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Exploring the correlation between students reported self-efficacy and retention

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Exploring the Correlation between Students Reported Self-Efficacy and Retention

Abstract

The Academy of Engineering Success (AcES) Program at West Virginia University, supported by an NSF S-STEM grant since 2016, employs literature-based, best practices to support and retain students in engineering. AcES students participate in a one-week summer bridge experience; a common fall semester course focused on professional development, time management, study skills, and career exploration; and a common spring semester course emphasizing the role of engineers in societal development. Students are also immersed in co-curricular activities with the goals of fostering feelings of institutional inclusion and belonging in engineering, providing academic support, teaching student success skills, and providing professional development.

AcES students participate in the GRIT, LAESE, and MSLQ surveys at the start and end of each fall semester and at the end of the spring semester each year. Focus group data is collected at the beginning, middle and end of each semester and one-on-one interviews occur at the start and end of each semester. The surveys provide a measure of students' GRIT, defined as perseverance for long term goals, as well as, general self-efficacy, engineering self-efficacy, test anxiety, math outcome efficacy, intrinsic value of learning, inclusion, career expectations, and coping efficacy.

A previous study, based on an analysis of the 2017 AcES cohort survey responses, produced a surprising result. When the responses of AcES students who retained were compared to the responses of AcES students who left engineering, those who left engineering had higher baseline values of GRIT, career expectations, engineering self-efficacy, and math outcome efficacy than those students who retained. These results appear to support the Kruger-Dunning effect. This paper presents the subsequent analysis of two years of participant data, the 2017 and 2018 cohorts, to further explore the possibility or the strength of this effect for these students and investigates possible reasons for the results.

1.0 Introduction

The Academy of Engineering Success (AcES) Program at West Virginia University is an NSF S-STEM supported program with a mission to support and retain students in engineering. One objective of this program is to increase graduation rates from underrepresented populations, including women, first-generation students, and underrepresented minorities, in an effort to ultimately diversify the engineering workforce.

This paper first reviews the AcES program and then discusses the continued analysis of a previously identified trend in an ongoing study of program participants. The results of surveys, taken by the 2017 AcES participants (2017 cohort), designed to measure participants' self-efficacy and grittiness, among other attributes, appeared to be indicative of the Kruger-Dunning Effect. The Kruger-Dunning Effect states that people who are most unskilled often overestimate

their abilities [1]. When the responses of AcES students who retained in engineering were compared to the responses of AcES students who left engineering, those who left engineering had higher self-reported values of GRIT, career expectations, engineering self-efficacy, and math outcome efficacy, on the surveys taken at the start of their first semester in college, than those students who retained. This paper presents the subsequent analysis of two years of participant data, the 2017 and 2018 cohorts, to further explore the potentially identified trend.

1.1 Program Description

The AcES program was founded in 2012 and was developed with an overarching goal of increasing the number of high-achieving, low income students from underrepresented populations who pursue and ultimately graduate with engineering degrees. The program now includes: a one week summer bridge experience; a two credit hour professional development course in the fall; a three credit hour course in the spring designed to communicate how engineers throughout history have shaped society; a mentor program including both student mentors and mentors from industry; social events; and scholarship opportunities. Cohort building, aiding in developing academic skills, providing career guidance, and creating a support system are main objectives of the program. Each year, the program enrollment is limited to 20-25 first-time full-time (FTFT) freshmen entering the engineering college. In 2016, the program received a NSF S-STEM grant which has provided operating funds and scholarship money for eligible students. Students who remain enrolled in the engineering college and maintain a cumulative GPA of 3.0 or higher have their scholarships renewed each year. Students remain under the academic advisement of a program faculty mentor until they meet the requirements to move into their desired engineering discipline. Annual social events are held in an effort to foster feelings of inclusion and belonging as well as maintain connections between faculty, student mentors, and program participants.

2.0 Methodology

AcES program participants complete survey instruments administered at the beginning and end of each fall semester and at the end of each spring semester. The three surveys used are a GRIT survey, a reduced version of the Motivated Strategies for Learning Questionnaire (MSLQ), and a modified version of the Longitudinal Assessment of Engineering Self-Efficacy (LAESE). During the fall semester the surveys were taken during the professional development course.

The version of the GRIT survey used is a questionnaire consisting of 12, 5-point Likert scale (1 = not gritty to 5 = very gritty) questions, developed by Angela Duckworth from the Department of Psychology at the University of Pennsylvania. [2]. Grit has been identified as a unique trait and defined as “perseverance and passion for long term goals” [3].

The LAESE survey was developed via the NSF-funded Assessing Women in Engineering (AWE) project, and consists of 31 questions (items 16-46 on the AWE LAESE survey) [4]. In the full LAESE survey there are 21 7-point Likert scale questions and 10 questions that have two separate scales per a question, one scale is a 7-point Likert scale asking “to what extent do you agree” and the other scale is a 5-point Likert scale asking “how important is this”. For subscale score calculations, only the 7-point scale measuring extent of agreement or disagreement is utilized. This method of response analysis was previously defined by Jordan [5] in her

dissertation titled “Intervention to Improve Engineering Self-Efficacy and Sense of Belonging of First-Year Engineering Students”. The subscales comprising the LAESE survey include: (1) Engineering career expectations, (2) Engineering self-efficacy 1, (3) Engineering self-efficacy 2, (4) Feeling of inclusion, (5) Coping self-efficacy, and (6) Math outcomes efficacy. The subscale titled “Engineering self-efficacy 1” indicates a student’s perception of their ability to earn an A or B in physics, math, and engineering courses and succeed in an engineering curriculum while not giving up participation in their outside interests. “Engineering self-efficacy 2” indicates the student’s perception of their ability to complete (but not necessarily obtain an A or B) engineering requirements such as math, physics, chemistry and also their general ability to succeed in any engineering major.

The MSLQ was created by researchers at the School of Education at the University of Michigan [6].The 1991 version of the MSLQ consists of 81 questions resulting in a total of 15 subscales in 2 main categories: motivational beliefs and learning strategies. The different subscales are designed to be modular and can be used individually or together in any combination to reach the goals of the researcher/instructor. In a 1990 study by Pintrich and De Groot [7], which ultimately led to the development of the 1991 version of MSLQ, the researchers developed a “short version” (44 item, 5 subscales) of the MSLQ. This study utilizes the short MSLQ with the 44 questions which are 7-point Likert scale (1 = not at all true of me to 7 = very true of me). The five subscales are shown in Table 1. The intrinsic value, self-efficacy and test anxiety subscales are part of the motivational beliefs category, while the strategy use and self-regulation subscales belong to the learning strategies category. The self-regulation and strategy use subscales are combinations of subscales in the 1991 version [6].

Table 1: Summary of GRIT, LAESE, and MSLQ Survey Subscales [8]

Survey	**Number of Questions Used**	**Likert Scale**	**Measures (Subscales)**	
GRIT	12	5 point	Grittiness	
LAESE	31	7 point	Engineering career expectations	Feeling of inclusion
			Engineering self-efficacy 1	Coping self-efficacy
			Engineering self-efficacy 2	Math outcomes efficacy
MSLQ	44	7 point	Intrinsic value	Self-regulation
			Self-efficacy	Strategy use
			Test anxiety	

3.0 Results and Discussion

Results from the GRIT, LAESE, and MSLQ surveys for two different program cohorts are presented and discussed in this section. Twenty AcES program students completed the surveys in fall 2017 and 22 students completed the surveys in fall 2018. Both cohorts completed the surveys during the first week of classes in the fall semesters. The results, presented below, give interesting insight to the initial mindsets of these students when entering into engineering. The average scores for each measure (sub-scale) of the GRIT, LAESE, and MSLQ surveys for the 2017 cohort are presented and summarized in Table 2 below and then discussed. In Table 2, the higher value of each subscale between students retained in engineering beyond their first year and those who left prior to the start of their second year is highlighted in orange to aid in interpreting the results.

Table 2: Summary of 2017 Cohort Results from GRIT, LAESE, and MSLQ Surveys [8]

Fall 2017 Cohort (n=22)	**Retained**	**Left ENGR**
GRIT *(Likert Scale 1 low - 5 high)*	3.49	3.97
LAESE *(Likert Scale: 1 low - 7 high)*		
Engineering career expectations	6.60	6.67
Engineering self-efficacy 1	5.87	6.87
Engineering self-efficacy 2	6.37	6.78
Feeling of inclusion	5.38	5.00
Coping self efficacy	6.49	6.44
Math outcomes efficacy	6.29	6.89
MSLQ *(Likert Scale: 1 low - 7 high)*		
Intrinsic value	5.79	4.56
Self-efficacy	5.61	5.15
Test anxiety	3.59	3.67
Self-regulation	5.11	4.37
Strategy use	5.14	4.18

Fifteen of the initial 20 students in the 2017 cohort were retained in engineering, while five left engineering. Students from the 2017 cohort who retained in engineering past their first year entered their engineering studies with higher feeling of inclusion and higher coping self-efficacy. They also had higher self-efficacy and initial motivational beliefs on the intrinsic value of studying engineering as well as the learning strategies of self-regulation and strategy use. In contrast, students who left engineering during their first year appear to have entered college with higher self-reported GRIT, higher engineering career expectations, higher engineering self-efficacy, and higher math outcomes self-efficacy than their peers who were retained in engineering.

Results of the GRIT, LAESE, and MSLQ surveys for the 2018 cohort are presented and summarized in Table 3 below and then discussed. Twenty-two students were in the 2018 cohort; 14 were retained in engineering, while eight students left engineering. The highlighted values in

Table 3 represent the highest value between students who retained and those who left, however if it is highlighted in green it means the trend result is consistent with the 2017 cohort result (e.g., students from both cohorts who were retained, rated higher on intrinsic value in the LAESE survey, so that cell is highlighted in green) and if the 2018 cohort trend result is different than the trend of the 2017 cohort then it is colored red (e.g., students who left from the 2017 cohort had a higher average GRIT than their peers who were retained, but in 2018 the students who were retained had the higher GRIT, thus the cell is highlighted in red).

Table 3 Summary of 2018 cohort Results from GRIT, LAESE, and MSLQ surveys

Fall 2018 Cohort (n=20)	Retained	Left ENGR
GRIT *(Likert Scale 1 low - 5 high)*	3.51	3.21
LAESE *(Likert Scale: 1 low - 7 high)*		
Engineering career expectations	6.74	6.33
Engineering self-efficacy 1	5.98	5.83
Engineering self-efficacy 2	6.64	6.39
Feeling of inclusion	5.75	5.75
Coping self efficacy	6.51	6.42
Math outcomes efficacy	6.54	6.22
MSLQ *(Likert Scale: 1 low - 7 high)*		
Intrinsic value	5.83	5.62
Self-efficacy	5.69	5.75
Test anxiety	4.63	4.53
Self-regulation	4.68	4.88
Strategy use	5.31	5.18

As can be seen from Table 3, there are only three of the 12 subscales, highlighted in green, which followed the same trend as the 2017 cohort. The three subscales that depict the same trend are coping self-efficacy in the LAESE survey and the intrinsic value and strategy use subscales from the MSLQ survey. Due to small cohort sizes (~15-25 students) and small number of students leaving (~1-5 students), the differences in subscale scores between retained and left engineering for each subscale are statistically insignificant. Additional data is needed. An interesting trend, however, appears to emerge. Students who start their engineering studies with higher coping self-efficacy and strategy use, as well as a strong belief in the intrinsic value of studying engineering appear to retain past their first year more than those students with lower scores in these three areas.

4.0 Conclusions and Recommendations

The trends identified in the 2017 cohort appeared to support the Kruger-Dunning Effect - Cohort students who were dismissed from the engineering college or who left voluntarily due to academic difficulties had higher average scores related to GRIT, engineering career expectation, engineering self-efficacy, and math outcome self-efficacy than the students in the cohort who were retained. Even at the end of the year, the cohort students who left engineering had higher self-efficacy scores than their peers who retained. It appeared that these students started their college-level engineering education with an over-estimated view of their abilities and

expectations. Once faced with difficulty, those with the highest expectations (of self and the program) chose to leave the program (either by selecting a different major or by failing out of engineering). Data from the fall 2018 cohort, however, support a more expected result in which those who left engineering within their first year scored higher in only two categories: general self-efficacy and self-regulation, but lower in all other areas. These students, apparently, had more realistic views of themselves, but assessed their situations and changed their majors away from engineering. Those students who displayed higher grit, engineering self-efficacy, math outcomes efficacy, and engineering career expectations retained in engineering through their first year. Interestingly, for the fall 2018 cohort, feelings of inclusion were equivalent for those who left engineering and those who retained.

Similarities between those who retained in both the fall 2017 and the fall 2018 cohorts include higher scores in coping self-efficacy, strategy use, and the belief in the intrinsic value of engineering. These measures appear to be those involving the ability to meet challenges and solve problems while maintaining the belief in the value of the profession.

Test anxiety appears to be increasing, in general, from 2017 to 2018, from 3.59 for retained students and 3.67 for students who left from the fall 2017 cohort to 4.63 for retained students and 4.53 for students who left from the fall 2018 cohort. It is also interesting to note that test anxiety appeared to be higher for the 2017 students who left, but for the 2018 cohort, the test anxiety score was higher for those students who retained in engineering.

While the sample size was small in both cohorts, the current result appears to be contradictory – with the 2017 cohort's results supporting the Kruger-Dunning Effect and the 2018 cohort results countering. To further explore the potential of this effect being pervasive in the population of first year fulltime students, a larger subset of that population needs to be surveyed and analyzed.

5.0 Future Work

Data from the fall 2019 cohort and future cohorts will be analyzed to further study trends in students reported self-efficacy and GRIT and student retention. Scholarship recipients have also been participating in one-on-one interviews and focus groups in addition to the GRIT, MSLQ, and LAESE surveys since fall 2017. Data from interviews are being analyzed currently by the project researchers with the goal of finding the longitudinal change in students' perceptions of engineering and engineers.

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