Measuring Students' Propensity for Lifelong Learning

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BACKGROUND

It is widely accepted that one goal of higher education is to instill in students the need for and the practice of lifelong learning. All major stakeholders of higher education – graduates, employers, faculty and accrediting agencies – agree that this outcome is critically important given the rapid pace of change of society, especially in engineering and technology. Our graduates must adapt to this change in order to remain productive contributors. Given the importance of lifelong learning, it is surprising that there is a paucity of methods to assess this outcome in students. Two recently developed assessment instruments (Kirby et al., 2010; Macaskill & Taylor, 2010) purport to measure various facets of this outcome in college students.

PURPOSE

We use these instruments to assess for differences between engineering students at a large, public university in the western United States, and also to compare the results between the two instruments as a check on congruence.

DESIGN/METHOD

Engineering students from the second through senior year of study in a variety of disciplines were surveyed using both instruments. The sample (n=193) also included a fair representation by females and minority groups. Analysis of variance was used to assess for differences between the various subgroups of students.

RESULTS

The results based on the survey for measuring lifelong learning skills showed that there were several differences between student populations. Comparing male and female students, a significant difference was found for "locating information," with males self-reporting a higher ability in this trait. In comparing between racial or ethnic groups, Asians self-reported lower abilities with "application of knowledge and skills," and "self-direction and evaluation." Finally, when students were compared based on their year of study, a significant difference was found between the second-year and senior students, with the seniors reporting higher abilities in "application of knowledge and skills" and "adaptable learning strategies." The results based on the survey for measuring autonomy of learning showed significant differences between Asian students and other racial or ethnic groups, with Asian students consistently self-reporting weaker scores on both subscales of learner autonomy.

CONCLUSIONS

Students vary in their abilities as lifelong learners, as expected. Certainly, we expect that they gain in skills associated with lifelong learning during their college years, and the preliminary results support this. What is perhaps somewhat surprising is that there are not more differences between student subgroups for more lifelong learning traits.

KEYWORDS

Lifelong learning, Learner autonomy, Self-directed learner.

Introduction

It is widely accepted that one goal of higher education is to instill in students the need for and the practice of lifelong learning. All major stakeholders of higher education – graduates, employers, faculty and accrediting agencies – agree that this outcome is critically important given the rapid pace of change of society, especially in engineering and technology. Our graduates must adapt to this change in order to remain productive contributors. Indeed, it can be argued that much – or even most – of what an engineering graduate needs to know several years after obtaining his or her degree will not have been learned in school but will need to be acquired through independent learning outside of formal instructional settings.

Given the importance of this learning outcome it is surprising that there is a dearth of instruments to measure it. Two recently developed assessment instruments (Kirby et al., 2010; Macaskill & Taylor, 2010) purport to measure various facets of this outcome in college students. Our two goals are to use these instruments to assess for differences in engineering students at a large, public university in the western United States, and to compare the results between the two instruments as a check on congruence.

Background

Lifelong learning is a relatively new construct in higher education (Kirby et al., 2010) and, though widely used in education currently, its definition is rather vague and imprecise. Some researchers equate lifelong learning with characteristics that lifelong learners possess, such as self-directed learning, autonomous learning, motivation to learn, and perceived competence (Kirby et al., 2010; Macaskill & Taylor, 2010). Even using these well developed psychological traits, however, the available instruments to assess them have rather severe shortcomings.

One instrument to directly measure lifelong learning was constructed by Deakin Crick and colleagues called the Effective Lifelong Learning Inventory (Deakin Crick et al., 2004; Deakin Crick and Yu, 2008). This 72-item survey was designed for a target audience ranging from young children to adults and, as a result, is laborious to complete because of its length, vagueness of some questions, and openness to multiple interpretations of others (Kirby et al., 2010).

Other instruments that measure associated traits exist, but each has problems that make it inadequate for use with college undergraduates. As Macaskill & Taylor (2010) described, the Self-directed Learning Readiness Scale (Guglielmino, 1977) has severe problems with its construct validity and other shortcomings, and the Self-directed Learning Readiness Scale for Nursing Education (Fisher, King, & Tague, 2001) is long and designed for a specific population. A widely studied and used instrument, the Motivated Strategies for Learning Questionnaire (MSLQ), for measuring aspects of motivation for learning among college students (Pintrich et al., 1991) seems appropriate but, in our opinion, is rather long and may not be compatible with some pedagogies and modern teaching practices.

The instruments under study are appealing in that both are based on educational psychology research, psychometrically sound, and brief, taking less than 10 min to complete both. Macaskill and Taylor's 12-item instrument (2010) aims to measure two subscales – independence of learning and study habits – that characterize an autonomous learner, which arguably forms the act of being a lifelong learner. Kirby et al. (2010) claims to directly measure lifelong learning as conceptualized through five traits: goal setting, applying appropriate knowledge and skills, engaging in self-direction and self-evaluation, locating information, and adapting learning strategies to different conditions. This instrument contains 14 questions.

Methodology

Participants

A total of 202 engineering students attending a large, public university in the western United States completed the survey. The students were recruited during the spring quarter of a three-quarter academic year from multiple sections of three courses: Introduction to Thermodynamics, a lower-level engineering fundamentals course required by several engineering disciplines; Dynamics, a lower-level engineering fundamentals course required by several engineering disciplines; and Thermal Systems Design, a senior-level mechanical engineering course. Nine participants were excluded from the final analyses due to either incomplete surveys or small number of respondents in the demographic group, leaving a final sample size of n = 193. Table 1 provides the demographic characteristics of the participants.

Table 1: Demographic characteristics of the sample (n = 193).

	n	%
1. Gender		
Male	158	81.9
Female	35	18.1
2. Race/ethnicity		
White	136	70.5
Asian	26	13.5
Hispanic	24	12.4
Not specified	7	3.6
3. Year of study		
Sophomore (2nd year)	58	30.0
Junior (3rd year)	59	30.6
Senior (4th or higher year)	76	39.4
4. Major		
Mechanical	99	51.3
Civil & Environmental	26	13.5
Biomedical	32	16.6
General	8	4.2
Industrial	10	5.2
Aerospace	4	2.1
Agricultural	6	3.1
Other	8	4.2

Procedure

The two instruments were combined into a single survey (Figure 1) and administered to the students at approximately the middle of the spring quarter (March to June) of 2012. The upper section of the survey (Figure 1) is the lifelong learning scale (LLS) of Kirby et al.

(2010), while the lower section is the autonomous learner scale (ALS) of Macaskill & Taylor (2010). For the ALS, items A-G form the "independence of learning" subscale, while items H-L form the "study habits" subscale. Each subscale of the LLS was formed from the following sets of questions:

Goal setting: Questions 1, 6, 7, 9, 14
Applying appropriate knowledge and skills: Questions 5, 10, 12
Engaging in self-direction and self-reflection: Questions 8, 13
Locating information: Question 11
Adapting learning strategies to different conditions: Questions 2, 3, 4

Circle your answers to these questions using these guidelines for 1 to 5.

1-Strongly agree 2-Agree	**3-Neutral**	**4-Disagree**	**5-Strongly Disagree**				
1. I prefer to have others plan my learning			1	2	3	4	5
2. I prefer problems for which there is only one solution			1	2	3	4	5
3. I can deal with the unexpected and solve problems as they arise			1	2	3	4	5
4. I feel uncomfortable under conditions of uncertainty			1	2	3	4	5
5. I am able to impose meaning upon what others see as disorder			1	2	3	4	5
6. I seldom think about my own learning and how to improve it			1	2	3	4	5
7. I feel I am a self-directed learner			1	2	3	4	5
8. I feel others are in a better position than I am to evaluate my success as a student			1	2	3	4	5
9. I love learning for its own sake			1	2	3	4	5
10. I try to relate academic learning to practical issues			1	2	3	4	5
11. I often find it difficult to locate information when I need it			1	2	3	4	5
12. When I approach new material, I try to relate it to what I already know			1	2	3	4	5
13. It is my responsibility to make sense of what I learn at school			1	2	3	4	5
14. When I learn something new I try to focus on the details rather than on the 'big picture'			1	2	3	4	5

Circle your answers to these questions using these guidelines for 1 to 5.

1-Very like me 2-Like me	**3-Neutral**	**4-Not like me**	**5-Not at all like me**				
A. I enjoy new learning experiences			1	2	3	4	5
B. I am open to new ways of doing familiar things			1	2	3	4	5
C. I enjoy a challenge			1	2	3	4	5
D. I enjoy finding information about new topics on my own			1	2	3	4	5
E. Even when tasks are difficult I try to stick with them			1	2	3	4	5
F. I tend to be motivated to work by assessment deadlines			1	2	3	4	5
G. I take responsibility for my learning experiences			1	2	3	4	5
H. My time management is good			1	2	3	4	5
I. I am good at meeting deadlines			1	2	3	4	5
J. I plan my time for study effectively			1	2	3	4	5
K. I frequently find excuses for not getting down to work			1	2	3	4	5
L. I am happy working on my own			1	2	3	4	5

Figure 1: Combined surveys of Kirby et al. (2010) (upper section) and Macaskill & Taylor (2010) (lower section). Note that questions about demographics are not shown.

As mentioned previously, the survey took less than 10 min to complete on paper, and was administered either at the beginning or end of a normal class meeting, as was convenient for the class instructor. The purpose of the assessment – to measure students' learning strategies and habits – was explained to the students prior to its administration. Only volunteers completed the survey and no remuneration or extra credit was provided for participation.

A series of one-way analyses of variance (anova) were carried out to determine how the characteristics of a lifelong learner (Kirby et al., 2010) or an autonomous learner (Macaskill & Taylor, 2010) are related to gender, race/ethnicity, year of study, and major. When comparing multiple groups for each subscale resulted in an overall anova p-value that was significant ($p < 0.05$), post-hoc pairwise comparisons of means were carried out using Tukey's method, controlling the family-wise error rate at 0.05.

Results

Lifelong learner characteristics

Comparisons on each of the five subscales (or traits) with study population characteristics found only a few significant differences, as shown in Table 2. The "Mean (std dev)" values represent the means and standard deviations for each trait and for each population group, and correspond to the summed values of all survey questions for that trait. Note that reverse-worded questions were reverse coded before the analyses. A lower mean score indicates a higher self-rated propensity for that trait.

Table 2: Significant differences between study population groups for each subscale.

Trait of lifelong learner	Mean (std dev)	Mean (std dev)	p-value
Locating information	Males: 2.27 (0.94)	Females: 2.69 (0.96)	0.0258*
Applying knowledge & skills	Whites: 6.10 (1.83)	Asians: 7.38 (2.40)	0.0106§
	Seniors: 5.80 (1.91)	Soph.: 6.72 (2.01)	0.0256§
Self-direction & self-evaluation	Hispanics: 4.13 (1.58)	Asians: 5.31 (1.52)	0.0225§
Adaptable learning strategies	Seniors: 8.62 (1.94)	Soph.: 9.78 (2.04)	0.0036§

* Indicates a significant difference in means; $p < 0.05$.
§ Indicates analysis of variance showing at least one significant difference in means among the population groups; $p < 0.05$.

Males and females differed only in their self-perceived ability to locate necessary information. Between race/ethnicity groups, significant differences were found between Whites and Asians, with Whites having a stronger perceived ability to apply appropriate knowledge and skills in their studies; and between Hispanics and Asians, with Hispanics having a stronger self-belief in their ability to engage in self-direction and self-evaluation. Finally, significant differences were found between the sophomore and senior students, with senior students exhibiting stronger self-beliefs in their ability to apply appropriate knowledge and skills, and to adapt learning strategies to different conditions. There was no dependence of any trait on the students' major. It is worth emphasizing that no significant difference was found for the lifelong learning trait of goal setting between any subgroups in our study population.

Autonomous learner characteristics

Comparisons on each of the two subscales (or traits) with study population characteristics found only a few significant differences, as shown in Table 3. The "Mean (std dev)" values

represent the means and standard deviations for each trait and for each population group, and correspond to the summed values of all survey questions for that trait. Note that reverse-worded questions were reverse coded before the analyses. A lower mean score indicates a higher self-rated propensity for that trait.

Table 3: Significant differences between study population groups for each subscale.

Trait of autonomous learner	Mean (std dev)	Mean (std dev)	p-value
Independence of learning	Whites: 15.96 (2.99) Hispanics: 14.92 (2.69)	Asians: 17.77 (4.11)	0.0047[§]
Study habits	Whites: 11.90 (1.83) Hispanics: 12.13 (2.26)	Asians: 14.81 (2.40)	0.0007[§]

[§] Indicates analysis of variance showing at least one significant difference in means among the population groups; $p < 0.05$.

Asians held significantly lower self-beliefs in both autonomous learner traits compared with the other two race/ethnicity groups (though there was no difference between Whites and Hispanics). No differences for either trait were found between males and females, between the students' year of study, or between the majors.

Inter-instrument comparisons

We turn next to inter-instrument comparisons to check for congruence between the two instruments. As mentioned previously, since a lifelong learner must possess the traits that characterize an autonomous learner, we expect the correlation between the two measures to be high for any participant. A comparison of the total mean scores for each of the instruments finds a correlation of 0.5934, with a p-value < 0.0001 and a 95% confidence interval of (0.49, 0.68). This indicates a significant and strong correlation between the two scales, i.e., someone who self-identifies as an autonomous learner tends also to self-identify as a lifelong learner.

Upon closer examination of each item of the LLS and the ALS, we conclude that there is substantial "cross listing" between the two instruments. That is, with few exceptions, every item within the LLS can be fit into either subscale of the ALS and, conversely, every item within the ALS can be categorized into one of the five LLS subscales. Based on this observation, we checked for correlation between each subscale of each instrument with the totality of the other instrument, and the results are shown in Table 4.

Table 4: Correlations between subscales of each instrument with the other instrument, showing correlation value, lower/upper 95% confidence interval, and p-value

trait	instrument	correlation	lower 95% CI	upper 95% CI	p-value
Independence of learning	LLS	0.58	0.48	0.67	<0.0001
Study habits	LLS	0.37	0.24	0.49	<0.0001
Goal setting	ALS	0.57	0.46	0.66	<0.0001
Applying knowledge & skills	ALS	0.41	0.28	0.52	<0.0001
Self-direction & -evaluation	ALS	0.35	0.22	0.47	<0.0001
Locating information	ALS	0.39	0.26	0.50	<0.0001
Adaptable learning strategies	ALS	0.22	0.09	0.35	0.0018

Table 4 shows that all correlations are significant ($p < 0.05$), with moderate to strong correlations for all the comparisons except for adaptable learning strategies by ALS, which shows a weak but significant correlation.

Discussion

That females rated themselves as less able than males at locating information (Table 2) is consistent with a previous study (Felder et al., 1995) which found that female chemical engineering students had lower self-assessments than males for solving basic engineering problems, problems that required creativity, and computer problems. That females did not self-perceive to be weaker for the other four lifelong learning traits is interesting, and perhaps sheds light on locating information as one area where instructors should provide more support to female engineering students. The fact that neither subscale of the ALS showed a difference between males and females may indicate the lack of ability of the ALS to measure for this specific trait.

The differences between Asians and other race/ethnicity groups was fairly consistent between the two instruments, with Asian students believing that they have weaker abilities in two of the five LLS subscales (applying appropriate knowledge and skills, engaging in self-direction and self-evaluation) and both of the ALS subscales (independence of learning and study habits). In fact, although the differences were not statistically significant from Whites or Hispanics, Asian students always had the lowest self-ratings in the other three subscales of the LLS. This finding may be interpreted based on recent findings about the effects of the "model minority stereotype" on Asian-American engineering students (Trytten, Wong Lowe, & Walden, 2012). This study found that although Asian-American students' academic record was not significantly different from other racial/ethnicity groups, the stereotype lead some Asian-American students to use it to judge their self-worth.

Although this study was cross-sectional in time rather than longitudinal, we nonetheless interpreted the differences found between the students' year of study as resulting from the time spent in school. The finding from the LLS that students gained in their abilities from the sophomore to senior years in two of the five lifelong learning traits is a welcomed one (Table 2). Furthermore, it is not surprising that their self-reported gains are for the traits of applying appropriate knowledge and skills, and adaptable learning strategies. These two traits, it can be argued, are more practiced and emphasized in most engineering curricula than the other three lifelong learning traits. The fact that the other three lifelong learning traits showed no significant gains throughout a student's academic career may indicate that either these traits were well developed before students enter the sophomore year of studies or, sadly, they are not being developed during college.

The fact that no significant differences were found for the students' year-of-study for either subscale of the ALS is somewhat surprising in light of the LLS results. It may be that "adaptable learning strategies" (Questions 2, 3 and 4 in Figure 1) as a construct in the LLS is not captured well in the ALS. This is supported by the inter-instrument comparison, which showed that this subscale had only a weak correlation ($r = 0.22$) with the ALS (Table 4). This argument would not explain why "applying appropriate knowledge and skills" does not manifest within the ALS.

Conclusions

Students vary in their abilities as lifelong or autonomous learners, as expected. While we hope that their educational experience will help them to make gains in these abilities, the results found here are mixed. Males and females appear to differ only on one trait, with females self-reporting a lower ability to locate information. But it seems that this is correctible through instructor support. Asian students were found to have weaker self-beliefs in several lifelong or autonomous learner traits, and we cannot easily explain this finding. Happily, we found that engineering students make significant gains in two traits that are

emphasized in most engineering curricula. This finding suggests that, perhaps, emphasis and effort should be put into developing curricula that focus on the remaining lifelong learning traits to help students develop them.

We found good congruence between the two survey instruments. This is not surprising since the characteristics of a lifelong learner must subsume those of an autonomous learner. This is supported by the moderate to strong correlations we found between subscales of each instrument with the totality of the other instrument. There does appear to be some evidence, however, that the lifelong learning scale of Kirby et al. (2010) is a more comprehensive instrument.

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