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Designing Introductory Industrial Engineering Courses to Improve Student Career Efficacy*

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This study sought to examine the design of Industrial Engineering introductory courses with students' career outcomes in mind. Specifically, this study focuses on career efficacy, or students' perceptions of their ability to succeed in a particular career field. Syllabi were reviewed in order to gain knowledge of variations in introductory course content and structure. 231 undergraduate Industrial Engineering students in the United States completed a 41 question survey that included four parts: student information, career efficacy, course information, and course evaluations. Survey responses indicated a significant increase in career efficacy in discipline-specific courses when compared with general introductory courses. Upperclassmen also reported significantly higher career efficacy than underclassmen. Students who reported enjoying the introductory course, as demonstrated by measures of satisfaction with the course, also had higher efficacy scores. The implications of study findings on the design of introductory courses in Industrial Engineering are discussed.

Keywords: Industrial Engineering; efficacy; introductory course

1. Introduction

Self-efficacy is often referenced as a predictor of student success in undergraduate engineering programs. Successful students often have high levels of self-efficacy, whereas students with low self-efficacy have a greater tendency to falter. There is no clear agreement on whether self-efficacy leads to success or vice versa, yet the relationship is nonetheless critical. As educators we should attempt to impact student self-efficacy positively early in the undergraduate programs. Within engineering, students often associate their chosen major with their intended career field. The examination of career efficacy, students' beliefs regarding their aptitude for success in their chosen career field, is essential throughout a student's academic program.

The choice of an academic major is often explored through an introductory course in a student's home college or department. Many Industrial Engineering programs offer introductory courses that cover discipline-specific topics as well as general student success strategies. At the college level, introductory courses are typically used to introduce students, in one course, to the many different fields of engineering. Introductory courses that are well designed should increase students' career efficacy and reinforce their selection of a career field.

2. Literature review

Several studies have examined the design of introductory courses with a focus on improving retention rates in the respective major or college, but few studies have reported success. A successful attempt was presented by Hoit et al., in which a lecture-based general engineering introductory course was converted to a laboratory-based course that engaged students in 'hands-on' activities for each undergraduate engineering discipline. The college experienced significant improvements to retention in engineering, measured as being in engineering at the start of the third year, with the altered course structure [1]. Courter et al. studied the effects of implementing an interdisciplinary design project to a traditionally lecture-based course but found no evidence of improvements in engineering retention, measured as being in engineering at the start of the second sophomore semester [2]. Similarly, Hatton et al. altered a traditional 'Introduction to Engineering' course to include more focus on student development and professional skills rather than solely providing an overview of engineering disciplines. Again, no significant improvements in retention within an engineering program were observed [3]. Other approaches to introductory course design have been proposed, such as the multidisciplinary course experimented with by Morris. This course covered two semesters and included multiple design projects and a wide range of engineering topics [4].

Similar to retention rates, academic outcomes such as degree attainment and grade point average are also commonly focused on in evaluating course effectiveness. Literature suggests that another outcome, students' efficacy beliefs, may also be an important measure of course effectiveness [5]. Bandura [6] defines self-efficacy as a person's perception of his abilities to complete a task successfully. Self-

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efficacy can have a positive or negative influence on a person's behavior. Self-efficacy beliefs of undergraduate students in STEM (i.e. Science, Technology, Engineering and Mathematics) majors have been linked to success and persistence within these fields [7]. Additionally, self-efficacy beliefs have been shown to affect interest, expectations, satisfaction, and choices of engineering students [8–10]. Shull and Weiner suggest that class design could impact student self-efficacy, particularly for underrepresented students [11].

Self-efficacy has been shown to impact not only student performance but also student career choices. Students who felt confident in their choice of career were found to be more persistent [12, 13] and consider more career opportunities [14] throughout their academic careers. Throughout a student's academic career, confidence and self-efficacy related to the attainment of academic milestones is an important predictor of a student's desire to be an engineer [15, 16]. The impact of self-efficacy on student success tends to be higher for first year engineering students and transfer students [17]. First year engineering student self-efficacy can be influenced by mastery experiences, student satisfaction, student motivation, and social persuasions [18].

Previous work examined self-efficacy beliefs of students in relation to their expectations and perceptions of a first-year engineering course. Results showed that the gap between students' expectations and their perceptions of a course was significantly related to academic, team, and career efficacy. The three efficacy types addressed a student's confidence related to individual academic performance in a course (academic efficacy), team performance on group assignments (team efficacy), and success in the chosen career field and related academic program (career efficacy). Self-efficacy beliefs were also found to be significantly related to student satisfaction [19]. This study further examined the self-efficacy beliefs of engineering students by focusing on career efficacy, or student perceptions of their ability to succeed beyond degree attainment. Effective introductory courses should foster career efficacy, resulting in students who are confident in their abilities to succeed in the Industrial Engineering field. This study examined the aspects of introductory course design that may positively influence students' career efficacy beliefs. Specific hypotheses include:

H1. Discipline-specific introductory courses are positively correlated with career efficacy.
H2. Laboratory-based introductory courses are positively correlated with career efficacy.
H3. Increased career efficacy from introductory courses is confounded by demographic factors.
H4. Upperclassmen have higher levels of career efficacy than underclassmen.
H5. Satisfaction with introductory courses is positively correlated with career efficacy.

Initial findings have been previously reported [20] and are expanded upon in this paper.

3. Methodology

3.1 Syllabi review

Introductory course syllabi from various Industrial Engineering programs were reviewed in order to investigate variations in course content and structure. Among the syllabi that were reviewed, introductory courses ranged from zero to three credit hours, which is indicative of the range of depth in content covered in these courses. Course types differed among strictly lecture based courses, combination lecture and laboratory courses, and primarily laboratory courses. Industrial Engineering topics that were commonly covered included: basic statistics, engineering economy, human factors and ergonomics, queuing theory, work measurement, quality engineering, and project management. Other professional topics that were commonly addressed included: engineering ethics, study skills, career opportunities, professional societies, and résumé development. While a small number of courses used Industrial Engineering introductory textbooks such as Turner, Mize, Case, and Nazemetz's *Introduction to Industrial and Systems Engineering* [21], other courses relied on supplemental reading with a focus on industrial engineering principles or professional development. Examples include Goldratt's *The Goal* [22] and Covey's *Seven Habits of Highly Effective People* [23]. Grade assignment typically included attendance or participation, homework assignments, tests and quizzes, and some courses included a course project as a large portion of the final grade. Knowledge of variations in course content and structure was helpful in identifying areas that should be addressed in the student survey.

3.2 Survey development

The goal in data collection was to assess aspects of introductory course design in relation to student satisfaction and career efficacy beliefs. A 48-item online survey was created using a survey hosting website. The survey contained four sections: demographics (20 questions), course information (15 questions), career efficacy (4 questions), and course evaluation (9 questions). The course information section addressed the content and structure of the introductory course taken (delivery method, credit hours, class size, instructor, grade assignment, topics covered) as well as when students took the

Table 1. Career efficacy survey questions

1. I'm certain that I can be successful in my Industrial Engineering program.
2. I'm confident that I can master the skills needed for the field of Industrial Engineering.
3. I'm confident that I can overcome challenges in my Industrial Engineering career.
4. I'm certain that Industrial Engineering is the right career choice for me.

Table 2. Satisfaction survey questions

1. The course increased my desire to become an industrial engineer.
2. I learned new information about Industrial Engineering in the course.
3. The course taught me information that will be useful in my career.
4. The course was critical to my Industrial Engineering education.
5. I enjoyed taking this course.
6. The course is worthwhile for Industrial Engineering students.

course and what grade they received. The course evaluation section addressed students' likes, dislikes, and overall satisfaction with the introductory course that they took. Career self-efficacy, as a measure of how confident a student is with his or her chosen career field, has been measured using the Occupational Self-Efficacy Scale (OSES) [24] and the Task Specific Occupational Self-Efficacy Scale (TSOSS) [25]. However, neither of these surveys focuses on one academic career field. Therefore, four questions specific to students' perceptions of their ability to succeed in Industrial Engineering were created. Questions addressing career efficacy and satisfaction are shown in Tables 1 and 2, respectively. Each question was formatted using a 5-point Likert scale, with 5 representing 'Strongly agree' and 1 representing 'Strongly disagree.'

3.3 Participants

A recruitment e-mail containing the survey link was issued to all undergraduate Industrial Engineering programs in the country. Upon completing the survey, participants were given the option of entering a draw to receive compensation. Five participants were chosen at random and a $50 gift card was mailed to the winners.

A total of 273 students took the online survey. With incomplete responses removed, 231 responses were complete and usable for data analysis. Among the participants, approximately 57% were male and 43% were female. Regarding classification, approximately 65% of respondents were seniors, 19% were juniors, 13% were sophomores, and 3% were freshmen. Transfer students (from junior colleges or other universities) accounted for 28% of respondents. Approximately 68% of respondents had a GPA above 3.00. Among the 68% of participants who had prior work experience, 62% had worked as a cooperative education student or interned in Industrial Engineering. Regarding the type of introductory course that participants had taken, approximately 84% had completed an introductory course in Industrial Engineering, while most of the others (15%) had completed a general engineering introductory course. The remaining respondents reported having completed an introductory course for engineering and science majors or some other type of introductory course. Approximately 49% of respondents reported having taken an introductory course with both lecture and laboratory components, while 48% of respondents reported that they took a lecture-based introductory course. The remaining respondents (2%) reported having taken a laboratory only course.

After downloading raw data from the survey host, Likert-scale responses were coded for analysis. Descriptive analysis and hypothesis testing were performed using MINITAB, using a significance level of $a = 0.05$.

4. Results

An overall career efficacy score was calculated by averaging responses for each of the four efficacy questions. The mean overall career efficacy for all respondents was 4.27 with a standard deviation of 0.74. The ten survey items were also tested with regards to inter-item reliability. The Cronbach's alpha values for career efficacy (0.8557) and satisfaction (0.9118) show a high reliability among the survey items. The following sections investigate differences in career efficacy based on course structure, demographics, and student satisfaction, with selected results presented graphically in Fig. 1.

4.1 Course structure

The design and delivery of an introductory course is the first aspect of the results that were investigated. A significant difference was found in average career efficacy when examining the type of introductory course taken ($F = 3.34$, $p = 0.037$). Students who took a discipline-specific (Industrial Engineering) course had higher career efficacy when compared with those who took a general engineering introductory course (Table 3). This supports the first hypothesis that discipline-specific introductory courses lead to higher career efficacy scores. There was no statistical support for the second hypothesis that course structure (lab versus lecture) impacted career efficacy. No significant difference was found between students' scores based on the course structure ($F = 0.16$, $p = 0.851$). Additionally, no significant relationship was found between the number of

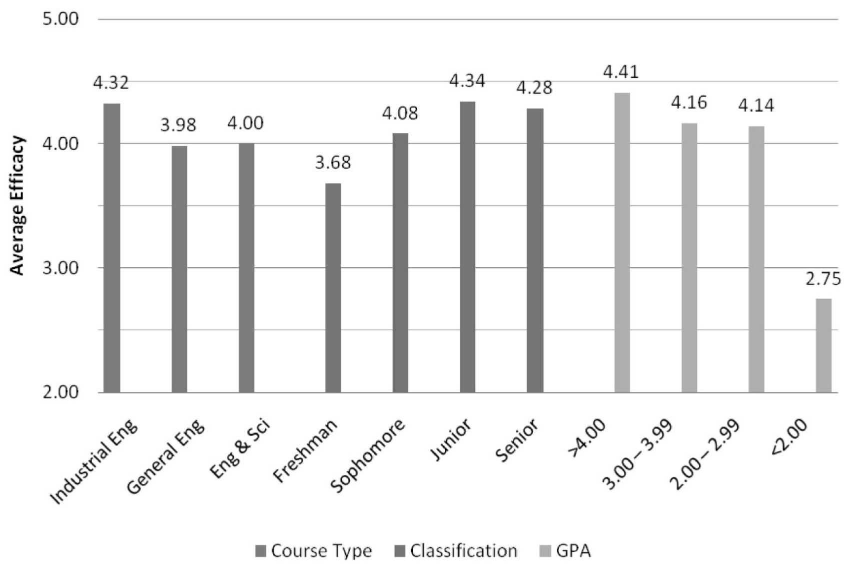

Fig. 1. Average efficacy based on course type, classification, and GPA.

credit hours offered in the course and career efficacy ($F = 0.15$, $p = 0.964$).

Two additional factors were found to impact efficacy significantly when individual efficacy questions (Table 1) were explored. First, the faculty that taught the class significantly impacted the scores on the first ($F = 2.70$, $p = 0.047$) and second ($F = 5.18$, $p = 0.002$) efficacy questions. For both efficacy questions, scores based on courses led by IE faculty were significantly higher than those led by non-IE faculty. There was no difference between other types of instructors (e.g. department head, dean, industry professor).

4.2 Demographic factors

The efficacy results were also analyzed based on various demographic factors, as shown in Table 4. Student classification proved to impact average career efficacy significantly ($F = 2.98$, $p = 0.032$), as predicted in the third and fourth hypothesis. Higher classification levels (juniors and seniors) had significantly higher efficacy scores than lower classification levels. However, no other demographic factors had an individual significant impact on average career efficacy scores. This included gender ($F = 0.68$, $p = 0.410$), co-op experience ($F = 1.29$, $p = 0.257$), transfer student status ($F = 0.02$, $p = 0.886$), and GPA ($F = 1.39$, $p = 0.227$). GPA significantly impacted the scores on the third efficacy question ($F = 1.97$, $p = 0.085$). While no two GPA groups were different from one another, a trend was apparent. The higher the GPA category, the higher the score on the third efficacy question.

4.3 Student satisfaction

The impact of student perceptions/satisfaction with the introductory course was also examined to see if a significant impact on career efficacy existed. As

Table 3. Impact of course structure on average career efficacy

Variable	Sample size	Mean	Standard deviation
Type of introductory course taken ($F = 3.34$, $p = 0.037$)			
Industrial Engineering	194	4.32	0.68
General Engineering	35	3.98	1.01
Engineering & Sciences	2	4.00	0.00
Introductory course structure ($F = 0.16$, $p = 0.851$)			
Lecture-based	112	4.24	0.82
Lecture/Lab combination	114	4.29	0.68
Laboratory-based	5	4.20	0.54
Number of credit hours in introductory course ($F = 0.15$, $p = 0.964$)			
Zero	4	4.38	0.43
One	66	4.26	0.79
Two	45	4.22	0.87
Three	99	4.30	0.70
Four	17	4.19	0.54

Table 4. Impact of demographics on average career efficacy

Variable	**Sample size**	**Mean**	**Standard deviation**
Gender ($F = 0.68$, $p = 0.410$)			
Male	131	4.30	0.67
Female	100	4.22	0.83
Classification ($F = 2.98$, $p = 0.032$)			
Freshman	7	3.68	1.22
Sophomore	43	4.08	0.97
Junior	151	4.34	0.66
Senior	30	4.28	0.53
Co-op/Intern experience in industrial engineering ($F = 1.29$, $p = 0.257$)			
Yes	101	4.33	0.76
No	130	4.22	0.73
Transfer student status ($F = 0.02$, $p = 0.886$)			
Transfer student	51	4.28	0.83
Non-transfer student	180	4.27	0.72
GPA ($F = 1.39$, $p = 0.227$)			
4.00	8	4.38	0.46
3.50–3.99	70	4.35	0.62
3.00–3.49	88	4.25	0.87
2.50–2.99	56	4.25	0.68
2.00–2.49	8	3.75	0.81
Below 2.00	1	3.25	—

shown in Table 5, students with higher satisfaction scores also had higher average efficacy scores. This relationship was shown to be significant ($F = 8.66$, $p < 0.001$), as predicted in the fifth hypothesis. Additionally, satisfaction and career efficacy scores were significantly correlated ($r = 0.335$, $p < 0.001$). The grade that a student received in the introductory course also had a significant impact on career efficacy ($F = 2.74$, $p = 0.030$). Students who received an 'A' in the course had significantly higher efficacy scores than those who received a 'B.' There were not enough participants who reported lower letter grades in the courses to analyze those responses meaningfully.

The first satisfaction question related to a student's desire to become an industrial engineer. That individual question was analyzed individually as it was most closely related to career self-efficacy. Responses on the first satisfaction question were significantly impacted by course credit hours ($F = 2.21$, $p = 0.069$), course structure ($F = 3.44$, $p = 0.018$), and faculty ($F = 2.91$, $p = 0.022$). The highest scores for the first satisfaction question were achieved for courses with three credit hours, a lecture/laboratory combination structure, and IE faculty leading the course.

4.4 Predictive model of efficacy

A predictive regression equation was created to explore the relationship between student demographics and average career efficacy. A stepwise regression model, Equation (1), identified two demographic factors as significant for predicting average efficacy: classification and GPA. The regression model is significant ($F = 5.85$, $p = 0.003$) although it accounts for a relatively low amount of variance associated with average efficacy (R—Sq(adj) = 4.1%).

Table 5. Impact of student satisfaction on average career efficacy

Variable	**Sample size**	**Mean**	**Standard deviation**
Average satisfaction with introductory course ($F = 8.66$, $p < 0.001$)			
>4.00	125	4.41	0.60
3.00–3.99	74	4.16	0.81
2.00–2.99	28	4.14	0.57
<2.00	4	2.75	2.06
Grade received in introductory course ($F = 2.74$, $p = 0.030$)			
A	168	4.32	0.69
B	43	3.95	0.96
C	5	4.50	0.50
No grade assigned	12	4.54	0.33
Pass	3	4.25	0.66

$$y = 3.39 + 0.151x_1 + 0.0902x_2, \quad (1)$$

where y = average efficacy; x_1 = classification level (1 = freshman, 2 = sophomore, 3 = junior, 4 = senior); x_2 = GPA level (1 = below 2.00, 2 = 2.00–2.49, 3 = 2.50–2.99; 4 = 3.00–3.49, 5 = 3.50–3.99, 6 = 4.00).

Based on the regression model, it is apparent that students' average efficacy will increase as they progress through their program and thereby increase their classification level. Additionally, students with higher GPAs will also have higher efficacy levels.

4.5 Qualitative results

Student participants also answered open-ended questions in the survey about what they liked, disliked, and would change about the introductory course they took. These qualitative responses provided additional insight into course factors that promote success within undergraduate industrial engineers beyond the results found in quantitative responses.

One common response was the high value that students placed on teamwork in introductory courses. Students reported teamwork as a valuable experience because it led to both a hands-on approach to learning as well as an opportunity to foster relationships with other students in the course. From one student's perspective, team work in their introductory course '*helped establish friends and colleagues in the department. Since then, I have had a friend in almost every class that I've taken, which has helped me perform better in classes*.' Another student referred to team experience as '*invaluable, even if we lack technical proficiency in Industrial Engineering techniques for problem solving*.'

Additionally, many responses referenced the use of guest speakers from industry who visited introductory courses. Those students who took courses that included outside industry speakers reported an increased understanding and appreciation of the career field after these talks. Many of the aspects mentioned for change within the course dealt with bringing in more guest speakers or visiting more workplaces in order to enlighten students from an industry perspective.

Students overwhelmingly reported an appreciation of the broad range of Industrial Engineering topics covered in many of the introductory courses. According to one student, the best part of the introductory course was that it *'covered many areas of Industrial Engineering and really showed what IE is all about.'* Some students even connected these topics to their decision to pursue Industrial Engineering as a career: '*It helped me finally come to the solid conclusion that I wanted to become an IE.'*

5. Discussion

The results presented above identify a number of relationships that can be used to improve student career efficacy through the design of introductory courses. Before describing those action items, however, one must begin by noting the high average career efficacy of all student respondents, 4.27. This average speaks very highly of the current state of Industrial Engineering education in preparing students to be confident engineers in the field. However, not all students reported a high career efficacy, as evidenced by the large variance in the responses ($s = 0.74$). Additional improvements can be made to introductory courses to minimize this gap and help all students to achieve a higher level of career efficacy.

With regards to student factors, it should not be surprising that senior level students had higher efficacy scores. As students progress through an academic program, they are exposed to more topics and courses related to the field, which serves to validate their choice of profession. Students who have decided that Industrial Engineering was not the correct field for them would likely change departments or programs before progressing to upperclassmen status. This matriculation of students also helps to explain the difference between classification levels.

With respect to course design, discipline-specific introductory courses within Industrial Engineering led to significantly higher career efficacy scores when compared with general introductory courses. While general introductory courses may be helpful in selecting an academic major, they are not as effective at validating the choice of a major as a career path for students. To best prepare our students for careers in their chosen field, it is essential that they be exposed to topics in the field early in their academic career. A certain level of detail with regards to content, typical job assignments, and topics are necessary to provide students with reassurance in their career field selection.

A closer examination of the questions used to explore efficacy and satisfaction identified additional course factors that improve student efficacy and satisfaction. The type of instructor in a course is essential for students to have the confidence to be successful in their program and master necessary skills. Based on the survey results, an Industrial Engineering faculty member is the best option for an introductory course instructor. An Industrial Engineering faculty member also helps to improve the students' desire to pursue a career in Industrial Engineering.

While the intention of introductory courses in Industrial Engineering is often varied between departments, one underlying purpose is the recruitment and retention of Industrial Engineering. Therefore, it is imperative that introductory courses inspire and motivate students to become industrial engineers. Based on the survey results, this is best achieved by offering a course with higher credit hours and a lecture/laboratory structure. These courses allow students to become more familiar with Industrial Engineering topics and the type of work expected in the field.

6. Conclusions

The design of introductory courses in Industrial Engineering was shown to have a significant impact on students' career efficacy. While not all expected factors played a role in student career efficacy, there were strong indications that both the individual student and the course structure and content impacted efficacy. Therefore, it is important to design the courses with students' career outcomes in mind, particularly their preparation for careers as industrial engineers. In-depth student interviews would also be useful to explore the qualitative nature of these results, highlighting the nuances that tend to make up student self-efficacy. It would also be useful to explore the impact of other curriculum designs on career efficacy. This could include aspects such as course loading (number of hours per semester), perceived course difficulty, and a curriculum's prerequisite structure.

References

1. M. Hoit and M. Ohland, The impact of a discipline-based introduction to engineering course on improving retention, *Journal of Engineering Education*, **87**(1), 1998, pp. 79–85.
2. S. Courter, S. Millar and L. Lyons. From the students' point of view: experiences in a freshman engineering design course. *Journal of Engineering Education*, **87**(3), 1998, pp. 238–287.
3. D. Hatton, P. Wankat and W. LeBold, The effects of an orientation course on the attitudes of engineering freshmen, *Journal of Engineering Education*, **87**(1), 1998, pp. 23–27
4. D. Morris, An experiment in freshman design, *Proceedings of the American Society for Engineering Education (ASEE) Conference*, Toronto, Canada, June 1990, pp. 839–841.
5. M. Ponton, J. Edmister, L. Ukeiley, and J. Seiner, Understanding the role of self-efficacy in engineering education, *Journal of Engineering Education,* **90**(2), 2001, pp. 247–251.
6. A. Bandura, Self-efficacy. In V. S. Ranachaudran (ed.), *Encyclopedia of Human Behavior, Volume 4*, Academic Press, San Diego, CA, 1994, pp. 71–81.
7. A. L. Selding and F. Pajares. Against the odds: Self efficacy beliefs of women in mathematical, scientific, and technological careers, *American Educational Research Journal*, **37**(1), 2000, pp. 215–246.
8. R.W. Lent, H-B Sheu, D. Singley, J.A. Schmidt, L. C. Schmidt, and C. S. Gloster, Longitudinal relations of self-efficacy to outcome expectations, interests and major choice goals in engineering students, *Journal of Vocational Behavior*, **73**(2), 2008, pp. 328–335.
9. M.A. Hutchison, D. K. Follman, M. Sumpter, and G. M. Bodner. Factors influencing the self-efficacy beliefs of first-year engineering students, *Journal of Engineering Education*, **95**(1), 2006, pp. 39–47.
10. S. J. DeWitz and W. B. Walsh, Self-efficacy and college student satisfaction, *Journal of Career Assessment*, **10**(3), 2002, 315–325.
11. P. J. Shull and M. Weiner, Thinking *inside* the box: Self-efficacy of women in engineering, *International Journal of Engineering Education*, **18**(4), 438–446.
12. M. E. Sandler, Career decision-making self-efficacy, perceived stress, and an integrated model of student persistence: A structural model of finances, attitudes, behavior, and career development. *Research in Higher Education*, **41**(5), 2000, pp. 537–580.
13. C. S. Srsic and W. B. Walsh, Person–environment congruence and career self-efficacy, *Journal of Career Assessment*, **9**(2), 2001, 203–213.
14. A. Bandura, C. Barbaranelli, G. V. Caprara, and C. Pastorelli, Self-efficacy beliefs as shapers of children's aspirations and career trajectories, *Child Development*, **72**(1), 2001, 187–206.
15. R. W. Lent, H. Sheu, J. Schmidt, B. Brenner, S. Brown, C. Gloster, L. Schmidt, H. Lyons, and D. Treistman, Social cognitive predictors of academic interests and goals in engineering: utility for women and students at historically black universities, *Journal of Counseling Psychology*, **52**(1), 2005, pp. 84–92.
16. R. W. Lent, D. Singley, H. Sheu, J. Schmidt, and L. Schmidt, Relation of social-cognitive factors to academic satisfaction in engineering students, *Journal of Career Assessment*, **15**(1), 2007, pp. 87–97.
17. J.P. Concannon and L.H. Barrow, A cross-sectional study of engineering students' self-efficacy by gender, ethnicity, year, and transfer status, *J. of Science Education and Technology*, **18**(2), 2009, pp. 163–172.
18. M.A. Hutchison, D.K. Follman, M. Sumpter, and G.M. Bodner, Factors influencing the self-efficacy beliefs of first-year engineering students, *Journal of Engineering Education*, **95**(1), 2006, pp. 39–47.
19. L. Strawderman, B. Elmore, and A. Salehi. Exploring the impact of first-year engineering student perceptions on student efficacy, *Proceedings of the American Society for Engineering Education (ASEE) Conference*, Austin, TX, June 2009.
20. L. Strawderman and L. Ruff. Improving industrial engineering career efficacy through introductory course design. *Proceedings of the American Society for Engineering Education (ASEE) Conference,* Louisville, KY, June 2010.
21. W. C. Turner, J. Mize, K. Case, and J. Nazemetz, *Introduction to Industrial and Systems Engineering*, 3rd edn, Prentice Hall, Upper Saddle River, NJ, 1993.
22. E. Goldratt, *The Goal*, North River Press, Great Barrington, MA, 1984.
23. S. R. Covey, *Seven Habits of Highly Effective People,* Simon and Schuster, New York, NY, 2003.
24. N. E. Betz and G. Hackett, The relationship of career-related self- efficacy expectations to perceived career options in college women and men, *Journal of Counseling Psychology*, **28**(5), 1981, pp. 399–410.
25. R. Rooney and S. H. Osipow, Task-specific occupational self-efficacy scale: the development of a prototype, *Journal of Vocational Behavior*, **40**(1), 1992, 14–32.

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