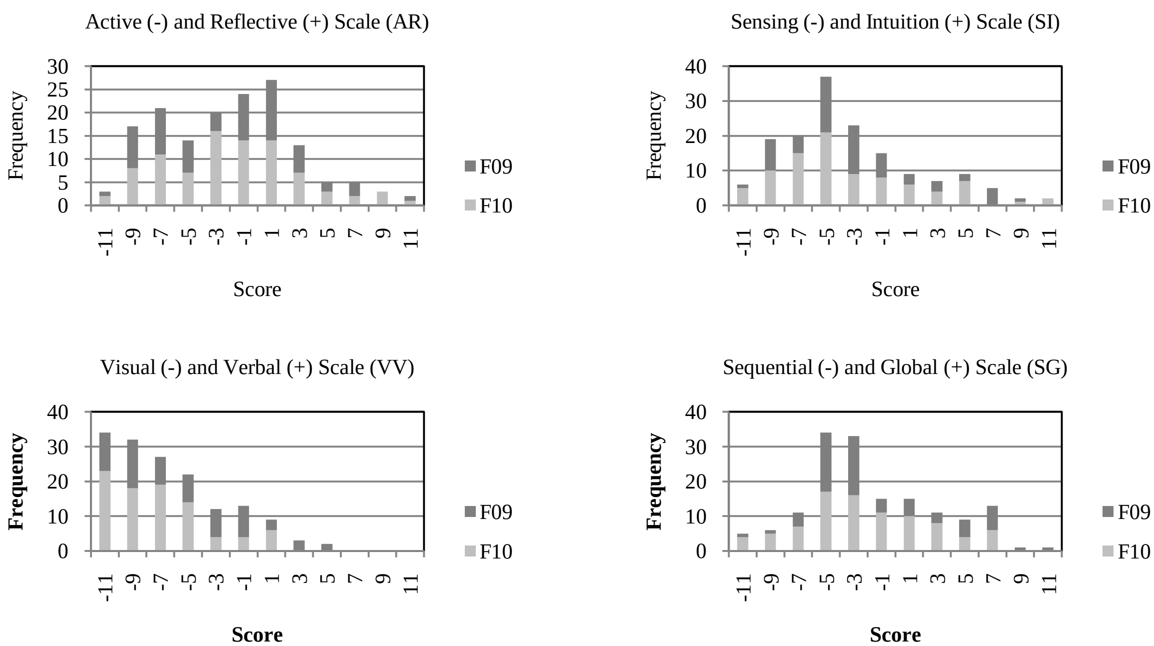

Figure 1 - Distribution of ILS Scores

The mean and variance for each group's scores on the four scales were determined and a single factor ANOVA was used to determine if significant differences existed. The results appear in Table 2.

Table 2 - Means, Variances and ANOVA results

Groups	*n*	μ_{AR}	σ_{AR}	μ_{SI}	σ_{SI}	μ_{VV}	σ_{VV}	μ_{SG}	σ_{SG}
F09	66	-2.21	24.97	-2.88	22.88	-5.36	20.30	-1.21	24.39
F10	88	-1.89	23.71	-3.48	25.75	-7.13	12.49	-2.11	21.78
p-value		0.685		0.459		0.006		0.249	
All Groups	154	-2.03	24.12	-3.22	24.45	-6.37	16.49	-1.73	22.94

Both groups exhibit a slight preference for active over reflective learning with no significant difference between the mean preference ($p = 0.685$). The strong emphasis on laboratory experiences in Engineering Technology curricula supports active learning styles. Contrary to popular anecdote, these results indicate that students do not exhibit a strong preference for active learning over reflective learning at the early stages of their undergraduate academic career. This suggests that active learning experiences including laboratory exercises and interactive problem sessions may provide a slight learning advantage over reflective activities (homework, reports) for students at this stage. Active learners typically prefer group learning over individual learning activities.

Each group in the sample exhibited a preference for learning through sensing rather than intuition. There is no statistically significant difference between group means ($p = 0.459$). Sensing learners prefer presentations focusing on facts and concrete examples. Additionally, sensing learners may challenge the necessity of learning new materials if the relevance has not been previously established. This supports the general premise of Engineering Technology curriculum which focuses on reinforcing laboratory exercises and the application of well-established theories and formulae in solving concrete problems. Students in the study may feel challenged when presented with abstract concepts or required to explore scenarios when provided little background information.

While there is a statistically significant difference ($p = 0.006$) between each group's mean preference for visual learning over verbal learning, both groups had strong inclinations toward visual learning. This is consistent with results reported for students in engineering programs [7] and a general preference for visual learning across STEM disciplines. Visual learners prefer to gather information from simulations, animations, graphs and tables and can be challenged with developing or interpreting written and oral descriptions. Visual learners are challenged by learning experiences which are heavily verbal or written and may experience difficulty in passive lecture scenarios or in analyzing written problems.

Each group, on average, exhibited a slight preference for learning through sequential rather than global presentation methods. Once again there is no statistically significant difference between group means ($p = 0.249$).Sequential learners focus on order and chronology and prefer algorithmic or universal solutions. Non-linear presentation of concepts or scenarios with open-ended scenarios are often challenging to sequential learners. This is of particular concern in Engineering Technology as graduates working in industry will routinely encounter unique cases which could be solved in a variety of ways. In order to satisfy industry's need for improved problem solving, students in this Engineering Technology program will need to become more comfortable with global thinking.

Conclusions

The results of this study indicate that students who enter this EET program are likely to have pronounced visual learning style preferences, slight preferences for learning though activity and are more likely to learn by direct observation than indirect analysis. Efforts to address these preferences present the best opportunity to incorporate effective instructional change.

Knowledge of students learning styles opens the door for tailoring instructional methods to best suit student's preferences and could suggest appropriate methods for assessing comprehension.

Novice level understanding potentially could be assessed using methods which closely match expressed learning styles preferences, while mastery level understanding could be assessed using methods contradictory to preferred learning style.

Recommendations

More information on the learning styles of the Electrical Engineering Technology and more general Engineering Technology student populations is needed to gain better insight into which instructional methods may be most effective. Expanding this study to a larger regional or national population could provide valuable insight into the specific learning characteristics of Engineering Technology students when compared to other groups.

A prospective study of learning styles over an extended period of time would allow for the examination of learning style trends. This can help to continually refocus curricula to the learning preferences of its students. As learning styles are influenced by multiple factors, including changing technologies, K-12 curriculum and societal values, it is likely that the learning style preferences of students will vary over time.

A follow up study of senior students and early post-graduates may provide insight into how students' learning styles evolve during their undergraduate experience. This may point to strengths or weaknesses in the curriculum, or an excessive focus on a particular learning style. If graduates are unable to function when presented with learning opportunities which contradict their preferences, they may be limited in their ability to succeed outside of a classroom.

References

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