

Board 145: Possible Relations between Self-Efficacy, Sociodemographic Characteristics, Dropout and Performance of Freshman Students in Engineering Courses

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Possible relationships between self-efficacy, sociodemographic characteristics, dropout and performance of freshmen students in engineering programs.

Abstract

The beginning of academic life has a significant impact for the student, which can affect both academic performance and dropout. This study aimed to search for relationships between sociodemographic characteristics, dropout, self-efficacy and performance of freshman students in engineering programs, and to test a model to identify school performance predictors, including the five dimensions of self-efficacy in higher education and age. A total of 407 students, mostly male freshmen from a private engineering school located in São Paulo - Brazil, with an average age of 18.5 years old, participated in the study. Sociodemographic Data Questionnaire and Higher Education Self- Efficacy Scale (HESES) were used, including 34 items and five dimensions: Academic Self-efficacy (capacity to learn and apply knowledge), Higher Education Regulation Self-Efficacy (ability to self-regulate one's actions), Social Interaction Self-efficacy (ability to maintain relationship with classmates and professors), Proactive Self-efficacy (ability to enjoy and promote educational opportunities) Academic Management Self-efficacy (ability to get involved and meet deadlines). The mean of 7.5 ± 1.1 of self-efficacy was considered high. It was observed that there is no significant difference between self-efficacy in participants: daytime and nighttime ($p = 0.253$), female and male ($p = 0.056$), and enrolled and dropped out ($p = 0.084$). However, confidence in the ability to learn and demonstrate it, self-regulate actions and proactivity was somewhat reduced compared to self-efficacy in social interactions and academic management. Multiple linear regression analysis showed that the model is significant ($p \leq 0.001$) and explains 37.8% of the variance of yield, the greatest weight in explaining achievement is academic self-efficacy ($B = 0.63$), academic management self-efficacy ($B = 0.38$), self-efficacy in training regulation ($B = -0.31$), self-efficacy in proactive actions ($B = -0.23$), and age ($B = -0.09$). It is suggested to promote activities that can nurture students' self-efficacy beliefs, so that they can better take full advantage of the course, with a focus on academic success.

Keywords: Self-efficacy, school performance, higher education.

Introduction

The concept of self-efficacy was first defined by Bandura [1] and was conceived as the beliefs that an individual has about his or her own ability to organize and perform a certain action [2]. These beliefs influence how people feel, think, are motivated, and behave. More specifically, there is a proposal to use the term self-efficacy in higher education. This is defined as "a student's beliefs in his/her ability to organize and execute courses of action required to produce certain accomplishments, concerning the aspects comprised by academic tasks pertinent to higher education" [3].

Academic self-efficacy beliefs can assist the student in planning to use the personal and environmental resources necessary to adjust to university. In addition, it can lead the student to a sharper perception of his or her ability to organize and execute actions necessary to achieve increasingly adequate levels of academic achievement and adjustment to the university environment, affecting the individual's choices and perseverance [4].

Students entering university, in general, tend to have lower perceived self-efficacy and, therefore, have greater difficulty in expressing ideas clearly and making pertinent comments to teachers and other classmates [5]. In turn, improving students' perceived self-efficacy is a valuable educational goal. The implicit assumption is that their empowerment will serve as a vehicle for improving other outcomes, such as academic performance, self-esteem [5], and interpersonal interaction [6].

Research on academic self-efficacy aims to provide educational institutions with information about these skills and thus contribute to new educational practices that make students feel more confident and supported by educational institutions and, consequently, they can achieve their goals related to higher education [7].

The student who perceives him/herself as academically self-efficacious, also perceives him/herself as capable of self-regulating his/her actions, organizing and executing the necessary actions to adjust his/her social and interpersonal relationships. The investigation of these variables is relevant since they can affect the decision to drop out or remain in higher education, and dropping out can bring personal, family, and institutional losses [8].

Therefore, a recent study [9] conducted with entering engineering students at a Midwestern university shows that high self-efficacy can lead to increased confidence and determination, and also a decrease in dropout. They also observed that students at risk of not completing their enrollment, as perceived by their academic performance, showed a reduced collective self-efficacy to learn when compared to students with higher performance.

For engineering students to effectively fulfill their academic programs, they must have the necessary skills and competencies. However, equally important is the belief that they are capable of accomplishing the tasks because they possess the skills and competencies [10].

Soares et al. [8] noted that depending on the gender and type of educational institution, public or private, the student uses different cognitive or behavioral skills to adapt their experiences to higher education. The highlight of the research was academic self-efficacy beliefs, which appeared to be used by most participants. Women use different strategies than men for their academic performance and achievement [11]. However, it is important to go beyond gender to get a more complete picture of self-efficacy differences. Temperament and personality issues between female and male students reveal heterogeneous groups and therefore call for caution regarding conclusions about self-efficacy [12].

It would be interesting if the student support service could hold orientation workshops for new students about organization and study techniques, positive action regarding personal changes in the first year of graduation, and contribution to the increase of self-efficacy, in order to stimulate intrinsic motivation, along with the promotion of integration into higher education [13].

In the research with 361 first-year engineering students from a public institution in Portugal, a positive association was found between self-efficacy and engagement, which refers to a positive psychological and motivational state. The instruments used were an adaptation of the academic efficacy scale that integrates the Patterns of Adaptive Learning Scales and the Higher Education Students' Academic Engagement Inventory. The results concluded that only self-efficacy and the behavioral dimension of engagement have a statistically significant impact on students' academic achievement, and in both cases in the positive direction. Thus, better

perceptions of self-efficacy and engagement in academic activities are associated with better school grades by students [14].

Since the beginning of academic life is a period of great change for students, which can affect both academic performance and remain in the course, this research aimed to verify which aspects of self-efficacy and whether the age of the entrant could influence academic performance.

Method

Participants

The sample was selected by convenience, according to the adherence of the students. A total of 407 freshman students in Engineering courses participated in the study. At that moment they had not yet chosen the engineering area. The average age was 18.5 years (SD 1.2), and most of them were male (65.4%) and enrolled in the daytime period (80.8%). The minority (9.6%) had previously studied in a public school, 65.1% finished high school in the year before entering the university, 87.0% do not work, and indicated family resources as the main source to pay for their studies (85.0%). Only 9.3% have a scholarship or educational credit. Most fathers (68.3%) and mothers (70.3%) of the students have completed college education. The research was conducted in a private higher education institution (HEI) located in the state of São Paulo, Brazil.

Instruments

The instruments used in this research for data collection were a Characterization Questionnaire and the Higher Education Self-Efficacy Scale. The first one identified the students as to gender, age, education of the students and parents, period attended, work situation, and main source of resources to pay for the studies.

Higher Education Self- Efficacy Scale (HESES) [15], 34 items, evaluated the students' beliefs of their capability to cope with the demands in higher education. The HESES has a Likert-type format with ten response levels, ranging from 1 (little) to 10 (a lot), and its items are grouped into five dimensions: Academic Self-efficacy (ability to learn and apply knowledge), Higher Education Regulation Self-Efficacy (ability to self-regulate one's actions), Social Interaction Self-efficacy (ability to have relationship with classmates and professors), Proactive Self-efficacy (ability to take advantage and promote educational opportunities) Academic Management Self-efficacy (ability to get involved and meet deadlines). The internal consistency of the scale is 0.90, ranging from 0.77 to 0.90 in its dimensions.

The students' academic performance was evaluated based on the academic performance coefficient adopted by the researched HEI, which uses the weighted average of the final grades of all subjects taken in the first series. This coefficient weights the workload and the grades of the tests and assignments of the subjects.

Data Collection Procedure

The research occurred after the project was approved by the Research Ethics Committee (REC), number 1.607.007. The inclusion criteria were: entering students, present at the time of data collection, with a minimum age of 17 years, and who consented to participate by signing the Free and Informed Consent Form. The application was collective, in a laboratory with computers, during the Adaptation and Integration of Newcomers class, after an explanation of the research objectives, confidentiality of results, and clarification of voluntary participation.

Procedure for analyzing the results

The aim was to characterize the sample, describe the self-efficacy results obtained and relate the variables age, self-efficacy (and its dimensions), and school performance, as well as the period attended (daytime and nighttime), gender (female and male), and enrollment status (enrolled and dropouts until the end of the school year). The data were analyzed using descriptive statistics, multiple comparisons tests, Spearman correlation, and linear regression models.

Results

Self-efficacy in higher education

The mean 7.5 (SD 1.1) of the students' self-efficacy was considered high. The lowest mean scores were obtained on the HESES items related to proactive actions, indicating reduced perceived confidence in the ability to take advantage of training opportunities, update knowledge, and promote institutional improvements. The lowest mean score (6.7) was obtained on the question "How much am I able to seek help from professors for the development of course activities?", suggesting that students feel less confident in seeking help from professors for the execution of required activities. The items with lower and higher mean scores on the HESES are seen in Table 1.

Table 1 - Items with the lowest and highest means of the HESES.

Items (How much I am able of...)	Minimum	Maximum	Mean	Standard Deviation
demonstrate what I have learned	1	10	6.8	1.8
claim extracurricular activities	1	10	6.8	2.1
keep up to date	1	10	6.8	1.9
seek help from teachers	1	10	6.7	2.0
contribute ideas	1	10	6.8	2.0
enjoy extracurricular activities	1	10	6.9	2.1
ask classmates for help	1	10	8.1	2.0
work in groups	1	10	8.3	1.5
cooperate with classmates in activities	1	10	8.4	1.5
make an effort in academic activities	1	10	8.0	1.7
complete assignments on time	1	10	8.4	1.7
establish friendships with peers	1	10	8.3	1.7

Table 2 shows that the mean scores obtained in the dimensions of the HESES scale ranged from 6.90 to 7.94, suggesting a relatively high perception of self-efficacy. The values of the mean and the 5% trimmed mean concerning the five dimensions are close to each other and reinforce the homogeneity in the scores of each dimension.

Table 2 - Mean, standard deviation, and 5% trimmed mean of the HESES dimensions.

Dimensions	Mean	Standard Deviation	5% Trimmed mean
Academic Self-efficacy	7.40	1.21	7.44
Higher Education Regulation Self-Efficacy	7.53	1.34	7.59
Social Interaction Self-efficacy	7.94	1.14	7.98
Proactive Self-efficacy	6.90	1.46	6.95
Academic Management Self-efficacy	7.92	1.40	8.01

Relationship between age and self-efficacy in higher education

The means and standard deviations of the HESES total score were calculated about the age of the entrants, categorized into age groups. Comparing the averages, Table 3 shows a decrease in the total score as the age of students increases.

From Hochberg's multiple comparisons test, used because of the large imbalance in the groups - 79% are aged 18-19 and only 2% are aged 22 or older, it can be seen that there is a significant difference in mean total HESES between the "22 or older" and "17 or younger" age groups ($p = 0.003$) and between the "22 or older" and "18 and 19" age groups ($p = 0.007$). The lowest self-efficacy scores are of students aged 22 or older.

Spearman's correlation was used to correlate the participants' age with the total HESES score due to the lack of normality of the data, verified employing the Kolmogorov-Smirnov test. There is a significant correlation between age and higher education self-efficacy ($p < 0.01$), however, this relationship is of small magnitude ($r = -0.133$). The negative sign shows that the older the entering students are the belief of self-efficacy in their higher education environment decreases, but with weak intensity (as indicated [16]).

Table 3 - Mean and standard deviation of self-efficacy total score as a function of age group.

Age	N	Mean	Standard Deviation
≤ 17 years old	32	263	35
18 and 19 years old	323	255	37
20 and 21 years old	43	248	39
≥ 22 years old	9	214	47
Total	407	254	38

A simple linear regression model was constructed relating total HESES as a function of students' age and resulted in a significant model ($p \leq 0.05$). However, the explanation of age in the variation of perceived self-efficacy in higher education of these students is only 1.7%.

Relationship between self-efficacy in higher education, age, and academic achievement

The number of samples was reduced by 4.9%, from 407 to 387, because outliers were excluded from these analyses. Females tended to have higher self-efficacy (7.7 versus 7.5), and higher academic achievement (6.5 versus 5.9). Daytime students showed an average self-efficacy score of 7.6, slightly higher than nighttime students (7.4), and higher achievement (6.2 versus 5.5). The dropouts showed reduced self-efficacy beliefs compared to the enrollees, 7.1 and 7.6 respectively. However, it was found that there is no significant difference between self-

efficacy and participants: from daytime and nighttime periods ($p = 0.253$), female and male sexes ($p = 0.56$), and enrolled and dropouts ($p = 0.084$).

Student achievement was significantly different ($p \leq 0.001$) between participants: female (mean 6.5, SD 1.1) and male (mean 5.9, SD 1.4) and daytime (mean 6.2, SD 1.3) and nighttime (mean 5.5, SD 1.4).

A prediction model was sought, with academic achievement as the dependent variable, and age and the HESES dimensions as predictor variables. Spearman's correlations between the variables are presented in Table 4. As can be seen, the performance measures and the HESES dimensions correlated positively with each other. On the other hand, the correlations of the HESES dimensions with age were negative.

Table 4 - Correlations between school performance, age and the HESES dimensions.

Variables	1	2	3	4	5	6	7
1. School performance	-						
2. Age	-0.22	-					
3. Academic Self-efficacy	0.50	-0.19	-				
4. Higher Education Regulation Self-Efficacy	0.15	-0.10 ^a	0.66	-			
5. Social Interaction Self-efficacy	0.17	-0.14	0.56	0.62	-		
6. Proactive Self-efficacy	0.18	-0.15	0.67	0.81	0.67	-	
7. Academic Management Self-efficacy	0.38	-0.23	0.69	0.71	0.63	0.74	-

N = 387; ^(a) $p < 0.05$; all other correlations: $p < 0.01$

In order to determine the predictive potential of self-efficacy in higher education and students' age on academic performance, we conducted a multiple linear regression analysis, whose results are shown in Table 5.

Table 5 - Multiple linear regression analysis predicting academic performance.

	Correlation			
	Beta	t	p	Part
Constant		4.34	<0,001	
Age	-0.09	-2.16	0.031	-0.087
Academic Self-efficacy	0.63	10.38	<0.001	0.420
Higher Education Regulation Self-Efficacy	-0.31	-4.17	<0.001	-0.169
Social Interaction Self-efficacy	-0.09	-1.64	0.102	-0.066
Proactive Self-efficacy	-0.23	-2.96	0.003	-0.120
Academic Management Self-efficacy	0.38	5.57	<0.001	0.225

N=387

Only self-efficacy in social interaction was not statistically significant in explaining the model. Therefore, perceived confidence in the ability to relate to peers and teachers for academic and social purposes does not explain academic achievement. The variable that has

the greatest weight in explaining achievement is academic self-efficacy (perceived confidence in the ability to learn, demonstrate, and apply course content; Beta = 0.63), followed by academic management self-efficacy (perceived confidence in the ability to engage, plan, and meet deadlines regarding academic activities; Beta= 0.38), self-efficacy in training regulation (perceived confidence in the ability to set goals, make choices, plan, and self-regulate their actions in the training and career development process; Beta = -0.31), self-efficacy in proactive actions (perceived confidence in the ability to take advantage of training opportunities, update knowledge, and promote institutional improvements; Beta = -0.23), and finally, age (Beta = -0.09). The negative value of this last coefficient in the model indicates that the oldest entering student had a lower average academic performance.

There is no multicollinearity and no uniqueness (tolerances > 0.10 and VIF < 10), that is, there is no high multiple correlations between the independent variables. Some examples of students' demonstration of self-efficacy were perceived in items: "How much I am able of demonstrate in tests what I have learned", "How much I am able of learn the themes necessary for my graduation", "How much I am able of plan the activities requested by the course", "How much I am able of set my professional goals", "How much I am able of ask help from teachers for the activities course' development".

Discussion

This study aimed to evaluate the relationships between self-efficacy, age, period attended (daytime or nighttime), gender, enrollment status, and performance of students entering engineering courses. Specifically, we sought to test a model to predict academic performance, using as predictors five dimensions of self-efficacy in higher education and age.

The mean self-efficacy score of students was considered high in the sample studied. It was noticed that the items dedicated to tasks that require actions, such as claiming and taking advantage of the institution's services, showed lower indexes, corroborating the study of Guerreiro-Casanova & Polydoro [3]. It was also considered relevant the reduced feeling of ability to demonstrate the knowledge learned in the evaluations.

Some of the highest mean scores are in self-efficacy in social interaction, so students perceive themselves as confident in their ability to relate to peers and teachers for academic and social purposes. The perceived ability to cooperate with peers in activities obtained the highest mean in social interaction. This peer environment is perceived by the students themselves.

Two items of self-efficacy in academic management also showed high averages, indicating that there is a perception of the student putting effort into academic activities and completing assignments on time.

It was noted that, in the items with the highest and lowest HESES averages, the answers obtained reached the extreme values of the scale (minimum 1 and maximum 10), showing great heterogeneity between the participants' perception of self-efficacy.

Increases in participants' age, perceived self-efficacy in regulating training (perceived confidence in the ability to set goals, make choices, plan and self-regulate their actions in the process of training and career development), and perceived self-efficacy in proactive actions (perceived confidence in the ability to take advantage of training opportunities, update knowledge, and promote institutional improvements) indicate that they result in a reduction in

the coefficient of achievement. This result may be explained by the fact that older students feel less able to perform higher education activities compared to younger students who have recently graduated from high school because the latter possibly had fewer obstacles to getting to university and having an easier time learning. However, a survey of elementary school children showed no significant differences in the self-efficacy of the different age groups [17].

Preliminary analyses detected some associations previously reported in the literature. Women showed a higher trend of self-efficacy, which corroborates the result of Silva et al. [17], and significantly higher academic achievement, agreeing with Soares et al. [11] when noting that women use different strategies than men for school performance. Other authors [18] also observed, in the sample studied, that female students presented higher levels in the Study dimension, showing more competence in issues related to study habits, time management, and learning strategies.

Students who dropped out at the end of the school year showed reduced self-efficacy beliefs compared to those enrolled, a result also found in the research of Ernst et al. [9].

However, it was found that there is no significant difference between self-efficacy and participants: daytime and nighttime students ($p = 0.253$), male and female students ($p = 0.056$), and dropouts and non-leavers ($p = 0.084$). The academic performance of daytime students was significantly higher than that of nighttime students since most daytime students do not work and have more time to dedicate to university tasks.

Self-efficacy in higher education and age predict academic performance for the sample studied. Through multiple linear regression analysis, it was found that the model is significant ($p \leq 0.001$) and explains 37.8% of the variance in performance. The greatest weight in explaining performance is given by academic self-efficacy, thus the perceived confidence in the ability to learn, demonstrate, and apply course content should be strengthened.

The results lead to reflect that the academic environment should promote activities that can strengthen students' self-efficacy so that they can confidently enjoy the course and, thus, succeed in school and professionally.

Important limitations of the study are highlighted, the main one being the sample, which came from a single institution and was not very diverse in terms of where the students came from age and engineering course. The specificity of the instrument used in the research. The five dimensions of the HESES, although comprehensive, certainly do not cover the entire spectrum of beliefs related to the student and university life. Another limitation refers to the cross-sectional nature of the study. Longitudinal research is suggested so that the temporal relationships between these variables can be more accurately determined. It is worth mentioning that more research on the subject is needed.

Still, the data presented help to glimpse that universities need to be better prepared to take on the theme of self-efficacy, associated with a psycho-pedagogical structure, so that student dropout in higher education can be prevented and that it allows them the condition of academic success.

Studies indicate this same path and it is understood that the implementation of strategies by educational institutions can minimize the impact of the difficulties experienced by students when entering university [3]. Intervention by the institution on the risk factors for dropout tends

to facilitate academic adaptation and, consequently, greater investment by the student in his career [19].

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