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The Influence of Program Concentrations on Enrollment and Placement

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Abstract

In many schools, students are able to tailor their undergraduate engineering coursework to emphasize a particular specialty field. When organized by the university, such an emphasis within the context of a major is often called an academic "concentration." Universities with a smaller array of majors in specialty engineering disciplines can employ concentrations to foster student success in a given field and attract students who are already interested in such a specialty, if it is not available as a major. Concentrations can generally be offered with relatively low cost, because the specialty coursework often comprises electives already taught in the program. Using survey and graduation data from Ohio Northern University, a small private engineering college in the Midwest, this paper examines the strength of concentrations' recruiting appeal against the cost to maintain them, the change in student interest over time, and the impact on post-graduation placement for students who complete the concentration.

Introduction

In many schools,[1,2,3] students are able to tailor their engineering coursework to emphasize a particular specialty field. When offered in a formal sense, according to a prescribed plan, such emphases are often called "concentrations." Some schools[4] refer to this as a "specialty." Typical concentrations in mechanical engineering, for instance, include robotics, aerospace, or manufacturing. Generally, such a concentration requires little or no coursework beyond the normal degree requirements for the major, only that the student select his or her electives in a particular way.

Concentrations are a way for students to prepare themselves for further studies or targeted employment in a given specialty field. They also have an impact on recruiting, as they capture the imagination of prospective students and help them envision themselves following a dream career. Smaller universities, offering a more limited number of major degree programs, can use concentrations to recruit a student who is aiming at a particular specialty field which is not offered as a major at that school. Successfully completed concentrations will be indicated on a student's transcript.

The cost of offering a concentration is generally much lower than the cost for a major degree program, because the concentration is composed mostly of courses which were already offered as electives for the major. The cost, however, is not zero. Advisors and administrators handle additional paperwork related to the program. A technical elective which supports a concentration may only be offered due to the particular specialty of one faculty member; if that faculty member leaves or takes a sabbatical, the concentration may need to be revised or an alternative substituted. When enrollment grows or other pressures limit course offerings, students may find themselves unable to complete the requirements of a concentration. There is

also the challenge of offering all of the electives, often biannually scheduled, in such a way that all upperclassmen – even across multiple departments – are able to take the electives that they need to complete the concentration. Co-op student rotations further complicate scheduling. Advisors work hard to help students complete concentrations that they have declared; both sides can be frustrated if it does not work out.

At Ohio Northern University (ONU), a small private comprehensive university in the Midwest, the authors were interested in weighing these costs against the benefits of its concentration offerings. The purpose of this study was to determine the following:

- For what proportion of students did an offered concentration make a significant impact in their choice of university?
- The strength of appeal of various concentrations in the college, and how that appeal changes over the students' time in the program.
- The difference between the number of students saying that they are pursuing a concentration and the number who officially declare that concentration.
- Any impact on job placement for those students who do complete a concentration.

Study data came from a student survey as well as historical data from the institution archive.

The table below displays the major degree programs available in the college as well as the concentrations offered for each. Students are not required to have a concentration, and most indeed do not complete one. All listed major programs have at least one concentration offering.

Major	**Concentration(s)**
Civil Engineering	Environmental
Computer Science	Robotics
Computer Engineering	Advanced Energy, Robotics
Electrical Engineering	Advanced Energy, Robotics
Mechanical Engineering	Advanced Energy, Aerospace, Biomedical Engineering, Robotics

ONU requires that concentrations must comprise at least 18 semester hours of coursework. These hours, however, are not required to be additional to the 128 hours required for the major. The mechanical engineering major curriculum, for instance, includes two math/science electives and four technical electives. Often the concentration requirements may be satisfied simply through the appropriate selection of these six courses (18 hours at 3 hrs/course).

Survey

A short survey was sent to all students enrolled in the engineering college. 540 surveys were distributed, and 334 responses received (62%). The survey asked the students to report their class year (freshman, sophomore, junior, senior) and major. Other questions on the survey:

- "Are you pursuing, or do you intend to pursue, any of the following concentrations? Check any that apply." (Followed by checkboxes and a full list of all concentrations offered for all majors.)

- "Think back to when you were choosing which college to attend. Did a concentration offered at ONU make a difference in enrolling here? (Whether or not you are now pursuing one.)
    - Definitely yes
    - Somewhat
    - A small difference
    - Not at all
- "Is there a concentration not currently offered that you would like to see?" (text box)

Results

Overall, 46% of engineering college students responding to the survey report that they are pursuing an academic concentration. Figure 1 shows the breakdown of these students by major.

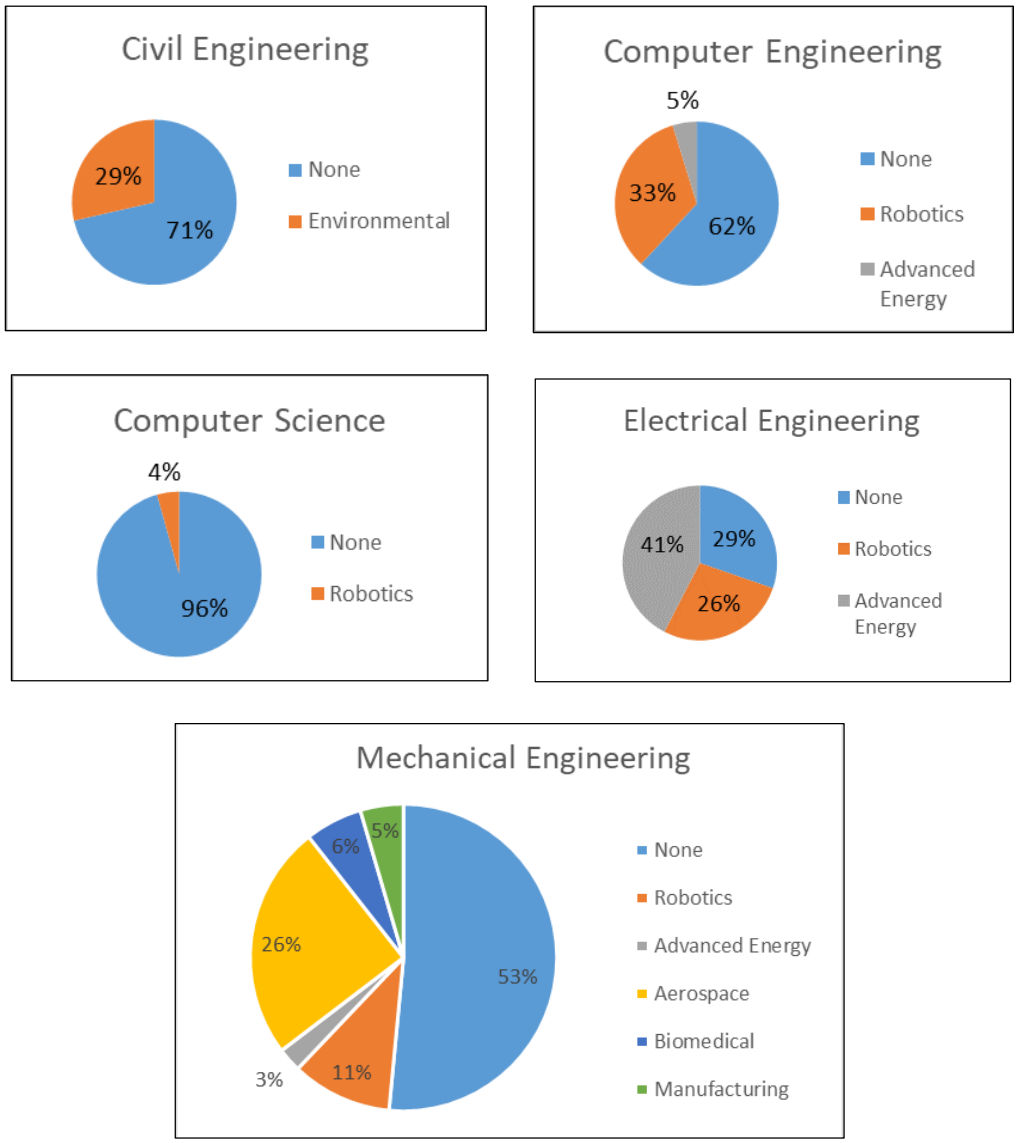

Figure 1. Students pursuing concentrations, by major

The number of students saying that they are pursuing a concentration is significantly higher than the number of students who have officially declared a concentration (14.3%). Students are not required to fill out the form declaring the concentration until their last semester, if they choose. They may take any or all of the courses required for the concentration without needing to declare it. So other than aiding their academic advisor to properly assist a student's course selection, there is little incentive to make the declaration. Indeed, many seniors who *did* earlier declare a concentration find themselves required to fill out the form again in their final year to remove a concentration that they no longer intend to complete.

Of key interest to the authors was the influence of the offered concentrations on student enrollment. As shown in Figure 2, 13% of surveyed students reported that a concentration offered at ONU "definitely" made a difference in their enrolling here. A total of 56% reported that a concentration made some measureable difference in their choice. Also of note: 11% of students say that the availability of a concentration definitely or somewhat affected their decision to enroll at Ohio Northern, but indicated that they are not pursuing it now.

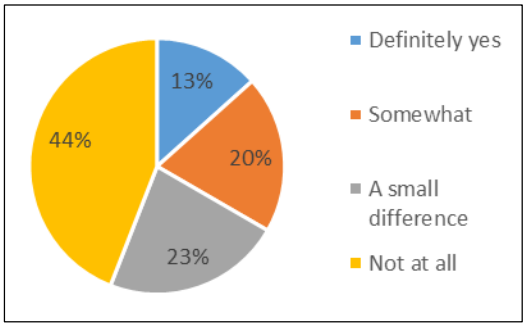

Figure 2. Influence of concentrations on engineering college enrollment at ONU

When broken down by class year, Figure 3 reveals a distinct drop-off for seniors in pursuing a concentration. (For this chart and those following, the "influenced enrollment" number includes responses of "definitely yes" and "somewhat.") Seniors' interests may have changed, another elective outside the concentration may have been more compelling than completing the concentration, or some schedule-related obstacle may have prevented its completion. The concentrations may not have lost their appeal for seniors, but they may require a greater sacrifice than the students are willing to make.

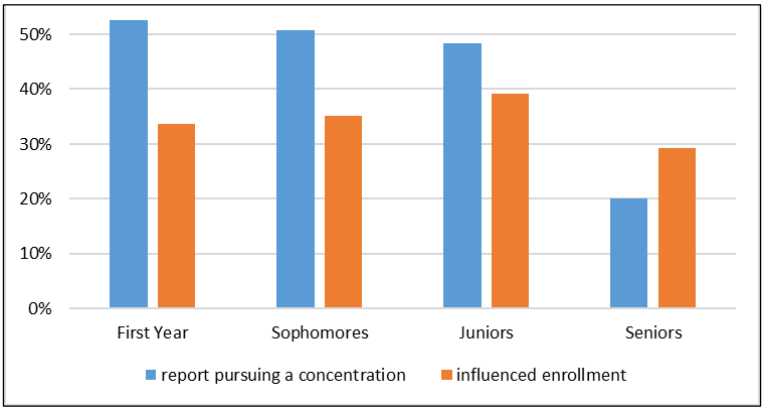

Figure 3. Concentrations by year

Figure 4 displays the concentration participation rate and influence on enrollment for the different majors offered in the college. The rightmost bars in the figure reflect the average numbers for all students in the survey. Generally speaking, higher participation rates are observed for those majors offering more concentrations (computer, electrical, and mechanical engineering). The computer-related majors report that concentrations had a lower influence on their enrollment.

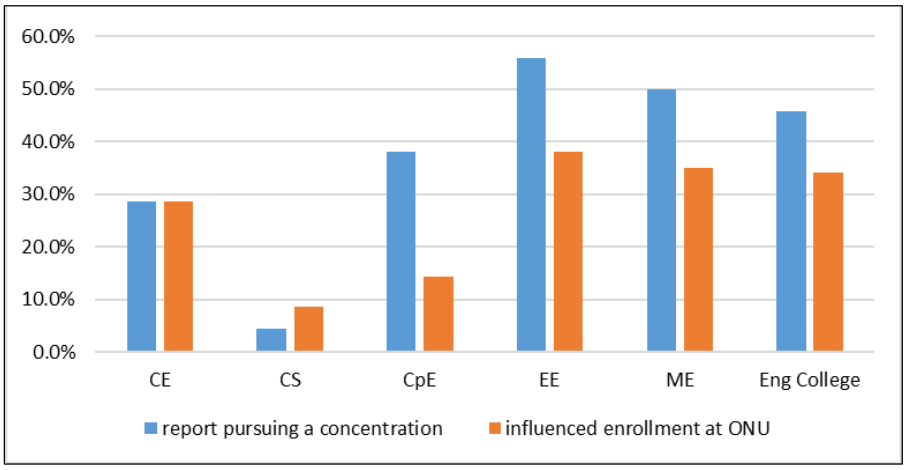

Figure 4. Concentrations by major

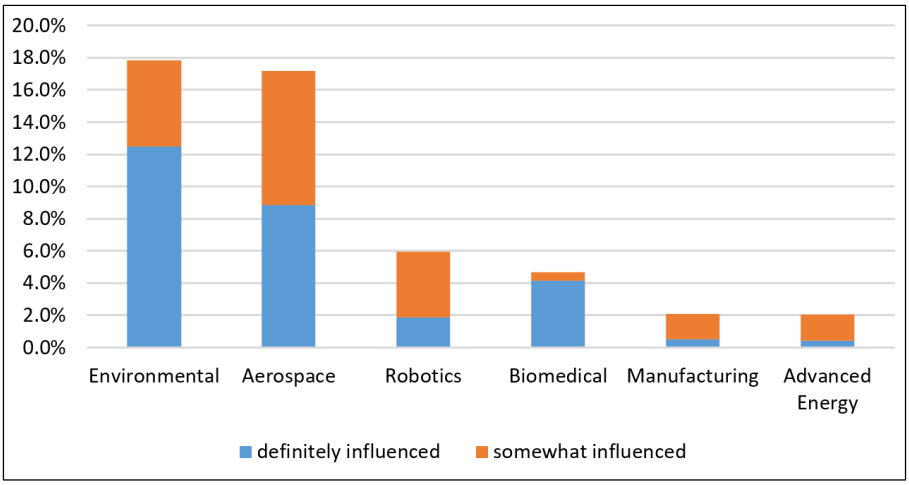

Figure 5. Influence on enrollment by concentration

Students reported that different concentrations had a very different level of influence on their enrollment, as shown in Figure 5. The percentages shown in this figure were the fraction of those students in majors eligible to pursue the concentration who were actually influenced by that offering. For instance:

- 12.5% of the civil engineering students polled (7 out of 56) reported that their enrollment was "definitely" influenced by the availability of the Environmental Concentration,
- Just under 2% of all mechanical, electrical, and computer engineers, as well as computer science students, were "definitely" influenced by the Robotics Concentration.

As previously described, the Environmental Concentration is the only offering for civil engineering students, and it is only offered for those students. There is an apparent disparity, then, between the 28.6% of CE students who report having their enrollment at ONU definitely or somewhat influenced by the offering of a concentration, but only 18% of those pursuing the Environmental Concentration saying the same. The difference is explained by the number of students who are not pursuing a concentration but stated that their initial enrollment was influenced by one. Those students could have changed major, dropped the concentration, or been originally attracted by a concentration in a different major that they did not realize was not an option for them.

Aerospace engineering has a strong appeal for many mechanical engineers, the only students eligible for this concentration. Biomedical engineering is being pursued by only 12 of 192 mechanical engineering students responding (6.3%), but for 8 of these students, this concentration definitely influenced their enrollment.

Adding the Manufacturing Concentration to the survey was actually an experiment to gauge its appeal; this offering had not yet been approved by the university and it appears in none of the promotional materials. Nonetheless, 10 students report that they are pursuing it and 4 named it as having influenced their enrollment. By contrast, the Advanced Energy Concentration is the oldest concentration in the college (2011), but only 15 survey respondents across three majors (6% of the 247 surveyed in those majors) are pursuing it. Part of the challenge for the latter concentration may be that it requires students to take some core elective courses outside their discipline (e.g. an electric machines course for MEs, and Thermodynamics for the EEs).

Student requests

The variety of possible concentrations is quite large. The mechanical engineering program at Michigan State, for instance, lists nine concentrations available to undergrads, including such topics as Computational Design, Cryogenics, and Global Engineering.[1] Programs with smaller faculty numbers are typically limited in the number of concentrations they can offer, and must limit offerings to those which will have the broadest appeal and/or most compelling societal need, while aligning with faculty interest and expertise.

When asked which concentrations that ONU students would like to see that are not currently offered, they responded as shown in Figure 6. Automotive (10% of respondents) and structural (4.7%) engineering options were by far the most frequently cited. Several students simply expressed a desire for more options available to civil engineering majors, who currently only have one choice.

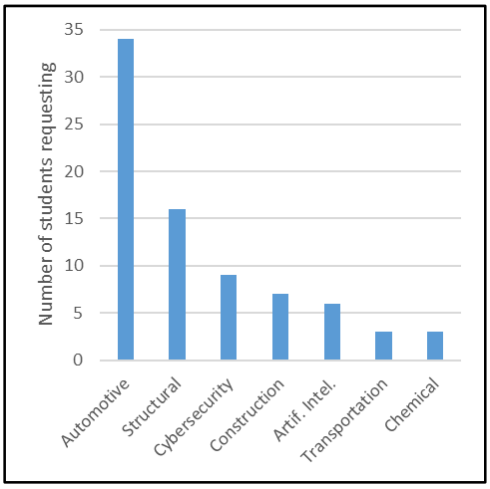

Figure 6. Other concentrations requested by students

Concentrations vs. Placement

Also of interest is whether a student's completed concentration had any connection to their placement in the first position after graduation. Data here is more limited, as it is difficult to ascertain the job duties or focus of graduate studies from institutional placement records.

Placement records were reviewed for the engineering and computer science classes of 2018-2020, comprising 269 total graduates. Of these students, 36 (13%) completed a concentration. Between 94-97% of all graduates in each of these three classes were placed within six months of graduation, so it would be difficult to distinguish any statistically significant difference in placement rates between those with and without a concentration.

For those students who completed concentrations, where the nature of the placement is known (for 32 of 36 students), 50% were placed into positions related to their concentration.

Furthermore, some interesting observations are apparent when looking at the ME graduates in these three years. The sample size is not large, of course, and these trends did not extend to graduates in the other majors. But the number of different concentrations available to ME students may be somewhat responsible for these differences.

- 62% of ME graduates were placed into positions related to their concentration.
- 38% (5) of the ME graduates went to graduate school directly after graduation, compared to only 9% of all ME graduates for those three years. All five of these are included in those listed above whose placement relates to their concentration.
- 31% graduated in the honors program, compared to 8% of all ME graduates for those three years.

The last two bullets suggest a relationship between concentration completion and interest (or perhaps aptitude) in academic endeavors. It suggests that, though many students choose to pursue a concentration within their major out of professional interest, those who are more likely to make the sacrifices necessary to complete the concentrations are the students with a stronger academic focus, or a clear goal to continue their studies.

Conclusions

All engineering college undergraduates at Ohio Northern University were surveyed regarding their interest in academic program concentrations. Sixty-two percent responded to this survey, lending a reasonable degree of credibility to the resulting data and conclusions drawn from it. Forty-six percent of students say that they are pursuing a concentration, although only 14.3% of them have one currently listed on their official record.

Thirty-four percent of all survey respondents, proportionally representing 194 students in the college, reported that a concentration played a significant role in their decision to attend Ohio Northern University. The availability of concentrations had highest impact on enrollment for electrical, mechanical, and civil engineering students. Concentrations do come with a cost, in terms of scheduling difficulty and providing the electives, but the positive impact on enrollment and ability to pursue employment or continued studies appears to represent a much larger financial impact than the cost.

All concentrations, however, do not have the same impact. Concentrations in aerospace and environmental engineering have drawn a significant number of students to ONU. But the Advanced Energy Concentration, at least in its current form, seems to have low appeal for the large number of students who could take it. Energy is, of course, a very relevant topic for the age and employs a sizeable number of engineers (even in the local region), but student interest is more swayed by other specialties. By contrast, the survey appears to support the implementation of concentrations in the manufacturing, automotive, and structural fields.

Finally, placement data for the past three years suggests that half of the students completing a concentration are placed into positions related to their concentration field. From the examination of mechanical engineering graduates, those completing the concentration are more likely to be academic-focused students – honors students or those heading to technical graduate studies – than those simply pursuing a particular professional interest.

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