

Benefits, Drawbacks, and Effects on Retention Rates to a 5 Year, Inclusive, Dual Degree Engineering Program

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Abstract:

This paper is an evidence based practice paper. Across the United States, many universities, especially smaller, liberal arts universities, do not have the facilities to offer engineering degrees. One thing that has become very common in these schools that can't or don't offer engineering is the 3 + 2 program, where students receive a degree from one university in three years, then transfer to a partner engineering university after graduation to complete the engineering degree in the final two years. Students in these programs earn two bachelor's degrees, one typically in math or science, and one in engineering. There are benefits and drawbacks to this type of arrangement and partnership, but they can be successful. Recently, we have been running a similar program but with a very important modification. Our program is still a five year program, and students still earn two bachelor's degrees, one from a liberal arts school (primary university), and one from a world renowned engineering school (secondary university). The difference is that students in our program earn the degree from both schools at the same time and are enrolled students at both schools simultaneously for the full five years, and no transferring is required. Having run the program for ten years, we have noticed several benefits and drawbacks to this kind of program over the traditional 3 + 2 version. The biggest benefit is that all students are members of the home institution for the full five years, making financial aid much easier for students to deal with. All scholarships, including athletic, are valid for the full five years of the program, and the students deal only with the business side of one university. All bills and fees from the engineering institution are paid by the home university, and students never see those. By being at the home university for the full five years, students can settle and perform better knowing they don't have to up and move after three years. There are many other benefits we see, but there are also drawbacks. Communication between the business offices at both universities, getting the bills paid and keeping track of students, can be difficult. Since students are getting degrees from both schools, all degree requirements must be met, and all classes must be clearly linked at the two schools so that no requirements are missing. Also, students have to register at two schools at the same time, and pre-requisites can be issues. Overall, although there are drawbacks, the benefits can outweigh them and make a program like this successful. This engineering program has retained 94% of its' students from first year to second year from graduating classes, and 97% from current students. Of the students entering the program, 83% complete it and graduate with an engineering degree, and 89% have completed any degree at the primary institution. Finally, 100% of the students who have graduated from this program have either placed into graduate school or accepted a position within the engineering industry.

Keywords: Dual degree, Engineering program, Engineering program creation

Introduction:

This paper is an evidence based practice paper. In today's world, STEM fields, especially engineering, are very popular majors for universities, and are attracting students due to the job prospects and graduation placement rates. Across the United States, three hundred ninety-three institutions offered engineering degrees as of 2018 [1]. But for many schools, offering an engineering major is not possible due to lack of resources or facilities. Many of these are smaller, liberal arts institutions.

These institutions started offering new programs in which students would major in a liberal arts and science major for three years, then transfer to an institution with an engineering major and complete the engineering major in two additional years. These programs are typically referred to as 3 + 2 programs. Recently, some schools have even started trying to work 2 + 2 programs. The benefit of these programs to the smaller institutions is that they still are able to get these engineering students to attend for the first three years, then students can transfer and get a second degree in engineering.

Downsides to these programs include that acceptance to the second, transfer university isn't always guaranteed. Other issues arise in tuition and financial aid. Students obtain financial aid and pay tuition at one institution for three years but have to reapply and attempt to get financial aid a second time after transferring. Due to the transfer, tuition often isn't the same or guaranteed either. Bigger problems arise as the transfer institutions often cap the time at two years, and minus extenuating circumstances, students do not have extra time, even if some classes don't transfer properly. Other downsides to this type of program is that the first institution generally awards BA degrees, not BS degrees. Also, the transfer between schools could be anywhere, and students may end up moving across multiple states to get to the transfer institution.

Ten years ago, Marian University started a new type of dual degree program. This program was originally developed through another local liberal arts university, and our school was given a similar opportunity. This new type of program is unique to these schools, and is not yet common across the US. This program operates very similar to the 3 + 2 programs mentioned earlier, with one important modification. The difference is that instead of having three years at a liberal arts school, then two years at an engineering school, students are enrolled at both the liberal arts institution, Marian University, from here called the primary institution, and the engineering school, Indiana University Purdue University Indianapolis (IUPUI), from here called the secondary institution, at the same time for all five years. In the process of the program, students earn two bachelor's degrees: the first from Marian in any liberal arts or science major, and a second bachelor's degree in engineering from Purdue University through the Indianapolis campus.

In this case, Marian University is a private, liberal arts institution in a major metropolitan area, Indianapolis, Indiana. Marian University has approximately three thousand five hundred undergraduate students, and approximately five thousand total students. The size of classes are typically in the range of twenty to twenty-five students in all classes: engineering, science and math, or general education. IUPUI is a large, state school with a world renowned engineering program through Purdue University. IUPUI has approximately twenty-eight thousand students across undergraduate and graduate programs. At the Marian, there are approximately sixty students in this dual degree program. At IUPUI, there are approximately three thousand total engineering students. Freshman level science, math, and engineering courses at IUPUI, as well as general education courses, can regularly approach two hundred students. Sophomore and junior level engineering courses can be as large as one hundred, and upper-level engineering courses are typically twenty to forty students. Many students who enter this dual degree program state they do so due the possibility of getting the engineering degree while maintaining many classes with small class sizes. As mentioned later in the discussion, a high percentage of students in this dual degree program also participate in university athletics, and this is another draw for this program.

Students enrolled in this program can enroll at both schools from the beginning of freshman year. The key to being able to run a program like this is location. The primary and secondary institutions are only two and a half miles apart, and students can commute between the two schools in under ten minutes. This allows students to take classes at both of the universities at the same time. So rather than needing to wait until year four to transfer to a new school and start the engineering degree, students can start from day one. Many students end up taking most classes at the primary institution over the first two years, but then take about half at each starting in year three. There is a lot that goes on with this program, and like the 3 + 2 programs, there are both advantages and drawbacks to this style.

Program Advantages and Drawbacks:

We can start by looking at the advantages of a program of this type. While analyzing the advantages and drawbacks, it is important to look at each from multiple angles: are these advantages or drawbacks to the students, the primary/secondary institutions, or both. The biggest benefit to students is that they are members of Marian University for all five years. This makes the financial aid and tuition issues seen in 3 + 2 programs much easier to deal with. Instead of getting financial aid for three years, then needing to reapply when transferring, students are awarded financial aid and scholarships that cover all five years during the initial admission process. All aid, including athletic scholarships, are valid for five years of the program. This allows students and parents to know exactly what they are getting from the beginning, with no surprises. This can also be an advantage to both universities. Marian University can plan for

students, enrollment, and financial aid for the full five years, while IUPUI does not have to manage any aid or scholarships for these students.

Another downside to students in 3 + 2 programs is the tuition difference. Students in this dual degree engineering program do not have to worry about that, as the tuition is paid only to the primary institution. This is another major advantage, as students never have to worry about billing, fees, or anything related to the business office at the secondary institution. Any fees or tuition costs are billed by IUPUI to the Marian directly, and the bills are paid between the schools, cutting the students out of the process entirely. This can be a disadvantage to the universities, as mentioned below.

Students also have an easier time adjusting in this program, as the thought of transferring is not something they have to worry about. This allows students to settle in and perform better in the classroom. Unlike the 3 + 2 programs, where students may transfer hours and states away, students in this dual degree engineering program are students at Marian University for five years. If they choose, they can live on campus in dorms or on campus housing for all five years, never needing to move even across a street, much less across multiple states.

As mentioned above, 3 + 2 programs have a problem in that students aren't always guaranteed acceptance into the engineering schools. In this dual degree program, students are analyzed by Marian University for admission standards at both schools, and students aren't admitted into the program unless they meet the IUPUI admission requirements. IUPUI has admission standards of five hundred seventy SAT math scores for admission. Post COVID-19, as schools are going more test-blind, the standards are now based on high school math courses taken. Students who have a B or higher in pre-calculus or above are admitted to the program, and students with a C or above in pre-calculus or calculus are then considered further. Marian University has lower admission standards for general students. These standards are similar to other engineering schools across the country. In this process, students first apply to Marian with an interest in the dual degree program, and are either accepted or denied admission to the university. Any students accepted to the university are then forwarded to a dual degree program admissions committee. That committee, typically two or three dual degree program faculty members, reviews student test scores or transcripts, depending on what is available. Anyone meeting admission standards for IUPUI is admitted to the dual degree program. Anyone not meeting the IUPUI standards are admitted Marian as an engineering physics or exploratory major. After review, the committee notifies students of their standing with admission. Students can appeal the decision and speak to the committee if they feel there is an error or extenuating circumstances, but it is rare for students to take this option. In the end, students may still not be accepted to the engineering school, but in that case, they know early on, and are not admitted as part of the dual degree program overall.

Another major advantage to this type of program is the resources available to students. Since they are students at both schools from day one, they have access to all student services at both schools from day one as well. This includes all tutoring centers, writing and speaking centers, and even career centers. Students can use job posting sites from both schools when looking for internships and jobs, giving them a broader view and a better chance of finding something that fits for them.

Although there are many advantages to this dual degree program, there are still some drawbacks as well. The major drawback is from an institutional side and is related to one of the student advantages. Students never see bills from the secondary university. Everything is sent through the business offices between the two schools. The communication between these offices can be difficult at times, and sometimes students will get lost in the shuffle. Those bills end up not being paid and billed separately later, making costs difficult to track. Since IUPUI is a state school, the tuition rates are different for in-state and out-of-state students, while the private Marian University has a single tuition rate. From the perspective of Marian, tuition and fees can be estimated and planned out for a typical freshman class of fifteen to twenty students, but the exact amount can't be predicted until the background and homes of students are known. This means the tuition fees Marian pays can vary semester-to-semester based on the student population.

Additionally, since students are graduating with degrees from two separate schools, all graduation requirements for both universities must be met. Classes between the two schools must be tracked and properly listed in the systems and software of each university. This can cause issues with pre-requisites, as sometimes they don't properly come in. For example, Calculus I may be taken at Marian, and it is set to register at IUPUI during degree audits. During the audits, the class appears as complete. However, it doesn't always appear as a completed pre-requisite, and these have to be manually overridden, delaying class registration.

Since students are enrolled from day one at both schools, it could sometimes occur that students are inactive and un-enrolled from the secondary institution. Occasionally, students take all their classes at the primary university. When this happens, they end up showing as taking no classes at the secondary university, and are labeled as inactive, and a hold is put on future registration. The secondary institution has created a zero-credit hour course for cases like this so students can register for something, but that requires students to enroll, and since it is zero credits, it doesn't effect their schedule and is easy to forget. This can be corrected by the admins of the two schools, but it once again can cause delays to registration, causing students to miss classes that fill up.

Although there are both advantages and drawbacks to the dual degree program when compared to traditional 2 + 2 or 3 + 2 programs, the advantages tend to outweigh the drawbacks. The advantages of the program can be seen in the data on program analysis.

Data and Discussion:

This dual degree engineering program has now been running for ten years. The tenth freshman class started classes in the fall of 2021. Over the ten years, there have been six graduating classes, with the sixth class recently graduating in May of 2022. Data analyzed will include overall retention rate for first-time, full-time freshmen (FTFTF), graduation rate where applicable, six-year graduation rate at the institution whether in the engineering program or not, and post-graduation placement rate in industry or graduate school.

Of the classes to have graduated, there are a total of thirty graduates that completed the full dual degree program. One of the benefits of the dual degree program being inclusive for five years is the variety of major combinations possible. Of the thirty graduates, nineteen have graduated as mechanical engineers, eight as biomedical engineers, two computer engineers, and one as construction technology (an engineering technology major). The major from the Marian University has a wide range, with sixteen math majors, six chemistry majors, four biology majors, and one major each from business, computer science, theology, and Spanish.

Other than the variety in majors, the retention, graduation, six year graduation, and job placement rates are all very high. Table 1 shows the rates and data for each of the five graduated classes, and the anticipated May 2022 graduating class.

Graduating class	# FTFTF	# Engineering program graduates	# of transfers	# of graduates at the primary institution outside the engineering program	# of engineering program graduates with job/grad school
2017	2	2	0	0	2
2018	2	2	0	0	2
2019	7	5	1	1	5
2020	7	6	1	0	6
2021	11	10	1	0	9*
2022	7	5	1	1	5

Table 1: Retention and graduate numbers of all programs graduates.

The placement rate for the class of 2021 in the table above has an asterisk next to it. Of the ten graduates, nine have either a job or have started grad school. The final student has a standing job offer in engineering but has chosen to turn professional in athletics first. The student has worked for the company, and they understand the desire to attempt to participate in the professional sport and have offered a job once the professional career is over.

The data gathered in Table 1 is rewritten in Table 2 as retention, graduation, and placement rates.

Graduating class	# FTFTF	Freshmen-to-sophomore retention rate at university (%)	Overall retention rate in engineering (%)	Graduation Rate of FTFTF in engineering program (%)	6 year graduation rate of FTFTF at primary institution (%)	Post-graduation placement rate for engineering program (%)
2017	2	100	100	100	100	100
2018	2	100	100	100	100	100
2019	7	100	71	71	86	100
2020	7	83	83	83	83	100
2021	10	100	80	80	90	100*
2022	8	88	75	75	88	100

Table 2: Program retention rates and graduation rates for past graduates

Overall, in the six years the engineering program has been producing graduates, thirty-six students have started as FTFTF. Of those thirty-six, only four have transferred out of the university entirely, and two have changed majors within the university. Of the six to not complete the engineering program, only two have made the change after their freshmen year, and both of those have been students who transferred, one of whom transferred directly to IUPUI. These equate to an engineering program graduation rate of 83%, and a six year graduation rate at the university without regard to major of 89%. These numbers are significantly above other engineering program graduation and six-year graduation rates. [2],[3] The job/grad school placement rate for the engineering program is 100%. The FTFTF retention rate of the engineering program at the university is 94%.

The rate that persisted to second year, 94%, is above the benchmark rates of 82% [4]. The graduation rate in the program of 83% is much higher than the reported rates, which typically remain around 50% [5],[6],[7],[8],[9],[10],[11],[12]. A job/grad school placement rate of 100% cannot get any better.

Digging deeper into the placement rates post-graduation, eight students have gone directly into graduate school. Of those eight, three have gone into aerospace engineering, four have chosen to pursue mechanical engineering, and one has gone into computer engineering. In addition to these eight, four graduates have obtained jobs in industry, and gone to grad school part time with funding provided by their employer. Two of these four are studying mechanical engineering, a third is studying environmental engineering, and the fourth is studying public affairs with a concentration in environmental policy. The other twenty graduates have placed directly into industry.

After accounting for the six graduated classes, there are four remaining groups of classes. Table 3 shows the breakdown of these classes based on retention rates in the engineering program and at the university.

Projected graduation year	# FTFTF	Freshmen-to-sophomore retention rate	Still at primary institution	Freshmen retention rate in engineering program	University retention rate
2023	10	10	10	100	100
2024	12	12	11	100	92
2025	18	17	16	94	89
2026	21	20	21	95	100

Table 3: Current students retention rates

Overall, the retention rate at Marian University, regardless of major, is 95%, and the freshmen-to-sophomore retention rate is 97%. Like the numbers for the graduating classes, these rates are well above the average across the US.

In the current group of students, we have also seen a broader choice in majors. In addition to the engineering majors mentioned in the graduates section, students are also majoring now in electrical engineering, energy engineering, and motorsports engineering. At Marian, additional major choices include engineering physics (introduced with the class of 2023), environmental science, history, and graphic design.

The dual degree program also shows advantages in some of the data within the student population. One of these areas is the percentage of students that are women. Typically, the rate of women in engineering hovers around 20% of the student population [13],[14],[15]. Over the ten years of the program, twenty-six of the ninety-one total FTFTF have been women, a rate of 29%. Of the students who stayed in the engineering program, twenty-four out of eighty-eight students in the program, or 27%, have been women, well above the 20% national average.

The other area that we see large increases in student rates is student athletes. The percentage of student-athletes who are engineers across the US is hard to find, but schools typically self-report numbers in the 18% - 22% range. Of the eighty-eight students mentioned above that are still in or have completed the engineering program, sixty-five have competed on university sponsored athletic teams (not intramural). This is a rate of 74%! Over the life of the program, while completing two degrees, one in engineering, across two universities, 74% of the students have competed in intercollegiate athletics for three or more years (this includes three students forced to withdraw from athletics due to career ending injuries). This may come from students being able to be at the university for the full five years, so all athletic scholarships are handled by one university and can run the entire length of the program. This, along with the ability to compete at the NAIA level, may be attractive and could help explain this number.

Conclusions:

Having an engineering program across two universities, while keeping students enrolled at both at the same time, earning two separate degrees, certainly comes with its' drawbacks. Some of these have to do administratively with multiple offices needing to communicate. Others are student tracking and records related, in terms of pre-requisites and meeting graduation requirements. Despite the drawbacks, the advantages to the university and students outweigh the challenges. These advantages can be seen in the numbers on the program. 27% of the students either in or graduating from the program are women, and 74% have competed in intercollegiate athletics.

Even in graduation and retention rates, the differences can be seen. This engineering program has retained 94% of its' students from first year to second year from graduating classes, and 97% from current students. Of the students entering the program, 83% complete it and graduate with an engineering degree, and 89% have completed any degree at the primary institution. Finally, 100% of the students who have graduated from this program have either placed into graduate school or accepted a position within the engineering industry. Overall, this program has been a success.

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