

A Successful Transition from an Associate Technology's Degree to an Engineering Bachelor's Degree

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Abstract— *Engineering programs requires a solid mathematic and scientific preparation that some students do not meet. Then the associate technology degree programs become an alternative for those students who may transition later to a bachelor's in engineering. Consequently, transitioning from an associate technology's degree to an engineering bachelor's degree program is a significant milestone marked by academic, social, and personal adjustments. This paper explores the challenges students typically face during this transition and identifies key strategies for success. Drawing on academic research and real-world experiences, this paper offers practical advice for prospective engineering students to navigate their journey effectively. This paper also emphasizes the importance of early preparation, academic resilience, and proactive engagement in both academic and extracurricular activities.*

Keywords— *Engineering education, associate degrees, transition from associate degree to engineering programs.*

I. INTRODUCTION

Traditionally, community colleges across the United States and Puerto Rico offer two-year academic programs such as associate degrees (AD), and universities usually offer four-year baccalaureate programs [1]. Generally, two-year school programs are very attractive to many minority students (e.g., women, Black, Latino, Native American) in science, technology, engineering and math (STEM) careers because their affordability, regularly scheduled remedial courses, support services, supplemental instruction, and proximity to their place of residence [1-2]. Frequently, these students seek to continue their education, aspiring to attain a bachelor's degree at a four-year institution. However, making the transition from a two-year college to a four-year academic institution is challenging for most students [3]. According to literature, students who begin their higher education at two-years colleges are less likely to attain a baccalaureate degree at a four-year college than students who begin their higher education at four-year institutions [4 - 5]. Usually, transfer students may experience adjustment difficulties once they moved to a four-year college due to several reasons such as academic expectations, social and culture differences, and personal demands at home.

Although the partnership between community colleges and four-year colleges and universities is very common [1],

only a limited number of universities offer both types of undergraduate degrees, particularly in STEM (Science, Technology, Engineering and Mathematics). The latter approach aims to reduce difficulties on the transition from a two-year to a four-year program given that AD students are immersed in the university culture and system, and the transition is focused mainly on the academic aspect.

This paper aims to provide insights into the challenges faced by students transitioning from a two-year to a four-year program, and strategies that contribute to a successful transition, ensuring that students are well-prepared to excel in their engineering education.

Additionally, this paper presents the challenges faced by students transitioning from the associate degree in technology to a Bachelor of Science (BS) in engineering. Section III presents a background of the School of Engineering (SOE) at Universidad Ana G. Méndez - UAGM at Gurabo. Then, the strategies implemented by UAGM to support students transitioning from the AD to a BS are presented on section IV followed by some statistical analysis. Finally, a summary is presented in section V.

II. CHALLENGES FACED DURING THE TRANSITION FROM THE ASSOCIATE DEGREE TO BACHELOR'S

The transition from associate technology's degree to an engineering bachelor's degree program represents a critical juncture in a student's academic journey. This transition involves adapting to a more rigorous curriculum, developing specialized technical skills, and embracing a new learning environment. Successful navigation of this transition sets the foundation for a rewarding career in engineering.

Transitioning from associate technology degree to an engineering bachelor's degree program presents several challenges frequently encountered by students:

1. *Academic Rigor:* The demanding coursework in engineering programs requires strong foundations in mathematics, physics, and other core subjects. Many students find the pace and depth of study significantly more intense than their high school experience.

2. *Time Management*: Balancing coursework, labs, assignments, and extracurricular activities can be overwhelming. Effective time management becomes crucial to maintaining academic performance and personal well-being.
 3. *Technical Skills Development*: Engineering programs often involve hands-on projects and technical skills development. Students may struggle with learning new software, tools, and methodologies essential for their field of study.
 4. *Social Adjustment*: Transitioning from a technical environment to a bachelor environment can be socially challenging. Building new friendships and finding a sense of community within the engineering cohort is essential for academic and personal support.
 5. *Expectation Gap*: Some students may find discrepancies between their expectations and the realities of engineering education. Coping with setbacks and adjusting academic goals accordingly is part of the learning process.
 3. *Electronic Engineering Technology (AEETE)*: Emphasizes specialized areas of electronics, instrumentation, and communications. Employment opportunities in the electronics, pharmaceutical, and medical devices industries. Aligned with the BS in Electrical Engineering.
 4. *Mechanical Engineering Technology (AMETE)*: Emphasizes areas of refrigeration and air conditioning, mechanical design, and manufacturing. Employment opportunities as a refrigeration technician, mechanical operator, or mechanic in industries requiring industrial machinery. Aligned with the BSs in Mechanical Engineering and Civil Engineering.
 5. *Electrical Technology and Renewable Energy (AEETE)*: Emphasizes specialized areas of electrical installations, renewable energy systems, machinery and electric motor controls. Preparation to obtain an Electrical Expert license. Aligned with the BS in Electrical Engineering
- The bachelors' programs offered by UAGM- Gurabo are ABET accredited and are as follows:

III. BACKGROUND –SCHOOL OF ENGINEERING (SOE) UAGM AT GURABO

The school of engineering at Universidad Ana G. Mendez (UAGM) at Gurabo, Puerto Rico offers five associate degrees (AD) and five Bachelors of Science (BS) degrees. The AD degrees are designed for two-year completion and the BS for four years which is common practice in United States and Puerto Rico. It is worth mentioning that each AD is aligned to a BS and around 80% of their credits are transferable to the appropriate BS.

A. Undergraduate programs

The AD offered by UAGM at Gurabo are the following:

1. *Quality Control Engineering Technology (AQETE)*: Emphasis on quality improvement, industrial process control, and industrial safety management. Employment opportunities in electronics, pharmaceutical, medical devices, biotechnology, among others. industries. Aligned with the BS in Industrial and Management.
2. *Computer and Network Engineering Technology (ACTN)*: Emphasis on computer technology including installation, configuration, maintenance, and repair. Employment opportunities in service, sales, pharmaceutical, and medical devices. Aligned with the BS in Computer Engineering.
1. *Bachelor of Science in Civil Engineering*: Emphasizes in the development, construction, and maintenance of infrastructure works. Career opportunities in the design, construction, operation, and maintenance of buildings, bridges, transportation systems, and water resource systems, among others.
2. *Bachelor of Science in Electrical Engineering*: Emphasizes in areas of power, electronics, control systems, communications, and signal processing. Professional career opportunities in the design, construction, operation, and maintenance of products associated with electrical and electronic systems.
3. *Bachelor of Science in Mechanical Engineering*: Emphasizes in the application of physical principles in the design and construction of mechanisms, machine structures, and manufacturing methods, as well as in the analysis of energy sources and their processing. Professional career opportunities in the areas of design, manufacturing, and maintenance of mechanical systems.
4. *Bachelor of Science with a concentration in Industrial and Management Engineering*: Pioneer engineering program in Puerto Rico that emphasizes in management. This program emphasizes the design, development, implementation, and improvement of integrated systems to understand the relationships between engineering and the managerial tasks of planning, organization, leadership, control, and the human element. Professional career opportunities in goods and services companies.

5. *Bachelor of Science in Computer Engineering:* Emphasizes the application of hardware, software, data network and interface design principles to complex systems. Professional career opportunities in the design, development, operation, and maintenance of products that involve hardware, software, and the Internet.

B. Student admissions

The SOE's admissions policy aims to ultimately admit every student who is motivated to study engineering. However, a student is not officially admitted to any of the BS engineering programs until he/she demonstrates proficiency in basic mathematics and English. This provision stems from UAGM's stated goals, which mandate the SOE to provide opportunities for professional engineering education to all interested students in Puerto Rico. Therefore, the admission process depends on whether the applicant is a first-time freshman, a transfer student from another institution, or a current UAGM student seeking reclassification from another program.

Table 1. Minimum Combined Scores in English and Spanish Sections of CEEB (PEAU or PAA) Tests.

GPA	PEAU	PAA
2.00	983	970
2.20	977	965
2.40	970	960
2.60	963	955
2.80	957	950
3.00	950	945
3.20	943	940
3.40	937	930
3.60	930	925
3.80	923	920
4.00	917	910

1. Freshman Candidates

For freshman candidates, the SOE uses the achievement scores from the College Entrance Examination Board (CEEB) test [6]. Prior to December 2017, the CEEB test in Puerto Rico was known as the PEAU (Prueba de Evaluación y Admisión Universitaria); since then, the test was redesigned and is now referred to as the PAA (Prueba de Admisión Universitaria). Applicants to engineering programs leading to BS degrees in Mechanical Engineering (ME), Electrical Engineering (EE), Computer Engineering (CpE), Industrial and Management Engineering (IME), or Civil Engineering (CE) must satisfy the following admission requirements:

- a. A high school grade point average (GPA) of not less than 2.0 (4.0 being the maximum).

- b. A minimum achievement score of 550 in the mathematics section of the PEAU, or 520 in the PAA. Another option is to approve an exam to be placed in MATH 121 Intermediate Algebra at UAGM.
- c. A combined score in the English and Spanish sections of the PEAU or, equivalently, the PAA, as described in Table 1.

Newly admitted students are placed in the appropriate mathematics, English, and Spanish courses in accordance with their CEEB scores. Students may opt to take placement tests in each subject area to challenge the level indicated by their CEEB score. The Mathematics and English Programs at UAGM-Gurabo develop these exams in coordination with the SOE. Students are encouraged to take a review course before they take their mathematics placement exam. There is no cost for the student to take the review course; students are allowed only one attempt to pass the placement exam. Experience has shown that the review course has helped many freshman students gain an early entry to engineering courses.

2. Students from other UAGM programs

Students currently enrolled in other academic programs at UAGM, and seeking reclassification into one of the bachelor's degree engineering programs must meet the following requirements:

- a. Have a cumulative GPA of not less than 2.5/4.0 at UAGM.
- b. Pass MATH 151 Pre-Calculus I with a minimum grade of B. Or, in the case of students reclassifying from the Department of Business and Entrepreneurship, pass MATH 199 Quantitative Methods I with a minimum grade of B.

3. Transfer students from other universities

Transfer students from other universities must be in good standing and their institutions must be recognized and accredited by the appropriate governing bodies. Transfer students seeking to be admitted on a BS degree must meet the following criteria:

- a. Have a minimum GPA of 2.0/4.0. from ABET-accredited engineering programs or have a minimum GPA of 2.5/4.0 from non-ABET accredited engineering programs.
- b. Be eligible to start on at least MATH 151 Pre-Calculus I or approve a placement exam to be placed MATH 151.

Students not satisfying any of the above requirements to be admitted on the BS programs are encouraged to enroll in an associate degree program. Once they have achieved the necessary verbal, mathematics, and/or English language skills as required by the engineering degree programs, the students may submit a request to the SOE to reclassify to any of the engineering degree programs.

C. Career ladder

It is worth mentioning that students currently enrolled in an engineering technology associate degree program at UAGM may seek reclassification into an engineering bachelor's degree program in one of the following two options:

1. Complete the associate degree program and request graduation. In this case, the student will be able to transfer credits depending on the originating associate degree program and the baccalaureate program to which the student is seeking to reclassify.
2. Pass MATH 121 (Intermediate Algebra) *or* MATH 151 (Pre-Calculus I) with a grade of A or B *on the first attempt* and have a minimum cumulative GPA of 2.5/4.0 at the conclusion of that semester.

Therefore, some students transferred from the AD to the BS may have completed the process during their AD studies, while other students completed the process once they received their awarded degree.

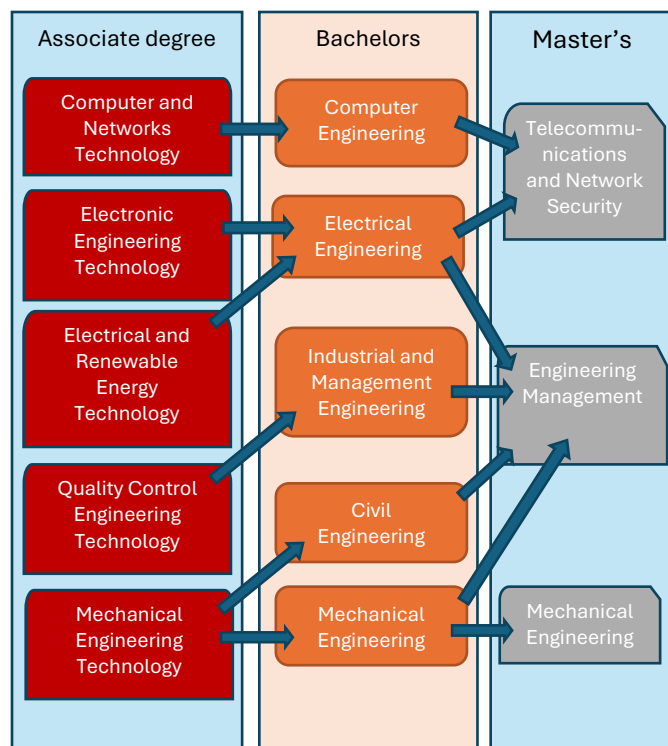


Figure 1. Career ladder

Figure 1 summarizes the career ladder available in the SOE UAGM – Gurabo. A student may begin with the associate degree and achieve a master's degree in six or seven years. Students in the AD in computer and network technology are expected to move to the BS in computer engineering. Students in the AD in Electronic Engineering Technology are expected to move to the BS in Electrical Engineering, and so on as shown in figure 1.

D. Additional challenges for students

During the last eight years, the university was affected by two natural disasters plus the covid-19 pandemic disrupting student's performance and generating an intensive emigration from Puerto Rico to the United States. These phenomena may increase students' stress level and affect the number of graduated of BS programs in island.

- At first, Hurricane Maria made landfall in Puerto Rico on September 20, 2017, as a category 4 storm. The intensity of the storm knocked power out for nearly a year and caused damage to buildings and infrastructure.
- Subsequently, a series of earthquakes struck the southwestern part of Puerto Rico at the end of December 2019 and in early January 2020, reaching a climax on January 7 with a 6.4-magnitude earthquake. The commotion that ensued caused anxiety in the university community just when a new semester was about to begin.
- Finally, Puerto Rico reported the first Covid-19 cases on March 13th, 2020. The university went into lockdown on March 16th. The pandemic caused major disruption to the normal operations of the university. The faculty was given one week to adapt all instructional materials for remote education, while all other administrative and student support services were provided remotely.

IV. STRATEGIES FOR SUCCESSFUL TRANSITION

To navigate these challenges effectively and ensure a successful transition, students could adopt the following strategies:

1. *Preparation:* Start preparing early by taking advanced math and science courses in the associate technology degree. Familiarize with engineering concepts and basic programming languages to build a solid foundation.
2. *Seek Academic Support:* UAGM provides tutoring services, academic advisors, and study aids. In addition, UAGM is an open-door institution where students are encouraged to engage with professors during office hours to clarify doubts and deepen understanding of course material.
3. *Get Involved:* UAGM encourages students to participate in engineering clubs, societies, and competitions to apply theoretical knowledge to practical projects. Networking

with peers and industry professionals can provide valuable insights and opportunities.

4. *Maintain Balance:* UAGM encourages students to balance academic commitments with social activities and personal interests to avoid burning out. Physical exercise, adequate sleep, and healthy eating habits contribute to overall well-being and academic success.

V. STATISTICS AND ANALYSIS

Table 2 shows the number of BS graduates from fall 2019 to fall 2024. As shown, 30% of the BS graduates transitioned from the AD programs. This high percentage represents students that initially did not meet the admission requirements for the BS or were not sure to pursue an engineering BS degree. Therefore, the AD programs support the institutional mission to ultimately admit every student who is motivated to study engineering. Also, table 2 demonstrates the effectiveness of the support strategies for successful transition from AD to BS degrees.

Table 2. Students graduated from BS engineering programs from fall 2019 to fall 2024.

Academic year	BS Graduated Students	BS Graduated students from AD	BS Graduated students also graduated from the AD		
2019-2022	119	28	24%	17	61%
2020-2021	108	30	28%	20	67%
2021-2022	117	40	34%	25	63%
2022-2023	128	40	31%	31	78%
2023-2024	157	54	34%	39	72%
2024-2025	40	11	28%	7	64%
Total	669	203	30%	139	68%

It is worth mentioning that 68% of the BS graduates that transitioned from AD programs also graduated from AD programs. Consequently, one could conclude that a student transitioning to the BS with the AD awarded has higher probability to complete an engineering BS than a student transitioning without an AD awarded.

Table 3 shows the number of BS graduates from fall 2019 to fall 2024 by engineering program. As shown, 30% of the BS graduates transitioned from the AD programs. In Electrical, Mechanical, Industrial and Computer engineering the percentage of BS graduates from the AD is around 30%. However, for Civil Engineering this number drops to 4% which is expected since there is not an associate degree focused on civil engineering technology and students interested in studying Civil Engineering that do not meet the requirements must begin in the AD on mechanical engineering

technology; The obvious question is “why?”, the answer is economic contraction in Puerto Rico, particularly in the construction activities. This contraction made a reduction in the number of Civil engineering prospects around the island. Therefore, opening an AD on Civil Engineering Technology is not attractive for private institutions. However, nowadays the number of students interested in Civil Engineering is increasing after Hurricane Maria and the earthquakes based on reconstruction plans for the island. On the other hand, the percentage of students with both degrees awarded is higher for Electrical and Mechanical Engineering, lower for Industrial and Computer Engineering.

Table 3. Students graduated from BS engineering programs from fall 2019 to fall 2024, by program

BS program	BS Graduated Students	BS Graduated students from AD	BS Graduated students also graduated from the AD		
ELECTRICAL ENGINEERING	156	44	28%	33	75%
MECHANICAL ENGINEERING	221	80	36%	55	69%
INDUSTRIAL & MANAGEMENT ENGINEERING	127	37	29%	24	65%
COMPUTER ENGINEERING	139	41	29%	26	63%
CIVIL ENGINEERING	26	1	4%	1	100%
Total	669	203	30%	139	68%

Table 4. Career ladder movement.

BS program	BS Graduated students from AD	BS Graduated students from the career ladder AD	Career ladder AD	
ELECTRICAL ENGINEERING	44	38	86%	AEETE
MECHANICAL ENGINEERING	80	79	99%	AMETE
INDUSTRIAL & MANAGEMENT ENG	37	28	76%	AQETE
COMPUTER ENGINEERING	41	35	85%	ACTN
CIVIL ENGINEERING	1	1	100%	AMETE
Total	203	181	89%	

Finally, table 4 shows the career movement of BS graduates from the AD. Around 89% of BS graduates that transitioned from AD follows the career ladder depicted in figure 1. This result demonstrates that the career ladder design

to promote students for the next level is well designed and works very well.

VI. CONCLUSIONS

The transition from AD to BS in engineering program represents a critical moment in a student's academic journey. This transition involves adapting to a more rigorous curriculum, developing specialized technical skills, and embracing a new learning environment. However, several strategies might be developed by institutions to support students during this transition. Statistics show that these strategies are effective and provide the opportunity of completing a BS degree in engineering to students that initially did not meet the admission requirements for BS programs.

Finally, the authors would like to present the following advice to undergraduate students: Embrace challenges as opportunities for growth and learning. Develop resilience to overcome setbacks and learn from failures, recognizing that perseverance is key to achieving long-term goals.

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