



Why Don't Undergraduate STEM Students Pursue Combined (4+1) BS/MS Degrees?

Ms. Mais Kayyali, Florida International University

Mais Kayyali is the Associate Director of Academic Support Services in the Office of the Dean at Florida International University's (FIU) College of Engineering and Computing (CEC). In her current role, she oversees all aspects of Graduate Education and Admissions for all the schools and departments under CEC. Her duties vary from admissions, recruitment, marketing, data analysis, graduate funding, etc. She also provides administrative support to the Associate Dean for Academic Affairs. Prior to her current position, she was the Program Coordinator/Coordinator of Administrative Services for the Department of Electrical and Computer Engineering (ECE) and prior to that the Program Assistant for the Department of Civil and Environmental Engineering (CEE) at the college. Mais holds a bachelor's degree in Finance as well as a master's degree in Hospitality Management from FIU.

Dr. MOHAMED ELZOMOR, Florida International University

Dr. Mohamed ElZomor is an Assistant Professor at Florida International University (FIU), College of Engineering and Computing and teaches at the Moss School of Construction, Infrastructure and Sustainability. Dr. ElZomor completed his doctorate at Arizona State University (ASU), Ira A. Fulton Schools of Engineering. Prior to attending ASU, Dr. ElZomor received a master's of science degree in Architecture from University of Arizona, a master's degree in Engineering and a bachelor of science in Construction Engineering from American University in Cairo. Dr. ElZomor moved to FIU from State University of New York, where he was an Assistant Professor at the college of Environmental Science and Forestry. Mohamed's work focuses on Sustainability of the Built Environment, Engineering Education, Construction Engineering, Energy Efficiency Measures and Modeling, Project Management, and Infrastructure Resilience. Dr. ElZomor has extensive professional project management experience as well as a diverse cross-disciplinary academic knowledge. Mohamed, distinct expertise supports fostering interdisciplinary research in addition to embracing innovative pedagogical approaches in STEM education. Dr. ElZomor has been integrating innovative and novel educational paradigms in STEM education to support student engagement, retention, and diversity.

Mr. Piyush Pradhananga,

Piyush Pradhananga is a Ph.D. student in Civil and Environmental Engineering at Florida International University (FIU). Piyush holds a B.S. in Civil Engineering from Tribhuvan University (TU). Following his graduation in 2016, he joined a leading real estate corporation in Nepal as the site engineer working on a multi-million project. He later joined a research firm based in London where he worked as an Engineering Graduate Researcher. Piyush is currently a Graduate Research Assistant at the Moss School of Construction, Sustainability, and Infrastructure at FIU where he focuses on multidisciplinary research that harmonizes sustainability in construction. His other research interests include Sustainable Construction, Construction Safety, Engineering Education, Green Building, and Energy Efficiency Measures.

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Abstract

In the U.S., engineering and computing programs usually follow a 128-credit bachelor's degree requirement followed by a 30-credit master's degree program. A combined bachelor's and master's degree, commonly known as the 4+1, is designed to reduce the conventional time by educating students on engineering fundamentals as well as advanced discipline-specific knowledge content. With the increased competitiveness and demands of the workforce, such combined programs provide minority students with a competitive edge. However, fewer students take advantage of such combined programs. Therefore, this research aims to identify the reasons behind the low interest in applying and enrolling in the 4+1 programs. This research utilizes a mixed research method approach to understand and assess student's knowledge, level of understanding, and perception of the 4+1 programs through the administration of a survey to 486 undergraduate students at the College of Engineering and Computing in a minority-serving institution, Florida International University. A binary logistic regression model was then developed to determine the variables influencing the expected student enrollment in the combined programs. From the obtained results of the undergraduate graduating student survey, 25% of the students indicated their intention to apply for graduate studies post their undergraduate and 58% maintained a GPA above 3.0, which reflects their readiness and possible eligibility to apply for a 4+1 program prior to their graduation. The findings of the study provide a deeper understanding of students' motivational factors for joining 4+1 programs, current effective and ineffective recruiting practices, and the various opportunities offered by such programs. As poor and lack of diversity continues to be an issue in engineering especially in graduate programs, 4+1 programs foster an immense potential to attract and increase the number of underrepresented students in graduate education as well as retain and recruit top candidates for the doctoral programs.

Introduction

With the ever-changing and evolving industries, professional needs have become more challenging and demanding, resulting in a wide competency gap between science, technology, engineering, and mathematics (STEM) graduates' attributes and current employers' expectations. Therefore, with the growing demands from industry, it has become vital for engineering programs to focus on equipping students with non-technical or professional knowledge and skills [1]. Brunhaver et al. explain that with technical knowledge and skills becoming "less central or less sufficient" for performing engineering work, professional knowledge and skills have become more significant [2]. As such, programs are now tasked with widening their focus towards not only ensuring that their graduates obtain adequate in-depth discipline specific knowledge, decision making and problem-solving skills but also towards ensuring that graduates are acquainted with ample informal pedagogies to support the development of profound personal traits associated with a career [3]. However, this is not as simple as it seems as universities are now challenged with providing non-standard curriculum offerings because as explained by Passow "engineering curricula whose graduates will thrive in practice must develop

competencies beyond the traditional emphasis on “math, science, and engineering knowledge,” and possibly beyond ABET’s eleven” [4]. As access to education increases and continues to grow throughout the nation, competition for both education and jobs is rising; thus, making it more difficult to fill these spots.

In the U.S., engineering and computing programs usually follow a 128-credit bachelor’s degree requirement. With state legislature playing a major role in setting standards and requirements to meeting performance-based funding (PBF) set metrics, such as 4-year graduation rates and number of strategic degrees awarded, several state university’s funding gets affected by such metrics, thus the pressure to readdress the minimum number of credit requirement within bachelor’s degree programs strengthens. However, some argue that the reduction to 120-credit hours may lower the quality of the degree awarded, which results in graduating students that are not prepared for the profession nor possess enough professional skills when joining the workforce. With the increased competitiveness and demands of the workforce, several students graduate and struggle to find employment. We are witnessing a change in desired position requirements as many professions are now requiring a master’s degree for entry-level positions. Therefore, since the industry is already struggling with graduating student’s competency, the introduction of the combined BS/MS or 4+1 program, an accelerated program designed for outstanding undergraduate students, maybe the answer to such a dilemma, as a 30-credit master’s degree program usually focuses on advanced discipline-specific content. This provides the student with a competitive advantage and the much-needed skill sets that the industry is seeking in comparison to their peers who graduated with only a bachelor’s degree [1]. Additionally, as Galloway states that it is not possible “to provide to engineers within a four-year period all of the skills they need to practice” hence why “the master’s degree is essential to professional practice today” [5]. Therefore, by researching the views and attitudes of undergraduate students towards the 4+1 programs, we can gain insights into student’s perceptions and experiences which will help in addressing the question; why don’t STEM undergraduate students pursue combined BS/MS degrees? By understanding the reasons why students are not taking advantage and pursuing combined BS/MS degrees at an early stage of their undergraduate academic careers, we then may be able to create a positive change by increasing the number of enrolled students in such programs.

Also, as diversity continues to be an issue in engineering education, especially within graduate programs, the 4+1 programs can help attract and increase the number of underrepresented students in graduate school. Historically Black Colleges and Universities (HBCU) and Hispanic-Serving Institutions (HSI) can take advantage of such programs by retaining their undergraduate students for an additional year to complete their graduate studies, thus converting the graduate program’s pool by becoming more diverse. Also, from a funding point of view, there are several graduate funding opportunities such as fellowships that are limited to a selective number of students that meet a specific criterion including first-generation, minorities, women, Hispanics, etc. With the lack of diversity in graduate programs, several fellowships may end up not being filled or might be awarded to non-engineering programs. Additionally, with PBF metrics affecting state university funding, the pressures of reaching these set goals for each of the metrics become eminent. Hillman et al. [6] found that PBF models negatively affect minority-serving institutions and as a result, can change their institutional missions. It is important to note that with more students in the 4+1 programs, universities can: a) increase the number of strategic

degrees produced and thus positively affect one of the set PBF metrics; and b) utilize these programs to retain talent by identifying top candidates for doctoral programs, which can increase the number of strategic degrees awarded. Not to mention, students in the 4+1 programs become eligible for graduate assistantship funding as soon as their graduate career level is activated. Since research is a major component in R1 institution's mission, such early career opportunities are vital to student's success as this fosters the exposure to research at an early stage, which further hones and develops students' professional and technical skills. The 4+1 program could foster an effective educational paradigm by integrating undergraduates to collaborate and work with graduate students to enhance their technical and professional skills [7].

Background and Motivation

STEM Education in the U.S. has undergone drastic changes over the past years due to concerns relating to the quality of education being offered to prepare the next generation of engineers and scientists. Despite prior changes in focus and attempts to set improvements, engineering graduates seemed to be "poorly equipped to utilize their scientific, mathematical, and analytical knowledge in the design of components, processes, and systems" [8]. Since then, there still seems to be a gap and mismatch between current graduates' attributes and the industry's focus. This reinforces the need for a change in engineering design education which is vital to the development of future workforces of engineers and scientists providing "a lasting foundation for U.S. industry's international competitiveness" [8]. In 2002, Eggert performed a survey to determine the current state of supply (academia) and demand (industry) in engineering education. The study found that there was a "supply gap" in academia's coverage of specific design skills [9]. In an effort to improve the quality and access in STEM undergraduate education, a shift in emphasis from teaching to learning emerged [10]. Instructors were now expected to utilize "new modes of curriculum, pedagogy, and learning assessments in their own classrooms and departments, education researchers, program evaluators, and those public and private agencies who have promoted and funded innovation and the adaptation and dissemination of more effective" [10] science, mathematics, engineering and technology (SMET) teaching methods. Lahidji found that the most essential skills needed for a graduating student going into the field of manufacturing engineering were applied engineering, communication skills, and interpersonal/teamwork [11]. Further studies suggest how vital it is to bring awareness by "bridging the gap between the relevance of what they are learning in the classroom and what they will be doing as engineers in the future" [12].

Despite the 4+1 program's considerable significance at academic institutions, there yet remains a lack of research pertaining to students' enrollment in such programs. There is a scarce number of journal articles and publications discussing the implementation and precedence of the 4+1 programs, which makes the literature review limited. This could be due to the fact that these programs are fairly new when compared to other established programs and thus, universities may have been focusing more on improving their regular academic programs which affect university set metrics and thus their funding. In a benchmark study conducted to assess how Georgia Tech and its peer institutions promote and develop combined BS/MS programs (mechanical engineering), the most mentioned reasons for students to apply to these combined programs was the ability to start graduate coursework during their undergraduate studies, and thus allowing the accelerated completion of their master's degree [13]. What's interesting is that when comparing

the number of students in these programs to the total student headcount, the average percentage of students in these combined programs was slightly over one percent of the total enrolled population in mechanical engineering, which is low. Therefore, the need to explore such poor enrollments in the 4+1 programs is critical.

The theoretical framework that frames the problem of this study is the Expectancy Value Theory (EVT). In this research, EVT was applied to explain how and why undergraduate students decide to pursue a combined BS/MS degree. Eccles et al. proposed four sub-components of value which affect a person's value of a certain activity: (1) intrinsic value or interest, (2) attainment value, (3) utility value, and (4) cost. Barron et al. revised model includes cost as a "distinct component, along with expectancy and value, that determines motivated behavior" [14]. Identifying student's expectations of success and perceived values from this experience will allow us to understand the different types of costs that influence the student's decision to stay another year and complete their master's degree. Studies found that exposure to research at an undergraduate level creates positive experiences for students which as a result, leads engineering students to pursue their graduate studies [1], [15]. Moreover, social interactions with graduate students, mentors, as well as professors, can play a role in the decision to pursue post-graduate degrees. Lastly, Abhyankar et al. studied the socializer influence on engineering students' career planning, which revealed that these different socializer categories influence students' post-graduation plans in three areas: "thinking about specific jobs, job exploration in general, and choosing whether to pursue further education" [16]. This research focuses and explores (1) a deeper understanding of students' motivational factors for joining 4+1 programs, (2) current effective and ineffective recruiting practices, and (3) the various opportunities offered by such programs.

Methodology

To better understand student's motivation for joining the combined BS/MS programs, the study targeted a sample of 486 undergraduate students at Florida International University (FIU) – College of Engineering and Computing (CEC). Being Miami's first and only public research university, as well as the number one Hispanic-serving institution in the U.S., with more than 80% of its undergraduate students being minorities and first-generation, FIU is an ideal site to conduct the study to attempt to expose the root of this dilemma. Currently applications and the matriculation of students in such combined programs are very low, with only 12 active students pursuing a combined BS/MS degree in Spring 2020 term, out of which seven are newly matriculated. In addition, based on the Office of Graduate Education and Admissions (GEA) at the CEC there is a significant number of students that fit the admission criteria and are eligible to apply for such programs; however, only a few seem to end up applying, matriculating, and enrolling in the program. By understanding the motivations of undergraduate students in CEC for joining these combined programs, we can begin to see where and if there is a problem hindering their enrollment in such programs. Finally, the GEA office also relayed that based on the undergraduate graduating student survey for academic year 2018-2019, 25% of the students indicated their intention to apply for graduate studies post their undergraduate, and from the survey respondents 58% students maintained a GPA between 3.0-4.0, which reflects their readiness and possible eligibility to apply for the 4+1 program during their undergraduate studies.

The research attempts to identify the reasons why students aren't applying during their undergraduate career using a mixed research method design to evaluate student's perception of the 4+1 programs. Student's attitudinal feedback was collected through the administration of a STEM student's perception of the combined BS/MS programs survey. The research study involved both quantitative and qualitative methods in which it surveyed undergraduate students at the CEC to understand and assess their knowledge, level of understanding and perception of such combined programs as well as their expectancies, values, and costs related to the program. The questionnaire was created through Qualtrics, a web-based tool to conduct survey research, evaluations, and other data collection activities, and was sent out through mail merge to the CEC undergraduate student mailing list at the start of the term. The survey questionnaire was comprised of 35 opinion statements and multiple-choice questions to address the subject matter and the analysis was done through SPSS Statistics and Nvivo.

For the quantitative analysis, the survey design was based on a research question that identifies the factors that affect the enrollment of students in the combined program. The survey was prepared to answer the following research question: What are the variables that influence student's decision to enroll in a combined 4+1 program. To address this research question, a binary logistic regression model was developed which analyzed and predicted the probability that an observation falls into one of two categories of a dichotomous dependent variable (i.e., Expected Enrollment) based on independent variables. A binary logistic regression analysis was selected since it analyzes a dependent variable with two possible values (i.e., pass/fail) represented by an indicator variable where the values are either 1 or 0. For this study, the parameters are defined as follows: X_{EE} is the Expected Enrollment; AS is the current Academic Status; IS is the International Student; TS is the First-generation Student; G is Gender; E is Ethnicity; FO is Fully Online; PR is the Preference of Respondent and; ER is Exposure to Research. Afterwards, the SPSS tool was used to estimate the values of regression coefficients and the p-value from the t-test.

The binary logistic regression model utilizes these parameters through the following equation:

$$X_{EB} = \beta_0 + \beta_1 * AS + \beta_2 * IS + \beta_3 * TS + \beta_4 * G + \beta_5 * E + \beta_6 * FO + \beta_7 * PR + \beta_8 * ER + \varepsilon \quad (1)$$

β_0 , to β_8 in the above equation are regression coefficients that correlate between each parameter and the participants' expected enrollment (EE). The error factor (ε) captures the reality that the students' expected enrollment is not perfectly predicted by the regression equation. Furthermore, the significance test, which validates the binary logistic regression analysis, uses the t-score to describe how the mean of the data sample with a certain number of observations (i.e., $n=486$ in the case of this study) is expected to behave. Whereas the p-value indicates the confidence level, in terms of correlation, of each variable with the dependent variable. The confidence interval in the analysis is assumed to be 90% for this study; thus, the area under the curve (z) is obtained as 1.645.

Results and Discussion

Through this questionnaire, 486 STEM students at a minority-serving institution shared their perception and knowledge of the 4+1 programs, of which 32% of respondents were female, 40% first-generation students, and 70% Hispanic students, as shown in Figure 1.

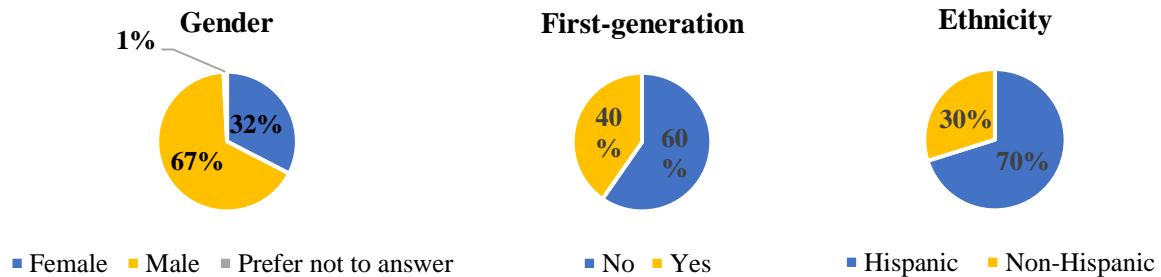


Figure 1. Socio-Demographics profile of the Respondents (N=486)

The students were first asked if they are aware of the combined BS/MS programs, where 56% of the respondents stated that they have heard of the program by word of mouth and from the university's website, as shown below in Figure 2.

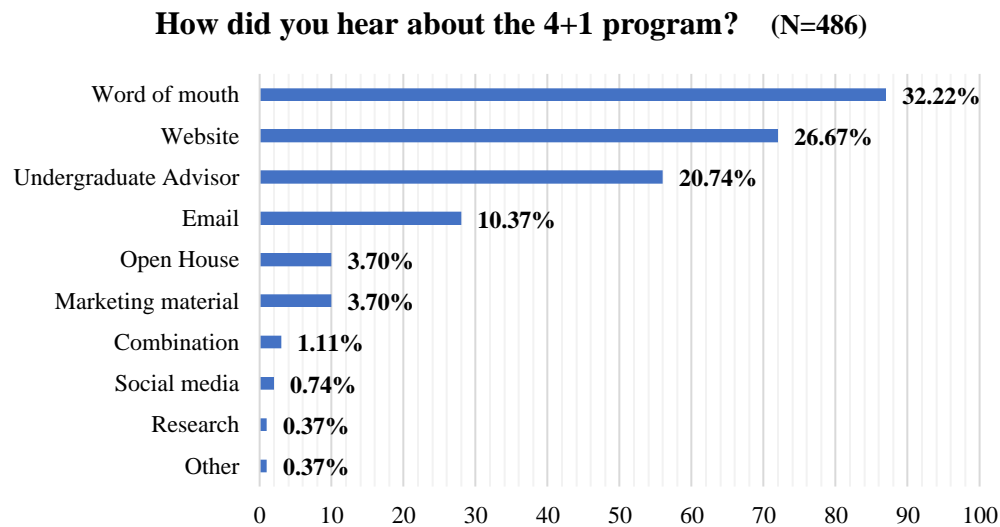


Figure 2. A Graphical Representation Indicating How Students Heard About The 4+1 Program

The remaining 44% (indicated that they have not heard of the program before), were asked a follow-up question about their interest in the program after the quick explanation provided in the question about the 4+1 programs. From this group, 84% indicated their interest in the 4+1 program. Another supplementary question was asked to the remaining 16% of students (who were still not interested following the explanation of the program), to select the reason/s behind their decision. Their answers were as follows: 12% due to limited funding, 18% because they have not heard or thought about it before, 18% not interested in graduate school, 44% prefer gaining experience in industry before pursuing an advanced degree, and the remaining 9% had listed other responses.

Students were also asked to explain if they recognize any advantages to the program and to explain why. Approximately 95% of the respondents perceived an advantage to the program while the remaining 5% either mentioned that they did not see any advantages to the program or are still unsure or have nothing to add due to their lack of familiarity with the program. One of the responses from the 5% group that saw no benefit to the program explains how unimpressed she/he was with the structure of the program adding *“not really, it seems very badly structured.”* Another student relayed a similar concern adding her/his frustration towards the education offered in her/his major, explaining: *“Almost all professors under a certain age discuss what they're teaching us isn't really in use and the professors who handle much more important concepts like Data Structures or Theory of Algorithms decry how we aren't prepared enough.”* Additionally, the respondent suggested foreseeing no benefits in what she/he called a *“lackluster program,”* as an additional year wouldn't help anyone but the university. Another respondent had a different opinion believing that the program encourages *“retention from the undergrad-grad transition.”* On a positive note a student stated the following: *“I do not know the program other than what I've learned through this survey. Based on my limited knowledge, the program sounds very advantageous, especially for students who have already considered pursuing a master's degree. I have never really considered a master's degree, but a program like this one might have made me more open to pursuing one.”*

The majority of the students expressed the benefit of saving time and money by pursuing a combined degree. One student explains: *“Yes, it allows students the opportunity to accelerate their way to a graduate degree with a stem focus which is a major advantage. To be more specific, another advantage would be the money that could be saved by the student finishing the program in 5 years versus the typical 6-7 years going from Bachelor's to Master's completion.”* Students also expressed the advantage of developing a stronger foundation in their subject area as one student explains that the 4+1 program provides students with a *“chance to have a 12 credit overlap, and be exposed to courses that are more in tune with their career which not only helps to build a good foundation but allows the student to fulfill their goal quicker to engage in the workforce.”* Another student also conveyed how the program *“allows students to be more competitive compared to their undergraduate peers since it will force applicants to be of better overall character, more decisive in career planning, expand their academic and professional network, be presented with more opportunities and define a clearer vision of what life they plan ahead of them following 4+1 completion.”* Also, a student addressed how the program supports students' understanding and engagement in their field by providing career specialization options; thesis (research) or non-thesis (professional) tracks. The student explains: *“The program shapes students to become active within the field, either via a research track or professional track (for Biomedical Engineering Combined BS/MS) & rewards students both monetarily & academically for taking the initiative with their education.”* Others expressed how the program benefits students interested in pursuing advanced degrees as it can support their application; *“especially for students interested in higher education such as Ph.D.”* as one student explains.

When asked about the disadvantages, approximately 48% of the respondents said yes that they did see disadvantages to the program. Some expressed concerns over the perception of incurring debt, lack of financial aid, not entering the workforce earlier, stress due to heavier course loads as well as issues pertaining to the curriculum and admissions process. However, approximately 11% of the respondents answered that they are unsure since they are still not familiar with the

program or are unaware of any defined disadvantages to the program. For example, one student is under the impression that they must complete both degree requirements to receive both the bachelor's and master's degrees which is not the case. She/He explains: *"Not sure. If it costs more to do this than a normal master's program, then yes or if they don't get their BS before the program is over and have to wait for both their BS and MS at the same time. Other than that, I don't see how it would be a disadvantage."*

Other responses suggested a lack of resources as well as a complicated and undefined application process as one student explains that *"the application process is too messy, and sometimes the advisors mess up with the application and make the process longer than it has to be."* Similar responses conveyed the frustration due to the unclear admissions criteria and process as one expressed *"it is not clearly defined whether admission to the program (Biomedical Engineering Combined BS/MS) is on a rolling basis or whether there is a strict deadline... Recommended action: List a tentative time calendar of how the application process works, which offices are involved, and their locations."* To address this statement, there is no deadline for the submission of the application as it depends on the student's current status at the time of the application submission. Having said that, there seems to be a lack of organization and communication when it comes to the application process, which may hinder their eligibility in partaking in the program. The following response demonstrates this lack of support with the process: *"One disadvantage is that once you take more than 12 credits for the BS and MS, you cannot take any more grad classes regardless if it's just to satisfy the MS requirements. If I'm graduating on time and not graduating with both degrees, it's counter-intuitive to restrict students not to take more. There's no explicit rule in the graduate program booklet yet the reason given by the advisor is "You're not 'technically' a Graduate student yet," and "graduate school will not allow it." Also, grad advisors might be the luck of the draw: some might be helpful in your questions and reach out to the higher uppers to confirm or will say no until pestered further. I want to learn more and take harder/better classes than in the undergrad, but I have to wait extra needless time until I can."* As far as other procedural and curriculum concerns, one student added that *"the process was EXTREMELY frustrating, which led me to many frustrated tears until I gave up completely."* One of the major concerns the student had was the fact that the courses listed on the website that students in the 4+1 program can take were not available to enroll in. The student further explains: *"I checked Fall, Spring, Summer semesters and nothing. I even found myself searching for students who might have taken the program so that they can advise me as there was NO ONE I could go to."* Unfortunately, the student decided to pursue a master's degree elsewhere due to the lack of support and confidence in the program at Florida International University.

Moreover, there seems to be a fear of companies not taking this program seriously, as one student expresses/claims that for certain majors, such as Civil Engineering, they are discouraged from pursuing a master's degree right after their bachelor's as students who follow that path will be perceived as having the theoretical concepts but lacking the real-world experiences employers are looking for. There is also distress over the idea of being overqualified and having limited experience due to the lack of industry knowledge. This is connected to the financial and opportunity costs that several other respondents brought up. The responses that follow describe these value costs: *"Another disadvantage would be for students that hope to enter corporate/industry, having a masters before having any formal job experience may put them at a disadvantage. Many companies and schools will also pay for someone to get their masters, so*

that may be a disadvantage as well if the student ends up paying for it.”; and “I can see students being overqualified or maybe coming into lower offers had they transitioned to the workforce first and then back to college. This is an assumption and opinion; it very well may not be the case and should be communicated with students.”

One can argue that when it comes to the “lack of experience,” students are expected to utilize opportunities on campus or internships as an example to build up their experience level during their undergraduate studies. This is exactly what one of the students conveyed in her/his response. The student states: *“Now before you dismiss the concept of lack of “experience” is a disadvantage because the University and other companies offer internships to students so they can gain experience. How many students receive an internship during their studies at a college or University? The National statistic itself is below 10%. So how would our students even gain the experience needed to make this decision?”* To add, that concern is heightened when we look at the international student population as opportunities for that group are usually limited. Also, on-campus employment may not provide them with the relevant experience employers are looking for. The Office of International Student & Scholar Services at Florida International University reported a total of 2,738 international students, out of which 57% are at the undergraduate level. The lack of self-efficacy was also exhibited in some of the responses, as it seems students are afraid of the course load. One student explains: *“I think the program is very challenging and intimidating; I wanted to apply but I do not know if I have the ability to do it.”* Another respondent describes that being that it is a STEM degree, students need to be well-disciplined to manage this heavier course load and thus suggesting that it is not for everyone. Others expressed “being forced” into maintaining a full-time status in the program which one student goes to explain: *“This program requires extra time since you must take 4 or 5 classes each semester and I cannot quit my job. So pretty much for students who have to work, this program is useless.”*

One of the recurring statements is associated with finances; a student explained the constant pressures they undergo as *“it is expected for students to join the work force immediately after receiving their bachelor’s degree so many must choose between earning a master’s or accepting a job offer.”* Several also added how they would be interested in the program if it was covered by financial aid while others suggested that benefits to the program include the ability to use scholarships they have acquired as an undergraduate student to start their master’s degree or apply to scholarships *“which would be otherwise mutually exclusive to either undergrad or grad students.”* Florida International University is perceived as a commuter school, as several students work part-time and full-time on and off campus. For many, not having a job can mean financial instability hence why financial aid was a major concern to many as one student explains how with financial aid covering up to five years only and with the current curriculum being over 120, students will surpass the 4-year mark if they do not maintain full-time status. Therefore, in order to utilize financial aid, students will have to take four or more classes and some may end up paying out of pocket and as one student expresses, *“school is already expensive as it is.”* Another respondent expressed how such programs are not advantageous for transfer students or working adults who have work experience credits. The student explains: *“The two disadvantages I believe may occur is towards transfer student/working adults who are only taking part-time classes while working full time, or who’s transfer credit may not be fully supported, as well as work experience credits.”*

The last opinion statement question asked what would persuade the students to complete that extra year. Several students answered that they are already enticed as it is; others relayed that they applied or planned to do so, while the remaining majority brought up the financial concerns and return on investment costs. Respondents believe that the availability of sufficient funding (fellowships, scholarships, etc.) or a discounted price would induce them to stay and complete their master's degree. Other comments depicted employability concerns towards pursuing an advanced degree as many expressed the need of a guaranteed job or internship with the expectation of a higher pay. Additionally, a student added that *"the right guidance and knowledge in signing up and completing this program"* would be the answer. This is key as one respondent explains *"I don't need any motivation. The reason I have not entered the program is that I was informed about its existence too late. I have too many credits to participate."* Finally, when asked about their GPA and the number of credits of coursework taken, with the exclusion of the students that were unsure of that information, there were 47 students who had a GPA of 3.2 or higher and a credit total within the 75-90 required range which is what most of the 4+1 programs require. Out of these 47 students, 17 did not learn about the program not until this survey and when prompted to respond if they would be interested in the program now that they have learned about it, 14 answered "yes" which the majority were at the Junior level.

Based on the enormous number of responses from 486 STEM undergraduate students at Florida International University, the research wanted to capture the main themes of their responses pertaining to the 4+1 programs. Therefore, a text mining through NVivo was conducted to visualize the most frequent words used and their respective weighted percentages. Figure 3(a) shows that the most frequent words used when asked about advantages are as follows: yes (6.70%), students (4.43%), time (4.35%), masters (3.14%), degree (2.71%), master (1.91%), and program (1.79%). In Figure 3(b), the majority of words used when asked about disadvantages included: students (2.89%), program (2.8%), time (1.89%), disadvantage (1.54%), think (1.51%), classes (1.41%), and may (1.35%). Finally, in Figure 3(c), the most repeated words when asked what would entice them to complete that extra year were: masters (2.99%), degree (2.95%), year (2.19%), program (2.12%), master (1.6%), extra (1.46%), and time (1.42%).

From a research perspective, as displayed in Figure 3(a), it seems that in the first opinion statement question relating to the advantages, students used the word "yes" the most, hence the weighted percentage of 6.7%. On the other hand, the same word when asked about the disadvantages had a weighted percentage of 1.13%. This may suggest that a higher number of students see more advantages than disadvantages to the 4+1 program. "Time" was another recurrent word used when asked about the advantages, as it is one of the key benefits to the program; as students can complete both degrees in less "time" by taking advantage of the overlapping courses which would be used to satisfy both the bachelor's and master's degree requirements. As far as the frequency of words when asked about the disadvantages, displayed in Figure 3(b), it seems that students are not using the right keywords to convey their perceptions of the disadvantages of the program as the word "time" was utilized as the third most frequent word used and "students" as the most frequently used word. One can assume that students simply want to complete their bachelor's degree and that another year can be perceived as "time" taken away from them joining the workforce. In addition to this, the word "disadvantage" received the fourth highest weighted percentage; however, the word "may" which is another frequently used word, could depict a level of uncertainty in the student's responses when asked about the disadvantages

of the program. Lastly, for the last opinion statement question, the most frequently used words, exhibited in Figure 3(c), were “masters,” “degree,” and “year.” This is interesting as it may convey student’s need for reassurance of attaining the master’s degree in a year, hence the “1” in 4+1. The word “time” was also one of the most frequently used words in the last opinion statement question. Therefore, one can conclude that “time” plays a huge role when discussing the 4+1 programs, as some may see the benefit of saving “time” while advancing their degree, while others may see it as a waste of “time” as it can delay them from joining the workforce.

- (a) Do you think the 4+1 provides any advantages to students? Explain.
- (b) Do you think the 4+1 provides any disadvantages to students? Explain.
- (c) What would entice you to complete that extra year?



Figure 3. Opinion Statement Questions’ Word Frequency

To address the research question, a binary logistic regression model was performed to determine which independent variables have a statistically significant effect on the dependent variable. Since all the variables have a significance value of less than 0.1, it is concluded that the hypothesis pertaining to the existence of the true relationship between the dependent and independent variables is correct. The regression coefficient (β) values for current academic status, international student, transfer student, first-generation student, gender, ethnicity, fully online student, preference of respondent, and exposure to research are -0.587, 0.794, -0.548, -0.964, -0.523, -0.371, -0.957, -0.743, and 0.626 respectively. These values indicate that the odds of students enrolling in the combined degree are higher for full-time, international, face-to-face, and Hispanic students. Similarly, the odds tend to be higher for those students who did not transfer from another university and are not first-generation students. Another observation is that students with research exposure and/or those who prefer face-to-face classes are more likely to be enrolled in a 4+1 program.

Table 1. Values of Regression Coefficients and Significance Test for Binary Logistic Regression Model

S.N	Variables	β	Sample Error (S.E.)	Wald	Degree of Freedom (D.F.)	P-Value	Exp (β)
1	Indicator variable for current academic status (1 if Part-time student, 0 otherwise)	-0.587	0.316	3.447	1	0.063	0.556
2	Indicator variable for International student (1 if respondent is international student, 0 otherwise)	0.794	0.229	12.039	1	0.001	0.452
3	Indicator variable for transfer student (1 if respondent is transfer student, 0 otherwise)	-0.548	0.238	5.276	1	0.022	0.578
4	Indicator variable for First-generation student (1 if respondent is first generation student, 0 otherwise)	-0.964	0.215	20.101	1	0.0005	0.381
5	Indicator variable for Gender (1 if respondent is Male, 0 otherwise)	-0.523	0.212	6.096	1	0.014	0.593
6	Indicator variable for Ethnicity (1 if respondent is Non-Hispanic, 0 otherwise)	-0.371	0.219	2.861	1	0.091	0.69
7	Indicator variable for fully online (1 if respondent is enrolled in fully online program, 0 otherwise)	-0.957	0.346	7.674	1	0.006	0.384
8	Indicator variable for preference of respondent (1 if respondent prefers online courses, 0 otherwise)	-0.743	0.21	12.466	1	0.0005	0.476
9	Indicator variable for Exposure to research (1 if respondent has been exposed to research, 0 otherwise)	0.626	0.251	6.197	1	0.013	1.87
10	Constant	3.592	0.583	37.926	1	0.0005	36.324

Therefore, the regression model consists of eight dependent variables which influence the expected enrollment of students in the combined BS/MS program. It can be inferred from these results that students who have been exposed to research at the university and having face-to-face classes as the mode of instruction, will increase the likelihood of students enrolling in such combined programs. Since the university enrolls a significant number of Hispanic and international students, it is expected that they are more motivated to enroll in the combined degree. Besides, first-generation students might be less motivated to enroll in combined degrees potentially because they face additional barriers and these students may be exposed to less family guidance in understanding the pros and cons of new advanced academic degrees.

The limitations of the study include time and the sample size; as despite the enormous number of efforts to gather approximately 500 STEM students' responses from a minority-serving institution, Florida International University, the authors wanted to indicate that the sample size could have increased if the survey's duration increased.

Conclusion

Undergraduate students face high costs and obstacles and are influenced by experiences and interactions in their pursuit of earning a graduate degree. In an effort to close this competency gap that we are witnessing due to the changing needs and requirements of the industry, this study was focused on exposing the motivations and values that prompt undergraduate students to pursue combined BS/MS degrees. Student's perceptions and understanding of the programs were investigated to understand how to retain and recruit more students into these combined programs. Several key themes emerged and were exhibited in the responses; as far as expectancies, values and costs, students seemed to be motivated by time and money. The idea of earning an advanced degree in less time meant saving on tuition costs as well as career advancement in the future. The

results also shed light on some of the reasons that may be hindering students from pursuing these degrees some of which are related to the communication and recruiting practices, program-related issues, lack of self-efficacy as well as financial risks and costs associated with the program. A binary logistic regression model developed for quantitative analysis indicated that there should be more exposure to research for students in their undergraduate career to motivate them to pursue higher degrees. Furthermore, the 4+1 programs should be inclined towards face-to-face classes since many students are likely to be motivated to enroll in combined BS/MS programs in such an environment. Overall, the results of the statistical analysis indicated that if more efforts are put into promoting the advantages of 4+1 programs, there is a higher probability of Hispanic and international students to enroll in the combined programs. With that said, the second stage of the study will include a qualitative method, which is comprised of interviews and focus groups. Interviews will be held with currently active 4+1 students, while focus groups will target eligible students that meet the program's admission criteria but who have not applied to the program. Findings from both stages of this research study will allow administration at academic institutions to more effectively plan out how to promote such programs as well as foster initiatives to better attract students and support their success through these combined programs.

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