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The Unwritten Syllabus: It's not just equations Student thoughts on professional skills

Mr. Stanley M. Forman, Northeastern University

Stanley Forman and Susan Freeman are members of Northeastern University's Gateway Faculty, a group of teaching faculty expressly devoted to the first-year Engineering Program at Northeastern University. The focus of this team is on providing a consistent, comprehensive, and constructive educational experience that endorses the student-centered, professional and practice-oriented mission of Northeastern University

Dr. Susan F Freeman, Northeastern University

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Introduction

To graduate, engineering students must acquire many technical skills. Yet, more subtle and possibly more important, they must gain a degree of personal and professional maturity. Much of the change occurs during the first year of school, enabling students to become polished during their upperclass years. Would they change as much over time if not for the indirect lessons imparted by their institutions?

Many of the skills acquired are forms of additional personal growth of students that may be the result of indirect, undocumented lessons linked to values, ethics and beliefs, that is, the lessons from the Unwritten Syllabus. These skills, frequently described as professional skills or soft skills, are often discussed by both teachers and human resource personnel. Skills such as creativity, motivation to learn, personal accountability and positive work ethic are not always subject to defined teaching methods. There are clearly benefits to acquisition of professional skills, but what methods and techniques provide paths to success in these skills? The Unwritten Syllabus, if implemented correctly, may encompass many of these professional skills, including intellectual curiosity, caring for others, honesty and ability to overcome obstacles
In prior research on the Unwritten Syllabus[1], a cross section of engineering faculty was surveyed and asked to identify professional skills needed and most lacking. The two professional skills the faculty identified as needed but lacking in their undergraduate students are Time Management and Perseverance to Learn. Time Management is all the skills necessary to organize work, deliver results on time and generally be viewed as a responsible student. Perseverance to Learn are the skills encompassing a lifelong desire to learn, a willingness and a curiosity to challenge oneself beyond the scope of class.

There were a total of 17 categories of skills identified by faculty as lacking. The top six, including the two previously described, were:

1) Time Management
2) Perseverance to Learn
3) Communication Skills
4) Professionalism
5) Personal Responsibility
6) Problem Solving

This paper will present the results of further research specifically aimed at understanding first-year student's perception of themselves with regard to these skills. Do students see themselves as organized? Do they see themselves as eager learners? What skills do they consider are needed to be successful? What will they improve? The ultimate objective of the ongoing work is to find methods to train students in the professional skills of the Unwritten Syllabus. It is necessary then to know both what skills are deemed lacking and also to know student attitudes and perceptions to effectively devise teaching methods that will enhance skills while simultaneously shifting attitudes to match situational reality. The results will be drawn from a survey of freshman having just begun their undergraduate engineering studies at a major urban University.

Background

To both identify the key soft skills perceived to be important and not currently being learned by the students and to then codify classroom techniques for enhancing these skills, a multistep approach for this investigation was started.[1] A multistep approach is used because each step directs the next, and although these are seen as the steps now in our plan, our research may alter these. The steps are a) identifying the key attributes or skills that may be seen as lacking in students, b) validating that student's perceive these as problems, c) researching methods to improve or overcome deficiencies and then d) assessing degree of change for validation. The first phase being complete, the current step focusses on what the students perceive are the needed skills, their perception of their capabilities and how they learn and use these professionals skill sets. This work looks at first-year students as they enter college, they will add 4 to 5 years of schooling and accumulate some of the wisdoms that come with that age. The shaping of skills starts during the first year of school, with continued change and development during their upperclass years.[2] But are the changes just from the benefit of this increased age? Do they know what professional skills they need to learn and acquire, beyond technical skills and knowledge, in order to be successful engineers?

Some of the skills acquired are results of direct training, such as improved speaking and writing skills.[3] There are documented formal methods to enhance these skills. Other skills, however, are forms of additional personal growth of students that may be the result of the indirect, undocumented values, ethics and beliefs they acquire while at school, that is, the lessons from the Unwritten Syllabus. These other skills, frequently described as soft skills, are often discussed by both teachers and human resource personnel for employers.[4]This set of soft skills, such as personal accountability and greater work ethic, is not subject to defined teaching methods. There are clearly benefits to acquisition of these skills, but it has been a challenge to describe the methods and techniques used to achieve success in these skills and the list of these skills varies from source to source. The Unwritten Syllabus may encompass skills such as intellectual curiosity, caring for others, ability to overcome obstacles and more. In addition, many of these

soft skills are being successfully learned and transferred to the students.[5,6] The focus of the first step was on the skills that are not being learned, what is still lacking as students move through our programs as reported by a diverse group of faculty.

ABET has been driving the inclusion of soft skills since the early 2000s. In the latest set of criteria approved in October, 2011[7], ABET continues with General Criteria #3 listing 11 outcomes required for graduates. The list encompasses soft skills such as the ability to communicate, the ability to work on a multidisciplinary team and the ability to engage in life-long learning. While the skills specifically listed by ABET are important for new engineers in the workplace, there are additional skills needed by students to successfully transition through undergraduate studies such as time management and elements of personal responsibility. Although this research focuses on an unwritten syllabus, some of these skills are listed in syllabi throughout engineering curriculum. For the most part, though, traditional engineering courses focus on learning objectives for the technical skills, with potentially only some of the soft skills outlined. The classic list of soft skills is found at careerbuilder.com (Lorenz[8]). This list starts with a strong work ethic and positive attitude, which are challenging to teach. The more teachable skills include good communication skills, time management, problem solving skills, and teamwork skills. Shuman, et al[9] have a long list of skills, but some of the top skills are listening, decision making, problem solving, communication and time management. They concluded that soft skills can be taught, albeit not through traditional lecture means and a degree of mentoring is recommended in the workplace, if possible. They tended to see the skills enhanced through experiential project work. Similarly, Parker and Anderson[10] at the University of Wisconsin deleted specific lectures on time management and teamwork skills in favor of having students do appropriate project work to learn these same skills in a trial introduction to civil and environmental engineering course. Vasko, et al[11] concluded that once a project experience was concluded, soft skills such as life-long learning could be adequately assessed by student survey techniques. Tallon and Budny[12] took a different approach in adding specific public speaking and writing components to the two freshman introduction to engineering courses at the University of Pittsburgh, though continued practice through various course and university activities was also encouraged. Specifically for engineers, we can look to the attributes listed for The engineer of 2020[13] – strong analytical skills tops the list, but here the list starts to match and expand the list in the introduction. The engineer of 2020 needs skills in practical ingenuity, creativity, communication, business and management, leadership, along with high ethical standards, sense of professionalism, dynamism, agility, resilience and flexibility. Encompassed in this is the imperative for engineers to be lifelong learners.[8] Here is the telling paragraph:

What attributes will the engineer of 2020 have? He or she will aspire to have the ingenuity of Lillian Gilbreth, the problem-solving capabilities of Gordon Moore, the scientific insight of Albert Einstein, the creativity of Pablo Picasso, the determination of the Wright

brothers, the leadership abilities of Bill Gates, the conscience of Eleanor Roosevelt, the vision of Martin Luther King, and the curiosity and wonder of our grandchildren.[13]

The engineer of 2020[13] and Educating the engineer of 2020[14] both influenced a number of papers looking at and assessing the impact of ABET criteria and the look at our future engineers. They also continue to reinforce the need for many of the identified skills, such as this emphasized skill from Educating the engineer of 2020[14]:

> *In addition to producing engineers who have been taught the advances in core knowledge and are capable of defining and solving problems in the short term, institutions must teach students how to be lifelong learners.*[14]

Further discussion overlaps many of the topics in this research, such as communication (with technical and public audiences), an ability to communicate using technology, and an understanding of the complexities associated with a global market and social context. Flexibility, receptiveness to change, and mutual respect are essential as well. These publications are guiding and forming future curricula, and this research has demonstrated that many skills seen as needed for our future engineers are not necessarily easily taught or integrated into our curriculum. The hope is to influence that change further. One of these major studies is *Prototype to Production: Processes and Conditions for Preparing the Engineer of 2020*[15] (P2P will be used to represent this). This is a large-scale NSF study seeking to promote dialogue about the engineer of 2020. There are 26 universities providing data, and six institutions participating in *Prototyping the Engineer of 2020: A 360-degree Study of Effective Education.* In 2010 and 2011 there were 18 papers written from this study, some discussed here. It is important to note that the data is for sophomores through seniors, with some data on the characteristic measures of a student as they enter college (SAT scores, GPA, skills in math and science) and demographics. These are large, extensive detailed studies that informed our work.

The vast amount of data from the P2P study is used in a number of ways. Knight[16] used cluster analysis to group skills of senior mechanical and chemical engineers. The professional skills identified by the students as strengths were leadership, teamwork, communication and contextual awareness, demonstrating that our graduates are likely bringing these desired skills to their future work, and our programs are accomplishing this. In a study that asked undergraduates their view on excellence in engineering education[17], the students reported that the goals of teaching engineering were seen as learning skills including critical thinking, problem solving, organization, creativity, communication and teamwork. These were not first-year students, but the list has many common items to this research and other similar work.

There is discussion that seems to contend that integrated curricula will be more successful in impacting these professional skills, but they say it is to a lesser degree than the acquired discipline skills, and there is a such a diversity of assessment and data, that the impact is not

clear.[18] There are a number of papers that focus on one skill and how the program or curriculum has demonstrated improvement in teamwork[19] or contextual competence.[20,21] Others claim that students improve professional skills in their course or project because they practice them, even if there is no data showing assessment.[22] Contextual competence, often referred to engineering in societal context or as part of the global community (there are many definitions) has received considerable focus. It is embedded in the ABET outcomes, and the focus may be as a result of the challenge to "teach" this. These papers[18,19,23] suggest program and integrated curricular changes in colleges and departments are likely needed. Students do not identify this skill as often, even upperclassmen. Other looks at engineer's professional skills focus on preparation for graduate school[21], what is the role of liberal education[24], and how does a non-US engineering school compare[25]. These papers underline the importance of these professional skills, the challenges of methods to teach them, and are part of the motivation to continue to learn what is needed for our future engineers and how we might be instrumental.

While there are countless papers on engineering skills that are needed, there is a limited amount of published material for what students think or perceive about professional skills in the first-year. From the research done thus far, there are two important key areas of focus here – that the students' professional skills do change in measurable ways over the course of their undergraduate work, and that faculty, students and employers consider these skills vitally important. The list and definitions vary widely, as does how these skills are learned; directly (classes, workshops, mentoring, direct practice) or indirectly (Unwritten Syllabus, role modeling, practice as part of other work). Therefore, our goal is to look at the list of skills that the faculty, the students and the research indicate are needed and how we might use the Unwritten Syllabus to guide student skill acquisition where possible.

The Survey and Students

In order to gain student attitudes and perceptions of professional skills, a survey was administered to the incoming freshman engineering class at Northeastern University in the fall of 2012. The survey was given in the first two weeks of the semester only to freshman and comprised 546 responses.

Northeastern University is a major teaching and research institution located in an urban environment in the Northeast. The College of Engineering supports all common engineering disciplines and starts first year students through a common curriculum, which includes two General Engineering courses, as an introduction to the field of engineering.

In the survey, there were approximately 80% males and 20% females, indicative of the general percentages now seen in schools of engineering (Figure 1). The population was further stratified by course levels. At Northeastern University, students can be in the general population (Non-Honors) or can be those invited to participate in the University-wide Honors program. Students

are invited to the Honors program as a result of their high school class rank, their GPA and their SAT/ACT test scores. These students represent approximately 10%-15% of the freshman engineering population. The Honors students are separated during their first year into specialized Honors sections of the same basic courses, with the coursework presented with more challenge and opportunity for creativity. The discussion of attitude and perception will be shown subdivided by Honors vs. Non-Honors where that subdivision generated points of interest to discuss.

The survey questions were designed for first-year students, knowing that they have a limited view of attributes of engineers and professional skills at this juncture. Many of the questions are about homework, organizing their time and planning and not directly about professional skills. It was deliberately designed not to give them lists of skills from which to pick, nor to ask opinions on a prescribed topic or skill, but to review student open-ended responses. The questions on homework tease out student attitudes, for example, *what kind of homework assignment would you not do*, had a large response that they would do all homework problems, showing a work ethic and determination to learn. Without giving them situational questions, it is challenging to ask how they would apply professional skills in varying contexts and situations. The survey purpose was to have them identify skills needed and needing improvement as they enter the university.

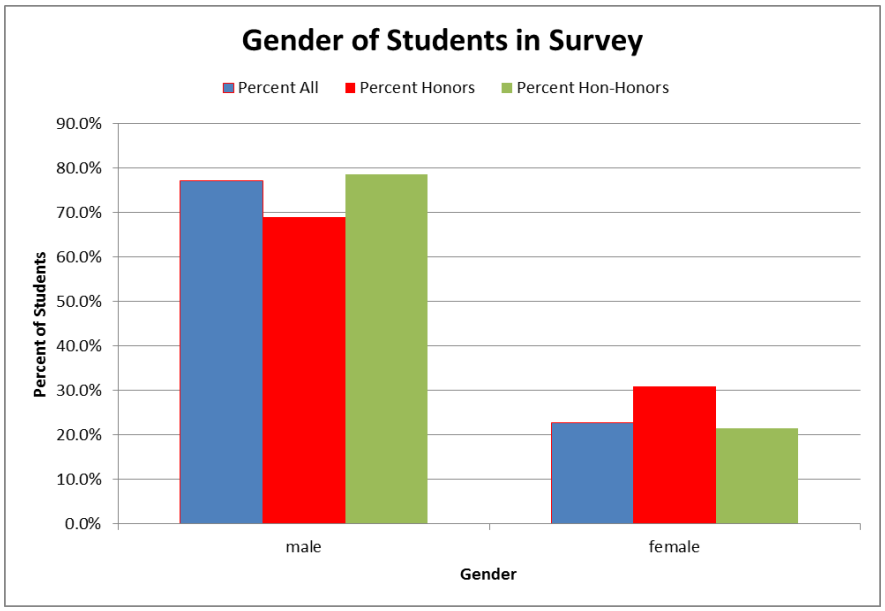

Figure 1

Overall Results

Students' Perception on their Organizational Skills

The survey asked a series of questions where students reported their perception of their organizational skills, both on an absolute scale and as compared to their peers. Students reported that they saw themselves as fairly well organized. Close to 50% believe they are very organized or more organized than most others and an additional 40% see themselves at least as somewhat organized. That leaves only 10% of all students who see themselves as scattered or disorganized in their work (Figure 2). This is a similar result for the total population of students, as well as each subcategory of Honors and Non-Honors students. In prior research[1], faculty members reported time management as a key skill lacking in students, which is a contrary point to the view as reported by students themselves.

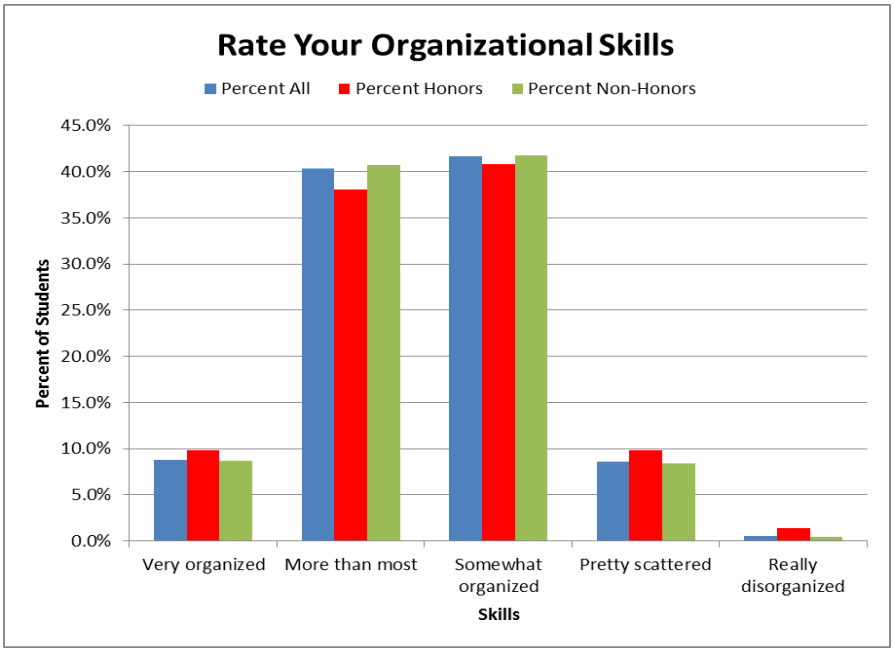

Figure 2

The students were also asked to compare themselves to peers regarding degree of organization (Figure 3). Across all three student categories, students saw themselves as better organized than their peers, either somewhat better or much better, about 42% of the time and another 42% reported believing they are at about the same level of organization. That totals to 84% of students who see themselves at least as organized as friends or better. Only 16% see themselves as much worse or needing to improve as measured against friends.

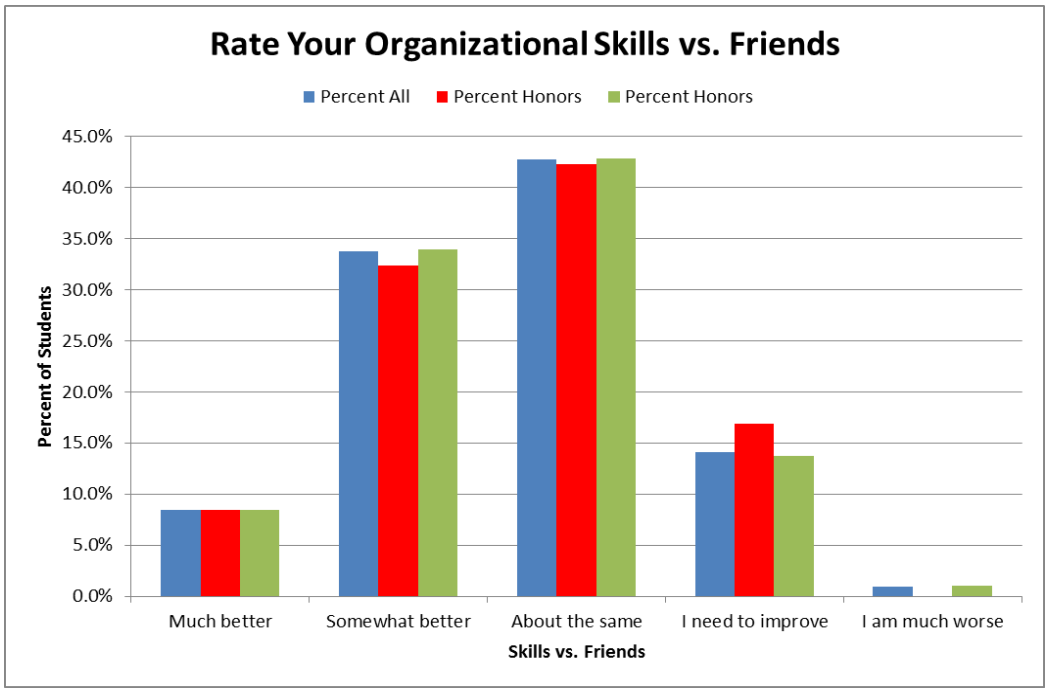

Figure 3

In both measures above, we see a disproportionate number of students reporting themselves as *above average*, as may be a common view among newly matriculated students!

If students see themselves as extremely well organized, then they must employ a broad set of tool and techniques to achieve that result. The students were asked to report these self-organization tools. First, they were asked to describe what techniques help them plan their homework activities. The students were asked to select from 4 common ideas or to list a different idea as *other*. Students could assign a rank to these 5 choices and the responses were totaled and a weighted average rank order was derived for the 5 categories of responses.

Figure 4 shows the results of the weighted average rank of the techniques. Common across the 3 student populations was the technique of *making a list*, at a rank of 4.1 out of 5. Next, at rank order scores between 3.7 and 4.0, was *looking ahead to future assignments* and *doing work everyday*. This indicated that students see they have an ongoing job to perform as students. They are in a daily rhythm of planning out work and doing work, so as to best utilize the available time capacity and avoid a last minute pile-up. The next technique was *figuring out time needed per assignment*, a means again of apportioning the available time across assignments so as to have enough time for a given task. This technique was less utilized generally, but seemed to be favored by Honors students. This may be either because they have more total work to complete or because they are used to more challenging assignments and need to do better time allocation. Ranked lowest was the *other* category, but not so low as to be disregarded. Approximately 10% of all responses listed something in this category. Some of the key ideas provided here were use

of a planner or calendar, again as an aide to future time planning. Sticky reminder notes seemed favored here also and a small portion of students use a method where they break the work into smaller pieces and try to then get started on the work promptly. By doing this, one assumes they have less of a planning viewpoint and more of a do-it-and-be-done approach!

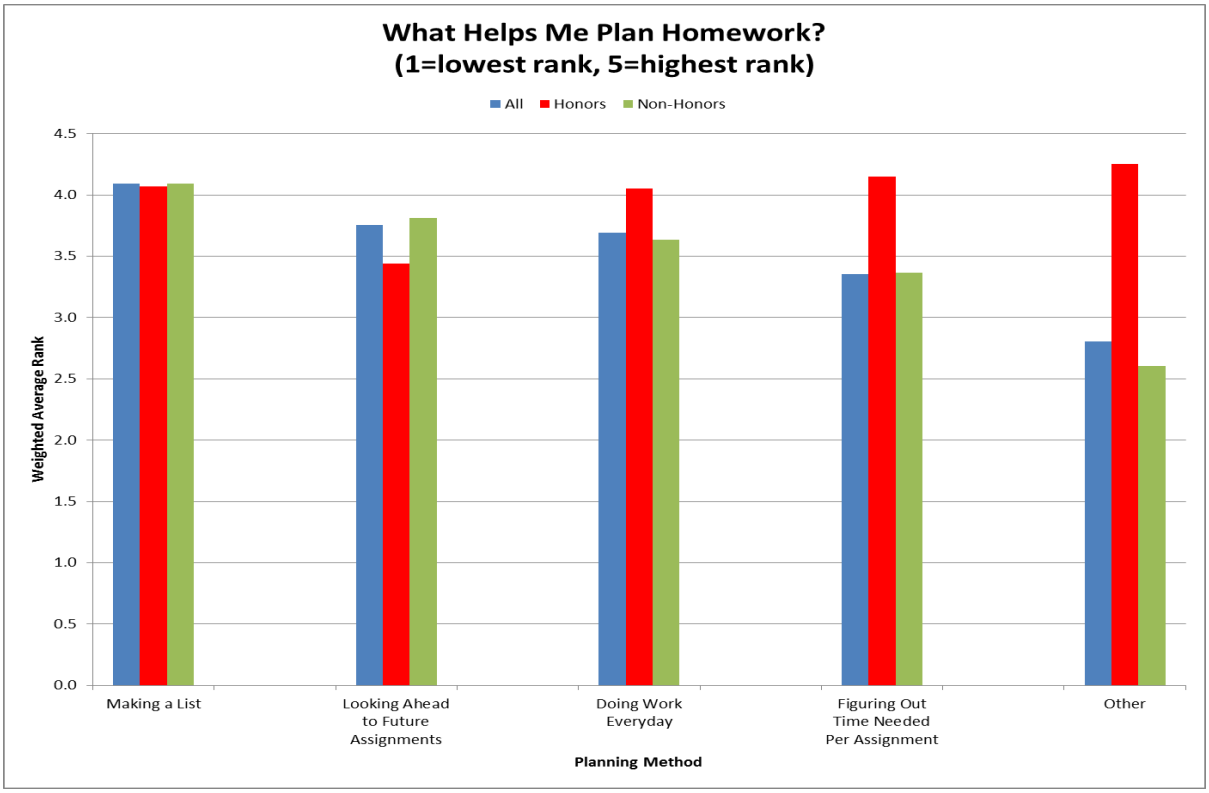

Figure 4

Finally, students were asked a more general organization question about what time management tools they employ overall (Figure 5). First on the list again for all three student categories was *make a list*. This seems to be the universal organization and time management technique for all students! Next popular was *planning ahead*, though the Honors students seemed to utilize this technique less than the Non-Honors students. Since all these students are newly matriculated, the students are generally reflecting their high school experience, where Honors students may have had less need to do pre-planning, given their aptitude and capabilities. *Do work promptly* was chosen and utilized by all student categories, though at a lower preference rate. *Use a calendar* was the overwhelming choice of Honors students and much less so for Non Honors students, though this tool was at about the same preference level overall as *prioritize work*. There still is a drive to either get the work done or at least figure out what needs to be done first, next and so on. The *other* category represents about 8% of responses, with 30% of these responses favoring use of a planner. So, again, this represents a combination of list making and calendar planning in a combined step.

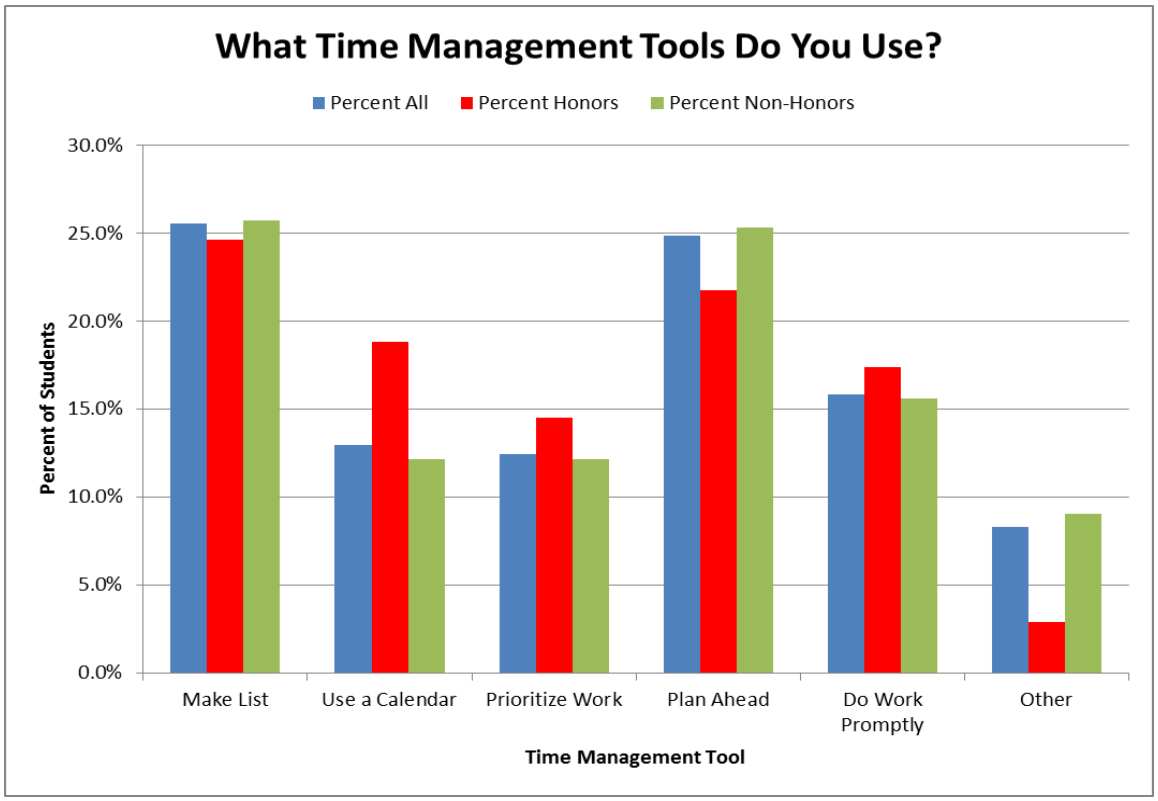

Figure 5

Student perceptions about their organizational skills and the tools they then employ to manage their work flow and time are noteworthy in two regards. First, as shown in figures 2 and 3, this group of new college students has an overwhelmingly positive view of their degree of organizational ability, both as an absolute measure and as a relative comparison to their peers. No one is just an average organizer here! And second, as shown in figures 4 and 5, the tools they employ to deliver this stellar organizational activity seem very typical and ordinary. The degree of success achieved in organization by students, then, likely lies in the consistency of use and depth of detail employed rather than in the novelty of the tool.

Students' Perception on Handling Their Load

Summarizing students' perceptions of their ability to handle their upcoming load, the results generally show that they believe they can handle college level work. They use a number of different resources, including their text and instructors when needing help, and will spend time attempting to solve new problems.

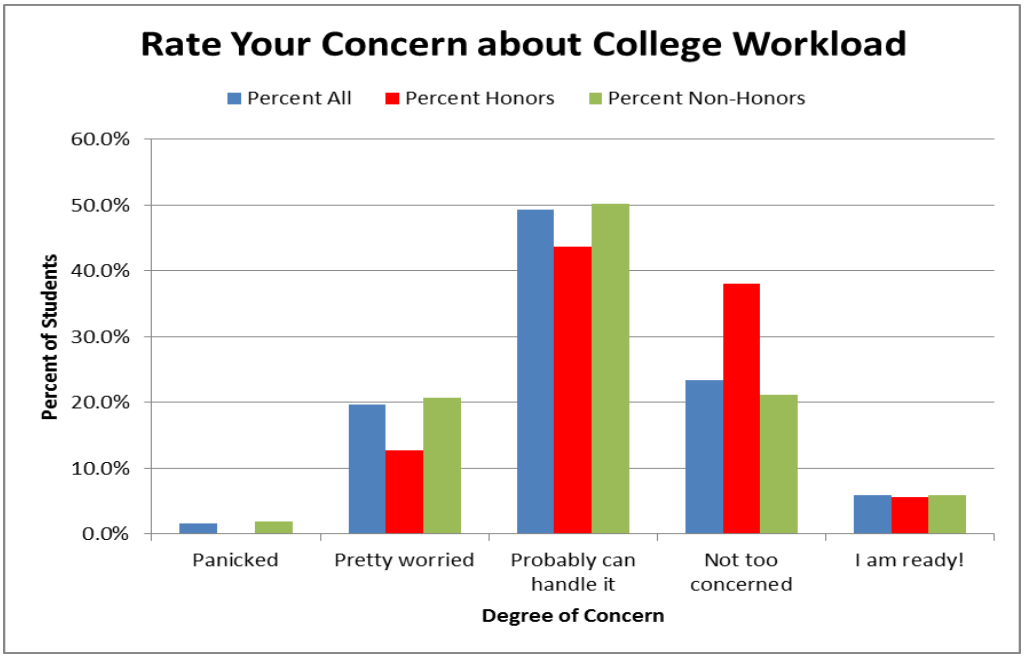

Figure 6

As Figure 6 shows, more than 75% of the students report that they think they can *probably handle* the workload, with 6% saying they are ready (with emphasis). The Honors students show a significant difference with more stating that they are *not too concerned* than the Non-Honors. Given the amount of AP credits and college level courses in high school, this may not be unfounded, but might change by the end of their first year.

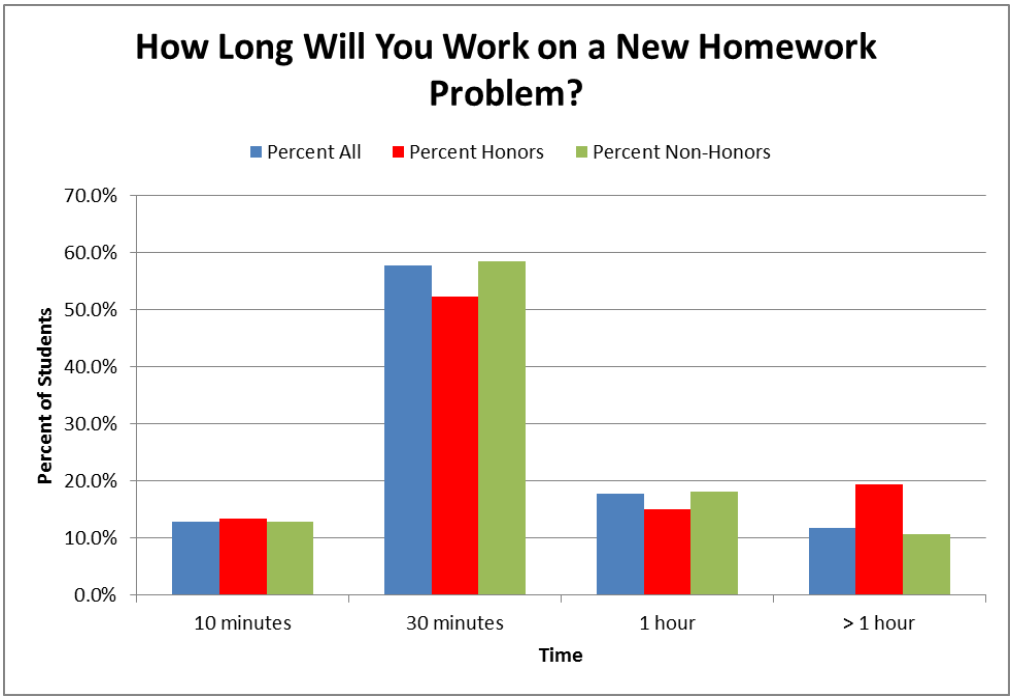

Figure 7

On average, the students are willing to spend 42 minutes on a problem that is new to them. As seen in Figure 7, more than 50% will spend 30 minutes and about 25% an hour or more. Honors students would spend greater than an hour on a problem more frequently than Non-Honors.

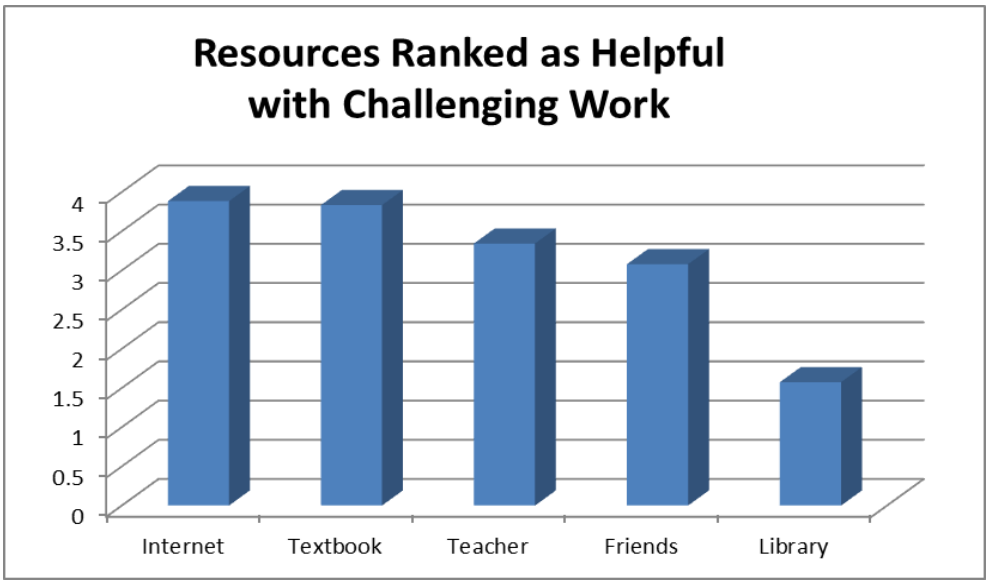

Figure 8

Students were asked what resources they turn to when needing help. The responses were ranked and a weighted average rank order was computed for the categories, with a rank of 1 being lowest ranked and a rank of 5 being highest ranked. Students see their prime resources for help as the internet and textbook with the highest average rankings of 3.88 and 3.84. Shown in Figure 8, 35% of the students ranked the internet as their top resource, 30% ranked textbooks as their top choice for help. Teachers and friends have similar average rankings 3.34 and 3.08, and 20% of the students ranked teachers as their first choice, with only 11% going to friends first. The library is ranked last, with less than 2% selecting that as a first resource. We were relieved at the reported perception that instructors are viewed as helpful, even if they are not the primary sources. In this culture, where many reach for the internet for information, the students view the textbook as still significant for their learning and help. Advice to instructors here might be to continue to use and refer to a textbook, if one is required. The students are not only going to the internet, and if we want them to use other sources, it appears that they will.

Student Perceptions on Homework – Planning, Value, Challenge

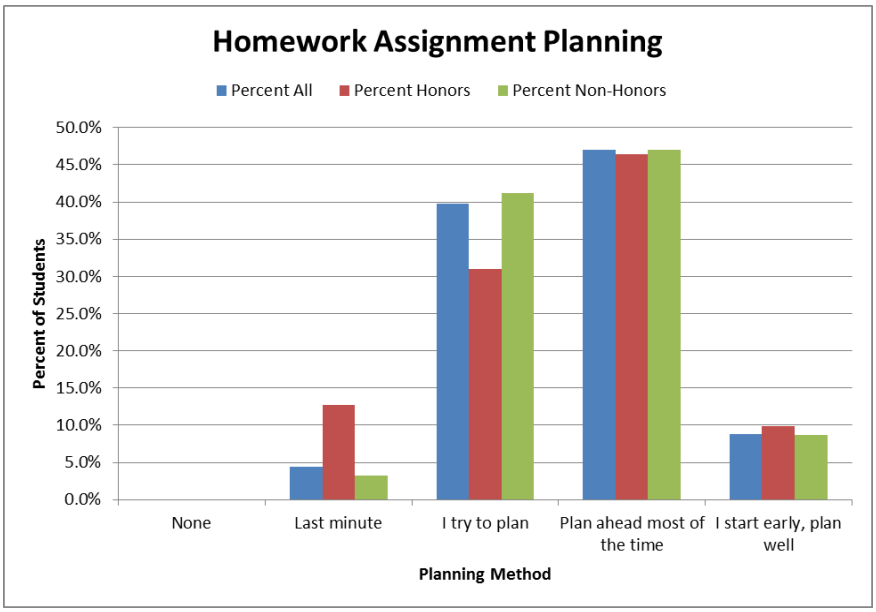

Figure 9

When asked about planning for homework assignments, very few say they do it at the last minute, but this is self-reported, and often we see a very different picture in our classes (Figure 9). If you look at time stamps of electronically submitted work, or even ask students verbally or have a discussion, we get different results. Our experience is that much of the homework, and even projects, are done at the last minute. Student perception and reality may not match. Like many of us, they intend to plan and do some planning, but still do work at crunch time. That they are claiming to plan at all means that more work may actually be done ahead than we credit to them.

What is a valuable homework assignment to a student? The answers were not too varied, overly descriptive or surprising (Figure 10). Good homework is *skill building and relates to class*, but also *challenging*. A number of other answers were: creative, real world and covers new material. What they are unwilling to do are assignments that are TOO challenging : "don't know where to start", or too long or repetitive (some others say "busy work"). Since it is homework, a large percentage report that they do all the homework problems, regardless of level of perceived value. The profile of Honors vs. Non-Honors appears to be different here. For Honors students, *challenge* and *related to class* dominate *skill building*, the opposite being true for Non-Honors.

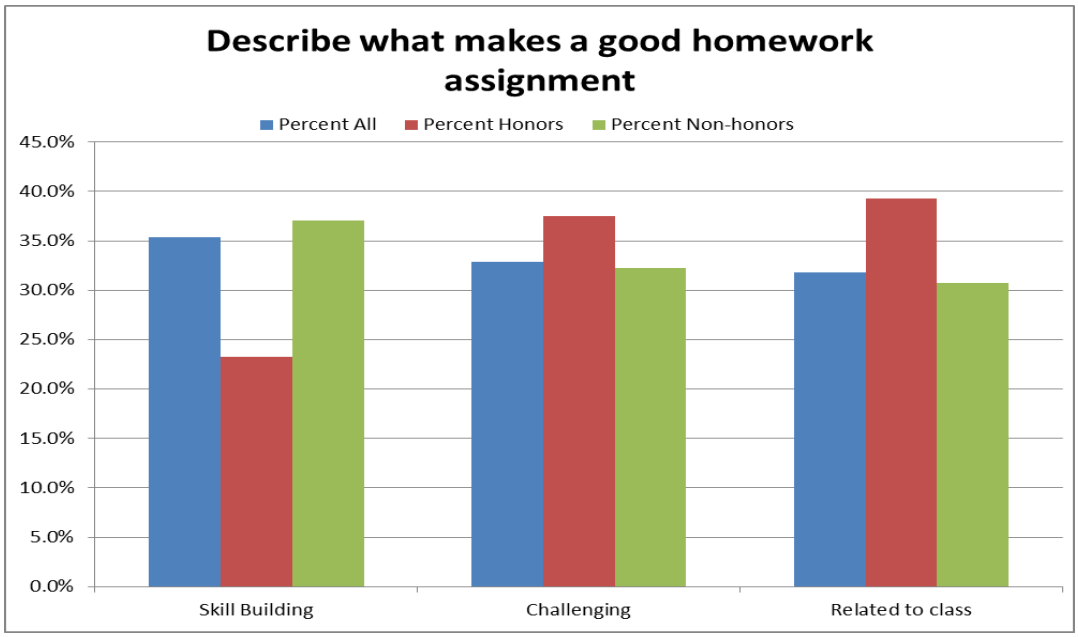

Figure 10

And Honors students are more likely to reject too long or repetitive assignments (Figure 11). They do not have a higher percentage saying they will do all homework problems. Interpreting these results is left to the reader, but Honors students seem to have higher expectations and possibly higher demands on their time, allowing them to feel justified in expressing unwillingness to do certain problems. Does that mean that they do not actually do all of the homework? Having taught many Honors sections, the answer would be that the Honors sections do far more homework consistently than Non-Honors, even if they feel it is not a "good" assignment.

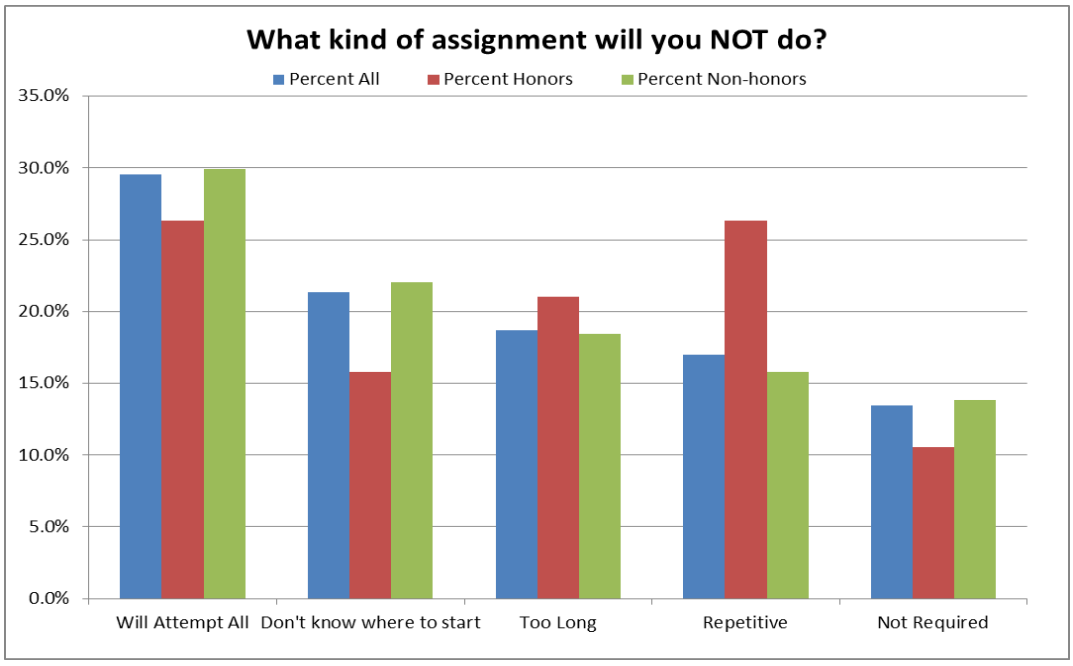

Figure 11

The results are very consistent on how students handle new challenges (Figure 12). They will re-analyze the problem, as well as look for some outside help, ask friends, ask teachers and search the internet. In looking at the *other* written-in answers, a few responses seem interesting, such as: review similar problems, keep trying, and review textbook or notes. There were very few "give up" type of responses (one "cry"), which gives hope to having successful students with "grit", that will overcome obstacles and persevere.[26]

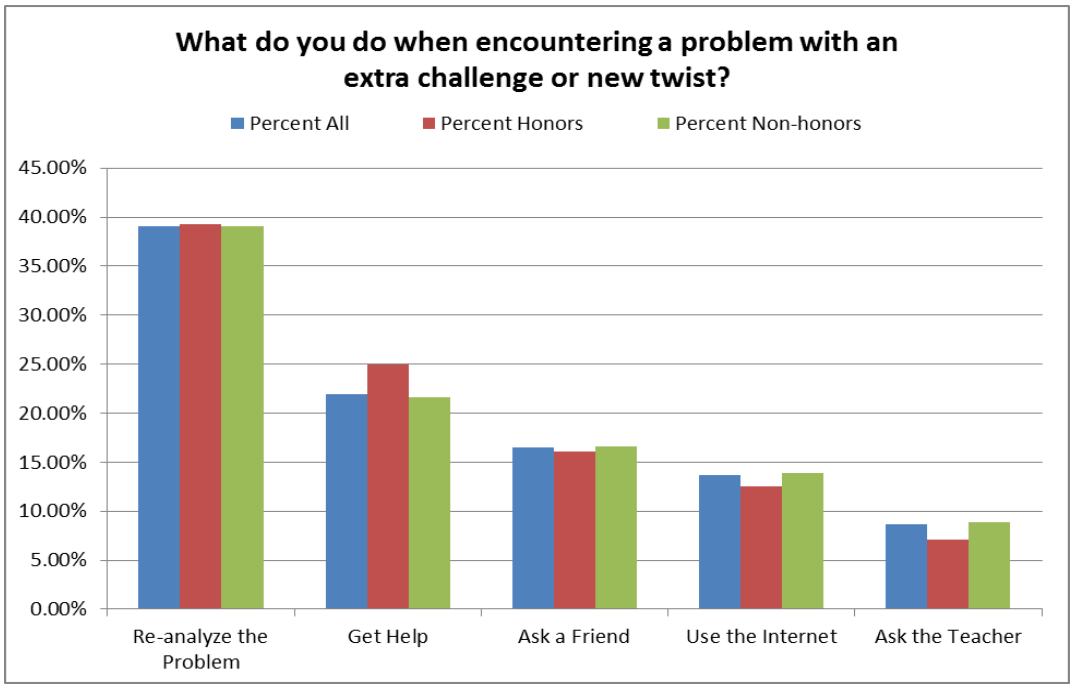

Figure 12

Students' Perceptions on Professional Skills

Several questions relate to professional skills in looking at their work ethic, management of time and coping with the upcoming challenges of engineering problem solving. Engineers need technical skills but equally important for their careers, they need a broad set of professional skills. Students and faculty both understand that time management skills are absolutely mandatory. Students were therefore asked, beyond time management, for their perception of what other skills they thought would be needed by a successful engineer over their career. Figure 13 shows the results, with creativity and collaboration being the two most reported. Interestingly, the Honors students saw collaboration (teamwork) as more highly valued whereas the Non-Honors students saw creativity as the top skill. This may result from the Honors students suffering an abundance of confidence in their creative skills, but less in their teamwork skills and the Non-Honors students feeling a need to enhance their creativity. All students noted

a need for good organization and a strong work ethic, with the Non-Honors students highlighting problem solving skills and the Honors students emphasizing persistence. Again, the backgrounds of the subgroups may explain the different relative emphasis placed on the two categories. All understood that leadership was valued, but, curiously, it was ranked the lowest skill needed.

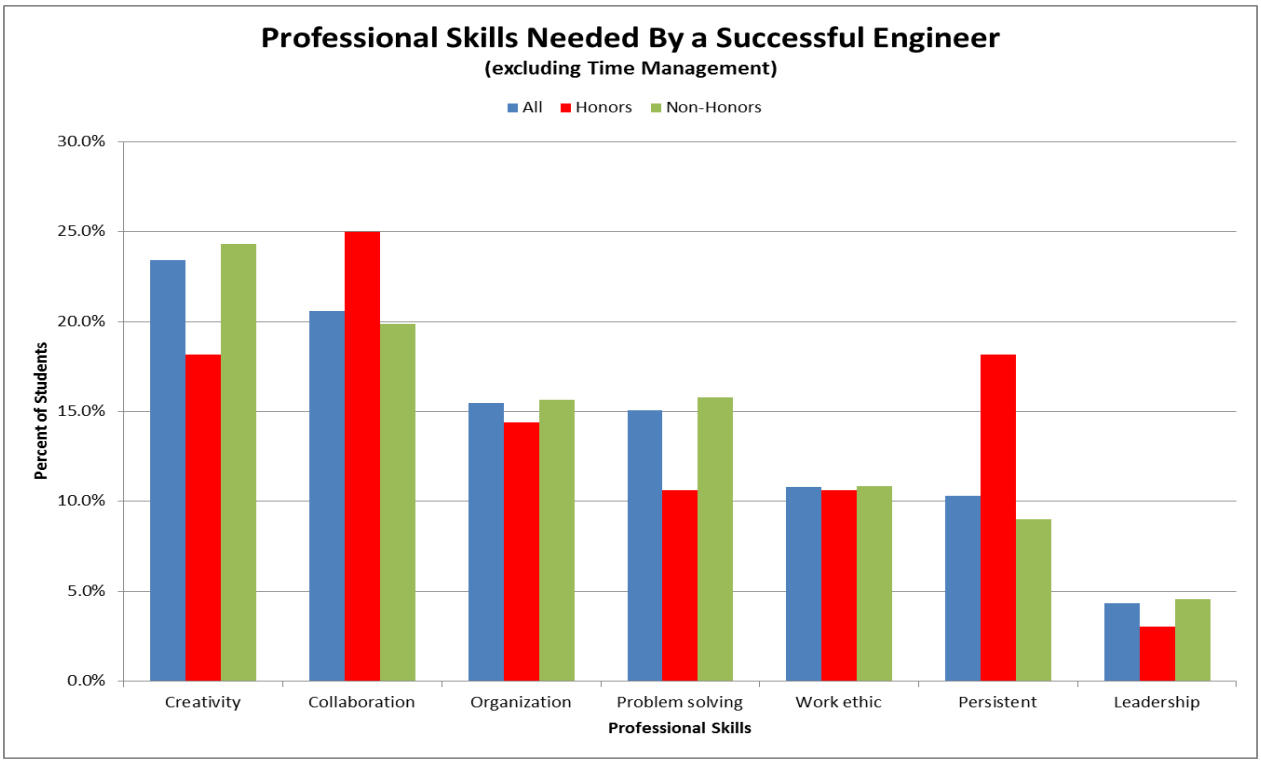

Figure 13

Students were then asked for their belief about how they could improve the skills they had just highlighted as critical to possess for a successful career (Figure 14). 50% of all students suggested that practice or experience would improve their ability to perform. Equal groups of 15% of students saw coursework or formal learning and group work as effective in improving professional skills. 10% of students thought possessing a strong work ethic would help them improve whatever was lacking in their skills. It would seem a robust trial and error approach of experience while working hard at self-improvement is the consensus view of students. Only a small group saw formal training of any kind as particularly helpful in gaining improved skills.

Figure 14

Finally, students were asked for a self-evaluation of their skill levels, particularly what skills they saw they individually needed to improve. As shown in Figure 15, 18% of students reported communications, both written and oral, as the top skill they needed to improve. Organization skills, creativity, time management and teamwork were the next four skills reported as needing improvement. These top five skills were reported by 80% of the students, with a trailing list of 13 additional skills or traits, each of those selected by 6% or less of students.

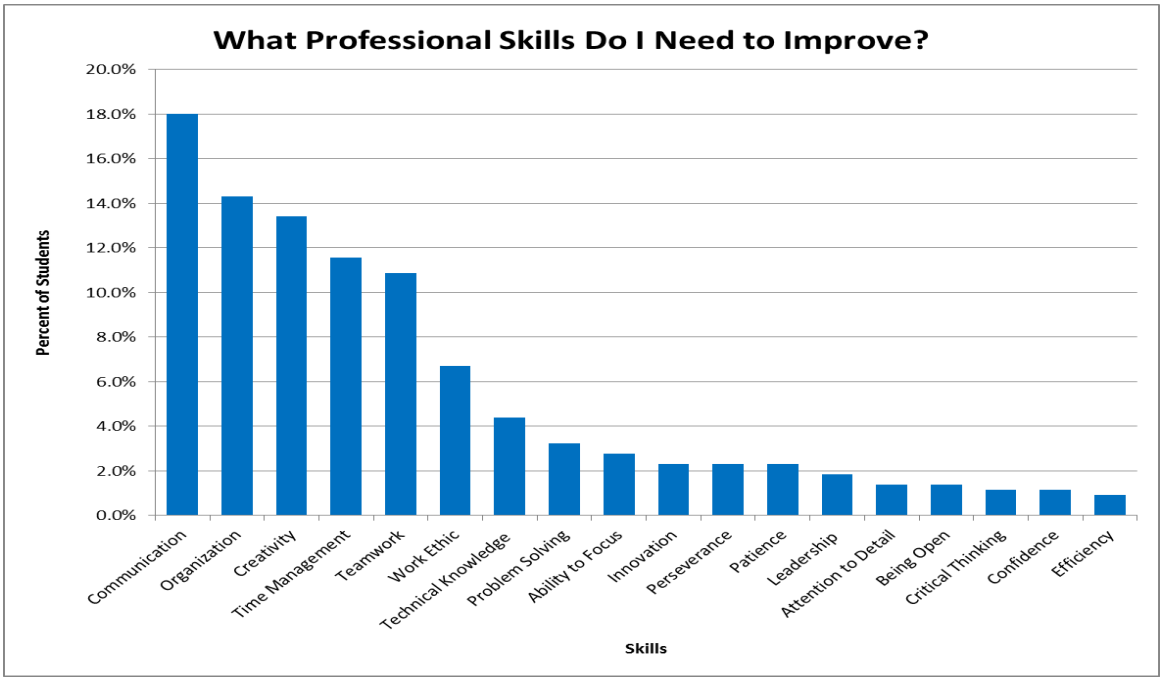

Figure 15

It is noteworthy that the top five skills are ones that have been previously identified as lacking by faculty members[1] and that are also included in the Northeastern University first year engineering curriculum. In the first two General Engineering courses, students are required to write various forms of professional communication and to make presentations ranging from 2 minute individual to 10 minute small team presentations.

A further observation is that many of the skills listed as needing improvement are not skills so much as they are individual traits, usually not acquired but rather inherited. Examples of these are work ethic, patience, being open and ability to focus. As such they are difficult to improve or train in an individual. You usually either have them or not, though they may be latent and can be cultivated and drawn out. An environment that demands and rewards these talents, as in an engineering curriculum, may well be the force that helps these traits become more exposed and utilized

Conclusion

After all of this information, here is the list again, from our faculty, of skills that were important and lacking or needing work.

1) Time Management
2) Perseverance to Learn
3) Communication Skills
4) Professionalism
5) Personal Responsibility
6) Problem Solving

Comparing faculty and students responses is one focus. Students do not view time management as a problem, yet they haven't had the chance to really need it. They have not been overloaded this early in their college career but, in their later semesters, time management skills will be tested to a much higher degree. Their confidence is evident in that these freshmen expect that they can handle the load. Any data on retention shows that most will, though some won't.

Perseverance to learn is a trick to capture from the students. Some responded to what skills they need to improve with *curiosity*, but with insufficient numbers to see on the charts. There are a number of other responses that approximate this, such as *work ethic*, *patience*, *being open*, *ability to focus* and *innovation*. Since they are just starting a long stretch of learning, perseverance to learn is not seen as a needed skill or shortcoming right now. Yet it remains on every list for educating our engineers.

Student concepts of professionalism and personal responsibility do not appear to be solidified at this stage. Their practice, project and cooperative work experience will bring this into focus and the faculty see this as a skill that needs growth or attention. Exactly how to achieve professionalism in our classes is a provocative discussion, though team projects, setting standards for work and responsibility for quality and timeliness are part of the written and unwritten syllabus, in hopes to impact exactly these skills.

Problem solving is on all lists and continues to be deemed important. It is more important to tie this to societal context and real world problems, looking at hands-on and service-learning to help practice this in impactful ways.

Creativity! This was not high on the faculty list as lacking, but very high for the engineer of 2020 and high on the student list. It may be that it is already in the courses and the faculty view that students possess the creativity needed. It might be something to verify in engineering courses and curriculum. A cynical view might be that the faculty in engineering don't want too much of that, that they would prefer to simply "stick to the equations".

After looking at all of the results, it was positive to find that even these new students recognize the value and can name a large number of professional skills that will be needed and our programs are credited with supplying. Yet a challenge remains: how do we ensure that the skills are acquired and what are the methods to be used?

Recommendations and Next Work

As this survey was done as students had just entered the College of Engineering, we have an early view of student perceptions and attitudes on professional skills. They have had little schooling and no work experience. It is likely there will be shifts in attitudes as time and experience accumulate for the students. Possible future work would be to re-administer identical or similar surveys to students at the end of the first year, at the middle of their college experience or after they have had a significant work experience in a co-op job, while still in school.

A survey at the end of the first year would give us a good reading on how the effects of loading on students has shifted, or not, their perceptions of their ability to organize their work and their ability to actually perform college level work. Surveys done later in time, beyond the first year, would help identify shifts based on both maturity and actual situational experiences.

The question remains, what do we do differently to promote or increase these professional skills? We can employ techniques such as role modeling or designing class situations that require use of certain of these skills. For example, use of case studies that highlight skill building is often

mentioned in many resources when hands-on practice is not available. Possible use of service-learning projects may provide the required societal context that is seen as key for new engineers. As we have seen, though, the list and definitions of professional skills varies widely, as does how these skills are learned. Some methods focus on direct learning, via workshops, skill-building classes, mentoring or direct required practice. Other methods are more indirect, such as role modeling, practice as part of project and assignments or from the indirect lessons of the Unwritten Syllabus itself.

The engineer of 2020 has a set of guiding strategies that may be of help in forming teaching techniques. The set of strategies is:

- Engage in a comprehensive effort
- Consider the linkages
- Focus on levers for change
- Pursue student-centered education
- Develop a research base
- Communicate, communicate, communicate

While some of these do not apply directly to professional skills, the details embedded in these strategies can be used to further focus and evaluate future work. Possible future work, then, may be identification and compilation of skill-building teaching techniques and evaluation of these techniques using the strategies from the engineer of 2020 combined with our continued growth in learning about and improving our teaching.

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Appendix A

Professional Skills Survey

Please circle one: Male Female
Please circle one: Transfer student Not-a-transfer student

1. Rate your organizational skills.

Very organized	*More than most*	*Somewhat organized*	*Pretty scattered, I get by*	*Really disorganized*
1	**2**	**3**	**4**	**5**

2. Rate your level of homework assignment planning:

None	*Last minute*	*I try to plan*	*Plan ahead most of the time*	*I start early, plan well*
1	**2**	**3**	**4**	**5**

3. Rate your organizational skills compared to your friends or others in classes with you:

Much better	*Somewhat better*	*About the same*	*I need to improve*	*I am much worse*
1	**2**	**3**	**4**	**5**

4. Rate your level of concern about the workload of college:

Panicked	*Pretty worried*	*Probably can handle it*	*Not too concerned*	*I am ready!*
1	**2**	**3**	**4**	**5**

5. What helps you most to be organized? (If you select more than one, rank them 1, 2…)

Rank:	
_____	a. Making a list
_____	b. Looking ahead at future assignments
_____	c. Doing work every day
_____	d. Figuring out time needed per assignment
_____	e. Other: _____

6. How long will you attempt to solve a problem that is new to you?

   a. 10 min
   b. 30 min
   c. 1 hour
   d. More than 1 hour

7. Select the best resources for you to get help with challenging work. (If you select more than one, rank them 1, 2,…)

Rank:	
_____	a. Library
_____	b. Internet
_____	c. Textbook
_____	d. Teacher
_____	e. Friends
_____	f.

Other: _____

Please be honest and descriptive for the following questions:

8. Describe what you think makes a good homework assignment – that is, one that you feel is worth doing, that you are glad to dig into:

9. Describe what you do for time management:

10. Describe what you do when you encounter a problem that has an extra challenge or a new twist?

11. What kind of problem or assignment would you decide to just **not** do? Why?

12. There are many professional skills needed to be a successful engineer that are not technical knowledge. What do you think are the top three – ***not including time management***?

    1. _____

    2. _____

    3._____

13. How do you think you can/will improve any of these professional skills?

14. Of these and any other professional skills, in what area do you think you need the most improvement?

    Explain.