

Why Did Students Select a New Engineering Education Degree Program? Round Two

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Ohio Northern University has introduced a Bachelor of Science degree with a major in Engineering Education. This degree provides graduates with a foundation in engineering, mathematics and education, qualifying the graduate for licensure as a secondary math teacher in the state of Ohio. The degree is similar to a General Engineering degree seen in some other Universities, expanding potential career opportunities to general engineering (sales, training, etc.) and unique opportunities in venues such as Science and Technology museums.

The degree program had an initial cohort of four students and has grown to twelve in its second year. This paper will present the results of a qualitative study of two cohorts of students discussing why these students selected this major over a more traditional engineering or education track. Each student will answer a series of open ended questions and present a narrative discussing how they selected this major and if they feel the program is meeting their expectations thus far. The narratives will be culled for common or unique themes. The group of students will then be asked to discuss the individual themes in a focus group.

This paper will be of interest to any institution considering adopting a new, pioneering degree program.

Background:

Ohio Northern University introduced a new Bachelor of Science program in Engineering Education in 2011. Graduates of the program earn a B.S. degree in Engineering and meet the requirements to obtain licensure as an AYA (Adult and Young Adolescent) Mathematics Teacher. The engineering plan of study is similar to a General or Interdisciplinary Engineering degree offered at a few universities. An initial cohort of four students began in fall 2011, with a new cohort of six in 2012. Additionally, two students transferred into the program.^{1,2,3}

One recurring question is: Why would a student choose this major when a typical, discipline-specific major would offer, on average, a much higher salary than a secondary school teacher? Clearly, students who select engineering as their field of study motivated by potential financial gain would tend to be attracted to other, more typical disciplines within engineering. Students who might have selected a more typical major within education may seek a degree from within education for the ability to practice engineering as well as teach.

Motivation to study Engineering:

The Center for Advancement of Engineering Education (CAEE) ⁴ reports that students were motivated to study engineering by (in order):

1. Intrinsic (psychological) factors
2. Intrinsic (behavioral) factors
3. Social good
4. Financial
5. Influence of mentors
6. Influence of parents

Further, students who were motivated to study engineering for their own intrinsic reward were more likely to persist. These findings are supported by research from Purdue University: studies have shown that including affective characteristics (for example, motivation and student self-perception of leadership ability) lead to a more effective prediction of student success (retention into the second year of study) than models using only cognitive variables (GPA, number of semesters of math, etc.) ^{5,6} An additional study from an American Society for Engineering Education (ASEE) committee ⁷ emphasized the importance of student motivation toward their success and is strongly linked to self-efficacy, the belief that the individual student can succeed at a specific task. ^{8,9,10}

These findings indicate that students who may be more driven toward engineering for intrinsic factors and/or the desire ‘to do good for society’ often select engineering for a field of study; that desire for future financial gain is not the primary motive of many students entering engineering.

This paper will explore the first two cohorts of students’ answers to explain:

1. Why did students select this major?
2. Were there any common factors prior to college that emerge?
3. Where do these students view themselves in five years?

Methodology:

The initial cohort of four students who entered in 2011 was emailed a series of open ended questions. The second cohort of six students was offered the same opportunity to respond to the series of questions including:

1. What did you plan to study in college (maybe since your junior year in high school)?
2. Why did you choose Engineering Education?
 - a. Were there any influences (parents, etc.)?
 - b. Would you say you selected this because it was brand new and unique, or because it matched your interests (or both)?
3. Why should someone select this major? Any reasons they should not?
4. Why should someone select a major that is unique / new?
5. How is it going so far? Is it meeting your expectations?
6. Where do you see yourself in 5 years?

The intent of the questions was to glean characteristics of the students who selected this major and begin to identify factors that may have had an influence on their selection of this major. Answers were read and “chunked” for similar concepts, and interesting quotes were pulled. Three of the four students from the initial cohort and two of the six from the second cohort participated.

Results:

Plans prior to college and influences:

Each of the students said that they specifically had planned to major in engineering while in high school, although one was more interested in teaching in some capacity. One said that he repeatedly heard the message that, because he was good at math and science, “I should be an engineer.” As this is a common message in K-12, it certainly may have been true for the other students as well, even though it wasn’t expressly mentioned. Two specifically cited designing with Legos and K’nex building toys as kids and developing an interest toward design from the experience.

Each of the respondents said that they had an interest in teaching or working with children in some aspect, and each student cited their parents for influencing them toward engineering. The two students in the new cohort both said that they chose this program after discovering the possibility of an Engineering Education degree in four years.

One student in the first cohort said:

“The thought of becoming a teacher and coach was always lingering in the back of my mind as I was deciding what to do for the rest of my life. But, my parents (who are both teachers), kept deterring me away from this idea and urged on my other interest of engineering.”

A student entering with the second cohort said:

“I had always enjoyed the idea of being a teacher, but I was unsure which subject I would end up getting a license for. My Calculus teacher served as one of my biggest influences for wanting to teach math, and my parents were receptive to that goal. This surge of inspiration didn’t hit until after I had toured colleges for engineering. Once I heard about the new program, it seemed like the perfect combination of my interests that I just couldn’t ignore.”

While the sample size is too small to draw a general conclusion, the students who participated each cited an interest in teaching and/or engineering and had parental influence toward engineering.

Selection of a unique major:

Each student said that they selected Engineering Education because it bridged the gap or brought their two interests together. Further, each student said that the fact that the major was new and unique had no influence in their decision; in fact, two specifically advised students not to choose a unique major simply because it was unique. The strength of the degree program with foundations soundly in both areas seems to be an important factor – more than simply the novelty of a new, unique or innovative degree program. Again, while the sample size is small, it is rewarding to see students reporting that they selected the major on its merits rather than its novelty.

On the subject of the selection of his program of study, one student said:

I was torn between engineering and teaching, and [the recruiter] told me about this new program that ONU was trying to get started called ‘Engineering Education,’ and the very next day I set up a tour of the school... When the tour had been over, I knew this was perfect for me, and I didn’t even apply to another school (not even [the original university selected]). After choosing to go here, participating in the STEM day at Washington Intermediate School in Piqua, OH made me certain of my choice. I could see myself teaching those same things every day of my life, and love every minute of it... Although it is very exciting that I am in a brand new program, it had no influence on my overall choice; it just made it a stroke of luck to find it. I am solely in this because it is THE perfect fit for me.

One student discusses the advantages of being one of the first in an innovative major:

“So far after my first semester, I got to participate in a STEM field day at an Elementary School, was on the front page of the University website and authored a paper about my major, was asked and interviewed on Television about a scholarship I received and what Engineering Education is, and I am co-authoring this paper. The professors really care about you and go out of their way to make these the best four years of your lives and who wouldn’t want that. We only started with four students in this major and it is growing bigger and bigger each year. Now we are up to about 10 and are planning on getting larger and showing the world what we can do.”

What will you do in five years?

None of the students had a specific plan; not surprising, given that they were first-semester students at the time of the survey. Four students mentioned the possibility of pursuit of a Master’s Degree on their way to a Ph.D., and two discussed their goal to enter academia. Three mentioned a strong possibility of teaching in the K-12 environment. Two mentioned working as an engineer; it may be significant that this was not the first option mentioned either time.

One student’s summation was typical of conversations we have had this year:

“Where and what type of employment this might be is still unclear do to the foggy career options that this major entails.”

Regarding graduate school, one student said:

“In five years, I see myself being a graduate of ONU and in graduate school somewhere getting a Master’s degree in Engineering Education. Getting this will help me find a job easier, as well as educate me more so that in the long run I will be ready for whatever comes at me.”

Another said:

“I wasn’t expecting graduate schools to take such interest in the Engineering Education program and the students. So far, everything I’ve experienced has exceeded my expectations.”

One of the advantages of introducing this major in a small, teaching-oriented University is the personal interaction with each cohort of student. The director of the program is able to discuss plans and interests of the students as they progress toward their degree. Although it is still early in the program, the director would estimate that about half of the students currently in the program show a strong interest in attending graduate school.

Developing Answers to Research Questions:

1. Why did students select this major?

Students cited this major as a combination of two existing interests, engineering and teaching or working with children in some aspect. The two students in the second cohort both discussed the realization of this program as the perfect opportunity to study in both worlds.

2. Were there any common factors prior to college that emerge?

Each student was encouraged to pursue engineering from their parents; in one case, the guidance counselor was also mentioned. Each student described a desire to teach or work with children, an idea that wasn't necessarily always supported by parents. Each described being positively influenced by campus visits and institutional representatives and/or the nature of the program itself.

3. Where do these students view themselves in five years?

Given the small sample size, the new degree program and that the students have only completed one semester of college, a fuzzy picture of the future isn't necessarily a surprise. Graduate school, teaching in the K-12 environment and employment as an engineer were each mentioned by three students. This makes sense as graduate school is a frequent topic of conversation with this small group of students. As the students continue through the program and discover other potential opportunities including careers in policy, educational entrepreneurship, alternate graduate school options, etc., their focus may certainly change or solidify toward one of the options listed.

Conclusions and Implications:

Students who formed the initial two cohorts of a brand new plan of study in Engineering Education had some similar and useful experiences and paths toward their selection of majors. The responses from the students were largely as expected as the degree program was developed. We expected interest from students who had interests in engineering and teaching, students who were interested in a general engineering degree rather than a specific degree program and those who would seek an innovative, cutting-edge new major. The results affirmed our expectations with the exception of students seeking the degree primarily for its unique nature. Currently, the program is seeing a steady increase in interest and new students as we prepare for the first graduate.

Each respondent had interest in both areas prior to college, and found the major fit their interests rather than constructing a new vision based on the uniqueness of the major itself. This can be an important finding for universities planning innovative degree programs. It may be important to establish an interest in the program based on its merits rather than simply for its novelty.

When a program is in its infancy, the responses indicated that support is important. These students have a built-in support system and the degree does allow them to have some unique experiences through their study. Offering adequate support toward their success is important.

Finally, the vision for the future is a combination of working as a practicing engineer, a K-12 teacher and/or graduate school. The outlook from these students seems to be no more uncertain than a student in a typical engineering discipline; it may be similar to asking a first-year electrical engineering student if he/she prefers controls, microprocessors or analog design in four years.

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Biographical Information

Dr. Kenneth Reid is the Director of First-Year Engineering, Director of Engineering Education and an Associate Professor in Electrical and Computer Engineering and Computer Science at Ohio Northern University. He was the seventh person in the U.S. to receive a Ph.D. in Engineering Education from Purdue University. He is active in engineering within K-12, serving on the JETS and TSA Boards of Directors and 10 years on the IEEE-USA Precollege Education Committee. He was named the Herbert F. Alter Chair of Engineering in 2010. His research interests include success in first-year engineering, introducing entrepreneurship into engineering and engineering in K-12.

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