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Understanding patterns in student learning styles to guide curriculum innovation

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Abstract

Student learning styles effect how students learn. If there is a mismatch between most students' learning styles in a class and the teaching style of the instructor, student learning can be compromised. Learning styles of the students of two curriculums in the Agricultural and Biosystems Engineering Department (ABE) at Iowa State University, Agricultural Engineering (AE) and Agricultural Systems Technology (AST), were measured in courses over several years using Felder and Silverman's Index of Learning Styles (ILS). Midterm surveys were implemented to assess student learning preferences. In focus groups assessing specific AE and AST upper level courses, students were questioned about their learning styles and the transcripts from these focus groups were analyzed with learning styles in mind to confirm or refute the aggregate results of the ILS. AE and AST students tend to be visual, active, and sensory learners, confirming the ILS results, and are mismatched with traditional teaching styles used in many courses. Using the outcomes of these assessments, several class changes and innovations to the curricula have been and are being developed. Examples of these innovations are inclusion of more visualization in courses, in-class active learning assignments, and the use of electronic portfolios across these curricula. Understanding patterns in student learning styles has pedagogical value, as it has helped ABE instructors understand not only how the students to tend learn best, but also how classes should be structured so that students can learn in situations that don't match their learning style.

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Comments

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Understanding patterns in student learning styles to guide curriculum innovation

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ABSTRACT

Student learning styles effect how students learn. If there is a mismatch between most students' learning styles in a class and the teaching style of the instructor, student learning can be compromised. Learning styles of the students of two curriculums in the Agricultural and Biosystems Engineering Department (ABE) at Iowa State University, Agricultural Engineering (AE) and Agricultural Systems Technology (AST), were measured in courses over several years using Felder and Silverman's Index of Learning Styles (ILS). Midterm surveys were implemented to assess student learning preferences. In focus groups assessing specific AE and AST upper level courses, students were questioned about their learning styles and the transcripts from these focus groups were analyzed with learning styles in mind to confirm or refute the aggregate results of the ILS. AE and AST students tend to be visual, active, and sensory learners, confirming the ILS results, and are mismatched with traditional teaching styles used in many courses. Using the outcomes of these assessments, several class changes and innovations to the curricula have been and are being developed. Examples of these innovations are inclusion of more visualization in courses, in-class active learning assignments, and the use of electronic portfolios across these curricula. Understanding patterns in student learning styles has pedagogical value, as it has helped ABE instructors understand not only how the students to tend learn best, but also how classes should be structured so that students can learn in situations that don't match their learning style.

INTRODUCTION

Learning is a process of perceiving and processing new information. Several different learning style models have been developed to facilitate understanding of how different people learn differently. Several learning style models are commonly cited in the literature, including: 1) Myers-Briggs Type Indicator (McCaulley, 1990), 2) Kolb learning style model (Kolb, 1984; Stice, 1987), 3) Herrman Brain Dominance Model (Herrmann, 1990; Lumsdaine and Lumsdaine, 1995), 4) Felder-Silverman learning style model (Felder and Silverman, 1988; Felder, 1993), and 5) Gregorc's Learning Style Delineator (Gregorc, 1982,1985; Schmidt and Javenkoski. 2000).

The Felder-Silverman model represents a student learning styles on four scales, each representing a dimension pertaining to how the students perceive and process information. Students are rated by their preferences to be: (1) active or reflective learners, (2) sensing or intuitive learners, (3) visual or verbal learners, and (4) sequential or global learners. Note that these scales do not truly represent an either/or situation. Learners are along a continuum between "opposite" ends of the spectrum. The learning style determined by the Felder-Silverman model denote learning preferences – individuals can indeed learn in situations that don't match their learning style, but it may take some adjustment on their part.

Focus groups can be effective in obtaining specific summative data about student learning styles and preferences. A focus group is "a carefully planned discussion designed to obtain perceptions on a defined area of interest in a permissive, non-threatening environment" (Krueger and Casey, 2000). Christopher (2000) reported on the use of student focus groups as one evaluation component of a university-level course. She found the open and interactive setting provided by the focus group to facilitate students sharing deep thoughts about the course and specific suggestions for change. Hendershott and Wright (1993) used student focus groups to explore student attitudes about and behavior arising from general education curriculum requirements at a university. They found focus groups uncover "rich data" going beyond information gleaned through surveys. Hamilton and Pritchard (2002) found that the use of student focus groups resulted in specific suggestions for course improvements as well as significant increases in student course evaluations ratings.

The objective of this study was to better understand learning style patterns of students in two curriculum of a particular engineering department so that course innovations would best address learning patterns in the class.

METHODS

Learning Style Index

To further understand the interactions between the instructor's learning style and that of the students, the Index of Learning Styles (ILS; Felder and Soloman) was used to assess preferences on four dimensions of Felder-Silverman (1988) model of learning styles. While other models may have also suited our purpose, the ILS was easily understood by students, fairly simple (only four dimensions) and web-based, making the ILS easy to implement. This assessment was performed on the instructors and also on students in two curriculums, Agricultural Engineering and Agricultural Systems Technology within the Agricultural and Biosystems Engineering Department of Iowa State University during 3 first-year student orientation courses and one upper level course. Freshman and transfer students in the AST curriculum were surveyed using the ILS in the fall of 2002. Similarly, freshman and transfer students in the AE curriculum were surveyed during fall 2000 and 2002. One class consisting of upper level students was surveyed during fall 2003. The results of the ILS were aggregated and analyzed. JMP software (The SAS Institute Inc, Cary, N.C.) was used to determine if statistical differences existed between courses in any of the learning style dimensions and to determine which of the learning styles had mean scores that were significantly different than zero.

Midterm Survey

At mid-term of spring 2001 and 2003 terms of an upper level AST course, students were asked to complete a course survey administered through WebCT. While responses to the survey were anonymous, WebCT indicated which students responded to the survey. For completing the survey, each respondent was given a small amount of course credit. The instructor examined the responses to identify reoccurring themes. Ambiguities and questions arising from the data were used in the development of guiding questions for the subsequent focus groups.

End-of-Term Focus Group

Near the end of the terms of the upper level AST course, students were asked to volunteer to be a part of a focus group to provide the instructor with course feedback. Students were selected to represent a wide academic cross section of class members. Anonymity of the focus group participants was protected. A focus group moderator and recorder developed guiding questions with input from the instructor, based on e-mail responses and the midterm feedback e-survey.

The guiding questions of these focus group sessions focused on understanding the learning styles of the students, what instruction methods they perceived as being most helpful for their learning, and what changes to the course would best help their learning.

Each focus group met for approximately one hour. In 2001, seven students participated, while in 2002, three students participated. The discussions were recorded on an audiotape. The recorder made annotations to indicate who was speaking. After the focus group met, the audiotape was transcribed, and student names were removed to maintain their anonymity. The transcripts were analyzed using the long table method (Krueger and Casey, 2000), to find potential answers to questions that were raised by data from the other assessments.

RESULTS

Learning Style Index

The first author (Steward) had a moderate preference for the reflective dimension of the active/reflective learning scale. On all of the other scales – sensing/intuitive, visual/verbal, sequential/global – he was balanced in his preference. The second author (Brumm) had a strong preference for active learning, and moderate preferences for intuitive, visual and global learning. The third author (Mickelson) had strong preferences for active, sensing, and visual learning, and a balanced preference for sequential/global learning. This shows the just how different faculty instructors learning style can be.

When the student data was aggregated, scores on the active, sensing, visual, and sequential end of the learning style dimensions were made negative to represent numerically the continuum on each of the four scales. There was no evidence of significant differences in the mean scores on any of the dimensions across the four classes. Aggregating the data from all of the four classes, we found that on three of the four learning style dimensional scales – active/reflective, sensing/intuitive, and visual/verbal – the mean scores were significantly different than zero, indicating on average there is a least some preference for one end of the dimension scale on three dimensions of the learning styles (Figure 1). In particular, on the visual/verbal scale, the mean score was -7.51 with a 95% confidence interval (CI) of ± 0.68. On the sensing/intuitive scale, the mean score was – 4.02 with ± 0.88 CI. For the active/reflective scale, the mean was –2.625 with ± -.94 CI. For the sequential/global scale, the mean was –0.64 with a ±0.89 CI. Thus the students on average had a strong moderate preference for visual learning as opposed to verbal learning and a weakly moderate preference for sensing. For the active/reflective scale and the sequential/global scale, on the average, the students were balanced in the learning style preference with a great deal of variability in those scales.

Student Survey Results and Focus Group Discussions

Though midterm surveys, students indicated how they thought the instructor could help student learning. These responses provided insight into student learning styles. Two themes emerged from the student responses. One theme was that “real world examples,” “more hands on stuff,” and “more practical stuff” would enhance their learning. The second emerging theme was that the students thought more examples, as indicated by responses such as: ". . . more examples . . .," and ". . . do more problems/examples," would help learning. These responses seemed to indicate that the students preferred to perceive new information by sensing.

Focus group discussions clarified the results from the ILS and mid-term survey leading to a deeper understanding of how students preferred to learn in two classes. In particular, the focus group discussions clarified what it meant for the class to be more “real-world” or “practical” –

themes that arose from the midterm surveys. Through the focus group discussion, we came to understand that when students refer to something being “real-world,” they mean they can see the connection between the course content and their practical experience. Many students bring experience to the class from their agricultural background – either growing up on a farm or having work experiences with mechanical systems. One student suggested, “Say you’ll find this circuit in X and it’s in this piece of equipment and this is how it works.”

The idea of something presented in a real-world fashion gave substantial insight into the students’ learning styles. In particular, there was a clear identification of a visual over a verbal learning style. When directly asked, the students were unable to directly talk about their learning styles. Nevertheless, a visual learning style over a verbal learning style was observed in the focus group discussions.

Students indicated, for example, that they had difficulties reading the textbook to gain an understanding of how things work. A student said, “I just can’t read about it and learn about it very well.” Or another, “I know myself I just can’t stick my nose in a textbook and learn everything I need to know.” Visualization is very important to them, “I need to see what is there and see how it works.” or “I just think it’s good to see how things work visually instead of just reading it.” They also found value in animations of systems that they were learning about. Thus, teaching methods that communicate concepts visually were perceived as helpful for learning.

From the mid-term survey responses alone, it was unclear how the class might be changed so that there would be more compatibility between the instruction and the students’ learning style. The instructor assumed from the beginning that the learning style of these students was different from his own learning style. Teachers tend to provide instruction that is consistent with their learning style (Felder, 1993). In an effort to better connect with the student learning styles, the instructor presented what he perceived as “real world examples” in the class to try to help the students make connections with subject matter that at times is rather abstract for agriculture students. Nevertheless, from the mid-term survey, the students indicated more practical examples would help their learning. These responses pointed out a need for further understanding of the students learning styles so that further improvements could be made in this area. The learning style patterns observed in the ILS results were confirmed by the midterm survey and the focus group discussions. In addition, the survey and focus groups provided insight into how these students prefer to learn and what instructional improvements they perceive as being helpful.

Course and Curricular Innovations

The results of this study have been used to shape innovation in the classroom. The first author, for example has been using questions based on the previous week’s class to shape the next class making the class more interactive. Because of the very strong visual preference of the student, more images and animations have been introduced each time the course taught to help students understand course concepts. More active learning exercises have also been introduced. It is not enough, however, to align courses with dominant learning styles. Students also need to be challenged to learn in ways that do not align with their preferences. For example, students were recently required to find, read, and understand a technical paper related to the course, and write a summary of the paper. Such an assignment required the students to perceive and process verbal information.

The authors of the paper came to understand that their learning styles can be different from that of their students. Therefore, they adjusted their classroom pedagogy to include more opportunities for different learning styles. For example, inclusion of more visual descriptions

and “real world” examples in all our classes help students that are visual learners, where as we relied more on equations and theories (verbal) to demonstrate concepts in the past.

Innovations in the AE and AST curriculums are being implemented. For example, electronic portfolios will soon be required of every undergraduate student in the department. Students will use them to demonstrate and develop competencies related to the program student outcomes. Given that our students tend to be visual learners, we believe students should find the creation and reflection of electronic portfolios an excellent learning experience for them.

CONCLUSIONS

From this study, we concluded that:

1. Consistent, salient learning style patterns exist in the students of two different curriculums in our department: our students tend to be strongly visual learners.
2. Other assessments confirm learning style patterns and clarify how students think about their learning styles or preferences giving instruction information necessary to affect change in instruction.
3. Knowledge of learning style patterns provides motivation and guidance in making classroom and course innovations and changes.

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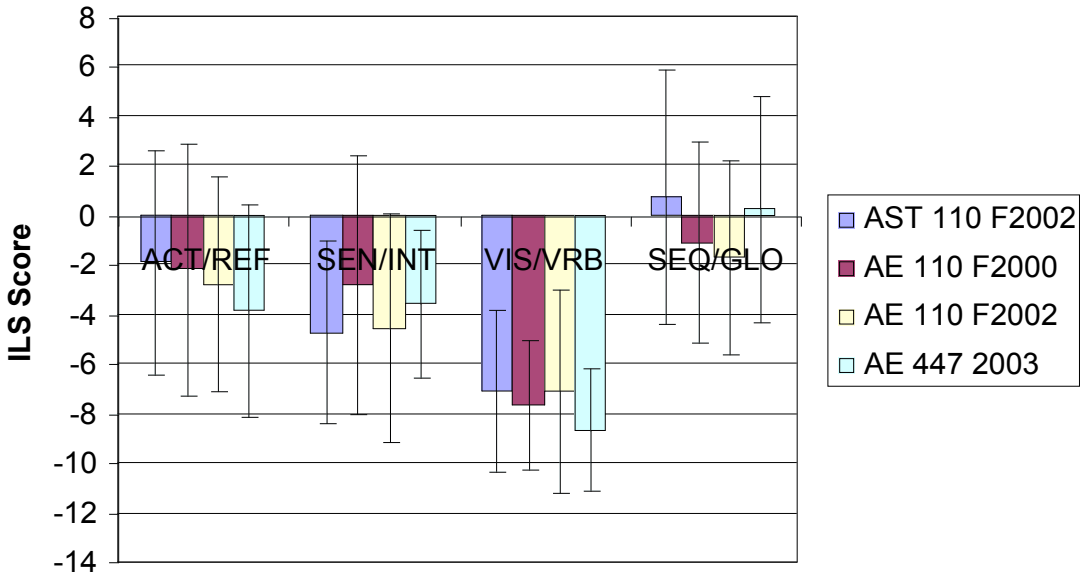

Figure 1. Diagram of ILS results for four classes of students. Negative scores represent preferences on the active, sensing, visual, and sequential end of each of their respective scales.