Are Students Overworked? Understanding the Workload Expectations and Realities of First-Year Engineering

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Abstract
A study was conducted to investigate first-year engineering undergraduate student workload at the Faculty of Applied Science and Engineering, University of Toronto, Canada. The study was prompted by student feedback suggesting high workload, impacting their learning experience in first-year and motivated by a Faculty whose goal is to increase accessibility and inclusivity for all students.

The multi-part study followed the 2016 cohort of first-year undergraduate engineering students as they completed their first-term of study. Each week in that term, a random sample of students submitted details of their weekly workload, including perceptions of difficulty, for each course quantitatively and qualitatively. These data are investigated in addition to information gathered at the beginning of term from all students and instructors of first-year engineering courses.

The analysis of expectations and realities of first-year student workload yields information that can lead to the development of a more integrated, inclusive first-year engineering curriculum. Observations suggest that workload almost doubles within the first three weeks of class and assessments (major and minor) have an amplifying effect especially as they can be inadvertently grouped-together on specific dates. Additionally, there appears to be a link between perceived difficulty and hours spent, with that link aligning better as the courses progress. Furthermore, data also suggests that the first-year design/communication course has a large spike in workload midway through the term, much larger than the increases seen in the heavy-weighted assessments in non-design courses. Qualitative responses suggest that students may feel less prepared for such courses, and consequently spend more time on them when compared to non-design courses.

A deeper look at the results suggest the emergence of several categories, some more dominant and impactful to first-year student workload and perceptions of difficulty than others. These categories, in decreasing order of prevalence include: Time, Volume, Course and Program Content, Transition, Instruction, Communication, and Expectations. From here, the observations clearly suggest that students tend to think of their time spent and volume of work completed on an activity significantly more often than references to instructions, modes of delivery, quality of instruction, and the expectations of the instructor.

Introduction
Engineers understand stress and strain as deforming forces acting on an object. These forces can change the object’s shape, sometimes irreversibly so. We use the metaphor of stress and strain to connect to the experience of the incoming, first-year engineering student at the University of Toronto facing mounting workload concerns. The stress and strain experienced by undergraduate students may be so personally ‘deforming’ at this stage, that students who were
high-performing prior to entering the university environment, may not be in a position to succeed during their first year, and consequently, persist in their program of study.

Practicing as a professional engineer in Canada is predicated on the successful completion of a 4-year Bachelor’s degree. Those who successfully complete one of these accredited programs will have completed appropriate qualifications to meet the knowledge requirements of licensure as a professional engineer, or P.Eng. Each of these programs in accredited to ensure standardized requirements of this professional designation. Research in engineering education has focused on the appropriate training and preparation for the professional engineer. The engineer in society may be responsible for the conception, creation and improvement of assets or systems that serve the human condition or quality of life, and possibly on all fronts, as social, cultural or economic impacts. The critical role of the engineer sits largely in an empowered, adaptive ability, and educating engineers that will be successful as working engineers, are those who are ready to face the challenges of an unknown future. Through this lens in an analysis of engineering as a profession, there is evidence that the occupations and activities of practicing engineers have been susceptible and adapted to changes over time. These might include changes made real through scientific advances, technical knowledge, shifting economics, regulatory developments and societal priorities. The successful engineer will be in a position to not only navigate these changes, but to lay the path for their realization as well. To scaffold the learning and application of engineering, instructors need to be cognizant of the challenges faced by students, and build an inclusive, accessible environment for all students.

Motivation

This research was initiated in response to first-year engineering student concerns regarding workload at a large public university, the University of Toronto. In order to address these concerns, both the first-year engineering students’ and course coordinators’ perspectives must be understood. By considering both perspectives, this study provides insights that may inform course scheduling, course curriculum development and integration of campus resources to improve student experiences with the first-year engineering workload. Further, this information will help our faculty to better support students’ transition to university. The result of this research may also lead to improved recruitment efforts and better planning of engineering programs. We hope that by tackling the issue of workload we will enrich and further improve the students’ experience. Numerous research studies show that students learn many of the professional and leadership skill sets required for workplace through their extracurricular activities [1]. Investigating student workload will inform the impact of existing workload on the students’ abilities to engage in extracurricular activities. Based on the academic calendar First-year students spend on average about 27 hours a week on lectures, labs, and tutorials. Our research will focus on how many hours student spent outside of the lecture/labs/tutorials for each course. A combination of this data will give a better picture of the current workload for first year engineering students.
**Research Questions**

The principal research questions driving this study are:

- What is first-year engineering student workload?
- How does student workload change throughout the term?
- Is student workload affected by conceptual difficulty of course content?

The specific perspectives we are investigating to help answer this research question are:

- What are the first-year undergraduate course instructors' expectations of student weekly workload?
- What is the actual weekly workload for first-year undergraduate engineering students (hrs/week), and is this influenced by course difficulty and/or other factors (described both quantitatively and qualitatively)?

The research study has the potential to situate across factors for success in post-secondary education (access, persistence, engagement, performance, graduation), with implications for both the student and instructor. Data may serve to inform the development of cross-discipline engineering strategies for course and program design that addresses workload concerns. The information gathered may help promote a more inclusive and accessible first-year undergraduate experience by integrating an evidence-based understanding of workload.

**Background**

Engineering undergraduate programs are known to be very demanding as course schedules have a significant number of classes, laboratories and tutorials. On average, a first year engineering student at the institute of our study will have 27 hours of classes/tutorials and laboratory. This workload is just for attending classes and does not account for studying, assignments, projects and other course assessments that occur outside of the scheduled calendar.

Due to this heavy full course schedule, transitioning from secondary education to tertiary education presents many challenges for students as their expectations of higher education do not always align with their actual experiences. Brinkworth et al. found inconsistencies between student expectations, actual student experiences and instructor expectations relating to workload, feedback on work products, learning styles and access to instructors in a study investigating first-year student preparedness in the sciences and humanities [2]. Bowyer developed a model to consider perspectives in transition. More specifically, research suggests that students' perception of engineering courses were different from reality which led to a lack of preparation for taking on the demand of engineering programs [3]. Improving the communication between the course coordinators and students can potentially align these expectations.

Efforts to support incoming students on their transition into the university include communicating workload expectations to students and their families in advance of the program start. Sample timetables for a number of different courses across disciplines are shared with students and posted on the Faculty website, with a blank timetable for students to begin to plot their own anticipated workload schedule.
In order to effectively study first-year engineering workload, the term “workload” must be defined, as workload can be interpreted in a variety of ways. Workload is often associated with the time it takes to complete a task (studying, homework, class time etc.) and can further include the difficulty of those tasks. Bowyer expands on the typical definitions of workload to incorporate the time needed for contact and independent study, the quantity and level of difficulty of the work, the type and timing of assessments, the institutional factors such as teaching and resources, and student characteristics such as ability, motivation and effort [4]. As such, workload can be considered a multidimensional construct that is subjected to change based on various factors such as student's ability and motivation, environmental factors, institutional factors and different teaching methods. This study considers time requirements, conceptual difficulty of subject matter and scheduling of course tasks (including assignments, tests, exams, laboratories) when analyzing first-year engineering student workload.

Research supports active engagement in learning and its role in motivating students [5], particularly to contend with workload challenges. Kember et al. found that perceived workload is not necessarily an accurate measure of actual workload but that it is a function of individual characteristics, approaches to learning, and conceptions of the learning context [6].

A heavier workload has been correlated to a more ‘surface approach’ to learning, contrasted with a ‘deep approach’ found to be connected to higher levels of overall student satisfaction within a course of study [7] [8]. Literature suggests that an instructor or course that encourages a surface approach to learning, yields perceptions of a heavier workload, whether or not it is ‘heavier’. Kyndt et al. found no significant relationship between perceived workload and students’ approaches to learning, but found a perceived lack of information “consistently increases students’ surface approaches to learning regardless of the induced workload and task complexity” [9]. This suggests that student expectations, a consequence of available information, can influence perceptions of workload and motivation.

Researchers demonstrate that workload related stress can affect student's learning ability [10]. For example, a student who is overloaded is most probably engaging in surface learning and will not have a chance to engage in deep learning that has a long lasting positive affect. Studies show that deep learning and active engagement in learning has a positive effect on student's motivation for studying. [5] [8]

Kember and Leung found that there is a correlation between student's English proficiency and perceived workload [11]. This correlation suggests that students with lower proficiency scores may perceive a higher workload, when compared to native speakers. Since the number of international students and bilingual students is significant in our institution, it is important to be aware of the impact of this work on creating an inclusive and accessible environment for all students. As such, the researchers in this study have enabled both qualitative and qualitative input from the student participants to better understand workload concerns.
Methods

Participants
Two groups of participants were considered in this study to represent two specific perspectives on first-year engineering undergraduate student workload; current first-year engineering undergraduate students (“current students”) and first-year engineering course coordinators (“coordinators”).

Current students have a diverse range of educational and personal experiences, which shape student expectations of the engineering workload and their ability to succeed in a first-year engineering program. It is important to consider this perspective when addressing workload expectations as these expectations build on the students’ prior experiences. Factors like time management and study skills and students' motivation and enthusiasm all play an important role in their expectation. Current students are actively engaged in their first-year curriculum and can reflect on their recent experiences and provide data regarding actual and perceived workload for first-year engineering students as they progress through their first semester of study.

Coordinators play an important role in the development of student workload expectations and the alignment of student workload and student performance. Coordinators determine the course content and the number and timing of assessments throughout the term and are responsible for communicating this information to the students. This is an important perspective to assess in understanding first-year engineering workload.

This study focused on student and coordinator perceptions for a selection of individual courses that are a part of the first-year engineering curriculum. Details of the courses under analysis are outlined in Table 1.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Course Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAT186</td>
<td>Calculus I</td>
<td>Core course in Calculus for all first-year engineering students; discussing limits and basic principles in foundational calculus</td>
</tr>
<tr>
<td>MAT188</td>
<td>Linear Algebra</td>
<td>Core course in Linear Algebra for all the first-year engineering students. Includes an introduction to numeric computation.</td>
</tr>
<tr>
<td>APS111/2</td>
<td>Engineering Strategies and Practice</td>
<td>Core course for engineering students; focusing on engineering design, teamwork, and communication. This course introduces and provides a framework for the design process, and uses a problem-based active learning pedagogical approach.</td>
</tr>
<tr>
<td>CHE112</td>
<td>Physical Chemistry</td>
<td>Core course for students in chemical, material, and civil engineering.</td>
</tr>
<tr>
<td>CIV100</td>
<td>Mechanics</td>
<td>Core course in engineering mechanics, presenting and applying the theories of objects in motion as applied to frameworks of civil and mechanical engineering</td>
</tr>
</tbody>
</table>
Rationale
Quantitative and qualitative methods are used to better understand the challenge of workload for first year students. This approach enables us to better scope the present investigation and capture student data at scale, while providing direction for future work in subsequent studies. We used the quantitative method to collect information from the large (~1200) class of first-year engineering students. We used qualitative methods to have a better understanding of the workload problem from multiple perspectives.

An ethics board-approved online survey was sent to sample groups of students each week to cover the large class of engineering students. Since our data is not coming from the exact same students each week – in an effort to prevent survey fatigue -- our interpretations are based on the reasonable assumption that these pseudo-random sample groups of 20 first-year engineering students are statistically similar samples. Getting data from groups of students with weekly frequency was the rationale behind this approach. The result and conclusion of this research is also based on the assumption that students are honest about their effort and their self-reported data is reliable, especially since the output of this work influences our collective understanding of workload.

For each dataset, we selected to use the median value of the student responses. The median was chosen as a measure of central tendency to better present the student population as we are interested in collective experience rather than individual experience at this point, and account for potential outliers in each sample group on a weekly basis.

Data Collection
The principal method used in this study is an online survey. Two surveys were developed as part of this study to target the two participant groups: instructors and students. Additional data considered in this study includes a schedule of the first-year engineering course workload (anticipated assignment, quiz, test, project, laboratory due dates) furnished by all first-year coordinators.

The first survey was distributed to all first-year engineering course coordinators via email (N=10). The survey received a 50% response rate. This survey consisted of a template for coordinators to provide consistent quantitative information regarding course deliverables including, the topic of the deliverable, the weight of the deliverable in the course, the deliverable due date, and the estimated time for the student to complete the deliverable.

The second survey was distributed to current students weekly throughout their first semester of their first-year in 2016. Twenty students were selected at random from each engineering program each week (N~120/week). Surveys were distributed at the end of the week in order for students to reflect and respond based on that particular week of study. The survey received a response rate of 26.87% with a completion rate of 77.88%. This survey focuses on the perceived operational and conceptual difficulty of course content, the nature of that content, the perception of course assignments, deadlines and expectations, and the overall instructional experience. Data at the point of analysis will be anonymized and used in aggregate to explore the elements under
investigation. Questions asked in this survey include both quantitative (multiple choice, scale) and qualitative (open-ended) questions and all participants are consenting to the research study, which is reviewed by the institutional ethics board.

From the distributed workload survey, we assessed quantitative data by interpreting the reported information by course, comparing student perceptions of conceptual difficulty, their time spent studying and the scheduling of course assessments across the first semester of study in an undergraduate engineering program.

**Results**

This section shows a compilation of data acquired from the Engineering Workload Study. This section includes data for conceptual difficulty and hours spent outside of class for each course in this study in addition to scheduling and weighting of assessments obtained from instructor surveys. Figure 2 through Figure 4 provide an overview of first-year engineering student experiences in five courses individually. Figure 6 focuses on the accumulated hours spent by students outside of class for all of the courses. Figure 7a present the average number of hours spent out of class for each course individually. Figure 7b present the media of conceptual difficulty reported by students for each course.

Figure 2 through Figure 4 show four technical courses, Linear Algebra, Calculus I, Physical Chemistry, and Mechanics while Figure 5 shows a professional engineering skills course, Engineering Strategies and Practice. Each show a comparison of the reported time spent by students outside of the class (solid line), the students’ perceived conceptual difficulty of the course material (dashed line), and the timing and percentage of assessments held throughout the course as reported by the instructors (assignments, labs, quizzes, and midterms).

The Y-axis represent the time spent outside of class and conceptual difficulty. Each of these variables have their own range. The number of hours spent outside of class varied from 0-16 hours for this study. The conceptual difficulty varied from 1 to 5, corresponding to the Likert scale used. The X-axis is a representation of time through the semester, segmented into weeks from September to December. The Y-axis on the right side represent the percentage of any test, quiz or lab during the semester for each specific course. These quizzes and tests are marked with various shapes and color of rectangle, circle and square.

The mean of sample values is prone to outliers, especially since the weekly response rate is variable. When mean was used, the graphs suggested greater volatility than the graphs which used median, and this was not an accurate representation of the data. Outliers in our data are those students that spent substantially longer hours, with respect to mean, studying subjects that they perceive to be difficult for them. As such, we consider the median of recorded values in each week to alleviate the effect of such outliers. Figure 1 through Figure 5 show data for all the courses that we investigated, using median as the measure for average. The assessments are plotted with respect to their respective percent-weight of the course.
Figure 1 Workload, conceptual difficulty and assessments of a first-year Calculus course

Figure 2 – Workload, conceptual difficulty and assessments of a first-year Linear Algebra course
**Figure 3** - Workload, conceptual difficulty and assessments of a first-year Physical Chemistry course

**Figure 4** - Workload, conceptual difficulty and assessments of a first-year Mechanics course
The data of Figures 1-5 show that the amount of time that students spent studying a particular course increases substantially prior to deadlines for major (i.e., having high weight in final mark) course assessments. To see the cumulative impact of workload for a typical first-year schedule, the average weekly workload for all courses above are plotted onto one graph, as seen below in Figure 6.

Figure 5 - Workload, conceptual difficulty and assessments of a first-year Engineering Strategies and Practice course
Figure 6 shows accumulated/stacked weekly median hours of study by participants for selected courses. In Figure 6, we can observe two weeks in October (i.e., week of Oct. 07 and Oct. 28) when students’ efforts are accentuated. These weeks correspond to accumulation of major quizzes and tests for majority of courses under considerations. The far-right points of Figure 6 also show increases in students’ efforts. These points can be explained by students’ efforts to prepare themselves for the finals. This graph shows that major tests and assignments for different courses are all scheduled around the same time that increase students’ workload for specific weeks. Another interesting observation is that students start with around 14 hours of studying at the beginning of the semester but this number increase by around 40% in 3 weeks and consistently stay around this number or higher until the end of the semester. It is not clear whether this large increase is because they were not expecting this workload or they just did not take the first week of classes seriously. Further data analysis between the incoming and current students may help answer this question.

Looking closer at the week of October 28th, the peak with highest number of hours, we can observe that the spike in the data is mostly driven by the ESP design/communication course and the rest are fairly linear. This observation might suggest that the non-design courses like calculus and mechanics are more predictable for students, compared to the ESP which follows a unique active learning problem-based pedagogical approach.

During the week of Oct.28, students spent around 34 hours on average outside of the class. Topping up this number with the class time which is 27 hours in average we are looking at 61
hours of work per week for a first year engineering student during heavy periods (such as Oct. 28th). Considering that we did not include all the first year courses in our study, as some students may decide to overload their schedule, we can see that there might be cases where students’ workload is more than 61 hour per week.

Figure 7a compares the median conceptual difficulty scores that students gave to each course in the duration of study. We chose the median because the collected data is ordinal. In Figure 7b, we compare the average time students spent per week on each course. We can conclude from the graphs of Figures 7a and 7b that students on average spent more time on courses that they perceived to be more difficult. Students on average spent more time on ESP and Linear Algebra. Looking at the curriculum of high schools, as discussed in the subsequent section, the majority of students have limited prior exposure to the content of these two courses. This observation may support the idea that students were ill-prepared to take on the demand of these courses and hence tried to compensate for their lack of preparation by spending more hours studying these courses. Further investigation is required in this area to better understand this observation.

On average, students found all the first-year courses to be difficult as their perceived difficulty is always higher than 3, on the 5-point Likert scale rating.

![Figure 7](image_url) – Median perceived difficulty (left) and average hours spent outside of scheduled class time (right) for each course

To add context to the perceptions observed in the quantitative data, we explored additional information through the collection of qualitative data. To analyze these data we read-through the collected responses to a final over-arching open-ended question asked as the final question of the circulated student survey: *Do you have any other comments that will help us better understand first-year student workload?*

Students offered substantial feedback and provided context for their survey responses. Open-responses extended from 3-words to 1235-words, with the number of students responding to this open-ended question changing from week to week. Over the 13 weeks the survey was administered, we received as many at 27 text responses (the first week of classes) and as few as 3 (the week prior to the final examination period). These responses were compiled and analyzed
for themes. Emergent groupings for these responses were identified and these data informed the creation of the following thematic codes or categories:

1. **Time**: references to student time available to study and for leisure; the scheduling of classes; the scheduling between assessments; differences in the amount of work or effort required week-to-week.

2. **Volume**: references to volume or quantity of work; whether the work was manageable, too much, notions of keeping or catching up with course pace; differences experienced week to week and across courses.

3. **Course and Program Content**: references to the perceived difficulty of; sequencing of material and assessments; perceived value of non-technical courses; differences between courses.

4. **Transition**: references to an adjustment period or changes; feelings of preparedness; differences perceived when compared to their high school experience.

5. **Instruction**: references to the perceived quality of instruction; instructor organization and modes of content delivery, how 'well' the course is taught; differences in the instructional 'success' between courses.

6. **Communication**: references to institutional emails; perceptions of extraneous information; difficulty navigating multiple platforms and online tools.

7. **Expectations**: references to the clarity of expectations on the part of the instructor, course or program; differences between communicated expectations and lived experiences.

We explored the incidence of each of these categories in our data. Over one third of the total text responses ($n=149$) refer to concerns either of time ($n=56$) and the volume of work ($n=54$). The next most-observed category, ($n=25$), describes concerns around course and program content. The areas of transition, instruction, expectations and communication were also relatively well-represented but to a lesser degree. The quality of these responses, the nuance of their content, and their interplay with the observed quantitative data, are discussed below.

**Discussion**

Overall, this paper aimed to contribute to an understanding of the experience of the undergraduate engineering student in their first-year, how they interpret the demands and stresses of their program of study and their interpretations of workload. This investigation has provided us a look into current understandings of workload as our students experience them. The data from this investigation appears to be consistent with existing learning from previous workload studies in the literature and may begin to draw attention to a few areas of interest to advance conversation in this area. While the interpretations brought forth in the context of this initial exploration may not allow us to draw any major conclusions at this time, they do highlight
interesting notions of the spectrum of student experience to advance the work of the engineering educator to better support the incoming student. It is important to note that we did not begin with any particular target value or metric of workload in mind and considered this data collection and analysis as exploratory work. Student perspectives of workload and their associated efforts with respect to time spent and the perceived difficulty of the content does yield some interesting interpretations.

We see evidence of the workload factors described in the literature manifesting in this population. Traditional definitions of workload incorporate the time needed for contact and independent study, the quantity and level of difficulty of the work, the type and timing of assessments, the institutional factors such as teaching and resources, and student characteristics such as ability, motivation and effort (Bower, 2012). These characteristics map indirectly to 7 emergent categories that seem to describe reported student workload experience in their first semester. Many of these constructs are delineated in traditional notions of workload, however in student commentary, these notions collapse to be referred to in tandem, and can be conceived as related or co-acting concepts. We can consider the major areas of concern in this way.

Perspectives on Time and Difficulty
Workload, conceptual difficulty and assessments are depicted in Figures 1-5. These visualizations show workload as a manifestation of that the amount of time that students spent studying for a particular course, the perceived level of difficulty in course content and when major assessments occur in each course. Not surprisingly, across all courses, the reported time spent preparing or studying increases substantially prior to deadlines for major assessments. In Figure 6 we can observe the stacked weekly median hours of study time reported by participants and note that the two weeks in October coinciding with major assessments (mid-term tests and other evaluations) align with accentuated student effort. Many major assessments are scheduled around the same time that contribute to a marked increase students’ workload for specific weeks. This phenomenon is echoed in student comments who mention scheduling of assessments as a notable point of concern:

"A larger gap between mid-term sessions would be very helpful!"

"Please don't put two midterms on the same week."

"It was very difficult to manage assignments, problem sets, and quizzes during weeks we had midterms. It was hard to know what to study because we wanted to do well on the midterms without falling behind in other courses."

"Having tests constantly every week for over two months were very stressful and worked against my plan to study for each course every night as I was forced to concentrate more on the upcoming exam rather than plan out an effective studying schedule and continued revisions."

"Very hard to keep on top of things, lots of classes demand lots of time."
"I feel like the schedules and class hours are too much. This leaves very little time for personal study"

These experiences suggest that students perceive workload and difficulty as functions of volume or quantity of assessments and time: the more they have to do and the more compressed the time available to do it, the heavier the workload appears.

**Perspectives on Volume and Difficulty**

Many students describe workload as a function of the volume of work they are required to complete. This may be contributing to their assessments in the quantitative data. Students express this, in just the first two months of their time as a student in the program, as:

"There's a constant amount (it's not TOO heavy just there's always something to do!"

"It's too much. I don't have much leisure time"

"The workload is very intense. Assignments that are expected by professors to take a certain amount of time almost always take a considerable amount more than that."

"Hectic. Hard to balance. I'm falling behind fast."

Many students echo this idea of falling behind or trying to keep up and that the pace, likely also a function of the time available for the demands of the program. In the courses we see a range of assessments that students are responsible for, sometimes weekly, sometimes just a few assignments across a longer period of time. However, the quantity of these assessments seems to be understood as an amalgamation of work across courses. Students describe this as overwhelming, a phrase repeated across many of the qualitative responses. This is also described as stressful, at times impossible and confusing. However, the root of these impressions and sentiments of difficulty may be a result of more than time and volume.

**Perspectives on Course Content and Difficulty**

In the most unfamiliar courses, students appear to spend more amount of time and interpret the course to be more difficult (Figures 7a and 7b). Students, on average, report spending more time on ESP and Linear Algebra. These two courses may represent the furthest departure from what students are anticipating or are prepared for when they begin their program, however, it may be for different reasons. The majority of incoming students have limited and/or no prior exposure to the content of these two courses. At first blush, this appears to result from lack of exposure to course content. However, in the case of Linear Algebra, students describe this difficulty as emerging from their preparation to understand the material:

"Students from BC, myself for example, tend to be more confused in linear algebra, and even calculus sometimes."

"It is difficult to deal with very conceptual questions in Linear Algebra especially without having a more basic understanding of the concepts. This makes for a lot of stress when
studying for the Tutorial Quizzes and doing the Tutorial Problem Sets. Otherwise the workload is quite reasonable."

However, preparation may also include understanding or anticipating a workload that extends beyond tradition, technical subjects. Students reported considerable challenge with completing the work involved for the required, non-technical course, Engineering Strategies and Practice (ESP):

"I spent less time on it this week than I will next week by a large margin and I simply do not see the same returns for each hour spent working on ESP as I do for other courses. If I were to put the same time I put into ESP assignments into CHE112 or APS163 I would have excellent marks and be very knowledgeable about important topics for engineers. There is much more to engineering than design, despite the glamour appeal to it. I think this course places too much emphasis on design for your average engineering student."

"ESP Assignments have a huge impact on us students. Initially we are completely lost most of the time and then we have to spend much more time than is necessary completing these assignments."

"ESP is simply too time demanding in the sense that you can't simply draw up an idea and put it into words and complete your assignment. It requires a great deal of thought and analyzing."

These and other comments indicate that the course is perceived as not as relevant as the technical courses students are taking. In the case of ESP, students do report devoting a considerable amount of time to coursework. However, many suggest that this is factor of the volume of work, not its difficulty. Further, many report that the course detracts from other more 'academic' efforts. The amount of time taken to complete the work in the course seems to compound impressions of its value and detracting or taking time away from other, more 'relevant' subjects. It also seems to draw on skills sets that students may not have anticipated using. This speaks to interpretations on the part of students of what will be and what is included in an engineering program and what may be required of engineers in their profession.

**Perspectives on other Dimensions of Workload**

There is a notion of *difference* or inconsistency that emerges from the data, indicating that students perceive each of these elements of workload as manifesting in divergent ways in their experience. As a pervasive theme this may suggest that this lived variability of experience translates to increased stress and consequently, a perception of workload that is both variable and unpredictable.

**Perspectives on Transition**

As students settle into the program, there appears to be a marked increase across courses in the amount of time students report studying. Many attribute this time period as a time of transition and adjustment to university life and learning:
"Much of the first year workload comes from the fact that people have to get adjusted to university life before too much stress is put on. A lot of people are living without their parents for the first time and many students come from far and have many things to adjust to."

"It took a while to get used to university mainly because we had to figure out that maybe some lectures aren’t worth going to, because other professors are better or just that your prof isn’t very good and youtube is better."

While the reason for this is not clear, it does suggest that students may be adjusting to substantial differences between what they anticipated would be and what is required in a University program. The challenge of first-year transition across disciplines is well-documented, though the role transition plays on perspectives of student workload realities warrants further investigation.

**Perspectives on Instruction**

Students describe a number of elements related to instruction as contributing to their experience of workload. This manifests in how, or more definitely, the extent to which things are described or explained, and make reference to specific teaching and instructional strategies:

"The concepts 'explained' in class are not hard. But in classes such as Linear Algebra and Physical Chemistry the teacher keeps writing on the board without explaining it properly. Questions about key facts are always made but the teachers do not give a clear answer or, sometimes, ignore them. Teachers limit themselves to restate what is in the book without giving a proper explanation."

"This is I think the biggest issue that the students are facing, and it is causing a lot of ineffectiveness and inefficiency in the learning process: the lecture style. The lecture style is outdated and simply ineffective. We are supposed to attend these lectures as a way to enrich our learning by listening to the wise and experienced professors this institution has to offer. Instead, my peers and I find ourselves simply attending these lectures to do nothing but frantically write down notes with little context and explanation, which can definitely explain why students are having a tough time doing all of the work."

"Please encourage professors to give an overview of what the lecture will be about at the beginning of class."

These comments suggest a variety of concerns with instruction from how information is described to being able to discern information in the moment. Students may be embarking on their University career without the skills to cope with learning in a setting that is in large part very different from what they may be used to. Students may perceive workload as a function of this experience as well.
Perspectives on Communication

Students also mention the role of online forums, discussion boards and email communication:

"The workload overall is moderate; however what makes it particularly overwhelming at times is trying to figure out the order in which to effectively complete tasks..., from [online system] notifications. I find the [online] system to be very difficult to navigate because every course / every course administrator has a different layout on their respective pages. This makes finding things like problem sets, web work, future lecture notes, and information about upcoming assessments a very tedious, time consuming task."

"It's been difficult to sift through all the alerts to make sure the assignments and necessary set-ups and readings were done."

"One other big concern pertains to [online systems] and [mail client]. When first introduced to these I was sooo overwhelmed and frustrated as I did not know what their purpose was nor had any idea on how to use them. I found myself spending many hours just trying to understand it and it would have been very helpful if the first lecture of APS100 had a tutorial in a computer lab went through these different sites and explained what they did."

With course administrators, instructors and other sections of the University sharing well-intentioned communications with students, and setting up additional resources online, students describe the quantity and navigation of these communications as being very high volume and contributed to a sense of confusion or uncertainty surrounding discernment of the most valuable information. Challenges accessing a variety of portals and forums may increase student perceptions of workload, simply because of the operational difficulty required to access the information. The different venues through which students access information contributes to their notion of workload.

Perspectives on Expectations

Several students shared sentiments regarding expectations and the manner in which they were communicated:

"I think that the expectations regarding completing problem sets, doing homework, and studying for quizzes should be more clearly emphasize during lecture."

"Assignments that are expected by professors to take a certain amount of time almost always take a considerable amount more than that."

"Most professors say that we should have 5 hours in addition to lectures, but the problem sets and textbook homework..etc will take up to 10-15 hours sometimes during the week."

Students suggest that their interpretations of assignment expectations are derived from instructor guidelines. However, in some cases, the instructor expectations and student expectations differed remarkably, which may be indicating a need to consult instructional
requirements/expectations and explore how well aligned assignments are to both course goals and assessment needs. Students may be struggling to manage the material and contrastly, instructors may need to rework how they communicate expectations to determine a reasonable recommendation to students and what to do when your time spent exceeds that expectation.

Conclusions and Future Work

As seen by the climbing hours and efforts prior to substantive course assessments, many first-year engineering students encounter workload pressures that appear to lead to their adopting increasingly "strategic" approaches to their studies in individual courses [12]. There is more work to be done, especially in how these notions contribute to improving understanding, informing, and predicting student success. A clearer understanding workload expectations and realities, program structure, how students experience the conceptual and operational demands of their work, and the resources they draw on, all have profound implications for the work of the institution and the profession it serves.

The advantages of investigating the role that this information may have toward informing student success also informs our understanding of these students’ transition into engineering. Understanding the gaps that talented students face stepping into a challenging new program, and in many cases a new setting and lifestyle that they are not accustomed to, might enrich student experience and quality of life in their first-year. However, this also suggests that there is opportunity to scaffold the experience of these students before their post-secondary experience. How engineering is conveyed to prospective students and pre-university students generally has implications across the spectrum of engagement of students from access through graduation. If program outreach and recruitment efforts are not well-aligned with supporting the actual program requirements and experiences of future students, students are not being provided with an accurate impression of this program of choice, and are not set up to succeed in the program from the start. While learning and adjusting will inevitably happen as we confront new realms and challenges in life, if the preparation and information being providing students better aligns with the lived realities of current students, the better positioned we will be to welcome informed, ready and prepared students into our engineering programs to succeed.

Understanding the student’s perceived workload and the dimensions of that workload may enable course administrators and instructors to improve the student experience more generally. The results of this investigation will be shared with participating course instructors and their interpretations will be sought to inform course content and workload considerations in subsequent years. In addition to enriching and improving student experience, more needs to be known to decrease program and Faculty attrition, an issue that has plagued engineering programs. Attrition of students in STEM (science, technology, engineering and math) fields can present as high as one-half (48 percent), with students shifting disciplines or exiting post-secondary education entirely [13].

Framing this study is the role that workload has on the larger scope of student experience. This includes considerations for access, retention, persistence, engagement and graduation as students
select and move through their program of study. Supporting and augmenting student experience is influenced by all those who work with and engage current, as well as future, students. As such, there are pedagogical implications for instructors and administrators in addressing student perceptions and expectations. Future work will include collecting additional information from current instructors to better understand how workload expectations are determined and communicated to students. As this exploratory study did not focus on extracurricular commitments, data on the current workload for first year engineering students contained in this study, invites opportunity for future study to more deeply explore the engagements of undergraduate students during their transition to University both within and beyond the classroom.

Outreach and recruitment efforts for these programs must be supported by accurate descriptions of program goals and outlines, as well as workload descriptions that prepare students for their needs of the program they enter. This educative component should exist at the intercept of entering first-year programs or before. To better support these efforts, more research is needed to better understand the factors that play into workload expectation and the skills that are or can be developed in secondary courses preparing students for entry. Additional implications for this work include developing concrete tools for practitioners and an enriched understanding of how student experience prepares graduates to serve the profession.

References


