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WIP: Identifying the Pre-college Engineering Experiences of our First-Year Engineering Students

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Dr. O'Connell is an associate teaching professor in the First-Year Engineering program at Northeastern University. He studied at the University of Massachusetts at Amherst in 2006 then worked in industry as a Mechanical Engineer working on ruggedized submarine optronic systems. He returned to academia in 2011 at Tufts University planning to work towards more advanced R&D but fell for engineering education and educational technologies. His research now focuses on developing engineering technologies and learning environments, specifically makerspaces, to support engineering education at many levels. He's also heavily involved with his local FIRST Robotics Challenge team as a mentor.

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Abstract

This Work-in-Progress seeks to begin filling a gap in our understanding of our first-year engineering students' pre-college experiences. Initiatives such as the Next Generation Science Standards (NGSS) aim to enhance STEM learning [1], The majority of states in the United States include engineering skills within their education standards [2], and engineering-themed extracurricular programs are growing in availability [3]. Despite this, ill-defined disparities persist in access to pre-college engineering opportunities. Pre-college engineering exposure remains unclear, requiring first-year programs to assume limited prior experience simply.

This paper describes a pilot study involving the implementation of a survey to promulgate a better understanding of high school engineering education opportunities. The survey response was 8.8% out of the 650 students contacted, but respondents were comparable with the known demographics of the first-year engineering population. Preliminary findings from this small-scale study indicate that while 96% of respondents reported access to engineering courses, only 47% enrolled. Similarly, 72% had access to engineering-focused extracurricular activities, but only 39% participated. Familiarity with programming tools was widespread across respondents, while access to CAD tools and engineering platforms varied significantly, particularly for those without formal curricular exposure. Future iterations will expand survey distribution through collaboration with other institutions. Those partnerships will be key to reaching a broader and more widespread population to understand better the general experience level of our incoming First-Year Engineering students.

Introduction

High school engineering exposure plays a crucial role in shaping students' STEM understanding and career pathways. The Next Generation Science Standards (NGSS) framework encourages K–12 educators to integrate engineering concepts alongside scientific practices by incorporating model development, problem-based investigations, and iterative design processes [1, 4, 5]. At least 41 states have adopted engineering knowledge and skills into their educational standards. While Carr et al. [2] provided a baseline for engineering's inclusion in K–12 standards, the implementation and impact on student learning remain underexplored. The degree to which instructional approaches are consistently applied across different school systems is unknown, as engineering integration varies widely between districts and states.

Without such established baseline experiences, institutions often assume that most incoming first-year engineering students have minimal or no experience with engineering topics. However, the increasing availability of accessible programming languages, CAD software, and extracurricular initiatives suggests shifts in this landscape. Unlike AP Computer Science, which provides a structured national framework for programming education, engineering-related courses lack similar widespread adoption mechanisms, leading to inconsistent offerings across schools. Given that no comprehensive update to Carr et al. focused on implementation and availability is currently available, this study seeks to begin filling that gap by pursuing a current

snapshot of pre-college engineering exposure by assessing the experiences of first-year engineering students at Northeastern University.

This study evaluates the availability and impact of pre-college engineering education opportunities, focusing on students' familiarity with tools and concepts. A pilot survey distributed to all Northeastern University first-year engineering students collected data on high school courses, extracurricular activities, and self-reported familiarity and proficiency with engineering tools. By examining trends across high school types and geographic regions, the study highlights disparities in access and informs future curriculum development.

Background and Related Work

Efforts to integrate engineering concepts into K-12 education have expanded significantly in recent decades. Structured programs like FIRST Robotics (available to ~10% of U.S. high schools) and Project Lead the Way provide opportunities, though access remains uneven [3]. AP Computer Science courses illustrate a similar trend, with increasing enrollment demonstrating interest in programming, though access disparities still persist, particularly in underserved communities [6].

The NGSS emphasizes hands-on learning and integrating engineering practices to engage students and make STEM subjects more career-relevant [1]. However, the availability of specific courses, such as those in CAD or programming, varies widely across states and school types. Early exposure to engineering activities correlates with higher rates of pursuing engineering majors in college. Yet, many students rely on localized workshops or clubs, often constrained by geographic, financial, or institutional barriers [1, 3].

Despite progress in expanding engineering education, gaps remain in understanding the extent and nature of these opportunities. Comprehensive national data on high school offerings in engineering-specific areas is notably absent, underscoring the need for studies like this to inform curriculum and policy decisions.

Survey Design and Methodology

The survey design looks at the availability and impact of pre-college engineering education opportunities. It evaluates the prevalence of high school engineering courses and extracurricular activities and assesses students' self-reported familiarity with and proficiency in a variety of engineering design tools. The detailed demographic information also collected serves to contextualize findings, including high school type, geographic location, and socioeconomic factors, and identify disparities in access to engineering education opportunities across different populations and regions.

The survey targeted 650 first-year engineering students at Northeastern University in the fall of 2024. These students were enrolled in introductory engineering courses, providing a relevant population for assessing pre-college engineering experiences. The study aimed to capture a snapshot of the first-year engineering cohort's prior exposure to engineering concepts and design tools.

Survey Instrument

A copy of the survey, as exported from Qualtrics, is available in Appendix B. Survey logic, coded values, and HTML logic have been stripped for brevity.

The survey design incorporated demographic data collection methodologies established in prior engineering education studies, particularly those outlined by Fernandez et al. [7], to ensure a comprehensive and representative dataset that allows for meaningful subgroup analysis. Participants also provided information about their high school type and geographic location, as these factors were assumed to influence both curricular and extracurricular engineering opportunities.

The survey covered the availability of engineering-related course topics, specifically programming, CAD, and design. It distinguished between courses known to be available and those the respondents participated in. It made similar inquiries about community-based extracurricular activities involving engineering topics. The survey also sought self-reported familiarity with and proficiency in engineering tools, CAD software, and programming languages. Open-ended follow-up prompts for all sections allowed students to elaborate on their experiences and provide qualitative insights into their skill levels and learning contexts.

The survey utilized an adaptive design to streamline data collection while minimizing participant burden. Participants only answered follow-up questions if their prior responses indicated experience with a particular engineering topic or tool, allowing for a more efficient and customized survey experience. The survey was estimated to take 10–20 minutes to complete, balancing comprehensiveness with practicality. 79% finished the survey in under 30 minutes, averaging 10.6 minutes and a standard deviation of 6.6 minutes.

Survey invitations were distributed via LMS announcements for all First-Year Engineering Program courses as Northeastern University to maximize reach to target demographic of first-year engineering students. Before the survey began, participants were assured anonymity, and informed consent was obtained. Measures were taken to ensure data security, including restricted access to the dataset and de-identification of sensitive information before analysis. While participation was voluntary, some instructors opted to provide extra credit incentives, which may have influenced response rates.

Analysis

Survey Selection Data was analyzed to identify trends in curricular and extracurricular engineering opportunities and experience with engineering design tools. Descriptive statistics were calculated for key metrics (e.g., duration of survey completion, percent reporting of courses available, and number of tools reported as familiar or proficient). Additionally, cross-tabulations were used to explore relationships between demographic variables and reported experiences.

While the survey included open-ended questions intended to provide qualitative insights, this pilot study's analysis focuses on the discrete data due to time constraints and the preliminary nature of the findings. Qualitative analysis remains a future goal for subsequent iterations of the

study. Future efforts will categorize themes from open-ended responses to better understand barriers to access, types of engineering opportunities, and personal motivations for engagement.

Limitations

As an unfunded and limited pilot study, the survey faced several limitations regarding response rate, self-reported data, and limited scope. The low response rate (8.8%) may introduce self-selection bias, a critical issue in social research, as highlighted by Collier, Mahoney, and Seawright [8]. The authors caution against overgeneralizing findings from non-random samples, noting that such biases can distort causal inferences and broader applicability. However, research indicates that response rate alone is not always a determinant of data quality. Keeter et al., Fosnacht et al., and Wu et al. [9-11] found that lower response rate results often align with results from broader populations, particularly when distributions reflect known demographics, the sample is sufficiently diverse, and of sufficient size (500+) particularly in educational research.

In this study, the public vs. private school distribution of respondents closely aligns with national figures, and the demographics generally align with those of Northeastern University, suggesting that the dataset may still be informative for pilot purposes despite its small size. In recognition of these concerns, the findings presented are not intended to represent all first-year engineering students but to serve as an exploratory effort to generate hypotheses and refine methodology for future studies. Trends observed are primarily meant to inform local curriculum development and identify areas for expanded investigation.

Self-reported data and limited scope do remain concerns. The reliance on self-reported familiarity and proficiency could result in over- or underestimation of actual skills. Findings are based on a single institution and may not be generalizable to other settings. Future survey iterations will address these limitations by improving distribution strategies, offering incentives to increase participation, and expanding the study to include multiple institutions.

Preliminary Findings

With the given limitations in mind, this study does not claim generalizability but provides preliminary insights into trends in pre-college engineering exposure. The findings should be interpreted as exploratory, serving as a basis for refining methodology and expanding future data collection.

Demographics

The following demographic data points and findings were directly utilized in this initial analysis of disparities and trends in engineering education opportunities from this small pilot dataset, fully acknowledging its limitations and recognizing its role as an initial step toward refining the methodology and informing future, larger-scale studies. Gender, race/ethnicity, and socioeconomic background have not been considered in this initial analysis. The respondent breakdown of 42% female is within a few percent (46%) of Northeastern University reported enrollment [12]. The race/ethnicity data is not readily available for just first-year college of

engineering students, but the 40% of students identifying as white aligns with Northeastern Unviersity's reported numbers. Other ethnicities are more broadly represented in this study, but the survey did allow for more nuanced reporting of multi-racial ethnicities compared to the available report [13]. For further contextual background, see Appendix A for common demographic data collected but not utilized in this initial analysis.

Participants reported attending a variety of high school types, with 77% attending a form of public school, 13% attending a traditional private institution, and 10% attending a less common ('Other') school type which included charter, home/online, non-responses, etc. These proportions align with national statistics, where approximately 83% of U.S. students attend public schools, and 8-9% attend private schools [14]. While this does not confirm full representativeness, it suggests that the survey sample distribution is not significantly skewed regarding public vs. private school attendance.

Engineering Education Opportunities

Respondents reported their awareness of engineering topic-related courses available in their high school and which courses they participated in (See Fig. 1 on the following page). Columns are separated by Engineering Design (ED), Programming/Coding (PC), Computer-Aided Design (CAD), and Any. "Any" refers to any engineering topic-related courses, so the first three are counted within the "Any" category, indicating that multiple options are available. Columns marked "-A" indicate a curricular option was available, and "-P" indicates the respondent participated. Respondents reported their awareness of engineering topic-related extracurricular opportunities available in their community, as well as in the activities in which they took part (See Fig. 2).

Within this sample, Public schools accounted for most available curricular opportunities and participation, albeit most respondents attended a public option. While programming courses were widely available, the availability of Engineering Design and CAD courses were substantially lower, possibly due to a lack of standardized curricula offerings in these areas. Unlike AP Computer Science, which provides a structured national framework for programming education, engineering and CAD courses lack similar national frameworks, resulting in highly variable availability across schools. With regards to participation, PC courses had less relative participation by this cohort (39.2%) than the other topics (ED at 56.1% and CAD at 77.2%).

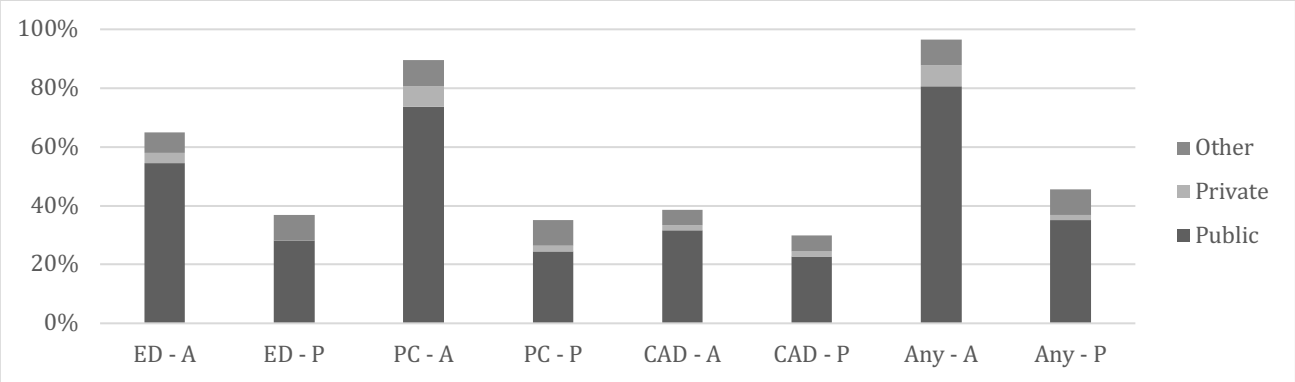

Fig. 1: Curricular Engineering Opportunities as % of Total Respondents by HS Type

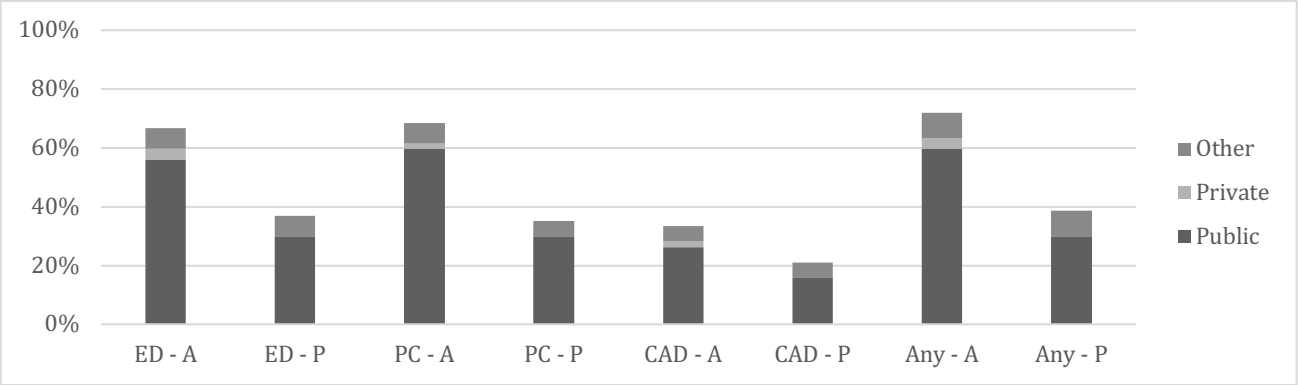

Fig. 2: Extracurricular Engineering Opportunities as % of Total Respondents by HS Type

Public schools accounted for the majority of both availability and participation in extracurricular activities as well, with the same caveat of their overrepresentation in the sample. Among the respondents in this study, private and other high schools had limited involvement. This aligns with an assumption of some relation between the formal curricular offerings and the available extracurriculars. Also, similar to curricular activities, programming, and coding activities were the most commonly available. Participation in CAD-related extracurriculars was the lowest but highest as a percentage of participants (63.1%) where it was available (vs. ED at 55.3% and PC at 51.3%). However, a larger sample would be needed to confirm if this trend holds more broadly and before any determinate factors could be identified regarding potential gaps in interest, access, or both

Engineering Tool Familiarity

Respondents were asked about several engineering design tools associated with engineering topics. These are broken down by the percentage of total respondents and then limited to those with curricular experience through taking a relevant engineering topics course. Results are binned into categories of Widely Used, Moderate Use, and Rarely Used based on their general popularity to simplify reporting (See Table 1 for specific tools and their bins). The data is presented by comparing the familiarity with design tools of the entire population to those who took a course on the topic, therefore having curricular experience (See Fig. 3) and comparing their reported proficiency in the design tools (See Fig. 4).

Familiarity with the various engineering design platforms, CAD software, and programming languages did not vary significantly between the respondents in general and those who had taken a course on the topic. Familiarity with the more widely used engineering design platforms (79% to 90%) and CAD software (76% to 83%) showed some variation within this pilot sample, but other comparisons remained within a few percent. Not surprisingly, those who participated in an

Table 1: Engineering Design Tools Binned By General Popularity

CATEGORY	WIDELY USED	MODERATE USE	RARELY USED
ENGINEERING PLATFORMS	Arduino, Raspberry Pi, LEGO Mindstorm	VEX Robotics, Makeblock, SPhero	EVO, Petoi
CAD SOFTWARE	Solidworks, AutoDesk Inventor, AutoCAD	OnShape, Fusion 360, TinkerCAD	Solid Edge, ProEngineer
PROGRAMMING LANGUAGES	Python, Java, C/C++, JavaScript	Scratch, MATLAB, SQL	Ruby, Swift, PHP/HTML, LABVIEW

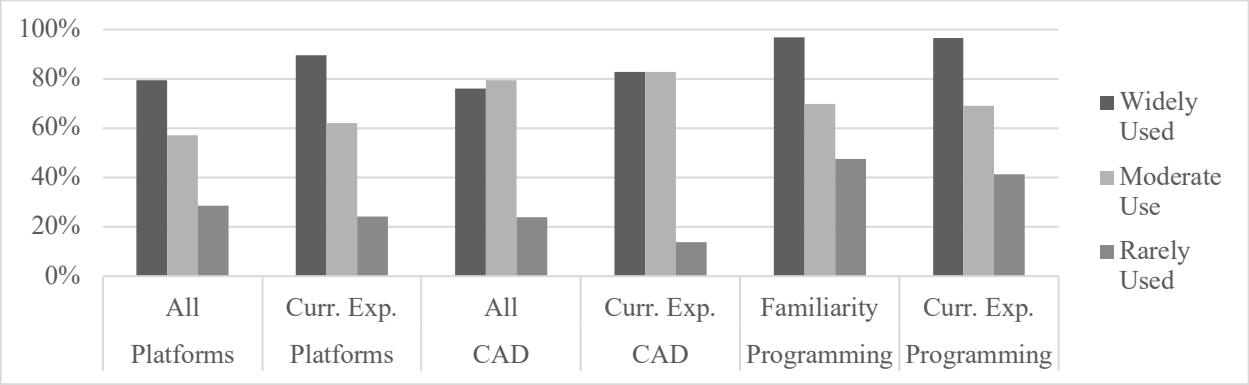

Fig. 3: Familiarity - % of Total Respondents vs those with Curricular Experience

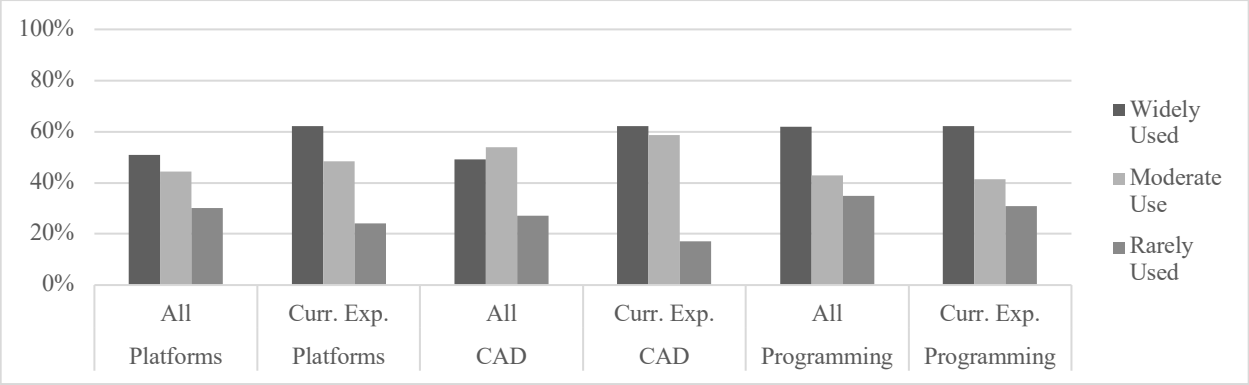

Fig. 4: Proficiency - % of Total Respondents vs those with Curricular Experience

engineering design or CAD-focused course did report higher proficiencies in the more widely and moderately used options. In all categories, the general respondents had a higher familiarity and proficiency with the rarely used options than those with curricular experience, possibly indicating personal exploration leads to discovering a wider range of options. Of note is that, for programming, having curricular experience provided no significant variation in familiarity or proficiency than for those who did not have such formal opportunities.

Conclusion

This pilot study offers an initial examination of pre-college engineering education opportunities and their influence on first-year engineering students. While based on a limited sample (8.8% response rate), these findings highlight key trends that warrant further exploration. Notably, respondent demographics were similar to those of the broader first-year engineering population, supporting preliminary validity. Additional data is needed to confirm whether these findings hold across a wider population.

Despite the study's limitations, responses indicate the growing availability of pre-college engineering opportunities, though access remains uneven. In particular, private institutions reported lower participation, and gaps in exposure to Engineering Design and CAD courses suggest these areas may require more attention, especially given the low number of respondents who reported coursework in these subjects. Preliminary findings suggest that in this sample, many students developed programming proficiency outside formal coursework, reporting

familiarity and skill levels comparable to those with curricular exposure. This underscores the importance of informal learning pathways, such as self-study, online platforms, and extracurricular activities, in shaping engineering preparedness. While many engineering tools showed high levels of familiarity among respondents, proficiency levels suggest a need for more hands-on and advanced training before their consideration as prior experience in the FY curriculum. Extracurricular participation appears to supplement gaps in formal coursework, with students who engaged in engineering-related clubs or competitions demonstrating higher self-reported proficiency in CAD and engineering design software. Future research should explore the extent to which informal learning environments, such as online resources, project-based clubs, and summer programs, compensate for gaps in school-based engineering education and how they shape student preparedness for first-year engineering coursework.

Limitations of this pilot study, including its small sample size and focus on a single institution, constrain the generalizability of these findings. Nevertheless, the trends observed provide a foundation for refining survey methodologies and identifying key areas for intervention, such as expanding CAD and design opportunities and ensuring equitable access across high school types.

Next Steps

Collaboration across institutions is essential to building a comprehensive understanding of pre-college engineering education. The upcoming ASEE conference will serve as a key venue for gathering input from the engineering education community to refine the survey design and methodology. Future iterations will incorporate insights from conference discussions to improve question clarity, recruitment strategies, and survey distribution methods. Moving forward, expanding response rates and ensuring broader institutional representation will be a priority. In anticipation of a larger dataset, the next iteration will consider AI tools in its survey design. As the dataset grows, future iterations will focus on strengthening collaboration and improving efficiency in data analysis. AI-driven survey enhancements will be explored to refine question adaptability, improve response pattern analysis, and enhance data processing efficiency, ensuring higher-quality insights for future iterations [15-17].

By involving additional universities of various types and from multiple regions, future iterations may broaden the respondent pool for a more representative sample, examine regional and demographic disparities in greater detail, and explore correlations between pre-college exposure and first-year engineering performance. Collaborating institutions will gain access to shared datasets, enabling tailored curricular improvements and contributing to a broader understanding of K–12 engineering education. While these findings are preliminary, broader collaboration and expanded recruitment will be essential to validating these trends. Future research will address current limitations by refining methodologies and increasing the study's scope. Through continued collaboration, we can expand access to pre-college engineering education, better prepare students for first-year coursework, and inform future curricular improvements that benefit all learners.

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Appendix A: Contextual Background

The following demographic data provides additional context for understanding the participant population but was not directly factored into the analysis. While not currently analyzed in detail, these insights could offer valuable perspectives and inform future studies as the dataset grows and more in-depth examinations are conducted.

Gender Identity

The pilot survey revealed a balanced representation of gender identities among respondents:

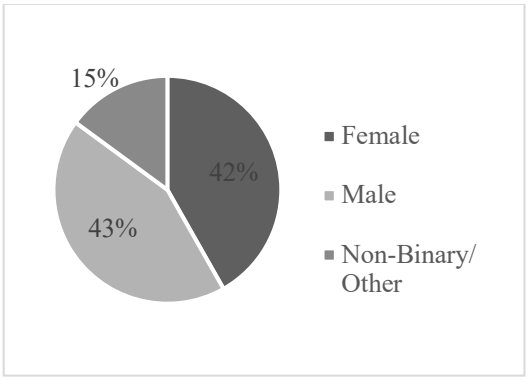

Fig. 5: Gender Identity of Respondents

Ethnicity

Respondents were allowed to select multiple racial and ethnic identities. The totals below exceed the number of participants due to allowance for multiple selections in the survey instrument:

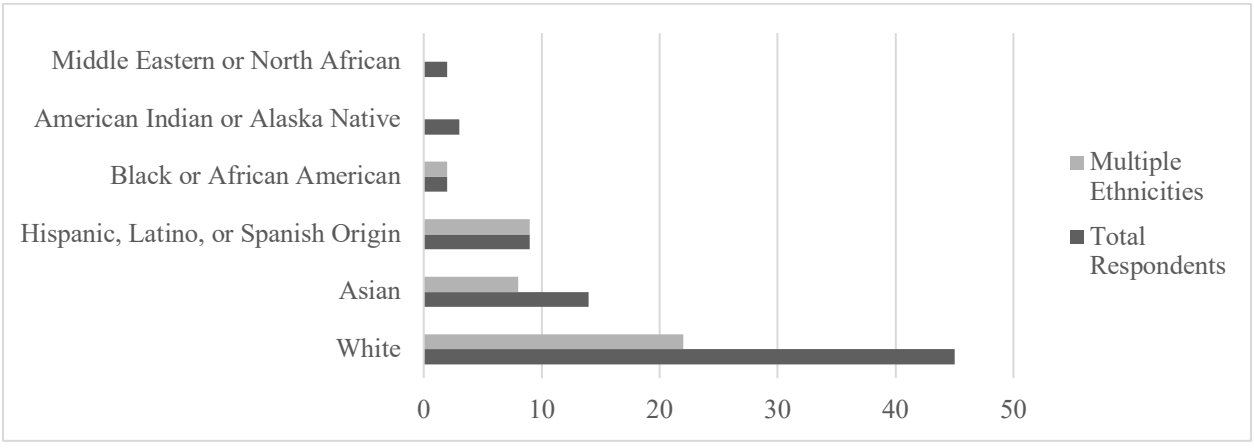

Fig. 6: Ethnicities of Respondents

Socioeconomic Indicators

Participants self-reported family income levels as follows:

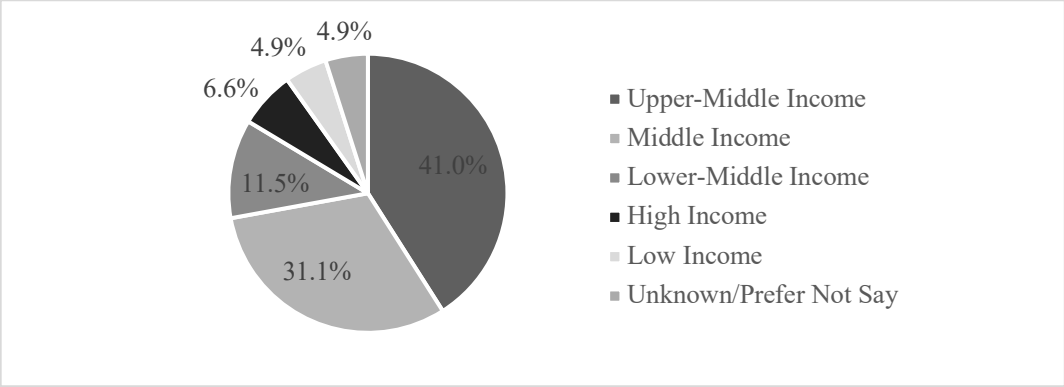

Fig. 7: Socioeconomic Standing of Respondents' Households

Parental Education Levels

The survey also captured information on the highest level of education attained by participants' parents or guardians:

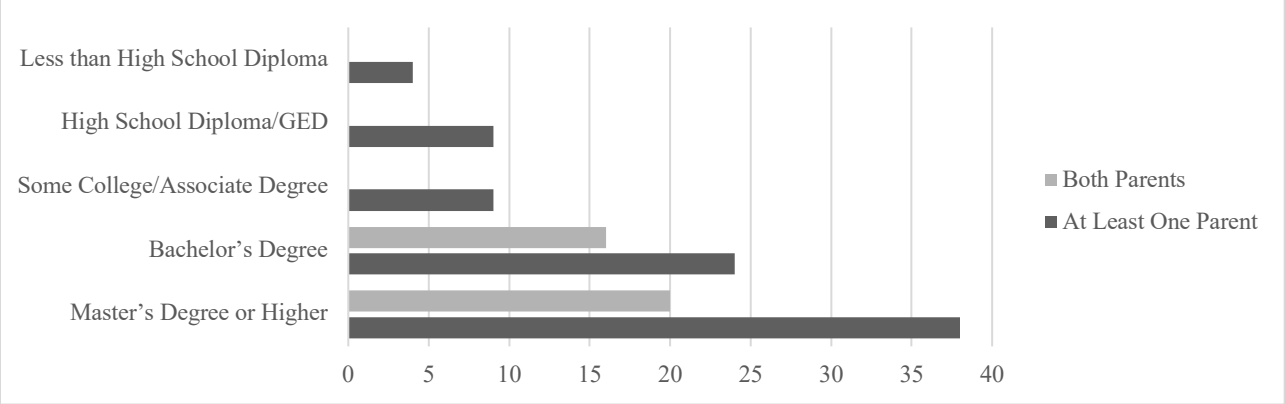

Fig. 8: Education Level of Respondents' Parental Figures

Appendix B: Survey Content

State of HS EngEd

Start of Block: Introduction

Northeastern University, First Year Engineering Program
Name of Investigator(s): *Brian O'Connell*
Title of Project: State of High School Engineering Education Opportunities

You are invited to participate in this survey, which will ask you some questions about your high school experience. This is part of a research study to understand better what engineering education opportunities are available for high school/secondary school students. You DO NOT NEED to have taken any engineering, CAD, or programming/coding courses to participate. Even if you have never taken an engineering, programming, or CAD course or your school did not offer any, your input is still of interest to us. You are being asked to participate as you are taking a first-year engineering course and, therefore, are more likely to know about the opportunities, or lack thereof, for engineering education in your community.

Here is some key information to consider before participating in this survey:

- This survey should take approximately 10-20 minutes to complete. You must be at least 18 years old to take this survey.
- The decision to participate in this research project is voluntary. You do not have to participate and can refuse to answer any question. Even if you begin the survey, you can stop at any time. You will not be reimbursed for your participation in this study.
- This survey is anonymous. However, it does ask for certain demographic information and information about your hometown and high school/secondary school that could, when combined, be identifiable. The possible risk is minimal as the data will be stored securely at Northeastern University and only accessible to the researchers. Also, only people already known to you could likely utilize those combinations of information to identify you.
- The study's possible risks or discomforts are minimal. The questions are primarily about the available resources in your community and whether you participated in them.
- Any reports or publications based on this research will use only aggregated data and will not identify you or any individual as being affiliated with this project. Your de-identified information could be used for future research without additional informed consent.

If you have any questions regarding electronic privacy, please contact Northeastern University's Office of Information Security via phone at 617-373-7901, or via email at privacy@northeastern.edu.

If you have any questions about this study, please contact Brian O'Connell, the Principal Investigator, at b.oconnell@northeastern.edu.

If you have any questions regarding your rights as a research participant, please contact the Human Subject Research Protection, Mail Stop: 560-177, 360 Huntington Avenue, Northeastern University, Boston, MA 02115. Tel: 617.373.4588, Email: IRBReview@northeastern.edu. You may call anonymously if you wish.

This study has been reviewed and approved by the Northeastern University Institutional Review Board.

Please print out a copy of this consent screen or download a copy for your records.

Thank you for your time. Prof. Brian O'Connell

Are you over the age of 18 and consent to participate in this research study? Selecting "I am over 18 and DO Consent." will indicate your consent and eligibility to participate in this study. Selecting the "Next" button below will take you to the main survey. Selecting "I am not over 18 and/or I DO NOT Consent." indicates that you do not

wish to participate. In this case, selecting the "Next" button below will take you to the end of the survey without having participated in the main survey.

- ○ I am over 18 and DO Consent.
- ○ I am not over 18 and/or I DO NOT Consent.

End of Block: Introduction

Start of Block: Demographics

This section will be asking for demographic information. It is being collected to allow the researchers to build a richer context for understanding the collected data through understanding some of the characteristics of participants. You may provide as much or as little demographic information as you wish. Every question has a "prefer not to say option" or can be left blank.

How do you describe your gender identity? (Mark all that apply)

- ☐ Female
- ☐ Male
- ☐ Genderqueer
- ☐ Agender
- ☐ Transgender
- ☐ Cisgender
- ☐ Non-binary / third gender
- ☐ Prefer not to say
- ☐ A gender not listed: _____

With which racial and ethnic group(s) do you identify? (Mark all that apply)

- ☐ American Indian or Alaska Native
- ☐ Asian
- ☐ Black or African American
- ☐ Hispanic, Latino, or Spanish origin
- ☐ Middle Eastern or North African
- ☐ Native Hawaiian or Other Pacific Islander
- ☐ White
- ☐ Prefer not to say
- ☐ Another race or ethnicity not listed above:_____

Please print your specific ethnicities in the space below. Examples of ethnicities include (for example): German, Korean, Midwesterner (American), Mexican American, Navajo Nation, Samoan, Southerner (American), Chinese, etc. Note you may report more than one group separated by commas. You may also leave it blank if you wish not to respond.

_____

What was the highest level of education for your parent(s)/guardian(s)? Please input a descriptor for your Parent/Guardian (i.e. Mother, Father, Stepmother, grandfather, etc.) and limit to those with the greatest influence/involvement with your day-to-day education

	N/A	Less than high school diploma	High School Diploma or GED	Some college or associate/trade degree	Bachelor's Degree	Master's Degree or Higher	Don't Know
Parent/Guardian 1	○	○	○	○	○	○	○
Parent/Guardian 2	○	○	○	○	○	○	○
Parent/Guardian 3	○	○	○	○	○	○	○
Parent/Guardian 4	○	○	○	○	○	○	○

Would you describe your family as:

▼ I prefer not to answer ... I do not know

Where is your hometown? Please provide as much information as you are comfortable with from the least specific (Country/Region) to the most specific (City).

- ○ Country/Region _____
- ○ State _____
- ○ Postal Code _____
- ○ City _____

What is your major?

_____

End of Block: Demographics

Start of Block: High School Info

This section will be asking for information about your High School and the engineering education options available. For the purposes of this survey, the term **High School** will be used for any **secondary school** you attended before attending Northeastern University. We are interested in what courses your High School offered that covered engineering topics and design tools. You do not have to have taken any such courses to complete this survey nor have a High School that even offered them. Even the lack of availability of such courses is of interest.

What year did you graduate?

▼ 2024 ... Prefer not to answer

Where was your High School located and what is it's name? Please provide as much information as you are comfortable with from the least specific (Country/Region) to the most specific (The High School's Name).

- Country/Region _____
- State _____
- Postal Code _____
- City _____
- High School's Name _____

What type of High School did you attend? Select all that apply.

- ☐ Traditional Public School
- ☐ Charter School
- ☐ Magnet School
- ☐ Virtual or Online School
- ☐ Traditional Private School
- ☐ Boarding School
- ☐ Language Immersion School
- ☐ Montessori School
- ☐ Private Special Education School
- ☐ Parochial School
- ☐ Religious School
- ☐ Reggio Emilia School
- ☐ Waldorf School
- ☐ I do not know
- ☐ Other

Did your High School offer any courses focused on the following Engineering topics or associated design tools? Select all that apply. You DO NOT have to have taken one, just know if any were available.

- [ ] Engineering Design
- [ ] Computer Aided Design
- [ ] Programming/Coding
- [ ] None of the above

Did you take any courses involving Engineering topics or associated design tools?

- ○ Yes
- ○ No
- ○ None available

Please list the courses you took? You do not need to fill all fields. Extra fields are included for those who took a greater than average number of courses.

- ○ Course 1 _____
- ○ Course 2 _____
- ○ Course 3 _____
- ○ Course 4 _____
- ○ Course 5 _____

End of Block: High School Info

Start of Block: Course Specifics

Please provide more information about [Dynamic Field based on Previous Inputs]. Any details about the course you're willing to provide is appreciated.

What topics did [Dynamic Field based on Previous Inputs] involve? Select all that apply

- [ ] Engineering and/or Design
- [ ] Computer Aided Design
- [ ] Programming/Coding
- [ ] None of the above

Please briefly describe [Dynamic Field based on Previous Inputs]. A sentence or 2 description and/or a short list of topics covered/involved is greatly appreciated.

_____

Who would be the best point of contact for further information about [Dynamic Field based on Previous Inputs]? The *instructor's email address* would be preferable, but a name is also sufficient. We may follow up with them as part of a future study on teaching philosophies

and content in HS Education. You may leave this blank if you do not wish to provide that information.

_____

End of Block: Course Specifics

Start of Block: Extracurricular Offerings

This section will be asking for information about any other engineering education opportunities in your community. We are interested in what extracurricular opportunities are available through your High School as well as those available through other organizations in your community.

Did your High School or Community offer any extracurricular activities or organizations, that you're currently aware of, focused on the following Engineering topics or associated design tools? Select all that apply. This is asking about activities and organizations that you were previously aware of. Consider only those that involved ongoing clubs, teams, or other repeating activities rather than single events.

- ☐ Engineering and/or Design
- ☐ Computer Aided Design
- ☐ Programming/Coding
- ☐ None of the above

Did you participate in any of those extracurricular activities or organizations?

- ○ Yes
- ○ No

Please list the extracurricular activities or organizations you participated in. You do not need to fill all fields. Extra fields are included for those who participated in a greater than average number of activities.

- ○ Activity or Organization 1 _____
- ○ Activity or Organization 2 _____
- ○ Activity or Organization 3 _____
- ○ Activity or Organization 4 _____
- ○ Activity or Organization 5 _____

End of Block: Extracurricular Offerings

Start of Block: Extracurricular Specifics

Please provide more information about [Dynamic Field based on Previous Inputs]. Any details about the activity or organization you're willing to provide is appreciated.

Who sponsors, hosts, or provides [Dynamic Field based on Previous Inputs]?

- ○ My High School
- ○ A For Profit Organization
- ○ A Non-profit Organization
- ○ I do not kno

What topics did [Dynamic Field based on Previous Inputs] involve?

- ☐ Engineering and/or Design
- ☐ Programming/Coding
- ☐ Computer Aided Design
- ☐ Combinations of the above
- ☐ None of the above

Please briefly describe [Dynamic Field based on Previous Inputs] .A sentence or 2 description and/or a short list of topics covered/involved is greatly appreciated. Please include the name of the organization involved if it's not already part of the activity name.

_____

Who would be the best point of contact for further information about [Dynamic Field based on Previous Inputs] A *contact email address* for the organization or the organizer would be preferable, but a name is also sufficient. We may follow up with them as part of a future study on teaching philosophies and content in engineering-focused extracurriculars. You may leave this blank if you do not wish to provide that information.

_____

End of Block: Extracurricular Specifics

Start of Block: Skills

This final section is about your familiarity and skills with engineering design tools. IMPORTANT NOTE: *You do not need to be familiar with any of these design tools. Selecting None is also useful information for this study.* The options listed are just commonly used resources and most courses will only utilize 1 or 2. There are also spaces for manually including unlisted options if the one from your High School differ from the provided options.

Which of the following development platforms are you familiar with? You can be just aware of the design tool but not have direct experience with it to select it. We are only asking about familiarity in this question.

- [ ] None
- [ ] Arduino
- [ ] Raspberry Pi
- [ ] LEGO Mindstorm
- [ ] VEX Robotics
- [ ] EVO
- [ ] Makeblock
- [ ] SPhero
- [ ] Petoi
- [ ] Unlisted 1 _____
- [ ] Unlisted 2 _____
- [ ] Unlisted 3 _____

Which of the following development platforms do you have some proficiency in? Proficiency here means that you have enough experience with the design tool to easily complete a High School senior level assignment for it.

- [ ] None
- [ ] Arduino
- [ ] Raspberry Pi
- [ ] LEGO Mindstorm
- [ ] VEX Robotics
- [ ] EVO
- [ ] Makeblock
- [ ] SPhero
- [ ] Petoi
- [ ] Unlisted 1 _____
- [ ] Unlisted 2 _____
- [ ] Unlisted 3 _____

Which of the following CAD softwares are you familiar with? You can be just aware of the design tool but not have direct experience with it to select it. We are only asking about familiarity in this question.

- [ ] None
- [ ] Solidworks
- [ ] ProEngineer
- [ ] AutoDesk Inventor
- [ ] AutoCAD
- [ ] OnShape
- [ ] Fusion 360
- [ ] Solid Edge
- [ ] TinkerCAD
- [ ] Unlisted 1 _____
- [ ] Unlisted 2 _____
- [ ] Unlisted 3 _____

Which of the following CAD softwares do you have some proficiency in? Proficiency here means that you have enough experience with the design tool to easily complete a High School senior level assignment for it.

- [ ] None
- [ ] Solidworks
- [ ] ProEngineer
- [ ] AutoDesk Inventor
- [ ] AutoCAD
- [ ] OnShape
- [ ] Fusion 360
- [ ] Solid Edge
- [ ] TinkerCAD
- [ ] Unlisted 1 _____
- [ ] Unlisted 2 _____
- [ ] Unlisted 3 _____

Which of the following Programming Languages are you familiar with? You can be just aware of the design tool but not have direct experience with it to select it. We are only asking about familiarity in this question.

- [ ] None
- [ ] Java
- [ ] Python
- [ ] Ruby
- [ ] C/C++
- [ ] JavaScript
- [ ] Swift
- [ ] SQL
- [ ] PHP/HTML
- [ ] Scratch
- [ ] MATLAB
- [ ] LABVIEW
- [ ] Unlisted 1 _____
- [ ] Unlisted 2 _____
- [ ] Unlisted 3 _____

Which of the following Programming Languages do you have some proficiency in? Proficiency here means that you have enough experience with the design tool to easily complete a High School senior level assignment for it.

- [ ] None
- [ ] Java
- [ ] Python
- [ ] Ruby
- [ ] C/C++
- [ ] JavaScript
- [ ] Swift
- [ ] SQL
- [ ] PHP/HTML
- [ ] Scratch
- [ ] MATLAB
- [ ] LABVIEW
- [ ] Unlisted 1 _____
- [ ] Unlisted 2 _____
- [ ] Unlisted 3 _____

Would you be willing to participate in future follow-up studies about these topics? These studies may involve further surveys, as well as interviews or focus groups about High School engineering experiences and opportunities. You will be given more information when those studies occur and be able to decline participation at that time.

- ○ Yes
- ○ No

Please provide an Email Address that we can contact you at for follow-up studies:

_____

End of Block: Skills

Start of Block: Last Question

Please list any engineering education activities you took place in that you felt did not fit in the previous questions. Be as detailed as you wish. You may leave this blank if you feel they have all been previously covered.

_____

_____

End of Block: Last Question