Graduate School Preparation within an Undergraduate Program (Work in Progress)

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Work-In-Progress: Graduate School Preparation within an Undergraduate Program

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Abstract

Graduate school is becoming a necessity for long-term success in the STEM fields. Unfortunately, many students are ill-prepared for the graduate school application process or for the graduate school experience, particularly if their undergraduate institution has only undergraduate programs, as is precisely the case at Wentworth Institute of Technology. While students at Wentworth get a first-rate undergraduate education, as well as a minimum of two semesters working in a co-op, student feedback often includes being under-prepared for graduate school. To fix this deficiency among the electrical and computer Engineering and computer science and networking majors, a consortium of faculty designed, executed, and evaluated a series of extra-curricular graduate school seminars to (a) gauge student interest in graduate school, (b) prepare students for the graduate school application process, and (c) inform students of their options for graduate degrees and programs.

This work-in-progress shares data and lessons-learned from the first round of seminars: we describe their organization and proceedings, as well as the results of surveys given before and after the seminars. The seminars were organized to first introduce our undergraduates, consisting largely of first-generation college students focused on job preparation, to their options for graduate school: types of degrees (MS, PhD, MBA, etc.), sources of financing (grants, assistantships, employer-assistance, etc.), application process (CV, personal statement, recommendations), and what to expect as a graduate student (research, coursework).

From the seminar surveys, preliminary data reveal that students show reluctance about finances and a general lack of information. After the seminar, students felt more comfortable, claiming they are now more interested in pursuing a graduate degree (mainly MS).

In order to help colleges better prepare their students for graduate school, we present our seminar organization and survey results. The work also presents tips for inspiring students and insights into the student motivation and interest in graduate school.

1 Introduction

Today's engineering job market increasingly necessitates a post-graduate education for long-term employment and advancement. Master's degrees are projected to make up 27 percent of the STEM workforce in 2018[1] as opposed to 22.2 percentage recorded in 2011[2]. In contrast, the projected percentage of Bachelor's degree holder demands no growth to meet the projected 42 percent in 2018[1]. At most universities and large colleges, undergraduate students are exposed to graduate school from a variety of sources (*e.g.*, graduate teaching assistants, mixed undergraduate/graduate courses, research seminars and presentations, undergraduate research opportunities in a graduate laboratory). Unfortunately, not all colleges have a graduate program that provides these same opportunities. As a prime example, Wentworth Institute of Technology is an undergraduate-centric college, without a day-time graduate program or on-campus graduate students. This likely puts the undergraduate students at a disadvantage, as they are not exposed to a graduate community; as well as decreasing the overall interest in graduate school, as students either don't know it is an option, or don't understand what they will be doing in graduate school and why and when it matters for career success.

A team of faculty at Wentworth has created a series of seminars to help inform students, focusing on both broad and specific aspects of graduate school, including applications, community, research, and finances. The seminars have been mainly targeted at electrical and computer engineers and computer scientists, but have been open to all majors. In the last year, the faculty team has held a number of these seminars and are continuing to re-design and amend the structure, all the while gathering data about the students' backgrounds, students' progress in graduate school preparation, and both qualitative and quantitative feedback on the seminars' effectiveness.

This paper lays out the structure of the graduate school information seminars along with the reasoning behind decisions made. While it is mainly aimed at engineering and science students at an undergraduate-centric college, the insights are applicable to a broader audience.

The rest of the paper is as follows: Section 2 describes related publications. Section 3 provides details on the seminars' structures. Section 4 provides both qualitative and quantitative results on the seminars effectiveness, as well as associated analyses. Section 5 concludes.

2 Related Work

The goal of this work-in-progress is to report on the activities of Wentworth Institute of Technology in educating students to make them more comfortable with graduate applications and studies. There is a wealth of related research in the field; however, only a few suitably compare to this work.

A number of published works revolve around the preparation and recruitment of undergraduates into graduate programs using graduate-style or industry-led research programs[3,4,5,6,7,8]. While Wentworth does have similar undergraduate-level research and industry-partner projects, these

projects are not a recruitment tool and are orthogonal to the efforts of the proposed information sessions.

As the proposed work is a supplemental set of seminars, they are unrelated to scholarship programs[9,10] and regular courses of study[11]. Some programs use similar techniques to those proposed here, but are able to focus on a smaller subset of students as part of a curriculum or scholarship program. The seminars presented in this work are voluntary and extra-curricular, and at present, cannot be easily placed into the existing curricula for the targeted majors.

A number of existing works focus on the encouragement of minority and women students in STEM[10,12,13]. While this may be considered an additional benefit (Wentworth Institute of Technology contains a significant number of underrepresented minority students), it is not the primary goal of the work reported here.

There are a few published works regarding graduate information seminars, as described in this work. The primary differences, when separated from the curriculum and scholarship programs as described above, revolve around the ability to integrate an existing cohort of graduate students into the seminars, including graduate student research talks and panels. As Wentworth Institute of Technology has no existing day-time, on-campus graduate students in the targeted fields of study, these types of activities would only be possible by involving other local graduate programs. Additionally, the schools in these works typically have undergraduate students interacting with graduate students in the classroom[9,11,13,14,15,16]. However, at Wentworth, there are no teaching assistants or graders, so undergraduates are not exposed to graduate students in the same manner.

Student motivations and hesitations have also been explored[11,16,17,18,19]. The results described here echo many of the same conclusions, including financial pressures and academic exhaustion, as well as seminars improving overall feelings towards graduate school. However, the existing studies are not targeted at undergraduate-terminal institutions.

Finally, there are external resources for educating students as to the rigors of graduate school[20,21,22]. These resources are used as supplemental documents to support the seminars.

3   Seminar Implementation

The overarching goal of the seminar series is to increase the number of students at Wentworth Institute of Technology that feel comfortable applying for and attending quality graduate schools. In order to accomplish this, however, individual seminars had more specific content outcomes: a) give information about why to get a graduate degree; b) explain the academic rigor and social aspects of graduate studies; c) prepare students for the graduate school search and application process; d) encourage more open discussion about post-graduate options for all students. All seminars were voluntary, but some of the material was additionally shared with students in the classroom in an ad-hoc fashion.

Seminar #1: "Is Graduate School for Me?"

The first seminar, outlined below, was held three times in the summer and fall semesters of 2016. It was primarily intended to initiate the conversation and focused on general information.

- Faculty introduction and survey distribution (with IRB disclaimer and instructions)
- Why Graduate School?
  - Growing reliance on MS degree in the marketplace
    - Degree inflation for sustainable and promotable positions
  - Demonstration of commitment to a field
  - Ability to prove you can dive deep on a topic and apply it appropriately
  - Breakdown of degree goals
    - Undergraduate (BS) teaches an ability to analyze problems, think critically, learn skills pertaining to a particular field
    - Master's teaches you specialty within that field, a little experience on the cutting edge
    - PhD makes you innovate, teaches you about how to research on your own
- Degree descriptions (each department should weigh in as necessary)
  - Master's:
    - 1-3 years full-time; approximately 5+ years part time
    - Classes (10-12, specializing in particular fields); may include some bridge courses
    - Project vs. thesis vs. classes-only
    - General environment (community of scholars/students)
    - Getting funding (scholarships, grants, TA position, getting employers to pay for it)
    - Research not a priority going in, but it doesn't hurt (talk to your professors)
    - Choose based on technical specialty within the department (could be in various departments, not just yours)
    - Online programs could be good or bad; check with rankings, ratings, and professors
  - PhD
    - 4-7 years full-time beyond the MS
    - Why get a PhD (teaching, research positions, jobs that NEED it)?
    - Seemingly "bad" reasons to get a PhD
    - Some classes, but focusing on research (independent or group)
    - Dissertation, defense, publications, and the role of the advisor
  - Other degrees (*e.g.*, MBA, law, medical, etc.)
    - May be easier to transition than you might think
    - Likely need to take a few bridge courses; add time to your degree
- Application process
  - GREs: SAT of graduate school; get a book, start studying, plan to take 1-2 times
  - Résumés: different from job résumés, include more projects, more details; no limit in size
  - Personal statements: standing out, prove your worth with evidence, aim it at the school, department, program, and advisor (research-specific)
  - References/recommendations: come from faculty directly…need lead time; think of 3 people who can give you a personal rec, not just a form letter
  - Transcripts: need official from the college, not copies
  - Application fees: will likely cost money; pick some safety schools, some reaches, some up the middle
- Open question and answer session
- Distribution of follow-up survey (5 minutes: repeat IRB disclaimer and instructions)

Seminar #2: "What is Graduate School Like?"

In the fall of 2016, an additional seminar was created to augment the general information session. This one focused mainly on the daily life of graduate students (*e.g.*, what classes to take, social/communal atmosphere, how to do research, etc.). This topic was chosen next to inform students about the graduate study life and community before starting the application process. The outline used by faculty is detailed below.

- Purpose of graduate school
  - Show devotion to a topic, increase upward mobility, salary ceiling
  - Expertise often gained through a few years of job experience
  - For PhD, explore the cutting edge of research, discover something new
- Difference between Master's and PhD in daily tasks and responsibilities
  - Master's
    - Mostly classes, 2-4 per semester, depending on credits, availability, finances, etc.
    - May also work in a research laboratory (paid or unpaid); need to find your own research advisor (if thesis/project is required)
    - Classes start in difficulty around senior-level electives in undergraduate, but may specialize based on professors' interests
    - If not in class or doing research, time is spent studying with classmates; the community here is important to getting through
    - Likely dedicating 60+ hours a week balancing classes and research projects
    - Social life may suffer a bit, but doesn't go away
  - PhD
    - Most of your time (60+ hours per week) will revolve around your research (*e.g.*, reading papers, gathering or analyzing data, writing papers/proposals)
    - Publications are a big part (conferences, journals, magazines, grant proposals); help your dissertation and eventual graduation
    - Lab-mates and fellow graduate students become people you rely on for technical and emotional support
    - Everyone has doubts (impostor syndrome)
    - Classes are a part; usually focused on research area; Could audit or sit in on classes, just for knowledge
    - Lab meetings, seminars, etc. are frequent
- Graduate school life vs. undergraduate life
  - Undergraduate: 3-5 classes, across humanities, social sciences, math, engineering, etc.
  - Graduate: 2-4 classes, focusing primarily on specific topic (chosen by you/advisor); some pre-requisites; topics are more research-oriented
  - Graduate: Less time for extra-curricular, but still some
  - Both: Rely on your classmates and friends
  - Graduate: Slightly more selective group, more focused on education and doing well; changes the mentality among friends; grades matter less, knowledge matters more
- When does it make sense to go (employment vs. graduate studies)
  - If you can afford it and you don't "need a break," at least a Master's right after undergraduate
  - If you need the money or a break, try part time to stay current and not lose momentum
  - Part-time Master's increases time-to-degree; PhD part-time is more difficult
  - Returning to school after working full-time can be a challenge, but is certainly doable
- Timeline for applying to graduate school

- ○ Freshmen/Sophomore years: focus on undergraduate; look for topics of interest; foster relationships with faculty; seek undergraduate research (should be done throughout undergraduate years)
  - ○ Junior year: prepare for and take GREs; look at schools; narrow your focus on possible graduate topics; start preparing materials (resume, personal statement)
  - ○ Senior fall semester: get letters of recommendation in order; send transcript and applications
  - ○ Senior spring semester: receive decision letters; visit research labs and graduate programs (often will be invited)
  - ○ Talk to your advisor throughout the process
  - ○ Future seminars will to cover this in more detail
- Funding and financing graduate school
  - ○ Would need to talk to schools about your personal financing and loans (if you need it)
  - ○ MS: hard to get full funding; look for TA positions, national or college-specific grants/fellowships
  - ○ PhD: goal is to get full funding (tuition and stipend)
    - ◇ Typically comes from professor (research advisor) grants (NSF, DARPA, DoD, etc.)
    - ◇ Paying you to do research; can be fired; not a lot of money, but enough to live

Seminar #3: "How Do I Apply to Graduate School?"

In the spring of 2017, seminars #1 and #2 were repeated. Additionally, a new seminar was created, focusing on how students can identify appropriate degree programs and how to create successful applications. The application process is a largely personal one, dependent on a student's qualifications and undergraduate activities and interests. Rather than try to cater to each student individually, the faculty used case studies, explaining successful and unsuccessful examples of personal statements, resumes, etc. A package of materials was distributed as well, so students could see more examples on their own. Additionally, time was given to allow students to ask more targeted questions.

- Choosing a school/program/lab
  - ○ Choose a topic you like (from courses, projects, jobs, general curiosity)
  - ○ Talk to your advisor, peers who have graduated, professors in the field
  - ○ Use rankings, but be more constrained (*e.g.*, size, location, topic-specific, support structures)
  - ○ Safety school and reach school: don't reach with all your picks; don't aim too low
  - ○ Check websites for school and advisors/labs: where are graduates working, size of the lab, publishing activity, funding sources
  - ○ Choose schools that have a specialty you are interested in, not just based on overall reputation
- Application creation
  - ○ Use the career center and your advisor to review these
  - ○ Résumé
    - ◇ General contents: education history, job history, all relevant projects from courses or extra-curricular, memberships (IEEE, ACM, SWE, NSBE), all skills/qualifications, research interests, relevant courses taken
    - ◇ Can be longer than job résumé
    - ◇ Reformat based on school/lab; may want to reorder projects or skills to be tailored to a specific school/lab
  - ○ Personal Statement/Statement of Purpose

- ◇ Explain why you want a graduate degree from that school and in that topic, and why YOU are suited to it
- ◇ Details on resume items (*e.g.*, what a project taught you, how it prepared you, how it applies)
- ◇ Try to stand out a bit; these get boring when faculty read a bunch of them at once
- ◇ Grammatical errors are a non-starter; readers will just put it down and move on, so PROOFREAD
  - ○ Letters of Recommendation
    - ◇ Usually 3-4 academic people (professors, instructors, department chairs, research advisor, academic advisor)
    - ◇ Can use bosses and supervisors, but focus on academics
    - ◇ Base it on something personal; should not be a form letter
    - ◇ You should and likely will have to waive your right to see it
    - ◇ Give time for this; don't wait until the last second
  - ○ GRE scores (TOEFL for international students)
    - ◇ Take it as early as you can; Can take more than once (you will need to pay for each time)
    - ◇ Send it to the schools directly, but list it on the resume/application
    - ◇ TOEFL is for international students, GRE for everyone
    - ◇ Not having scores can mean delay in application processing (or outright rejection)
  - ○ Transcripts
    - ◇ Sent from the school directly; not unofficial copies
    - ◇ If your GPA doesn't match or there is a discrepancy, will likely be a rejection (no need to take a chance)
  - ○ Timeline for applications
    - ◇ Junior/early senior year: Find schools of interest, take GREs
    - ◇ Early senior year: Get recommendation letters arranged
    - ◇ Fall senior year: Application pieces must be submitted for most schools
    - ◇ Spring senior year: Acceptances/rejections and visits
- After applications are sent
  - ○ Emails to faculty: could be a waste; get many such emails every application season; but worth a try
  - ○ Keep alert for questions; follow-ups from departments or faculty
  - ○ Schools will often bring you to campus if you are accepted
  - ○ Remember funding is the big goal; acceptance is good, but funding is key (specifically for PhD)
  - ○ In the end, choose based on school reputation, job opportunities, research opportunities, funding/cost, overall feel
- Question & answer session
  - ○ Keep focused on school search and applications
  - ○ Try not to get too specific for a particular student; take off-line

Further Seminar Plans   At the time of submission, the three aforementioned seminar topics were either held or are in development. More seminars will be added for future work as faculty further probe what students are interested in learning about graduate school.

4 Survey Results

Students in the seminars and those filling out the discussed surveys were primarily junior and senior students pursuing Bachelor's degrees in computer science, computer engineering, and electrical engineering. At Wentworth Institute of Technology, students in these majors take 8 semesters of courses and 2 semesters of a co-op experience. Most students will go into the workforce without seeking an immediate graduate program, as historically, courses are designed to prepare directly for employment and not necessarily for graduate school. However, the culture is changing, and more students and faculty are discussing research and graduate studies as viable options. The seminars and surveys discussed below are a result of this.

Students at seminar #1 were asked to fill out a survey before and after the seminar; at the second seminar, surveys were only collected at the end. Surveys were collected (66 from before seminar #1, 59 after seminar #1, and 7 for seminar #2), and the data is reported below.
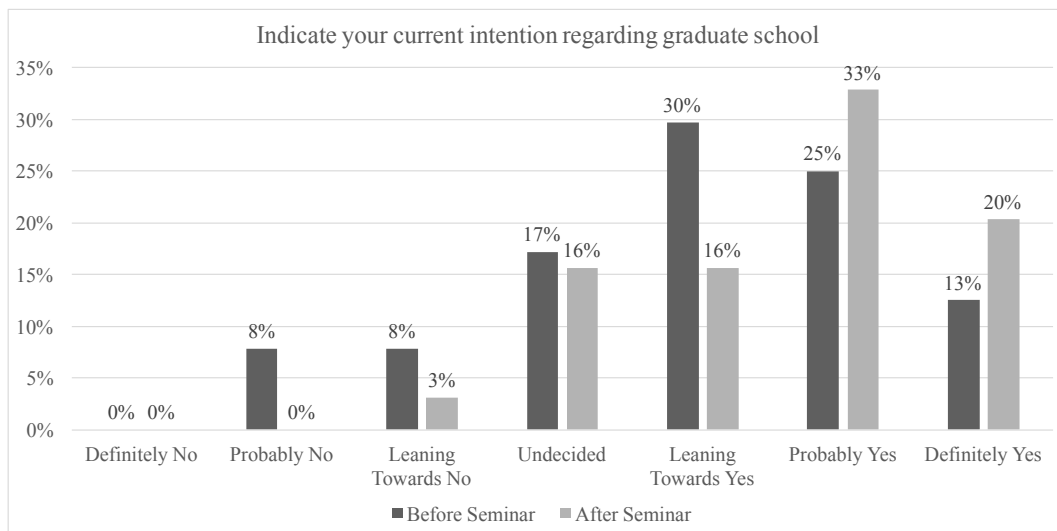

Figure 1: A large number of students indicated at least minimal interest in graduate school before the seminar, with a larger number being convinced of its importance after the seminar.

Seminar #1   The goals of the first seminars were to gather information about interest in graduate school within the student population and to give introductory information about graduate school. Thus, the surveys were designed to gauge the students' interest and knowledge.

Figures 1 and 2 shows that before the seminar the majority of students had not spent much time thinking about graduate school, despite being primarily seniors, but students were still leaning towards attending. Of course, as this seminar was advertised as being about graduate school, it is likely that the group was self-selected to be interested in graduate school. More importantly, after the seminar, the number of students interested in graduate school increased significantly, with the number of "definitely yes" and "probably yes" increasing by 7% and 8% respectively. The number of "leaning towards yes" decreased, as those students felt more confident in their future in graduate school.
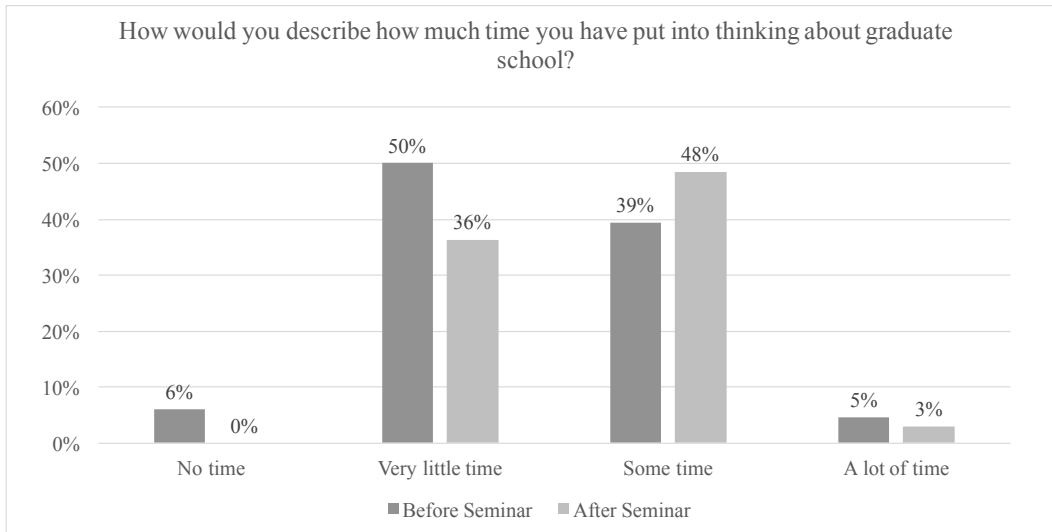
Figure 2: Seminar #1 improved the overall time students had thought about graduate school. The decrease in the "a lot of time" columns is attributed to a decreased number of responses from the two surveys.
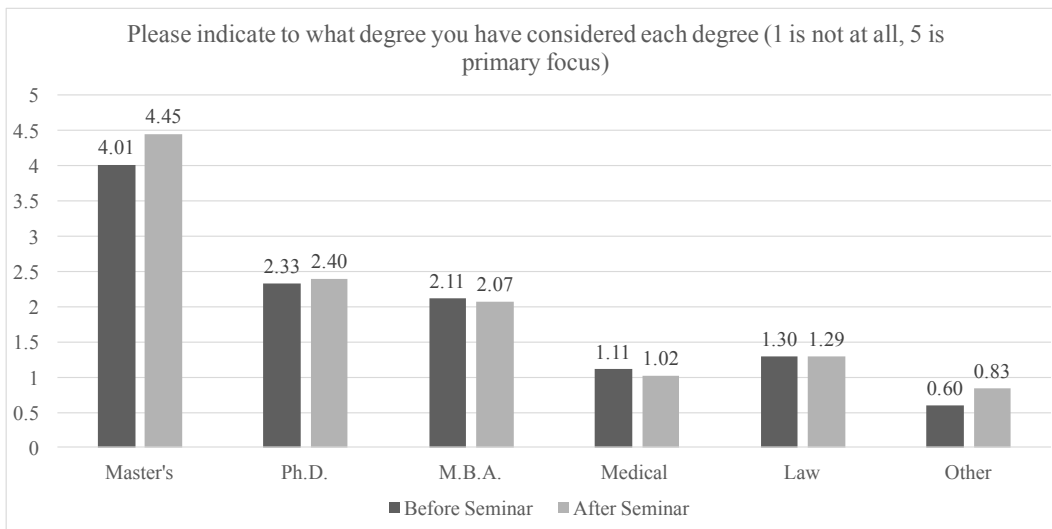

Figure 3: As might be expected, most students showed primary interest in a Master's or PhD degree program, with many also interested in an MBA.

Most students were interested in Master's degrees, with a significant number interested in PhD or MBA degrees, as shown in Figure 3. This information will help to structure future seminars, which will focus on Master's programs, with a secondary focus on PhD and MBA programs.

As with many students, the primary concern for graduate school was financial (see Figure 4). On a scale of 1 to 5 (5 being the most important), respondents before the seminar had a 4.25 average for finances, much higher than any other choice. The seminar discussed general information regarding scholarships and fellowships, but there was little change. This helped to inform the
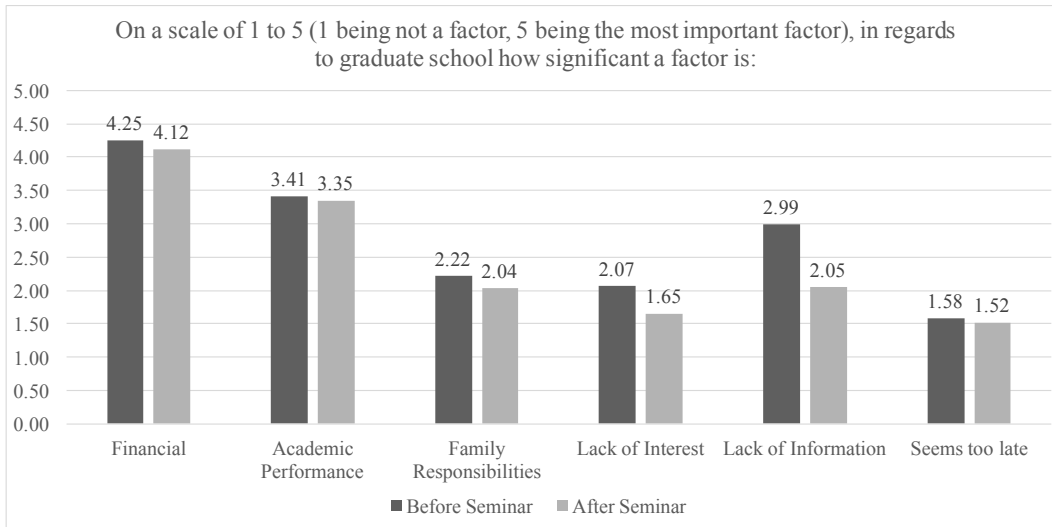
Figure 4: Finances, academic performance anxiety, and a lack of information were all found as concerns for students, with the lack of information going down significantly after the seminar. These findings are similar to other work[11,16,17,18,19].
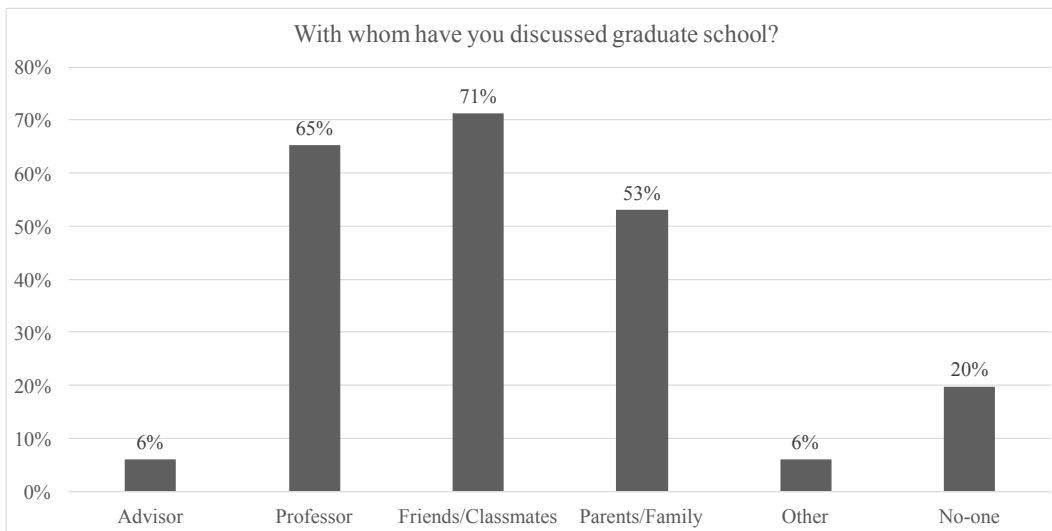

Figure 5: These answers were not exclusive, so numbers do not add to 100%. In this case, a professor is a separate entity than their assigned faculty advisor.

second seminar, where we gave more detail on how to pay for, get paid for, or work concurrently to studying. Additionally, the concern over a lack of information went from an average of 2.99 to 2.05 out of 5, as students now felt better informed, encouraging the faculty team to continue with more seminars.

According to Figure 5, 80% of students had previously discussed graduate school. Meanwhile, as Figure 4 shows, a lack of information was a high-scoring concern. This information will help to inform future discussions and seminars.
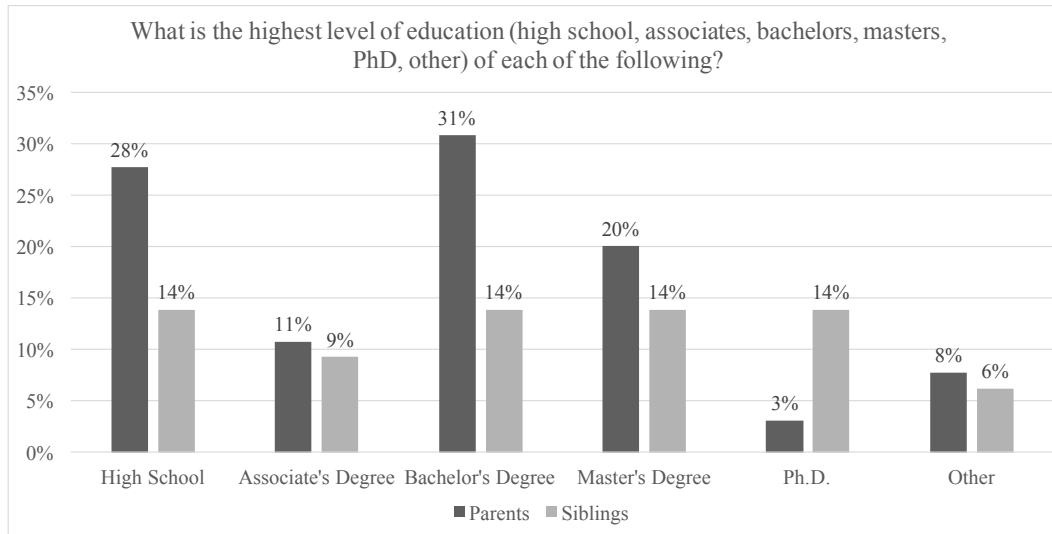
Figure 6: A background question of the highest level of education per student's family shows a mix of educational history.

Figure 6 reveals the students' family background in terms of highest level of education, simply to give context to the student population. These numbers are roughly on par with the national average[23].

Open-ended questions were also on the survey, in terms of giving general comments and open discussion of the primary motivations that would guide a choice in graduate program. The most common factors in school choice were location (most students preferred to stay in the vicinity of Wentworth Institute of Technology) and reputation of the school/program, with a few also citing cost as a concern. For the future seminars, the faculty will focus on local programs as they discuss the application process, as well as encouraging students to widen their view.

Seminar #2   In the second seminar, which focused on day-to-day life of graduate students, a new survey was distributed. On that survey, 83% of students said they have thought about graduate school more since the last seminar, and they have increased their interest in the last seminar. Similarly, all students claimed that they found the previous and new seminars useful.

Qualitative analysis shows an overall satisfaction with the choice of seminar topic, as it helped to clarify what graduate school entails and gave students better context for their desire (or lack thereof) to attend graduate school. While the sample size of survey responses was low, this feedback is nonetheless encouraging.

General analysis   Overall, students were satisfied to have more information about graduate studies. We will take the lessons learned and insights given in these surveys to help form the next semester's seminars.

Most importantly, students felt they lacked general information, which was discouraging many from pursuing a graduate degree. With these seminars, this gap is shrinking.

For future seminars, we will expand on these seminars, adding the application process as a dedicated topic, which through verbal discussion was identified as a concern for students.

5   Conclusions

Students at Wentworth Institute of Technology are not often exposed to graduate students or programs at any level, and thus are at a disadvantage compared to their peers. Surveys revealed they lacked information and felt that while graduate school was an option, it was not a top priority. A faculty team began holding seminars to help give general information about graduate school, specifically focusing on engineering and sciences. While the results are only preliminary, and this is a work-in-progress, the results are nonetheless encouraging, as students are increasing their interest in graduate degrees and are happy the seminars have been available. As more students graduate, the investigators hope and expect to see an increase in how many students attend graduate school. Results on that will be provided in the future work.

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