Work in Progress - the Undergraduate Perspective: How to Survive an Undergraduate Engineering Program

Bryon Kucharski, Wentworth Institute of Technology

Bryon Kucharski is an undergraduate Computer Engineering student from Wentworth Institute of Technology who will graduate in August of 2018. After the completion of his undergraduate degree, Bryon will attend the University of Massachusetts Amherst to pursue a Master's in Computer Science where he plans to focus on Artificial Intelligence.

Prof. Aaron Carpenter, Wentworth Institute of Technology

Professor Carpenter is an Assistant Professor at the Wentworth Institute of Technology. In 2012, he completed his PhD at the University of Rochester. He now focuses his efforts to further the areas of computer architecture, digital systems, cybersecurity, and computer engineering education.

Dr. Joan Giblin, Wentworth Institute of Technology
Dr. Mehmet Ergezer, Wentworth Institute of Technology

Mehmet Ergezer (S'06) received the B.S. and M.S. degrees in electrical and computer engineering from Youngstown State University, Youngstown, OH, USA, in 2003 and 2006, respectively. He received the D.Eng. degree in artificial intelligence from the Department of Electrical and Computer Engineering, Cleveland State University, Cleveland, OH, USA, in May 2014.

From 2003 to 2005, following his internship with U.S. Steel, he was a Graduate Assistant with Youngstown State University. In 2006, he was a Research Assistant with the Embedded Control Systems Research Laboratory, Cleveland State University, engaged in heuristic numerical optimization techniques. In 2008, he interned with the Digital Engineering Team, Philips Healthcare. In 2011, he worked on the the development of tracking algorithms for civilian aircraft as a Staff Engineer for ARCON in Waltham, MA, USA. In 2014, Dr. Ergezer joined the Research and Advanced Development signal processing team for Bose Corp. In 2017, he became an Assistant Professor for the Department of Computer Science and Networking at Wentworth Institute of Technology.

Dr. Ergezer is a member of ACM and Eta Kappa Nu.

Work-in-Progress - The Undergraduate Perspective: How to Survive an Undergraduate Engineering Program

Bryon Kucharski*, Aaron Carpenter*, Joan Giblin†, Mehmet Ergezer*

*{kucharskib, carpentera1, ergezerm}@wit.edu, †j.giblin@northeastern.edu

*Wentworth Institute of Technology

†Northeastern University

Abstract

Student retention across engineering programs often hinges upon students' ability to adapt to a new academic paradigm, for example, learning new study techniques, new academic habits, and of course new concepts. These techniques develop from various sources, including self-taught trial and error, advice from friends, and directives from faculty. Unfortunately, if students do not eventually find successful tactics, they struggle and are dissatisfied with their experience or leave without having completed the program. While faculty members, tutors, mentors, advisors, and more are a valid source of advice, students are more likely to make progress among peers.

Meanwhile, recent graduates and current junior/senior students often have a wealth of information regarding successful (and unsuccessful) study habits and other academic skills gained through experience. These are often passed down orally through classes and peer groups, while published strategies tend to be from faculty or administrative perspectives. The work presented here codifies the successful and unsuccessful strategies that students across numerous technical disciplines and from different backgrounds have used through their academic careers. The advice given is from a range of students at Wentworth Institute of Technology with a number of engineering and technical programs, gathered and analyzed by a team consisting of students, faculty, and administrators. The work serves as a guidebook for students, by students, in a range of rigorous programs.

A survey was distributed to recent graduates and upper-level students from various engineering and science backgrounds, intended to capture the realities of student habits, not just intention or knowledge of the "right answer." The surveys were then analyzed and correlated to determine what strategies students agreed were successful, whether they determined the strategies' merits prior to graduation or only in retrospect. The goal is that universities and engineering programs can share these strategies with their incoming or retained students or develop similar survey studies based on their own student body, helping students succeed in their respective programs and increase retention regardless of student background. Finally, a study guide is presented, growing from the survey results and molded by undergraduate students and the investigative team.

1 Introduction

Students enter college and combine past study habits with new learning strategies in an effort to handle the collegiate workload of 4-5 undergraduate courses. Undergraduates learn new learning strategies from personal experience, suggestions from faculty and staff, adaptation of past habits, and observation of and discussion with their peers. Thus, their ability to incorporate new strategies into their own academic life is in many ways limited to the people they have contact with, both in face-to-face settings, and now through the Internet. Undergraduate help-seeking behavior can be influenced by faculty and peers[1,2]. While faculty members, tutors, mentors, and advisors are a valid source of advice, recent graduates and current junior/senior students often have a wealth of information regarding successful (and unsuccessful) study habits and other academic skills gained through experience.

Study habits and skills impact academic achievement in significant ways. Without successful tactics, students struggle and are dissatisfied with their experience or may not complete the program. A meta-analysis of the research literature suggests a significant relationship between study skills and both overall academic achievement as measured by GPA and individual class performance[3]. Research also indicates that students make intentional decisions around how and where to seek help[2]. Most universities and colleges offer formal academic support, dedicating resources to help students improve their academic performance in the form of study sessions, tutoring services, web-based help, and more[4]. In addition, students utilize online sources to help them achieve their academic goals, but the effectiveness of either formal academic support or online information-searching is not well documented. Furthermore, understanding help-seeking behavior, rather than intentions, is a complicated endeavor in a realistic setting.

Many factors may inhibit students from asking their peers how they successfully approach studying and learning in the collegiate environment. Social perceptions, shame, and embarrassment all impact help-seeking behavior and these factors may also impact peer discussions about learning strategies[5,6].

The work presented here represents an effort to identify effective learning strategies actually utilized by students and to allow current undergraduates the opportunity to learn from their peers. Thus, the purpose of this research is to investigate student preferences of help-seeking behavior and provide an instrument for universities and engineering programs to share these strategies with their undergraduate students or develop similar research tools based on their own student population. This work-in-progress contributes to the literature by providing relevant, *real-world behavior* around help-seeking correlated with academic achievement.

The following research question guided this work: What types of help-seeking behavior do recent college graduates and undergraduate students in technical fields find beneficial to their academic success?

To investigate this question, an interdisciplinary team of faculty, students, and administrative staff created a survey asking students to record their habits and advice regarding undergraduate courses. A copy of the survey is included in Section 3. The survey includes questions regarding study habits, personal academic success, course preparation, and more. The survey targeted students of all levels, focusing on those enrolled in technical courses.

Wentworth Institute of Technology (WIT) is an undergraduate-centric university, including STEM majors and architecture and design majors. Students complete their bachelor's degree in four years, including two 2-semester co-op employment positions in industry. Students come from a wide variety of backgrounds and preparations. For context, Wentworth's recent students have an average high school GPA of 3.12 and average SAT math and reading/writing scores of 622 and 587, respectively. The average college cumulative GPA of the student body as of Fall 2017 is 2.9.

The survey, to date, has received over 200 responses from students currently enrolled in or recently graduated from various engineering and science programs at Wentworth Institute of Technology. The data were then analyzed to find trends among groups of students. As there are a variety of groupings and analyses possible for the 200 respondents and almost 30 questions, for this work-in-progress, the analysis will focus on the quantitative comparison of GPA groups. Specifically, high GPAs (3.0-3.5 and 3.5-4.0) will be considered successful or high performance and the students below 2.0 are considered low performance.

The results were combined into a single document that can be distributed to students as a way to encourage more successful study habits. The analyses reveal the real-world help-seeking behavior, as opposed the more often-analyzed student intentions. Similarly, the study habits recorded can help to shape tutoring and support services within the university. As a work-in-progress, the data are preliminary and future work will get a wider number of survey responses, answers to deeper questions, and have more analysis.

The rest of the paper is organized as follows: Section 2 explores previous work found through published literature. Section 3 provides details on the survey questions; section 4 presents samples of the data and analyzes them. Future directions are discussed in Section 6. Conclusive remarks are presented in Section 7.

2   Related Work

The presented work focuses on surveying undergraduate and recent graduates from Wentworth Institute of Technology, seeking insight into how undergraduates study and learn. These data are then formed into a collection of advice from undergraduates to their peers. There exists a number of published articles addressing some similar efforts, including discussing study skills[3,2,7], tutoring and self-help services[4,8], and social perceptions regarding seeking help[5,6]. Advice from peers around study habits and learning strategies can help boost self-efficacy, which is particularly important for upper-level classes[9]. The work-in-progress presented here represents an effort to identify effective learning strategies and to allow current undergraduates the opportunity learn from their peers; however, this work does not directly discuss how to achieve successful tutoring, focusing instead on examining if students know the services and strategies and use them appropriately. This differs from the more common exploration regarding the intention of students and college professionals regarding help-seeking. In addition, few studies have included the Internet among the sources of help sought[10]. This study contributes to the literature by specifically including the Internet as a potential source of assistance.

Previous researchers have focused on engineering undergraduate-based feedback and advice[11]. They asked students to reflect on their experience through interviews and suggest ways for

students to find happiness throughout their college years, for example, joining professional societies. That research did not focus on study habits, which is the crux of the present paper's process.

The study presented here is also unusual among help-seeking research because the results represent actual help-seeking behavior rather than an intention to seek help[12,13,14]. Help-seeking intentions, often used by researchers to control for varying needs for help, may differ significantly from actual help-seeking behavior[15,16]. The results of the study in this paper demonstrate actual real-world help-seeking behavior, albeit self-reported, not intentions to seek help in the future, which may or may not become reality. This distinction is particularly valuable and, thus, this work will provide insights that can (a) help undergraduate students and (b) guide future educational research.

Furthermore, previous work on learning strategies often focuses on particular learning strategies or individual populations of students with specific characteristics, such as students academically at-risk [17,18]. The current work described here asked an intentionally broad range of students, from academically high-achieving to students academically at-risk, in order to compare and contrast the learning strategies behavior actually used by students across all achievement levels who took part in the same educational experiences in the same time-frame. Previous literature focused on individual learning strategies or particular groups of students, differences in the environment in which assistance was needed varied from study to study as the differing studies took place at different institutions, during different time frames, using participants whose learning experiences differed across time and space. This study contributes to the literature by analyzing actual learning strategy behavior, not intentions, utilized by students during the same time-frame under the same conditions.

Previous researchers have explored factors such as motivation and prior knowledge [19,20]. This research includes preset questionnaires which are then aggregated and reported. These studies provide little in the way of practical advice to students. Educational researchers seeking to create and utilize effective interventions will find references to motivation, study skills, learning strategies, and time management, but will struggle to find the practical applications of these constructs. This gap in research knowledge motivates the study presented here.

A number of published works explore the evolution of study habits from high school to college in more detail[21,22,23].The analysis provided here will support some of the findings with the correlation between high school and collegiate habits and student academic success. The ability to self-regulate learning and to adapt to new challenges in learning is vital and predictive of academic achievement, specifically time management and self-efficacy[24]. This study provides specific peer-utilized examples of these strategies.

Overall, there exists a wealth of educational research regarding undergraduate study habits. Some of the conclusions drawn from this paper's analysis will supplement existing knowledge; some conclusions will give quantitative data to otherwise anecdotal or assumed information; some conclusions will be more novel and point to new directions of training. The work presented in the following sections takes the unique viewpoint of students helping students with real-world help-seeking advice, with the faculty and staff being the aggregators of information, not the original source. It is the hope of the authors that such a perspective will encourage incoming undergraduates to explore more successful habits as prescribed by their peers.

3 Survey Details

To gather data and advice from the undergraduate student population, a survey was created and distributed using Google Forms. The questions were targeted towards technical courses. This means humanities and social sciences courses were left out of the data, although future work in the area may include these as well.

In order to create classification categories, a number of questions regarding individual academic success were included. For the purposes of the subsequent analysis, academic success is measured by the students' GPA. Future work could further define success or focus on different aspects of student behavior and outcomes. The questions allowed the investigators to analyze the data in groups and spot trends. The classification information included major, graduation year, transfer information, and current GPA range (0.5 point increments, 0-4.0).

The next set of questions asked about how the students spend/spent their time. These gave insight into the expected and actual course workload of the students, as well as details of how the time outside of class is spent.

- At the beginning of the term, how long do you expect to spend studying PER CLASS?
- How many hours a week do you actually spend studying or working PER CLASS?
- How many hours a week do you spend with organized extracurricular activities (sports, clubs, professional organizations)?
- How many hours a week to do spend with work commitments (i.e., part-time job/work-study)?
- If you have an assignment or project due in 2 weeks, how far in advance do you usually start?
- If you have an exam in 2 weeks, how far in advance do you usually start studying?

A group of questions also addressed questions of how students seek help, including in class, through classmates, or through other means. Students have numerous ways to get information, especially with videos and tutorials being posted online for free. These questions helped investigators to better understand what students do more frequently.

- How often do you ask questions in class on average?
- How often do you ask friends and classmates questions through text/email/chat?
- How often do you ask professors questions through text/email/chat?
- How often do you use Internet sources (Google, YouTube, etc.) to get help?
- How often do you attend office hours or schedule an appointment with any faculty member?
- When you don't understand a topic in class, what are your typical actions?

The penultimate set of questions focused on student study habits and the general mindset of the student in a classroom setting. By understanding the underlying mindset and motivation, the conclusions drawn from the student survey and thus the advice given to the undergraduate population can be more meaningful.

- When you register for a class, how much research do you prior to the first day?
- When confronted with a project, what are your main focuses?

- If confronted with possible new study techniques, would you adapt or try these new techniques? (scale of not likely to likely)
- How much have your study habits changed since high school? (not at all to completely)
- When you begin an assignment, how confident are you that you will successfully finish (with or without help)? (not confident to very confident)
- How confident are you in your current methods of study and learning? (not confident to very confident)
- If you have changed study techniques in the past, what has motivated you to do so? (short answer)
- For your current study techniques, where did you develop or learn about them?
- What are your typical study habits/techniques for engineering/technical courses?
- What study habits/techniques have you tried, but not maintained?

The last set of questions were open-ended and asked the students to give advice to varying levels of learners ranging from high school students to college seniors. The answers to these are briefly discussed, but future work will provide deeper analysis on the results.

- What academic advice would you give to students in your own class year?
- What advice would you give to students in freshmen year?
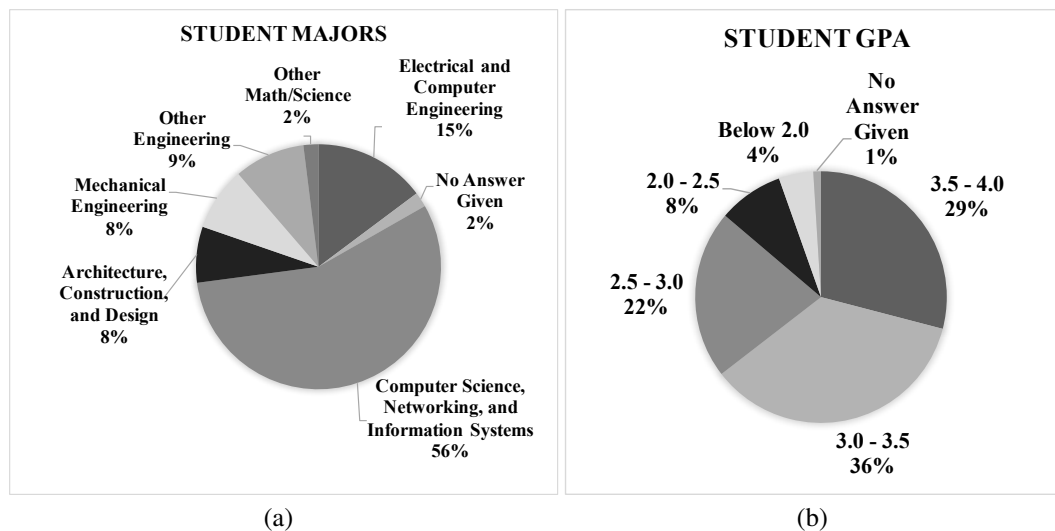- What advice would you give to students in high school preparing for their first year in any college?

Figure 1: (a) Percentages of students reporting each major (or group of majors). Some majors are grouped to save space. Note: the investigators are faculty in the computing area, resulting in higher response rate from those majors. (b) Percentages of students grouped by their reported GPA (out of 4.0).

4 Data & Analysis

The results of the survey together reveal real-world help-seeking behaviors and undergraduate learning strategies and create possible advice for undergraduate students. The quantitative data help to identify trends, while the more qualitative short answers offer more direct advice. A total of 29 questions were asked and more than 200 students from a dozen majors responded; thus, there are several lenses with which to analyze the data. This paper presents one such viewpoint, focusing on academic achievement (as quantified by GPA). For example, another perspective could use a breakdown by major to see GPA differences, but because of the small sample size for some majors, such analysis is left for future work after more surveys have been completed.

It is worth noting that some of the insights drawn from the survey and its accompanying analysis are already accepted within education research. Those insights can be seen as supplemental to and reinforcement of previously demonstrated conclusions; still, other insights are providing quantification to otherwise anecdotal or assumed student practices and intentions.

At the time of submission, 203 students had responded to the survey. Characteristic summaries of the data are given in Figure 1(a) (major) and Figure 1(b) (GPA). Graduation year was also recorded, but as it is not discussed in this work, it is left to future analyses. These classification data allow the investigators to sort the responses to the other questions. The data gathered here were sorted by GPA; each question was statistically analyzed to find possible insights.

4.1 Similarities across student population

There is a wealth of information provided by the survey. However, not all data points proved equally significant from a GPA-centric point of view. Before going into the details of where students had greater success (*i.e.*, higher GPA), it is worth highlighting the similarities seen across the student population.

The Internet: Students across all GPA levels and majors relied heavily on the Internet for studying. For all GPA groups, nearly 100% of students reported using the Internet as a primary means of studying, with some saying they use Internet searches 4+ times per week for a class, far outweighing studying notes and seeking help from individuals. Further, this is in contrast to the smaller percentage (42%) of students that use textbooks as a primary source of information. There are a few studies which have shown how students approach the Internet and its use as an information source[25,26], and these data reinforce such studies. The Internet-based help-seeking behaviors reported here outweigh what college professionals intend for students. Thus, it can be cause for concern, as the validity and quality of public online content varies. It is thus the suggestion of the authors (a) to ensure students know how to find quality sources and/or (b) to provide faculty-generated Internet or off-line digital content to the students.

Evolving techniques: As later discussion will detail, students vary in their study habits and the source of their learning strategies; however, all students showed some level of understanding that learning does not become static. The survey responses were mostly positive towards adapting new

techniques, showing students are willing to change study strategies as these strategies are presented, but as will be shown, academically at-risk students often wait too long to address their unsuccessful techniques.

Tutoring and friends: Students across all levels of academic performance were equally likely to seek friends or peer tutoring as a means to gaining understanding of a concept or skill. While there are gaps in other techniques, friends and tutoring seemed universally used, with around 80% of students seeking help from friends and 30% seeking help from formal tutoring, regardless of GPA and performance. The reluctance to seek professional or formal help has been presented in the past[27,28], but the data here reveal that students do seek help from friends, which is not as well-documented in the literature. Additionally, the reliance on peers could influence how professionals disseminate successful study habits.

4.2 Differences among student population

For each of the insights in this paper, the data will carry correlation, but do not suggest direct causality, which would take a more longitudinal and detailed study of the student population. Some causality can be inferred, but cannot be given finite value. For example, students with higher GPA reported a higher confidence in their study habits and their overall abilities when starting projects/assignments. This could be because they have more positive attitude, and a more optimistic approach helps them succeed. Conversely, one could conclude that since they have high GPAs, their history tells them to be confident, while the opposite is true for students with lower GPAs.

As previously stated, some of these conclusions have been considered intuitive or anecdotal in the past, and this work is partly intended to lend qualitative data to that. Similarly, this is actual reported student behavior, instead of their intentions of what they will do. Of course, every student population is different, so this survey will help to guide students from Wentworth as well as the general student population.

4.2.1 Time management and preparation

For any college or university professional, it is not surprising to say students struggle with time management. The analysis provided here gives quantitative understanding to how the students are spending their time. When these data are presented to incoming undergraduate students in the form of a study guide, the goal will be to remind students of their own habits and evaluate if the students need to seek help or new skills.

Preparation: When students register for classes, they have options to prepare for the class, including reviewing the entire degree program, researching the professor/instructor, reading the course description, and more. Figure 2 shows the breakdown of student responses of how they prepare for a semester. This figure shows that that students with higher GPAs were on average 3x as likely to review course material, prerequisites, and a course's place in the overall program, when compared to the lowest GPA group. Responses showed that the lower performing students
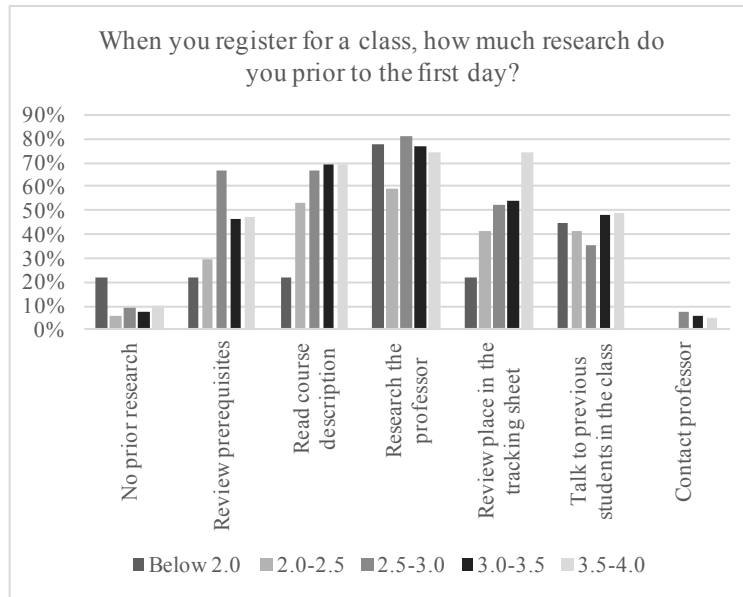
Figure 2: Student survey responses regarding preparation prior to the first day. Students could choose multiple options, so the values do not add to 100%.

relied most on researching the instructor and talking to students who previously took the class. The additional preparation done by the higher achieving students likely helps students to prepare mentally and academically for the topics in a current course.
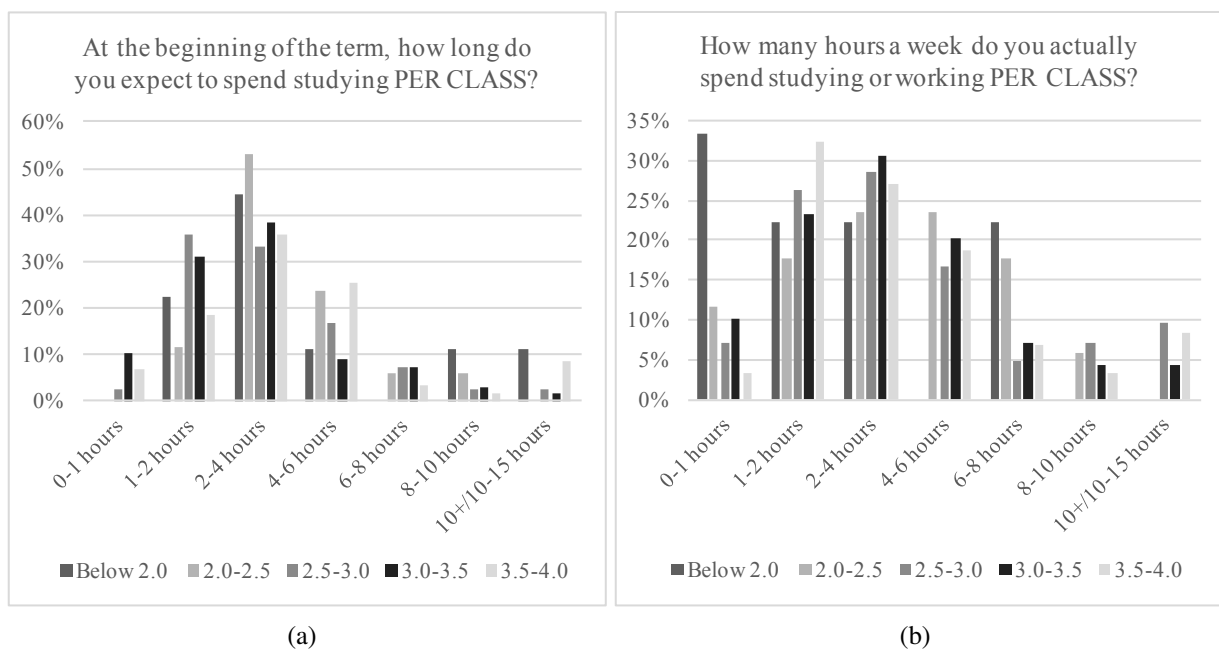

(a)

(b)

Figure 3: Student survey responses regarding (a) how much time students plan on studying/working for each technical course and (b) how much time students actually spend.

Time estimation: Along with this per-semester preparation, students need to allocate their time for several courses at once, including completing assignments and studying. Before entering a class, students can estimate how many hours per week they will spend studying, helping to manage their workload. Survey responses revealed that successful students prepare mentally for more hours per class. The same students spent more time on the class than the lower performing students; more than two-thirds of the students with lower GPAs spend less than 4 hours on each class, with a third spending less than an hour. Figure 3 demonstrates the full breakdown of responses. Overall, time management and planning can be used as predictors of student success. This type of intention vs. reality insight is critical to better providing students with the skills necessary to adapt and succeed in higher education.

Starting early: Students vary in their procrastination habits or time management skills. In this survey, it was revealed that higher performing students had a habit of beginning their studies sooner than those with weaker performance (Figure 4); thus the inferred advice for new or struggling students would include developing strong time-management and starting early on assignments and studying. This is another conclusion that seems intuitive, but discussion of this point serves two greater purposes: 1) provide data to reinforce the "start-early" mentality to incoming students in the study guide; and 2) show the reality of when students begin assignment compared to their own understanding that they *should* start early.
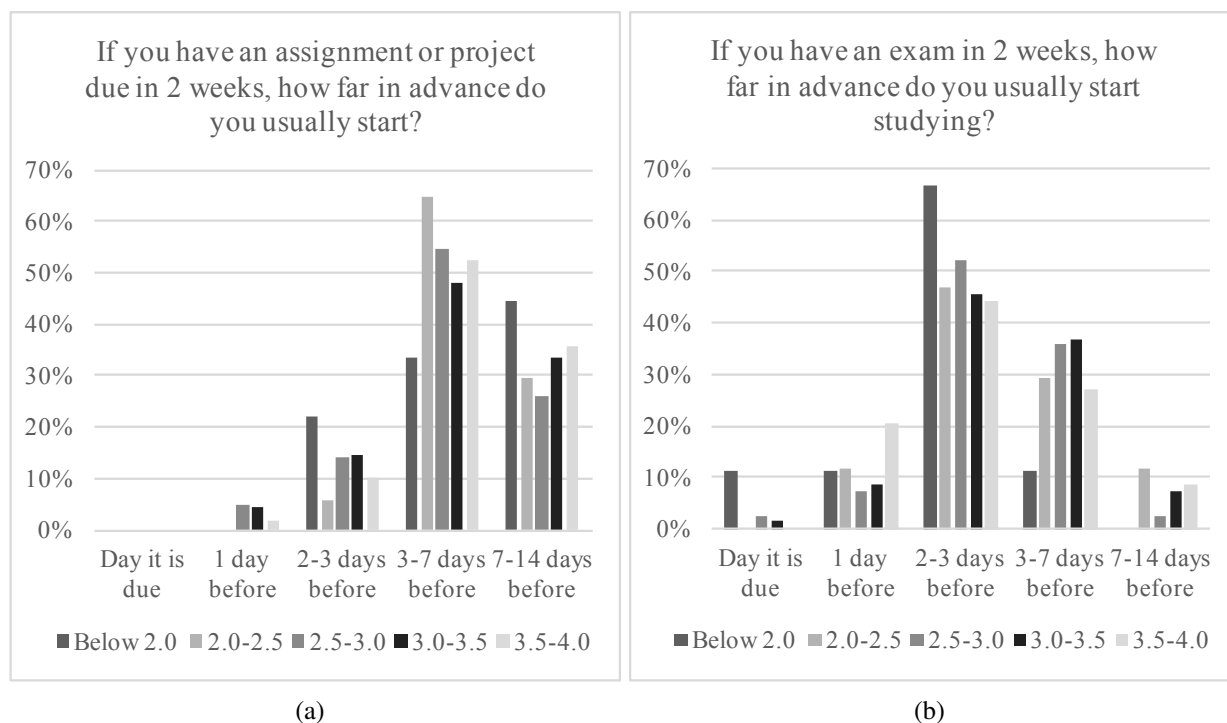

(a)   (b)

Figure 4: Breakdown of when students begin studying (given 2 weeks notice of a deadline. (a) shows when students would begin a project or assignment and (b) shows when they start studying for an exam. The percentages are based on the number of students per GPA grouping.
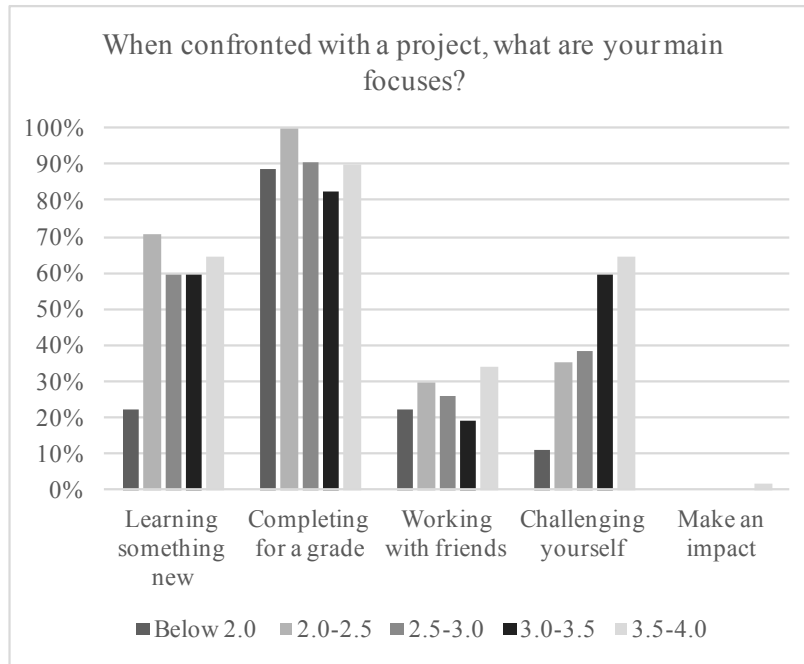
Figure 5: Student survey responses regarding: what are the central motivations and goals for students entering into a new project. Note students could check more than one answer, so the numbers to not add to 100%.

4.2.2 Approach to class

The mindset a student brings into the classroom is a major and, in some cases, deciding factor in the student's performance. The survey results show a contrast between the student groups in their approach, as summarized in Figure 5.

Mentality when starting projects: As an example of the mindset students have, Figure 5 summarizes the general goals students have when beginning a long project or assignment. The first thing to notice is that most students are trying to get a good grade, which makes sense in a college setting. However, the more distinguishing factors seem to be that the more successful students attempt to challenge themselves and set out to learn new skills or concepts, while the students with lower GPAs focus only on the grade. It is possible that the students with lower grades cannot focus on anything other than the grades, as they are in danger of academic issues such as probation or expulsion. However, a student with a lower GPA could change their mindset and still approach assignments as a challenge to learn rather than a grade-driven task, even if they choose not to. The data support at least the correlation of mindset and performance.

Completing assignments: To pass a class, students must complete assignments as given. Successful students would thus be expected to submit all assignments. This was in fact the case, but the results show students with lower GPAs also submit all assignments (self-reported). Meanwhile, students in the middle groups of GPA (2.0-2.5 and 2.5 to 3.0) responded that only

about 60% submit all assignments, with the remaining students claiming they submit *most* assignment. To speculate, students with poor academic performance know that not submitting an assignment could result in further academic performance problems (*e.g.*, probation). However, students with decent grades feel less compelled to hand in each assignment, but are not motivated enough (factors notwithstanding) to complete them all. These students in the middle group also have a lower tendency to use textbooks or attend office hours when in need of help.

4.2.3 Getting help and study habits

Students enter their undergraduate program having had some level of success in high school. Thus, as they transition to college classes, their approach often evolves to better serve the new environment[21,22,21,23]. Similarly, students have to find new sources of getting help, whether from professors, friends, or more formal tutoring and mentoring. To understand the students' own behaviors strategies, the survey explored these areas. In some cases, the investigators seek out a student's intentions, but the focus is the *realities* of their habits and strategies.
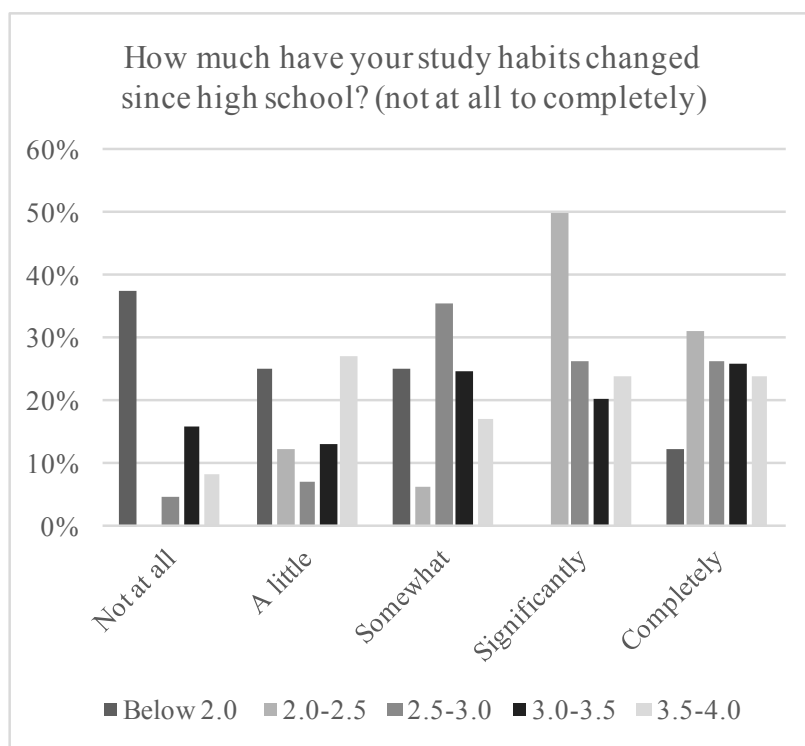
Figure 6: Student survey responses regarding: on a scale of 1 (not at all) to 5 (completely changed), how much students have changed their study habits since high school, organized by GPA grouping.

Source of study habits: The ability to adapt to new class structures is certainly a critical skill for sustained success in college. Figure 6 shows how much students believe they have changed their study habits since high school (1 indicates not at all, 5 indicates completely new study skills/habits). While all groups of students indicated a change in their study habits, the most

concerning result is that 38% of the students with low GPAs claim to have not changed their habits at all and only 13% have completely changed them. This result, combined with student confidence (55% students with lower GPAs reported a lack of confidence in their own habits) and a willingness to accept new habits (66% of lower performing students would likely adapt new strategies), implies that students do not know how to study and lack an overall insight into how to adapt. This is an insight best viewed by university professionals. Professors, counselors, and administrators should re-evaluate how new strategies are shared with a wide audience early in their careers.

Motivation for change: Along with the multiple choice question, another question asked students what motivated a change in study behavior. Both higher and lower performing students most frequently cited their past academic performance as the primary reason for adapting or changing their study habits and learning strategies. In response to this open-ended question, lower performing students more likely noted their "grades" were the primary reason for change. Higher achieving students' responses indicated performance as a motivator, but also indicated a desire to learn more and master the material. For example, one respondent noted "passion to learn more outside of the classroom" and another noted "getting something worthwhile." These students appear to possess a desire to learn about the material.

Higher achieving students also noted that concerns around the efficiency of their studying also motivated change. Unlike lower achieving students, who simply stated grades as their entire response, higher achieving students indicated they "notice what works" and sought to be more efficient with their time. Responses which included a theme of efficiency often indicated a theme of a set goal, such as "produce quality work" coupled with a concern about the time it took to achieve that goal. The issue of time and efficiency towards accomplishing the goal appeared as a central theme for high achieving students as a motivation for changing student habits, but did not appear in the lower achieving students' responses.

Seeking help: Figure 7 shows the survey results for the question of "When you don't understand a topic in class, what are your typical actions? Check all that apply." Earlier, this paper discussed that the Internet was a primary source for all students, but here the data show the separation in how students seek help. Students with higher GPAs were more likely to (a) study their own notes, (b) speak with a professor, and (c) ask questions in class. The latter two imply that these students are looking for help from instructors (at Wentworth, there are no TAs). Without attaching direct cause, students that are asking for help directly from the professors have a higher chance of succeeding overall. Seeking knowledge from experts is also an important skill for long-term career success. Students should view this insight as a means to evaluate their own help-seeking behaviors and potentially adapt to improve themselves.

4.3   Qualitative open-ended responses

The student survey gave students the opportunity to share more direct open-ended advice with their peers, rather than the multiple-choice style presented so far. A keyword analysis of the open short answer questions revealed the most common pieces of advice for a student's peers were
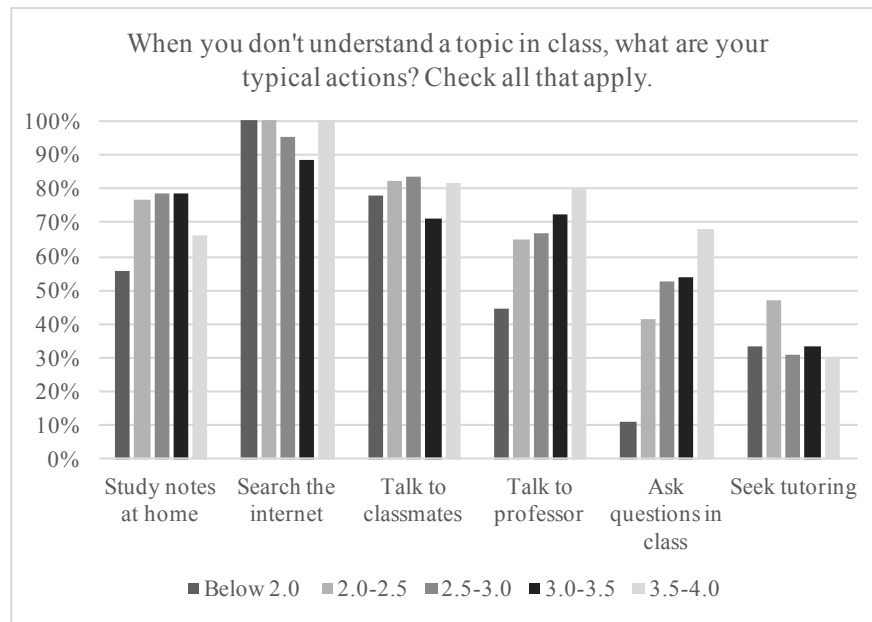
Figure 7: Student data regarding how students strategize when they do not understand a concept in a class. Note students could check more than one answer, so the numbers to not add to 100%.

regarding time management (24% of comments), attending class (23%), and seeking help from either instructors or tutoring (20%). These findings show that students recognize the importance of time and effort and do not stigmatize getting help or tutoring. A deeper analysis of the qualitative short answers will be a part of the future work.

5 Student Advice for and from Students: A Study Guide

The primary goal of this work is to encourage students to adapt stronger study habits based on their peers' successes and failures. Thus, the above analysis is aggregated into a single document that will serve as a study guide for students. It consists of the conclusions from previous analyses and qualitative comments (paraphrased and quoted) given in the survey. The document was created by the investigators, including an undergraduate student researcher who helped present it in a way most palatable to undergraduate students.

The survey and its accompanying data, being focused on students at Wentworth, are more likely to be adopted by incoming or struggling students. Future work will evaluate the students' willingness to evaluate their study habits and adapt new ones as necessary. The study guide document focuses on what students revealed as their tendencies and then supplemented those with advice. Figure 8 contains a portion of the sample study guide that will be shared with incoming or academically-struggling students, based on the qualitative and quantitative results of the survey. This represents advice from students to students.

<div style="border:1px solid black; padding:10px;">

Tutoring and Friends
- Seek help from tutoring, friends, professors
- Friends are sometimes the best resources because often "a group of friends [is] taking all of the same classes"
- Everyone has different study techniques, "which may help you to see a problem from a different viewpoint"
- "Explaining your own work and helping friends will give you a better understanding of the topic"
- "Find friends who are going to be a positive influence"

Seeking Help
- Use the class time and professor to improve your understanding, by asking questions and engaging in discussion. It will help with your ability to really learn the material
- Important part of growing in your learning is to seek outside help
- Tutoring does not have the stigma that some students believe it has
- Use office hours and set up one-on-one meetings with professors
- Part of instructor's job is to make sure you understand the content
- Don't be afraid to "speak to other professors that explain in a way you understand"
- "Try to ask as many questions as possible" since it will help you and all other people in the classroom with the same questions

</div>

Figure 8: A portion of the sample study guide that will be shared with incoming or academically-struggling students, based on the qualitative and quantitative results of the survey. This represents advice from students to students.

6 Future Directions

This work is still in progress but has provided insight into future directions for the investigators. To give context to the future work, some next steps have been listed with the analysis in the appropriate previous sections (to help with context and direction) and in this section are simply restated. For example, as described in the previous section, a deeper qualitative analysis of short answer responses will be included in future efforts, building on what was learned in the analysis so far.

The survey as presented here will be revisited to further refine the questions and potentially expand on the interesting insights found in the initial questionnaire. For example, these data revealed a correlation between study habits and academic performance, but do not reveal a causal relationship. Thus, a new generation of survey would contain questions that would determine more certain causality and get deeper insights to specific questions not answered yet. These results will also be further correlated with the state of the art in educational research.

The preliminary findings will be made publicly available to the student population, hopefully inspiring students to reflect on their own learning strategies and adapt as necessary. Similarly, college counselors, tutors, professors, and other student-centric staff at Wentworth Institute of Technology will use this data to better train first year students on learning strategies and help students in academic distress (warning, probation) to correct habits. Further work will explore the efficacy of these new changes both inside and outside of the classroom.

7 Conclusions

Undergraduate students vary widely in their study habits and learning strategies, often adapting them from high school to college curricula. These changes are spurred on from professors, friends, self-reflection, and academic professionals; often the transfer of habits is done in a one-to-one setting, passing from peer to peer. However, the word-of-mouth is not analyzed at a higher scope to help reveal trends, inconsistency, and best practices, and often students do not ask for broad help from their peers. This paper has presented a survey given to more than 200 undergraduate students and recent graduates to help identify what strategies are being used and by what groups of students. By first organizing and analyzing these data by GPA, this work has given some insights into undergraduate mentality, including what students do when they struggle, where they get their current study habits from and how they manage and prepare for class. Specifically, the survey seeks to understand students' real-world study habits and help-seeking behavior in their lives. These results will (a) help the current cohorts of students in undergraduate programs to better understand successful habits, not from authority figures, but from each other and (b) influence how college professionals help new and/or struggling students.

References

[1] R. Ames and S. Lau. An attribution analysis of help-seeking in academic settings. 74:414–423, 06 1982.

[2] S. Karabenick and M. Dembo. Understanding and facilitating self-regulated help seeking. *New Directions for Teaching and Learning*, 2011(126):33–43, 2011.

[3] M. Crede and N. Kuncel. Study habits, skills, and attitudes: The third pillar supporting collegiate academic performance. *Perspectives on Psychological Science*, 3(6):425–453, 2008.

[4] D. Rheinheimber, B. Grace-Odeleye, G. Francois, and C. Kusorgbor. Tutoring: A support strategy for at-risk students. *Learning Assistance Review*, 15(1):23–24, 2010.

[5] A. Ryan, P. Pintrich, and C. Midgley. Avoiding seeking help in the classroom: Who and why? *Educational Psychology Review*, 13(2):93–114, 2001.

[6] J. Giblin and J. Stefaniak. Achievement goal structure and type of assistance sought in an undergraduate classroom. *Journal of Applied Instructional Design*, 6:33–42, 2017.

[7] K. Rawson and T. Stahovich. Predicting course performance from homework habits. In *2013 ASEE Annual Conference & Exposition*, June 2013.

[8] C. Amenkhienan and L. Kogan. Engineering students' perceptions of academic activities and support services: Factors that influence their academic performance. *College Student Journal*, 38(4):523–540, 2004.

[9] D. Lynch. Confronting challenges: Motivational beliefs and learning strategies in difficult college courses. *College Student Journal*, 42:416–421, 2008.

[10] M. Puustinen and J. Rouet. Learning with new technologies: Help seeking and information searching revisited. *Computers & Education*, 53(4):1014–1019, 2009.

[11] C. Foor, S. Walden, T. Combrink, L. McClure, and D. Trytten. I wish someone would've told me: Undergraduate engineering students offer advice to incoming students. In *2006 Annual Conference & Exposition*, June 2006.

[12] S. Karabenick. Relation of perceived teacher support of student questioning to students' beliefs about teacher attributions for questioning and perceived classroom learning environment. *Learning and Individual Differences*, 6(2):187–204, 1994.

[13] S. Karabenick. Perceived achievement goal structure and college student help seeking. *Journal of educational psychology*, 96(3):569, 2004.

[14] S. Karabenick and R. Sharma. Perceived teacher support of student questioning in the college classroom: Its relation to student characteristics and role in the classroom questioning process. *Journal of Educational Psychology*, 86(1):90, 1994.

[15] N. Huet, C. Dupeyrat, and C. Escribe. Help-seeking intentions and actual help-seeking behavior in interactive learning environments. *Advances in help-seeking research and applications: The role of emerging technologies*, pages 121–146, 2013.

[16] A. Kozanitis, J.-F. Desbiens, and R. Chouinard. Perception of teacher support and reaction towards questioning: Its relation to instrumental help-seeking and motivation to learn. *International Journal of Teaching and Learning in Higher Education*, 19(3):238–250, 2007.

[17] J. Hattie, J. Biggs, and N. Purdie. Effects of learning skills interventions on student learning: A meta-analysis. *Review of Educational Research*, 66(2):99–136, 1996.

[18] N. Bas, R. Heininger, M. Utesch, and H. Krcmar. Influence of study skills on the dropout rate of universities: Results from a literature study. In *International Conference on Interactive Collaborative Learning*, pages 133–144, September 2017.

[19] C. Baillie and G. Fitzgerald. Motivation and attrition in engineering students. *European Journal of Engineering Education*, 25(2):145–155, 2000.

[20] B. French, J. Immekus, and W. Oakes. An examination of indicators of engineering students' success and persistence. *Journal of Engineering Education*, 94(4):419–425, 2005.

[21] N. Honken and P. Ralston. High school homework habits and success in first-year engineering. In *2015 ASEE Annual Conference & Exposition*, June 2015.

[22] M. Anderson-Rowland. Understanding engineering freshman study habits: The transition from high school to college. In *2009 Annual Conference & Exposition*, June 2009.

[23] M. Lammi and T. Branoff. High school students' habits of mind and action in engineering design. In *2012 ASEE Annual Conference & Exposition*, June 2012.

[24] A. Kitsantas, A. Winsler, and F. Huie. Self-regulation and ability predictors of academic success during college: A predictive validity study. *Journal of Advanced Academics*, 20(1):42–68, 2008.

[25] H. Peng, C. Tsai, and Y. Wu. University students' self-efficacy and their attitudes toward the internet: the role of students' perceptions of the internet. *Educational Studies*, 32(1):73–86, 2006.

[26] C. Bond, D. Fevyer, and C. Pitt. Learning to use the internet as a study tool: a review of available resources and exploration of students' priorities. *Health Information & Libraries Journal*, 23(3):189–196, 2006.

[27] J. Wolfe, J. Fawcett, and B. Powell. Help-seeking among undergraduate men and women in engineering. In *2015 Annual Conference & Exposition*, June 2015.

[28] D. Thompson and M. Mwavita. Help seeking behavior among freshmen engineering students: A predictor of calculus performance. In *2006 Annual Conference & Exposition*, June 2006.