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Results of the First Six Years of a 2+2 Online BS Industrial Engineering Degree Pathway

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Results of the First 6 Years of a 2 + 2 Online BS Industrial Engineering Degree Pathway

abstract

This paper reports on the success and difficulties with a 2 + 2 online Bachelor of Science in Industrial Engineering (BSIE) at Lamar University. The degree pathway was launched in fall 2014. In the 2+2 online model, students complete the first two years at a community college and the final 2 years online at Lamar University. This approach provides a pathway for students who cannot attend a traditional 4-year program due to barriers such as full-time work, location, financial limitations, and dependent care responsibilities. The final two years are online except for a one weekend manufacturing lab where students make a metal hammer in a machine shop. The remaining labs including Work Design, CAD/CAM, Simulation, Senior Design, and Automation have been adapted to online learning.

The program has grown to 15 to 20 graduates per year. Most students transfer with the lower coursework complete including math to differential equations, physics, and chemistry. Lamar University currently also offers all lower division courses online except for physics online that allows students to complete any missing requirements. The online students are a diverse population with a wide range of backgrounds. Many online students are early and mid-career students who work full-time primarily in manufacturing and chemical industries in a wide range of roles. A smaller group of students are traditional students that attend pre-engineering programs at community colleges and want to remain in their community. The department also receives students who are unable to complete at a 4-year school due to relocation and job-related issues. Placing all upper division courses online has also aided our traditional on campus students by giving students the opportunity to take a course while at co-ops and internships. Survey feedback from face to face and online students indicates no major issues with the educational experience. Outcome assessment data and student course evaluations indicates a similar level of performance between online and face to face students. Student placement data does not indicate problems with the online program.

1. introduction

The pathway to an engineering degree may be blocked for some students due to location and time of day restrictions. Online degree options can help these students overcome the barrier. Beginning from the fall 2014, the Industrial Engineering department, now the Industrial and Systems Engineering (ISE) department, at Lamar University (LU) began offering a BSIE degree in a 2+2 online format [1]. The 2+2 online degree has students take the first 2 years at a different school, typically a community college, and the final 2 years at a 4-year college/university online without relocating. While all courses except for Physics are offered online, the department only promises students that courses required for the final 2 years are offered online. Relatively few universities currently have online undergraduate engineering programs including Arizona State University (Electrical, Mechanical, Software, and Engineering Management) [2], University of Alabama (2+2 Mechanical Engineering) [3], North Dakota State (Chemical Engineering, Civil Engineering Electrical Engineering, Mechanical Engineering, Geological Engineering) [4], Liberty University (Civil) [5], Penn State (Software Engineering) [6], Florida International

University (BS Electrical Engineering, BS Computer Engineering) [7], Old Dominion University (BS Computer Engineering) [8], and Stony Brook University (Electrical) [9]. Clemson University offers online BS Electrical Engineering degree completion program where many but not all credits are offered online for transfer students [10]. This paper reports the progress of the program including the reaction of students and faculty since our prior publication about the program in 2016 [11].

Data on the program at LU is shared to increase the body of knowledge available in the literature on online engineering programs. Based on our review of online programs nationwide, LU has the only BS Industrial Engineering program with an online pathway and one of five universities with online pathways for traditional engineering disciplines excluding computer engineering. Our experience represents one data point to start building knowledge about the impact of online programs on student success, diversity, and enrollment. When combined with the experiences of other programs, the effectiveness of undergraduate online education can be established. Due to the unique aspects of online undergraduate engineering programs including significant math and science requirements and limited degree plan flexibility, the effectiveness of online engineering programs might be significantly different than other undergraduate education programs especially those outside of STEM. Our experience indicates that an online BS pathway attracts a diverse range of students who are traditional underserved by engineering education as discussed in section 4. This paper also documents our outreach approach (section 2) and student success (section 5).

As the background on the program, the department offers a BS in Industrial Engineering, a BS in Industrial Technology, a MS in Engineering (Non-thesis), a MS in Engineering Science, a MS in Engineering Management, and a Doctor of Engineering degree. In 2008, the department started moving a significant number of Industrial Technology courses online. By 2012, the Industrial Technology degree could be taken using online courses. In 2014, the BS Industrial Engineering and MS Engineering Management were offered online. In 2018, the BS Electrical Engineering was offered in a 2+2 hybrid online format.

LU is a public university with over 16,000 students. The university has 13 online undergraduate programs including the 2+2 online programs in Industrial Engineering and 2+2 hybrid online program in Electrical Engineering and 23 online graduate programs. LU's largest online programs are graduate education, nursing, and business. The University offers undergraduate engineering degrees in Electrical, Mechanical, Civil, Chemical, and Industrial Engineering. In 2019, the total enrollment of the College of Engineering was 1,403 undergraduates, 149 master students, and 71 doctoral students.

2. market and outreach

Prior to the onset of the 2020 COVID-19 pandemic, many undergraduate students were already taking at least one online course, especially at US public universities [12], and some public schools were starting to have a strong presence in the online education where private for profit schools had previously dominated [13]. A number of companies have websites offering marketing solutions to help promote online programs, but in one survey educators did not feel that marketing was important to the success of a program [14]. In our case, we have been relatively successful in attracting students utilizing the department's and university's website as

the primary marketing tool. The outreach messaging stresses the math and science background required to be successful in the program and expectations of an undergraduate engineering degree. The following and similar statements are clearly displayed on the website and all marketing materials.

> "Students should complete at least 6 math based lower division courses (such as Calculus I/II, Diff. Eq., Linear Algebra, Physics I/II, Chem. I/II, Statics, or similar courses) before joining the BSIE 2+2 online program option. Most large community colleges offer these courses. To be successful in the BSIE 2+2 online program, you should have reasonably good grades (mostly A and B) in these math based lower division courses." [1]

The department has a webpage dedicated to 2+2 online outreach. This page receives considerable traffic and is consistently one of the most visited pages in the College of Engineering (COE) website. A YouTube video on the page has received over 800 views in 18 months [1]. The program has received several rankings of online schools in part due to the small number of online BS degrees in engineering that also drive traffic to the website:

1. 2020 Best Online Colleges Offering Bachelor's in Engineering Degrees by OnlineU [15] and ranked #1 for most affordable [16].
2. 2021 Ranked #4 for online engineering by intelligent.com [17].
3. 2020 Ranked one of the ten most affordable BS Engineering degrees by bachelorsdegreecenter.org [18].
4. 2020 Ranked in the top 10 of online engineering schools by accreditedschoolsonline.org [19].
5. Ranked #17 for online engineering by nonprofitcollegesonline.com [20].

While the above rankings are due to being one of the few schools with an online BS engineering degrees and relatively low tuition ($440 per credit hour based on an instate student taking 12 hours per semester), they might drive traffic to our website and help with outreach. LU also offer scholarships specifically for transfer students. Our program has not used paid marketing to assist outreach efforts beyond university wide outreach efforts.

The department has also cultivated relationships with community colleges. The department has 4 active articulation agreements and more in development. The chair and faculty have visited community colleges with an average of 4 visits per semester. Due to not offering Physics I and II online, the community colleges are critical to the departments 2+2 online program. Chemistry and Math courses are sometimes offered online, but a formal agreement with those departments to provide online service courses does not exist. Community college tuition costs are low with some being under $100 per credit hour including all fees [21]. Many community colleges in the state offer online sections of lower division courses. The department has no current plans to develop a fully online program since the target populations are covered by the 2+2 online program.

3. curriculum and delivery approach

The 2+2 online degree plan is displayed in Table 1. For community college transfers, “Work Design” and “Engineering Materials and Processes” are moved to the 3rd year and history and government courses are moved to the first and second years as compared to our recommended degree plan for on campus students. Several community colleges have Calculus III, Thermodynamics I, or Dynamics as part of their Associates of Science in Engineering curriculum. The department accepts both courses as technical electives with a limit of 2 lower division technical elective courses. The department does not accept a lower division 1st year level computer aided design course and only accepts one hour of Introduction to Engineering instead of the two-hour course taught at most community colleges in the region. Several community colleges also have a college learning skills course that is not accepted. Several community colleges teach a 4-hour circuits class that is transferred as a 3-hour class. Based on the articulation agreements, typically 1 to 5 hours from an Associates of Science in Engineering do not apply to our degree plan. The department has 4 active articulation agreements with the goal of having agreements with all major community colleges with active pre-engineering programs in Texas by the end of 2022.

Computer Applications is typically accepted using a course substitution process. Our Computer Application course teaches a mixture of Excel, SQL, and Python. Community colleges teach a range of computer programming languages including Java, C++, MATLAB, or Python, typically with limited exposure to Excel and SQL. The current department policy is to allow any computer programming course that is designed for engineering and computer science students as a substitute with the justification that the logic of programming is the key learning outcome.

Texas has a unique 42-hour core curriculum that includes 6 hours of history, 6 hours of government, 3 hours of fine arts, and 6 hours of communication [22]. Community colleges inside Texas structure their programs to meet this core. By rule, LU must accept courses in a core area from other public universities and community colleges in Texas. For students transferring from outside of Texas, meeting this core educational requirement might require several additional lower division courses.

Several courses have labs. The lower division lab courses of chemistry I and II and physics I and II are taught by our community college partners. Others have observed that student engagement in online labs depends on their perception of the value of the activity and the ease of use of the online interface to the lab [23, 24]. INEN 3380 Work Design lab is done using observational studies that can be done remotely. The lab for INEN 4345 Computer Integrated Manufacturing have a software lab session that teaches Autodesk Fusion 360 software and is offered online asynchronously to students. INEN 4320 has a lab with data collection that can be done at home. INEN 3322 Engineering Materials and Process has a lab where students make a hammer using our machine shop to learn about materials and shop procedures. For the online program, we have condensed the lab into a 3-day weekend lab where students must come to the LU campus. INEN 4375 Simulation and INEN 4396 Automated System have a significant software component without a formal lab session where students develop simulation models and PLC control system in homework assignments.

In addition to labs, we offer project-based courses online including a 2 semester 6 hour senior design sequence. Senior design projects often involve solving a problem at a company or organization such as exploring purchasing a new piece of equipment and process improvement using a methodology such as 5S, Six Sigma, or Lean. Several students have used projects from their current employers. When a students uses a project at their current employer, the project must have a significant academic component with a literature review, an academic report, and using industrial engineering methodologies such as simulation, data mining, or optimization beyond the scope of their job requirements. A limited number of projects are research based on topics developed by faculty such as designing and building a low-cost industry robot, developing tooling to manufacturing parts for research projects, or design studies on different topics. Due to COVID-19, the class of 2020-2021 had fewer industry sponsored projects. In most cases, projects have integrated teams with both online and face-to-face students. Students have adapted well to this format and understood that the skills gained working on a geographically separated team are valuable in the modern workplace.

Table 1. Degree plan for BS Industrial Engineering.

FIRST YEAR			
INEN 1101 Intro to Engineering	1	INEN 2360 Comp. Appl. IE	3
CHEM 1311 Chemistry I / Lab	4	CHEM 1312 / Lab	4
ENGL 1301 English Composition 1	3	MATH 2414 Calculus II	4
MATH 2413 Calculus I	4	PHYS 2425 Physics I	4
COMM 1315 Public Speaking	3		
TOTAL	15	TOTAL	15
SECOND YEAR			
INEN 2373 Engineering Economics	3	**INEN 3380 Work Design**	3
INEN 3322 Engr. Matls. & Procs.	3	ELEN 3310 Fundamentals of EE	3
CVEN / MEEN 2301 Statics	3	MATH 3301 Diff. Eq.	3
MATH 2318 Linear Algebra	3	Creative Arts Elective	3
PHYS 2426 Physics II	4	PHIL 2306 Ethics	3
TOTAL	16	TOTAL	15
THIRD YEAR			
INEN 3320 Probability & Stat for Engr	3	**INEN 4320 Stat Dec Making Engr**	3
INEN 4315 Industrial Management	3	**INEN 4345 Comp. Int. Manufacturing**	3
INEN 4350 Production & Inventory Ctl.	3	**INEN 4370 Operations Research**	3
Approved Elective	3	**INEN 4300 Quality Improvement**	3
HIST 1301 History I	3	HIST 1302 History II	3
TOTAL	15	TOTAL	15
FOURTH YEAR			
INEN 4323 IE Systems Design	3	**INEN 4385 IE Design**	3
INEN 4375 Simulation of IE Sys.	3	Approved Elective	3
INEN 4316 Industrial and Product Safety	3	Approved Elective	3
INEN 4396 Automated System	3	Approved Elective	3
POLS 2301 American Gov't. I	3	POLS 2302 American Gov't. II	3
TOTAL	15	TOTAL	15

Beyond senior design, most instructors have a group project as part of their class to prepare students for senior design with INEN 4345 Computer Integrated Manufacturing having a large project where students design a part in Autodesk Fusion 360 and INEN 4375 Simulation having a project where students model a system that they observe. INEN 4331 Technology Entrepreneurship is a new course developed over the last several year in conjunction with the Lamar University Center for Innovation, Commercialization, and Entrepreneurship (CICE) [25]. The entirely online course challenges students work in a team to develop a business model, step-by-step throughout the semester, starting with ideation and covering topics such as product design, market research, patent search, cost estimation, and pitching to investors. Product design is based on the FDA version of the waterfall model [26], and teams consider verification tests and quality control for their products which provides enough details for them to create sophisticated financial estimates. The course has been taught twice in the online format for undergraduates and a graduate version of the course has also been taught twice. Feedback from students has been generally positive, team building and organization is frequently cited by students as the biggest hurdle to be overcome.

One literature article suggests that a factor in faculty acceptance of online labs is faculty perception of how labs are evaluated; in-person labs tend to use qualitative evaluation (the instructor gets direct feedback on the students' progress), while online labs tend to use quizzes and exams as assessment [27]. Many of our labs and especially our online project-based course provide ample opportunity for qualitative assessment of student performance as well as personalized interaction between faculty and students. Educators often look at broad principles such as UDL [28] and Quality Matters [29], as well as more course specific methods to engage students [30]. Our faculty have taken advantage of a Quality Matters program supported by LU and tailored content for specific courses.

Courses in the department are taught by 8 tenure track full time faculty members and 2 instructors. The department uses 2 highly qualified adjuncts with doctoral degrees and significant teaching experience to teach safety, six sigma, and lean including a former tenured associate professor who left for employment in industry. Teaching loads for research active faculty are 2 courses per semester, and 4 courses for instructors and faculty not actively involved with research. The 15 courses in bold in Table 1 plus 6 elective online sections, in addition to on campus sections, must be taught once per year online and face to face to support the program. This teaching requirement places additional load on the faculty. The faculty members were initially compensated by the university for online teaching with a small stipend equally to adjunct pay for out of load online courses, currently faculty members receive no additional compensation for teaching online. Teaching online has become part of the standard workload of the department faculty members who generally have no preference as to course delivery mode. The paper co-authors view online as more flexibly but the same or more work as a traditional classroom instruction. Literature suggests that faculty opinion regarding online teaching is more acceptable at schools that have adopted it and much less so at schools that have not [31]. All faculty in our department, excluding a faculty member who primarily serves in administrative roles, have taught multiple courses online many times.

The primary challenge with having a 2+2 online program is increased faculty workload. To support traditional students especially international students, almost all 3rd and 4th year classes

must be taught online and face to face (15 courses). Some elective courses must be taught in both modes. Labs are also a challenge. The majority of lab experience in LU's IE curriculum occurs during the first two years in chemistry and physics that is not part of the 2+2 online program. After the 2nd year, a single weekend lab is used for our material process lab where students make a hammer in our machine shop. The Work Design lab is mostly observational studies that can be conducted offsite. Computer aid manufacturing and automation labs are software based. Another challenge is students having consecutive multi-semester internship, co-ops and full-time employment where they take classes part time that extends the average time to graduation and complicates reporting program effectiveness including NSF S-STEM grant effectiveness. High performing students tend to take longer than 4 years to graduate due to employment. While this occurs in all engineering programs, the online pathway allows students to have full time employment before graduation without geographic and time restrictions. The final challenge is faculty acceptance of the format. LU faculty had some experience teaching online prior to 2014 in our technology program, resulting in the format being accepted by the faculty.

4. impact on enrollment and diversity

The overall impact on enrollment has been positive. Overall enrollment in the department in Industrial Engineering has fluctuated from 70 to 110 students between 2013 and 2020 with a slight positive trend after implementing the online pathway. Senior design registration and the number of graduates has increased since the online pathway was implemented; the number of online students has increased suggesting that the online program influenced growth (Table 2). The advisors tend to limit online coursework to fully online students and traditional students with a justification such as work or dependent care, so senior design enrollment is a reasonable estimate of online compared to face-to-face students by the senior year. Our online program is not separated in our administrative software system, so a clear distinction between the populations is not available and both populations receive the same degree; there is no separate designation in our information technology system for online students therefore we use senior design enrollment to estimate the online population.

Table 2. Senior design enrollment from 2015 to 2020 by section registration.

Year	Online	In Person	Percent Online	Total Students
2015	3	11	21%	14
2016	3	17	15%	20
2017	4	14	22%	18
2018	12	14	46%	26
2019	22	10	69%	32
2020	19	8	70%	27

The department has become more diverse in terms of several measures (Table 3). Ethnic diversity has increased in the department. The share of traditional unrepresented students has increased from 32% to 56% since the online pathway was implemented. The growth in Hispanic

students is partially due to the online program being able to attract students from outside of our local area.

Table 3. Number of students by group.

		White	African American	Hispanic	Asian	Inter-national	2 or More	Not Reported	Total
Spring 2019	Number	30	34	28	7	9	1	1	110
	Percent	27%	31%	25%	6%	8%	1%	1%	100%
Spring 2013	Number	39	19	11	8	15	0	0	92
	Percent	42%	21%	12%	9%	16%	0%	0%	100%

In terms of the age distribution of students (Table 4), the online program has attracted working older students with the percentage of students over 25 increasing from 25% to 40%. The percentage of female students has remained relatively constant ranging from 21% to 30% between 2013 and 2019 with 29% in 2019.

Table 4. Number of students by age group

Age	Under 20	20-21	22-24	25-29	30-34	Over 35	% Over 25
Spring 2019	16	18	32	25	13	6	40%
Spring 2013	12	28	27	14	5	3	25%

The program has had limited impact on the number of out of state students (Table 5). The number of international students declined, but this decline is similar to the trends in other departments at LU during the time frame of the online program implementation.

Table 5. In State student status.

	Instate	Out of State	International	Total
Spring 2019	97	5	8	110
Spring 2013	64	2	21	87

The online program has increased the ratio of 4th year students to 1st and 2nd year students based on classification by credit hours (Table 6). Historically the department had a large population of 1st year students that was reduced by students leaving engineering for academic and non-academic reasons. The department in 2013 also had a large population of students with over 90 hours since many students take more than 4 years to graduate due to pre-requisites, co-ops, coursework and taking fewer than 15 hours per semester. After adding an online program, most of our students take 3rd and 4th year courses with 66% having over 90 credit hours. Today, we have significantly more seniors than 1st year students.

Table 6. Students by number of credit hours.

		<29	30 – 59	60-89	Over 90
Spring 2019	Students	9	10	18	73
	Percent	8%	9%	16%	67%
Spring 2013	Students	27	20	9	31
	Percent	31%	23%	10%	36%

A troubling issue is the decline in the 1st year traditional students (Table 7). This decline can partially be attributed to a decrease in international students that occurred over the time-period from 2014 to 2019. Beyond the decline in international students, the department's outreach materials clearly state that the BS Industrial Engineering degree can be completed both 2+2 online and traditional face to face to reach both transfer students and traditional students. The outreach materials also discuss the benefits of having an online pathway for traditional students to allow for extended internships and employment while in school. Given that most incoming students would be aware of our online offering, a potential reason for the decrease is that traditional students might avoid programs with an online pathway due to bias against online education. This item is an issue for future study for the department and continuous improvement in outreach.

Table 7. First year traditional students

Year	Less than 30 Hours
2012	36
2013	29
2014	26
2015	28
2016	30
2017	12
2018	17
2019	13

The department's retention rates are higher than the retention rate for the university in 2019. Given that the department is a mixture of first year engineering students and part time students, having retention rates above the university average suggests that the program is attracting students who have the skills required for the degree.

During the time of 2015 to 2021, the department shared a S-STEM NSF grant (DUE-1457880) with the mechanical engineering department. Since most students in the grant were mechanical engineering, the impact on enrollment for the Industrial Engineering department was small. The online option complicated the S-STEM grant with several students leaving the program due to consecutive multi-semester co-ops, internships and full-time employment with part time enrollment that are not uncommon in our student population. Internship and reduced course load resulted in several students leaving the grant program prior to graduation. Balancing between

rapid completion and internships is an ongoing challenge in our student population. While students working in positions of responsibility is generally a good problem, reporting time until graduation and program completions in S-STEM are complicated with highly successful students being reported as taking a long time to graduate and dropping out of the S-STEM cohort.

5. job placement and alumni survey

All graduates from Spring 2015 to December 2019, 78 students, were studied by a search of LinkedIn and a questionnaire. A search of LinkedIn and other public data source found 64 employed (64 / 78 = 82.0%) in industrial engineering or related jobs, 8 students (8/78 =10.3%) in graduate school, out of the labor market or in jobs outside of scope engineering, and 6 students (6/78 = 7.7%) without any publicly available data about employment status and no indication of being out of the labor market. Of the 64 with engineering related jobs, 5 students are employed in non-engineering roles, but are closely related such as information technology, technical sales, and operational roles in industrial settings.

Most of our graduate find employment in manufacturing (Table 8) based on the 72 students (72/78=92.3%) where we could locate current employment. LU is located on a major ship channel in Beaumont, Tx. with 4 major refineries adjacent to the channel and numerous supporting chemical plants and industries. Two additional ship channels (Houston, Tx and Lake Charles, La.) with refineries are with 90 miles. Our graduates in the construction industry typically have roles in project management and planning supporting the chemical industry. The oil and gas employment is typically in manufacturing plants as opposed to field work. Combining chemical, aerospace, manufacturing, construction, and oil results in 48 graduates (48/72=66.7%) working in manufacturing related areas. No recent graduates found employment in healthcare and only a small number found employment in logistics, consulting, information technology, finance, retail, and government. The other category includes not in labor force or graduate school.

Table 8. Employment by industry of 72 graduates with known employment status.

Industry	**Number**	**Percent**	**Industry**	**Number**	**Percent**
Chemical	16	22%	**Transportation**	5	7%
Aerospace	12	17%	**Finance**	4	6%
Manufacturing	9	13%	**Oil and Gas**	4	6%
Construction	7	10%	**Government and Non-Profit**	4	6%
Retail	5	7%	**Other**	6	8%

The percentage of 2+2 online students (17/78=21.5%) is significantly lower than the percent of students who enrolled for the online section of senior design because many traditional students become online due to extended co-ops, other work, leaving the area, and family considerations. Since our computer system assigns the same code to both traditional and 2+2 online students, a clear separation between the populations is not possible and developing a formal process to change between the two categories is not required since the department views the students in the same program regardless of delivery method. Of the 17 students who were clearly 2+2 online

students who never took face to face courses, 9 (9/17=52.9%) found new jobs as industrial engineers and 7 students (7/17=41.1%) continue with their current employer in the same role that was closely related to engineering such as project manager or supervisory roles in a manufacturing plant. When the LU outreach staff asked a 2+2 online student what they would be doing next, the response was "I will be getting a lot more sleep, but I will continue to work with the current company that I am working with now" [1]. The 2+2 online population can be split into students who are looking to use the degree within their current employer and students who are using the degree to change employers and industry. For students who intend to continue with their present employer, the degree is a tool for advancement.

Based on LinkedIn and other public data sources, 21 (21/72 =29.2%) students have completed or are enrolled in graduate school with 11 completed (11/72 = 15%). This percent might be low due to individuals not updating their profiles. Of the 21 identified as attending graduate school, 9 are enrolled in industrial engineering with one doctoral student, 7 in MBA programs, 3 in Master of Engineering Management, and 2 in Mechanical Engineering. Our survey data also suggests that a high percentage of students are considering attending graduate school. By having a significant percentage of course online in undergraduate, students become comfortable with online teaching and may be more likely to pursue part-time graduate degrees as part of life-long learning. Of the 21 students who went to graduate school, 12 attended graduate school at LU.

The department conducted an Alumni survey via email. Students were invited to take the survey with a single email that lead to a low response rate. While the response rate was low (15/78 = 19.2%), the finding suggest that students are generally positive about the program. Key finding were:

- 60% (9 / 15) worked full time while taking classes with 5 working full time in all semesters and 4 working full time in some semesters. This agrees with faculty observations with students that many of our students work full time.
- 71% (5 / 7) responded yes to the question that online education helped with family and dependent care responsibilities with 8 alumni responding that they were not online students.
- 80% agreed (12/15) that being in a program with online and face-to-face students prepares students to work with a geographically dispersed team with 11 agree and 1 slightly agree.
- 86% agreed (13/15) that the program has students from a diverse range of backgrounds with 11 agree and 2 slightly agree.
- To the question, "I would recommend the Lamar IE program to a friend with a background and interests like mine," 12 alumni (80%) responded yes and 3 alumni (20%) responded maybe.
- 73% (11/15) responded agree or slightly agree to the question compared to graduates from other schools, I was prepared for employment.
- 93% (14/15) have completed graduate school, in graduate school or our considering graduate school in a specific area.

The alumni survey does not indicate any issues with the program, but additional study is required due to the low response rate most likely due to using email to attract survey participants as opposed to text message or other invitation method. The high percentage of working students in our population agrees with the observations of the co-authors in this paper that a significant percentage of our students work in a wide variety of jobs while in school. The results for both the LinkedIn review and alumni survey suggest that a significant percentage of alumni are considering, pursing, or completed graduate programs. Additional study is needs to examine the link between online education in undergraduate and going to graduate school part-time in online programs while working.

6. assessment process

The department assesses ABET outcomes in multiple courses using an assessment calendar as part of our continuous improvement process. The department is ABET accredited for a single degree that has 2 delivery methods. Both the online and on campus sections are assessed using the same process. The results are pooled to determine outcome assessment and process improvement. The department monitors the performance of both student populations separately to check that both delivery methods are achieving similar results at the course level and identify program improvement that are delivery method specific. The program was re-accredited in 2019 with the online pathway being reviewed.

7. conclusion

The department experience with a 2+2 online pathway is generally positive. Faculty members have accepted online education as part of their workload. Operating a 2+2 online program at the same time as a traditional on campus program requires significant duplication of courses. The impact on enrollment appears to have been positive especially for 3rd and 4th year student enrollment. Our alumni placement is consistent with our prior experience and an alumni survey shows a generally positive response to the program. While the program is successful, the number of students attracted to the program is relatively small compared to other online programs at the university with hundreds of students enrolled each semester. Future research will need to examine the experience of multiple community colleges and universities to determine the effectiveness of 2+2 online pathway. Additional studies will also need to explore the impact on diversity of online programs. Our experience indicates that an online program can increase the diversity.

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