Learning Strategy Growth Not What Expected After Two Years through Engineering Curriculum

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Abstract

As the pace of technological development continues to increase, consensus has emerged that undergraduate science, technology, engineering and mathematics (STEM) curricula cannot contain all of the topics that engineering professionals will require, even during the first ten years of their careers. Therefore, the need for students to increase their capability for lifelong learning is receiving greater attention. It is anticipated that development of this capability occurs during the undergraduate curricula. However, preliminary data from both first-year and junior engineering majors may indicate that development of these competencies may not be as large as desired. Data was obtained using the Learning and Study Skills Inventory (LASSI), an instrument whose reliability has been demonstrated during the past fifteen years. The LASSI is a ten-scale, eighty-item assessment of students' awareness about and use of learning and study strategies related to skill, will and self-regulation components of strategic learning. Students at Texas A&M University in both a first-year engineering course and a junior level civil engineering course took the LASSI at the beginning of the academic year. Improvements would normally be expected after two years in a challenging engineering curriculum. However, data on several different scales appears to indicate that improvements are smaller than might be expected.

Introduction

The Accreditation Board of Engineering and Technology (ABET) requires in Engineering Criteria 2000 (EC2000) that engineering programs must demonstrate graduates have "a recognition of the need for, and an ability to engage in life-long learning."[1] The requirement leads to a need for defining and assessing lifelong learning and is being approached in a variety of ways at the post secondary level.[2,3] For the purposes of the present paper, lifelong learning is defined as having the internal drive and skills to continue to understand topic areas at any level of perceived need. The perceived need may be as a result of job performance or may just be a result of seeing a prospective need in the distant future. The internal drive includes a gathering of information until the need is fulfilled whether this is through gathering of materials such as in a library, classroom, or on the internet. Also included are skills to process the information once it is obtained. Assessing the degree to which graduates can engage in lifelong learning may also raise questions about how much the capability for lifelong learning increases during a four-year undergraduate engineering curriculum.

In designing a four-year engineering curriculum, faculty members make assumptions about the capabilities for lifelong learning possessed by entering students. Further, these faculty members have assumed that through the instruction received in a strong engineering curriculum, the students will improve their capabilities for lifelong learning. Studies do indicate the enhancements of the capability for lifelong learning are impacted by the processes utilized in the classroom such as teaching method, classroom climate and type of assessments.[4] Examining growth in the capability for lifelong learning would enable the second assumption, the assumption about engineering curricula developing lifelong learning, to be tested and is the purpose of the current paper.

Examining growth in the capability for lifelong learning requires the ability to measure the capability for lifelong learning. While there are many approaches to measuring this capability, no one approach or combination of approaches has emerged as definitive. Since the present study is preliminary, it is not necessary to select a definite measure or set of measures. Instead, the study may select a set of measures that would provide some indication as to whether further inquiry might be warranted. Therefore, a widely used, well-tested instrument or set of instruments for exploration of the capability for lifelong learning was required. After some research, the Learning and Study Skills Inventory (LASSI) [5] emerged as a candidate.

Learning and Study Skills Inventory (LASSI)

Most students do not think about the process they follow as they strive to learn something new. The LASSI is designed to measure the covert and overt thoughts, behaviors, attitudes, motivations and beliefs that students utilize as part of this process that leads to successful learning in the post-secondary educational and training settings. [6] The LASSI provides students with areas of strengths and weaknesses on the ten scales: information processing, selecting main idea, test strategies, anxiety, attitude, motivation, concentration, self-testing, study aids and time management; as compared to other college students. One of the valuable aspects of the students assessing personal learning and study strategies is then interventions can be designed to address the areas of weakness.

The First Edition of the LASSI was developed in the late 1980's[7] and the Second Edition began development five years ago with release in 2002.[5] The second edition completed extensive development and testing including administration of a field test/norming version to 1,092 students from twelve different institutions representing different geographical regions as well as university, community college, state college and technical institutions. The second edition of the LASSI is available at the high school level as well as the college level.

The LASSI is built on a ten-scale design with the scales grouped according to the component measures of skill, will or self-regulation. The ten-scale subgroups measuring these three components of strategic learning are as follows:

Skill Component:	Information Processing
	Selecting Main Ideas
	Test Strategies
Will Component:	Anxiety

	Attitude
	Motivation
Self-regulation Component:	Concentration
	Self-Testing
	Study Aids
	Time Management

For further detail on the individual scales including detailed descriptions, item statistics and national norms, please refer to the LASSI User's Manual.[6]

Procedure

Once the LASSI was identified as the instrument with which preliminary explorations of the capability for lifelong learning would be conducted it was necessary to administer the LASSI to a group of entering first-year engineering students and a group of engineering students who were further along in their undergraduate study. Since one of the authors taught both first-year engineering students and junior/senior civil engineering students, expediency dictated the choice of the two groups. In addition, one other freshmen engineering professor offered permission to administer the LASSI. Neither of these classes were honors classes. Of the 190 freshmen engineering students in the two sections 88 volunteered to complete the LASSI second edition in the first month of the semester. Of the 100 junior level civil engineering students offered the opportunity to complete the LASSI, 52 volunteered to complete the LASSI. The second edition of the LASSI was conducted electronically for both the freshmen and junior level students.

There are no characteristics of either group of first-year students or junior-level students that suggest that they would not be representative of either first-year engineering students or junior-level civil engineering students, respectively. Although the numbers of students who completed the LASSI could be larger in a more comprehensive study, the size of the sample groups is sufficient for a preliminary study.

Results and Discussion

SPSS was utilized to conduct the statistical analysis including the mean percentile ranks and statistical significance for each of the LASSI scales as outlined in Table 1. The population mean percentile ranks were compared through the Wilcoxon Rank-Sum Test. This test was utilized based on the data not meeting a normal distribution. To evaluate change in each of the ten scales, a significance level of 0.01 was selected. Using this criterion, only two of the scales, study aids and self-testing, show any change of statistical difference and both were in the direction of lower competency.

Each of the three components of the LASSI: skill, will, and self-regulation, will be analyzed in greater detail. The skill component contains three scales: information processing, test strategies, and selecting main ideas. Mean percentile ranks on the first two scales are virtually unchanged between the first-year and junior level students. On the third scale, selecting main ideas, the mean score of the junior students is higher than the mean of the first-year students, which is encouraging. However, the magnitude of the change is not statistically significant using any reasonable criterion. Based on the sample of students in this study, the capabilities on the skill component of the junior engineering students are the same as the first-year engineering students. Little or no change in the skill component runs counter to the prevailing wisdom that expects students to become more capable at these lifelong learning skills after two years in a challenging undergraduate engineering curriculum.

Table 1. Calculated mean percentile ranks of the LASSI scale results.

LASSI SCALE	ENGR111 (Mean)	CVEN349 (Mean)	Significance *
Skill Component			
Information Processing	60.68	60.29	0.728
Test Strategies	64.33	63.27	0.962
Selecting Main Ideas	55.18	59.29	0.265
Will Component			
Anxiety	60.52	67.12	0.102
Attitude	42.47	34.56	0.075
Motivation	63.30	59.29	0.500
Self-regulation Component			
Concentration	61.31	54.56	0.174
Self-testing	52.47	37.92	0.006
Study Aids	60.24	45.04	0.008
Time Management	55.23	47.65	0.125

*Based on Wilcoxon Rank-Sum Test using SPSS

The will component contains three scales: anxiety, attitude and motivation. The mean percentile rank on the anxiety scale increases from the first-year to the junior year although the change is not statistically significant at the 0.01 level, it could be considered significant at the 0.1 level. An increase might be expected since the anxiety scale measures how tense and concerned the student is over approaching academic tasks and juniors would be expected to be less anxious than first-year students. Note that an increase on the anxiety scale corresponds to a decrease in the level of anxiety. The attitude score decreases substantially from the freshman to junior year, and although the change is not statistically significant at the 0.01 level, it is significant at the 0.1 level. The direction and magnitude of the change is a little alarming since the attitude scale measures a student's attitude toward school and the general motivation for succeeding in school. A large decrease would indicate that the juniors tested are less motivated and have a poorer attitude toward engineering than first-year students. Finally, the motivation score also decreases from the freshman to the junior level student but the change is again not statistically significant. Based on the sample scores, juniors are less anxious, have a poorer attitude toward academics, and have about the same motivation as first-year students. However, neither of the two changes is statistically significant.

The self-regulation component contains four scales: concentration, self-testing, study aids and time management. Alarmingly scores on all four scales decrease from first-year to junior level students and changes on two of the scales, self-testing and study aids, are statistically significant at the 0.01 level. The direction and magnitude of the decreases are unexpected and together the changes in the four scales suggest that junior engineering students are less adept at self-regulation than first-year students. Since self-regulation is a key component in almost any model of lifelong learning, the changes are really quite surprising and disappointing.

Conclusions

The results indicate that the assumption on the part of engineering faculty that the lifelong learning capability of engineering students increases during their undergraduate years may need to be revisited. Both of the statistically significant changes, self-testing and study aids, are in the undesirable direction. Trends for almost all of the means for other scales are either in the wrong direction or show little or no change. The exceptions are changes on the anxiety scale and the scale related to selecting main ideas. Changes in both of these scales are the desired direction, but the changes are not large enough to be statistically significant. Results from the present study suggest a larger, more comprehensive study to confirm or invalidate the trends.

A large, more comprehensive study would involve more first-year students, more juniors in more majors, and possibly additional instruments whose scores might be compared with scores on the LASSI scales. Additional research could help to determine if the students are really not progressing in their capacity for lifelong learning. Then if the students are truly not getting better at the skills projected to increase the capacity for lifelong learning, one could further determine what interventions might be effective in changing this trend.

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Bibliographical Information

[1] ABET, 2003-2004 Criteria for Accrediting Engineering Programs, http://www.abet.org/images/Criteria/E1%2003-04%20EAC%20Criteria%2011-15-02.pdf, January 14, 2003.

[2] Biggs, J. (2001) Enhancing Learning: A Matter of Style or Approach?, *Perspectives on Thinking, Learning and Cognitive Styles*, Edited by R.J. Sternberg, L.F. Zhang, Mahwah, NJ: Erlbaum

[3] Litzinger T.A. and Marra R.M. (2000) "Life Long Learning: Implications for Curricular Change and Assessment", *Proceedings, ASEE Annual Conference,* Session 2793

[4] Todd, B.A. (2002) "Short, Instructional Module to Address Lifelong Learning Skills", *Proceedings, ASEE Annual Conference*, Session 1065

[5] Weinstein C.E. and Palmer, D.R. (2002) *Learning and Study Strategies Inventory (LASSI), 2nd Edition*, Clearwater, FL: H & H Publishing

[6] Weinstein C.E. and Palmer, D.R. (2002) *LASSI User's Manual 2nd Edition*, Clearwater, FL: H & H Publishing

[7] Weinstein, C.E., Schulte, A.C., and Palmer, D.R. (1987) *Learning and Study Strategies Inventory, (LASSI) 1st Edition,* Clearwater, FL: H & H Publishing

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