INSTITUTE FOR Learning Styles RESEARCH

Institute for Learning Styles Research Journal

Volume 1, Fall 2007

Journal Editor

Dr. James E. Witte

Auburn University

witteje@auburn.edu

http://www.learningstyles.org/

Evaluation of Learning Styles and Instructional Methods in the NROTC Naval Operations and Seamanship Course

Jennifer Bell
Auburn University

Introduction

A mismatch exists between common learning styles and traditional post-secondary instructional methods. Because of this mismatch, students can become bored with course materials, can perform poorly on examinations, and can be discouraged with the curriculum (Felder & Silverman, 1988). Though there could be a tendency to cater to the individual learning styles, according to Felder and Spurlin (2005), a teacher should not accommodate certain learning style preferences because, for students to function as professionals, they need skills associated with both categories with a given learning style dimension. By assessing the learning style of a classroom, the instructor can provide effective instructional methods that support each of the different learning styles.

To illustrate the effectiveness of instructional methods that support learning style preferences, Felder (1995) investigated 123 chemical engineering students who took five successive courses with the researcher. The purpose of Felder's study was to examine the performance of an experimental group who received novel instructional methods and a comparison group who received the traditional instructional methods. Instructional methods used included inductive presentation course material, which moved from facts and familiar phenomena to theories and mathematical models, and use of realistic examples of engineering processes to illustrate basic principles. The participants were involved with laboratory activities, field experiences, and guest speakers, who spoke about how engineering concepts applied to the real world setting. The researcher/instructor used active learning with cooperative (team-based) groups, reduced lecturing time, asked open-ended questions, and required problem formulation homework exercises.

Felder (1995) found that the final grades in the introductory course were skewed toward the higher grades. The number of failures was equivalent to previous courses, but 56% of the participants earned a B average or higher. Six weeks into the introductory course, the researcher/instructor gave the option to complete homework individually instead of in the required study groups. Of the 115 participants, only three chose to work independently. Of the 67 participants who were seniors, 92% of them reported the experimental instructional methods were more effective than the other chemical engineering courses that were taught with traditional methods. Four years after the introductory course, 79% of the participants had graduated or were still enrolled in chemical engineering.

The purpose of this study was to assess the following research questions: (1) What is the predominant learning style for the students in the NROTC Naval Operations and Seamanship; (2) What are the instructor's primary instructional methods?; and (3) Are the instructor's primary instructional methods congruent with the predominant learning style of the students?

Evaluation Plan

Students. The students who were involved in this teacher evaluation included seven white males. These students were undergraduates at the Auburn University Navy Reserve Officers Training Corps (NROTC) Program. In their senior year, they began their course of study directly after high school graduation. The students ranged in age from 21 to 22 years old. These students had not completed a learning styles inventory prior to this evaluation.

Instructor. The instructor enlisted in the US Navy over 16 years ago. His professional experiences include operation and maintenance of the electrical and electrical generating equipment for the submarine, anti-submarine warfare Officer, and engineering training. Currently, the instructor serves as an Assistant Professor of Naval Science. His educational background includes a bachelor's and master's degree in Adult Education.

Course. Naval Operations and Seamanship is required course within the NROTC curriculum for senior-level students. The course is a continued study of relative motion, formation tactics, and ship employment. Other topics include an introduction to naval operations and operations analysis, ship behavior and characteristics in maneuvering, applied aspects of ship handling, afloat communication, naval command and control, naval warfare areas, and a review and analysis of case studies involving moral, ethical, and leadership issues.

Measure. Richard Felder, Professor of Chemical Engineering at North Carolina State University, and Linda Soloman, Coordinator of Advising, First Year College, at North Carolina State University, developed a learning style model to differentiate the learning styles among engineering students and to assist with instructional approaches to address those learning styles in the classroom (Felder & Spurlin, 2005). The model has four dimensions (Felder & Silverman, 1988; Litzinger, Lee, Wise, & Felder, 2005):

- *Active* processing (prefer active student participation in groups) or *reflective* processing (prefer passive student participation by themselves or with one familiar partner).
- *Sensing* perception (prefer concrete, practical content) or *intuitive* perception (prefer abstract, conceptual content).
- *Visual* input (prefer visual presentation) or *verbal* input (prefer written and spoken presentation).
- *Sequential* understanding (prefer linear thinking) or *global* understanding (prefer holistic thinking).

While the combination of these dimensions is unique to the Felder-Soloman Model, each dimension corresponds in other learning style models. The active/reflective dimension complements the Kolb's Learning Style Model. The sensing/intuitive dimension was directly taken from Myers-Briggs Type Indicator (MBTI), which was based on the theories of Carl Jung. This dimension is analogous to the concrete/abstract dimension from Kolb's Learning Style Model. The active/reflective and visual/verbal dimensions have similarities with visual-auditory-kinesthetic modality theory. Furthermore, visual/verbal dimension derives from information processing theory. The sequential/global dimension parallels left-brain and right-brain dominance theories (Felder & Spurlin, 2005; Larkin & Budny, 2005).

The Index of Learning Styles (ILS) has 44 items. The prompts present various situations and the respondent selects one of the dichotomous options that best describes him or her. The initial version was created in 1991. The instrument was revised in 1994 after factor analysis. The paper-pencil version was posted on the internet in 1996. The online version was posted on the internet in 1997. The ILS is available without fees for educational and research purposes (Felder & Spurlin, 2005).

There are two principal applications for the ILS. First, instructors can assess learning styles of his or her students and use the assessment results to guide instructional design. Thus, all learning styles can be addressed during instruction. Second, for individuals, the ILS can give them insight regarding their strengths and weakness and facilitate the learning process (Felder & Spurlin, 2005).

Each dimension consists of two categories, and each category has a score ranging from 1 to 11. Scores ranging from 1 to 3 indicate mild or well balanced between the two categories. For scores between 5 and 7, a moderate preference is indicated, which means favoritism for one of the two categories. Scores between 9 and 11 indicate a very strong preference, meaning difficulty with learning where the environment does not support that category (Felder & Spurlin, 2005; NC State University, n.d.).

The test-retest reliability for the ILS ranges from .73 to .87 after 4 weeks (Felder & Spurlin, 2005) and from .56 to .77 after 10 weeks (Litzinger et al., 2005). Internal consistency of the four dimensions ranged from .51 to .62 for active/reflective, from .65 to .76 for sensing/intuitive, from .56 to .69 for visual verbal, and from .41 to .54 for sequential/global. A factor analysis was conducted with the ILS revealed active/reflective, sensing/intuitive, and visual/verbal to be orthogonal. Sequential/global and sensing/intuitive dimensions were found to be associated (Felder & Spurlin). Discriminant validity was determined by conducting a bivariate correlation between the four dimensions. Correlations ranged from -.09 to .32, which indicated weak interrelationships among the dimensions (Zywno, 2003).

Procedures. An Index of Learning Styles Behavioral Checklist was developed using the National Survey of Science and Mathematics Education (Westat, 2000) and the Mathematics Teacher Questionnaire: Main Survey (TIMSS Study Center, 1998). Based on a review of literature three domains were created: Instruction, Independent Student Activity, and Student Interactions. Using the literature available regarding the Felder-Soloman Learning Style Model (Felder & Silverman, 1988; Felder & Soloman, n.d.; Larkin & Budny, 2005), each behavior was coded according to its association with each category. The instructor reviewed the Checklist prior to the first observation.

Participants were asked by the instructor to complete the ILS at the following URL address: http://www.engr.ncsu.edu/learningstyles/ilsweb.html. After completing the 44-item inventory, the participants were instructed to print the results summary and submit it to the instructor on the first classroom observation. The results were coding based on a strong (9 to 11), moderate (5 to 7), and mild (1 to 3) relationship with each of the eight categories.

The researcher observed the same class on two consecutive days. During the class period, the researcher indicated the number of times a specific behavior occurred on the Checklist. After the end of the observation, the frequencies were summed. Test-retest reliability coefficients were conducted to determine consistency of behavior frequencies between first and second observations. For instructional methods, the reliability coefficient was very good (.97). A reliability coefficient could not be assessed for independent student activity because there was not any independent activity during the second observation. The reliability coefficient was student interactions was .00 due to the format difference between observation 1, hands-on lab activity, and observation 2, lecture of content.

Evaluation Results

Pre-Dominant Learning Style. Descriptives were analyzed to determine the pre-dominant categories for each of the four dimensions. Table 1 displays the frequencies, means, and standard deviations by category. This group of students tended to be active, sensing, visual, and sequential learners. Thus, this group of students prefers concrete, hands-on learning experiences in pairs or small groups, and they prefer visual presentations of material in a logically and sequential order. The active and sequential categories were considered as mild, and sensing and visual were considered as moderate, which indicated moderate preference toward these categories during learning experiences.

Table 1

Frequencies, Means, and Standard Deviations by Category

Scale	*n*	%	*M*	*SD*
Active	7	100.00%	3.57	2.23
Reflective	0	0.00%	0.00	0.00
Sensing	6	85.71%	6.67	2.66
Intuitive	1	14.29%	1.00	--
Visual	6	85.71%	5.00	2.53
Verbal	1	14.29%	5.00	--
Sequential	5	71.43%	3.80	3.03
Global	2	28.57%	1.00	0.00

Primary Instructional Methods. A descriptive frequency count assessed the number of observed behaviors by time. Tables 2, 3, and 4 display the frequency behavioral count for each domain by time. Informal assessments (e.g., knowledge questions) accounted for 40% of the observed instructional methods. These quantified behaviors do not include other questioning comments, such as "make sense." "Do you agree," and "okay." The instructor applied the concepts to the real-world experience (e.g., aboard a ship) over 20% of the observed behaviors. During the first observation, the instructor allowed time for independent student activities. The primary source of activity was scenarios in the students' workbooks. The students tended to work in pairs for checking answers, asking questions, and reviewing assigned homework during the guided and independent practice sessions. The majority (51.52%) of student interactions during the first observation was in pairs. Due to the format of the second observation, the student interactions were divided among pairs, small groups, and large groups; however, the observation mean revealed pair groupings accounted for over 48% of the student interactions.

Table 2

Frequency Count for Independent Student Activity by Time

	Observation 1		Observation 2		Mean	
Behavior	*n*	%	*N*	%	*n*	%
Answered textbook, workbook, or worksheet questions.	4	44.45%	0		4	44.45%
Completed hands-on/laboratory activities.	3	33.33%	0		3	33.33%
Followed specific instructions in an activity.	2	22.22%	0		2	22.22%
Total	9	100.00%	0		9	100.00%

Table 3

Frequency Count for Student Interactions by Time

	Observation 1		Observation 2		Mean	
Behavior	*n*	%	*n*	%	*n*	%
Individual	9	27.27%	0	0.00%	4.5	23.08%
Pairs	17	51.52%	2	33.33%	9.5	48.72%
Small Groups	5	15.15%	2	33.33%	3.5	17.95%
Whole Class	2	6.06%	2	33.33%	2	10.25%
Total	33	100.00%	6	100.00%	19.5	100.00%

Table 4

Frequency Count for Instruction by Time

	Observation 1		Observation 2		Mean	
Behavior	*n*	%	*n*	%	*n*	%
Conducted a pre-assessment (e.g., factual review).	8	6.96%	4	2.58%	6	4.44%
Provided goal or objective of lesson.	2	1.74%	2	1.29%	2	1.48%
Presented new concepts lecture-style.	1	0.87%	1	0.64%	1	0.74%
Provided computer-assisted instruction.	5	4.35%	2	1.29%	3.5	2.59%
Provided graphic organizer.	4	3.48%	20	12.90%	12	8.89%
Provided skeleton outline or powerpoint handouts.	1	0.87%	1	0.64%	1	0.74%
Conducted a demonstration.	20	17.39%	13	8.39%	16.5	12.23%
Applied concepts to real-world experience.	17	14.78%	38	24.52%	27.5	20.37%
Used manipulatives.	3	2.61%	3	1.94%	3	2.22%
Used assessments embedded in class activities (e.g. informal assessments).	40	34.78%	68	43.87%	54	40.00%
Provided teacher-guided student practice.	14	12.17%	3	1.94%	8.5	6.30%
Total	115	100.00%	155	100.00%	135	100.00%

Congruence between Instructional Methods and Learning Style. A chi-square non-parametric analysis (Siegel, 1956) was conducted to determine if the observed behaviors of the instructors were different from the distribution of learning styles in the classroom. While the literature suggests supporting all learning styles during instruction, particular fields, such as engineering, are dominated with certain learning styles, which was the case with this group of students. The observed behaviors for instruction, independent student activity, and student interactions were summed by category according to the code sheet and averaged across observations. The expected frequency was based on the percentage of students in each category and the number of observed instructional behaviors within each dimension.

The frequency of observed instructional behaviors was statistically significantly different from the students' learning style for the first observation with the active/reflective dimension, $\chi^2 = 6.04$, $p < .05$; however, with the second observation, $\chi^2 = 0.03$, $p > .05$, and the observation mean, $\chi^2 = 1.71$, $p > .05$, there was not a statistically significant difference for the active/reflective dimension. For sensing/intuitive dimension, there was a statistically significant difference between the expected frequency based on the students' learning style and the frequency of instructional behaviors for all observations, $\chi^2 = 10.45$, $p < .05$ (observation 1), $\chi^2 = 11.93$, $p < .05$ (observation 2), and $\chi^2 = 11.19$, $p < .05$ (observation mean). One explanation for these significant results could be the small sample size ($n = 7$).

With the visual/verbal dimension, there was not a statistically significant difference between the observed and expected frequency of learning styles across both observations, $\chi^2 = 0.99$, $p > .05$ (observation 1), $\chi^2 = 3.02$, $p > .05$ (observation 2), and $\chi^2 = 0.98$, $p > .05$ (observation mean). For the last dimension of sequential/global, there was not a statistically significant difference between the instructional behaviors and the expected frequency based on the students' learning styles for the first observation, $\chi^2 = 1.64$, $p>.05$ (observation 1); however, there was a statistically significant difference for the second observation, $\chi^2 = 32.18$, $p < .05$, and the observation mean, $\chi^2 = 12.92$, $p < .05$. One explanation for these significant results was the instructional format of the two observations (application activity and lecture style).

These results suggested that the instructor's instructional methods are congruent with the students' learning styles for the active/reflective, visual/verbal, and sequential/global dimensions. The sensing/intuitive dimension had statistically significant results across both observations, meaning the instructor needs to add more open-ended and abstract scenarios into his instructional methods to support the intuitive learning style, but these results may be skewed based on the small sample size.

Conclusions

The findings of this teacher evaluation revealed the NROTC students were categorized pre-dominantly as active, sensing, visual, and sequential learners, which support the findings of Felder and Silverman (1988). The instructor used a variety of instructional methods during the two observations, but his primary methods were informal assessments and real-world applications of the course concepts. A limitation of the evaluation was the small size ($n = 7$); however, the chi-square results indicated a congruent relationship between the students' learning styles and the instructor's instructional behaviors. Future research could assess the congruence between learning styles and instructional methods across multiple instructors.

References

Felder, R. M. (1995). A longitudinal study of engineering student performance and retention. IV. Instructional Methods. *Journal of Engineering Education, 84*, 361- 367.

Felder, R. M., & Silverman, L. K. (1988). Learning and teaching styles in engineering education. *Engineering Education, 78*, 674-681.

Felder, R. M., & Soloman, B. A. (n.d.). *Learning styles and strategies*. Retrieved August 30, 2007 from http://www4.ncsu.edu/unity/lockers/users/f/felder/public/ILSdir/styles.htm.

Felder, R. M., & Spurlin, J. (2005). Applications, reliability, and validity of the Index of Learning Styles. *International Journal of Engineering Education, 21*, 103-112.

Larkin, T., & Budny, D. (2005). *Learning styles in the classroom: Approaches to enhance student motivation and learning.* Paper presented at the ITHET Annual Conference, Juan Dolio, Dominican Republic.

Litzinger, T. A., Lee, S. H., Wise, J. C., Felder, R. M. (2005). *A study of the reliability and validity of the Felder-Soloman Index of Learning Styles*. Paper presented at the ASEE Annual Conference, Portland, OR.

NC State University. (n.d.). *Learning styles results*. Retrieved August 30, 2007 from http://www.engr.ncsu.edu/learningstyles/submit.php.

Siegel, S. (1956). *Nonparametric statistics for the behavioral sciences*. New York: McGraw-Hill Book Company.

TIMSS Study Center. (1998). *Mathematics teacher questionnaire: Main survey*. Chestnut Hill, MA: Boston College.

Westat. (2000). *National Survey of Science and Mathematics Education*. Rockville, MD: Westat.

Zywno, M. S. (2003). *A contribution to validation of score meaning for Felder-Soloman's Index of Learning Styles*. Paper presented at the ASEE Annual Conference, Nashville, TN.

Author's Note

Jennifer Bell is a doctoral student in Educational Psychology and a research assistant within the Department of Educational Foundations, Leadership, and Technology, 4036 Haley Center, Auburn University, AL 36849