

Practice Makes Deeper? Regular Reflective Writing During Engineering Internships

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Abstract

Does regular reflective writing enhance engineering students' capacity to be reflective professionals? This study explores whether writing and sharing weekly reflections throughout a summer internship can transform the way engineering students' think about their work in a way that connects it more profoundly with their academic studies. A quasi-experimental mixed methods design is used with a sample size of 60 participants over two years. Using the AAC&U's Integrative Learning rubric, we find statistically significant improvement in the quality and depth of students' written reflection at the end of a summer internship enriched with regular writing. In their writing, students find explicit concrete and abstract connections between their studies and the internship work they do, drawing lessons from it and re-conceptualizing their role as both students and engineers. The reflections facilitate transformative learning during the internship experiences, guiding students in their professional development.

Keywords: written reflection, metacognition, transformative writing, professional preparation, internship

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Introduction

Successful engineers integrate skills from multiple disciplines to formulate and implement solutions to novel problems. A central learning objective of engineering education is for the academic foundations our students learn on campus to serve them well in their profession. One context in which engineering students start to transfer their studies into practice is the summer internship. In these apprentice-like positions, engineering students perform tasks expected of a working professional under the supervision and mentorship of full-time employees at the company. At times, however, students report feeling a disconnect between their projects in industry and their studies on campus. This research studies an effort to make the connections between these contexts explicit, hopefully transforming students' experiences and learning in both.

The setting is a course taught by the primary author to students participating in summer-long internships. The students work in engineering teams on projects related to computer science and engineering. The course (cseweb.ucsd.edu/~minnes/cse197/index.html) asks students to engage in transformative learning: through journaling and regular written reflections, students make meaning of their experiences both in their coursework and on the job. They reflect on the growth of their professional, problem-solving, and technical skills. The written reflections are shared with classmates on an online discussion board each week and are read and commented on by group members. While the instructor stipulates certain key topics that must be included in each weekly post, no evaluation of the writing is given throughout the summer. Nonetheless, in this study we observed significant average improvement in the quality and depth of integrative learning exhibited in the writing over the summer internship.

Research Question

To what extent does the writing of students transform over a summer internship experience, and does this change demonstrate a deeper sense of connection between on-the-job experiences and academic studies?

Related Work

This literature review will focus on the primary aspects of this study: transformative and integrative learning, written reflections, metacognition, and internships.

Transformative and Integrative Learning

Schunk (1996) argues that the primary criterion for learning is a change in the capacity for behavior due to experience. Clark (1993) defines transformational learning as learning that encourages extensive change in the learner, especially experiences which fundamentally shape the learner's perspective and create a lasting effect on their future experiences and actions. The Association of American Colleges and Universities (AAC&U) defines integrative learning as "an understanding and a disposition that a student builds across the curriculum and co-curriculum, from making simple connections among ideas and experiences to synthesizing and transferring learning to new, complex situations within and beyond the campus" (AAC&U, 2016). Combining these, we study the integrative learning that is prompted in the real-world

experiences student confront during internships, that then spur the critical reflection underpinning transformational learning.

Regular Reflective Writing Practice

The concept of practice, especially when aligned well with an authentic desired task, requires more than simple repetition to achieve deeper, more sustainable coding of information in a usable form (Eichenbaum, Yonelinas, & Ranganath, 2007). The ability to offer frequent opportunities for learners to engage in twenty-first century skills such as to critically think, collaborate, and communicate (written and verbally) are key to determining their true abilities to function in their professional career (Siemens, 2004). Mechanisms that can enhance a student's ability to model behaviors that parallel their industry expectations include self-talk and reflective writing. Reflective writing can lead to communicative learning, where new experiences are made sense of and interpreted in more familiar contexts (Mezirow, 1990). In addition, the process of writing, reading, rewriting, and reviewing others' writing forms the foundation for building metacognitive skills (Hennessey, 1999).

Metacognition

In its simplest form, metacognition is "thinking about thinking" (Flavell, 1979). In a deeper form, metacognition is a process used to plan, monitor, and assess one's understanding and performance. Metacognition includes a critical awareness of a) one's thinking and learning and b) oneself as a thinker and learner (Baker & Brown, 1984). The ability to consciously pause and examine the process of thinking, especially thinking about particular concepts that may not make sense, is an extremely valuable skill set. Metacognitive skills are teachable skills (Bransford, Brown, & Cocking, 2000). To develop these skills, learners should be provided opportunities to reflect, direct their thoughts through appropriate prompts, document (verbally and/or in writing) these thoughts, and have a mechanism for accountability (Zohar & Adi, 2009). Often this process occurs through written communication. When a highly metacognitive environment is created, learners are more likely to be able to reflect upon their thoughts, analyze, and detect if and how well they can apply and synthesize conceptual frameworks.

Internship

Providing authentic experiences in the form of internships can allow learners the ability and context to make the connections between their discipline content knowledge and how they will be expected to translate that knowledge for client usability. A successful internship program will allow the learner to engage in authentic low-stakes risk, while providing a true sense of the activities which they will ultimately encounter when they officially enter the profession (D'Abate, Youndt, & Wenzel, 2009). A delicate balance of sufficient responsibilities, with associated stress and anxiety, coupled with supportive mentors, supervisors, and instructors of record creates the best ingredients for a productive internship experience (Rothman, 2003). The interplay between sufficient real-world experience (real deadlines with real deliverables) and methods to assess the learners' results using well-aligned criteria and expectations is both challenging and essential for success (Jackson & Jackson, 2009). Setting the stage for expectations to transition the learner between the classroom environment and the workplace

environment is key. An overburden on one or the other can result in misunderstandings in both environments. Clearly articulated and measured expectations are the most effective manner with which to provide the learner the tools needed to transform and adapt the theoretical constructs into application (Narayanan, Olk, & Fukami, 2010). Incorporating foundational learning theories such as information processing, metacognition, and self-regulated learning into an informal learning environment will capitalize on what we empirically know about how we learn (Wilson, Iverson, & Chrastil, 2001).

Methods

This study compares the extent of integrative learning demonstrated in students' work at the beginning and at the end of summer internships. The study design is a mixed method quasi-experimental pre-assessment/post-assessment, with qualitative analysis informing quantitative results.

Participants

This study was conducted in the Computer Science and Engineering department of a public research-intensive university in North America. Participants were drawn from students in a companion course for summer internships. The internships are competitive: students typically apply months in advance for these paid, full-time, temporary, on-site apprenticeship-like positions. Students must have an internship offer "in hand" before enrolling in the course. The course activities last throughout the duration of the internship experience (between eight and fourteen weeks) and include daily journaling, weekly written reflections shared with peers, and ongoing discussions. While many students participate in multiple internships during their undergraduate program, students may only enroll in this course once. Therefore, while students in this course range from freshmen to seniors, none have previous exposure to the regular written reflections and discussions of their internship experience.

The pool of possible participants for this study consisted of students taking this course in two consecutive years. In the summer of 2014, this was a group of 100 students working at over 60 companies; and in the summer of 2015, 202 students working at over 100 companies participated. The university's institutional review board (IRB) certified this research exempt from review under category 4.

Data Collection

The collection of written reflections from both years' cohorts of students was anonymized and then made available "off the shelf" for research purposes at the completion of the summer 2015 internships (per the IRB requirements). Sampling from the subset of students whose internships were at least nine weeks long, 30 study participants were randomly selected for each of the two years studied. The random sample was found to have similar gender distribution to the overall class (roughly 80-85% male, 20-15% female). All information was numerically coded by randomly assigned user IDs, and confidentiality was maintained to the extent stated and required. The reflections from week 2 and week 9 for each selected participant formed the collection of anonymized writing samples.

Data Analysis Instrument

The AAC&U Integrative Value rubric was used to assess each of the writing samples. The AAC&U (2016) describe the rubric as “intended for institutional-level use in discussing student learning, not for grading,” which matches the objective for this study. The rubric attributes are as follows:

1. Connections to Experience: Connects relevant experience and academic knowledge
2. Connections to Discipline: Sees (makes) connections across disciplines, perspectives
3. Transfer: Adapts and applies skills, abilities, theories, or methodologies gained in one situation to new situations
4. Integrated Communication
5. Reflection and Self-Assessment: Demonstrates a developing sense of self as a learner, building on prior experiences to respond to new and challenging contexts (may be evident in self-assessment, reflective, or creative work)

The gradations for the rubric range from the highest level of Capstone (4) to Milestone (3 or 2) to the low of Benchmark (1). A zero score may also be applied, in cases where the learner did not display any of the noted characteristics.

Procedures

Beginning around March before each summer, students who had been hired by companies for summer internships began enrolling in CSE 197, the course associated with this study. As part of the enrollment process, students discussed their participation in this course with their company managers and/or supervisors and received permission to share their written reflections on the internship experience for the class.

Each participating student committed to daily journaling and weekly reflection throughout their summer internships. The weekly reflections described their activities over each week, including technical contributions (problems, frustrations, surprises, successes, key moments), and ethical and professional dilemmas, conversations, and insights. Students were also expected to analyze what they applied from their on-campus work in their internship, and the differences they observed between their academic studies and the internship. In addition, the course instructor (the primary author) picked a theme for students to reflect on each week. For example, the week 2 theme in Summer 2015 was “Real World Problems”:

What differences arise when working on real world problems in the internship as compared to assignments in your courses? What are your areas of strength and weakness in working on the real world problems presented by your internship? Can you use your strengths from your coursework [on campus] to help the problem-solving process?

The instructor assigned students to groups of 10 to 15, typically with similar internships (common start dates or durations, or common sectors within the computer science discipline). Group members read and commented on each other’s weekly reflections and sometimes engaged in follow-up discussions.

To accommodate the diverse locations of the summer internships, all weekly reflections and intra-group conversations were hosted on an online discussion forum ([Piazza](#)). Piazza is commonly used at this school to facilitate group discussion for courses. Many CSE 197 students were already familiar with its features. Students accessed Piazza via their own mobile devices and computers equipped with Internet access. The user interface is similar to a mail client like Outlook: each student can start a new post (reflection, note, question); other students can browse through all notes; readers can give feedback using comments, follow-up discussions, links, questions, and polls; search functions allow retrieval of relevant content. These features supported group-wide discussion during the summer. However, before data analysis, information identifying the author, internship company, and date of each post was removed. This ensured anonymity of the author as well as mitigated any possible bias stemming from the researchers who analyzed the quality of the writing knowing whether the reflection was written early in the summer or later.

Ultimately, 30 participants were selected from each of year 2014 and 2015, and two artifacts (week 2 and week 9) were used for each, producing 120 data points. The artifacts were anonymized and then reviewed and evaluated by two faculty members (the third and fourth authors) clinically trained on the [AAC&U rubric](#). To calibrate the application of the rubric, the two reviewers examined 10 artifacts, then checked on agreement. If they were within 1 point (on a 0 to 4-point scale), they proceeded to review. If they disagreed on any of the initial 10 by more than 1 point, they discussed their operational definitions of the rubric attributes and reviewed another 10. For the study, the reviewers agreed on eight of the first 10 by less than 1 point. They discussed, agreed on a value, then proceeded to another 10, where they reviewed, and were within 1 point. They then continued to review year 2015, reviewed and agreed on all except one, which was discussed. They then reviewed year 2014 in a similar fashion resulting in 95% agreement within 1 point. They discussed and ultimately agreed on all items within 1 point. To inform the quantitative analysis, the reviewers also made notes of common themes and selected writing samples that illustrated them.

Data Analysis

Sixty student artifacts (30 from week 1 and 30 from week 9) from each of the two years (2014 and 2015) were randomly selected for analysis, for a total of 120 data points. Responses were scored independently by two professionals trained in the use of the AAC&U Integrative Value rubric in the five sub-items of Connections to Experience (E), Connections with Discipline (D), Transfer (T), Integrated Communication (I), and Reflections & Self-Assessment (R). Scores obtained by the researchers exhibited strong agreement and differing responses were averaged to give each reflection a score for each of the five categories. Scores on the five items were then added together to give each student a combined overall score for each writing sample. The early (Week 2) writing sample gave a pre-score and the later (Week 9) writing sample gave a post-score. A matched pairs t-test was used to determine if the average combined post-score of all students was significantly different from the average combined pre-score. Subsequent post-hoc matched pairs t-tests were then performed for each of the five sub-items using Holm's method to adjust for multiple comparisons. Results were considered statistically significant if the resulting (two-sided) p-values were less than 0.05.

Results

On average, students improved in all five sub-items and exhibited a significant overall mean improvement of almost 1 whole point:

$$\bar{x} = 0.967, SE = 0.375, t_{60} = 2.580, p = 0.012$$

Furthermore, almost three-fifths (58%) of all students showed a positive overall gain (Median = 1.000, 75th Percentile = 3.125).

The mean improvement differed between 2014 and 2015. The mean overall improvement in 2015 was almost twice as large as the improvement in 2014, but the difference was not statistically significant because of the large amount of variability in improvement scores:

$$\bar{x}_{2014} = 0.667, \bar{x}_{2015} = 1.267, t_{58} = 0.798, p = 0.428$$

Looking at the five individual sub-items, we can see that Connections with Experience exhibited the largest increase in score and was the only sub-item which demonstrated significant improvement (Table 1). While only one sub-item showed significant improvement across all students, the overall gain was significant; in other words, students' writing was improving, just not necessarily in the same way.

Table 1

Results of hypothesis tests for non-zero mean improvements in each sub-item

Sub-Item	Mean Improve	SE	t	p-value (adj)
E	0.267	0.088	3.044	0.018
D	0.192	0.086	2.234	0.117
T	0.183	0.098	1.871	0.148
I	0.117	0.077	1.526	0.148
R	0.208	0.104	2.007	0.148

Note: The p-values were adjusted for multiple-comparisons using Holm's Method

A box-plot is used (Figure 1) to analyze the mean and outlier distribution of score improvements for each year. The lines in the middle of each box represent the medians of each variable while the upper and lower edges are the 25th and 75th percentile, respectively. In 2014, the majority of scores show overall improvement, but the median improvements for each sub-item were close to 0. This means that there was no uniform improvement across a particular sub-item; students improved, but not necessarily across the same dimensions. In contrast, 2015 yielded positive median improvements for all five sub-items.

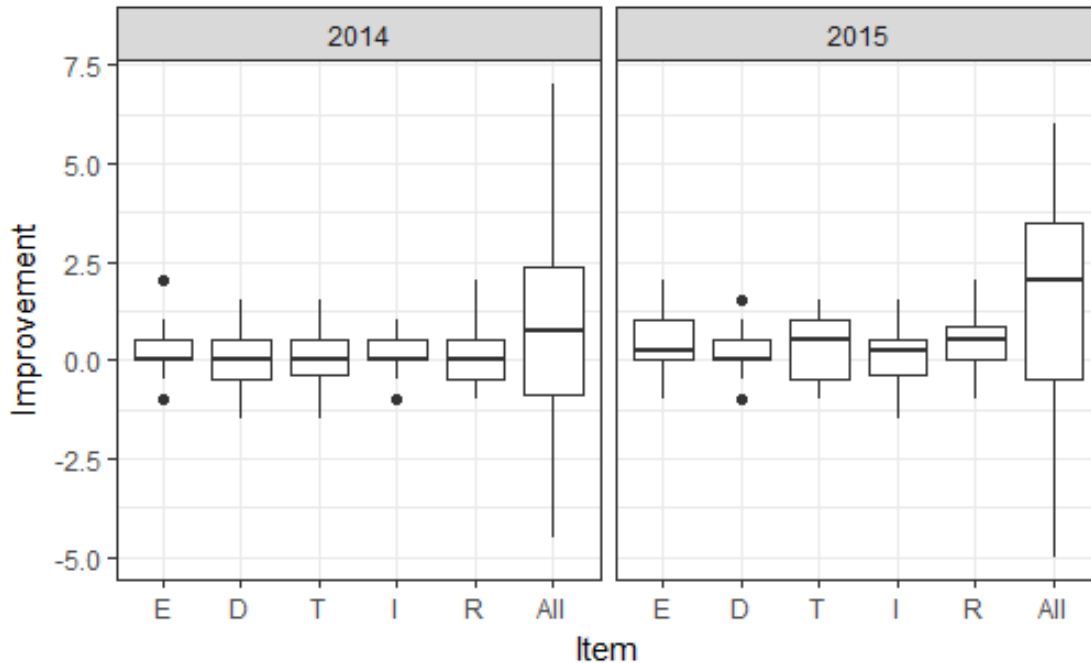


Figure 1. Box-plot comparing improvements for each sub-item and overall, for each year studied

As an example of the calibration of the rubric, here's a complete (anonymized) reflection from week 2 (2014 student # 212t):

Description:

This last week, I had my 1:1 meeting with my host to finalize milestones and communicate any concerns I had with the project. I also had lunch with different members on the team, and attended a few of the all hands meetings. Overall, I've been getting up to date on various projects on our team in addition to my own. I spent a majority of the week trying to understand previous code given for my project. I'm hoping I can submit a few code reviews this week, preferably two.

Also, my host won't be here for the next two weeks. She will be on vacation so I'll have to figure out how to keep up progress in the meantime she is not there. She also didn't set specific expectations of me in the time she is gone so I'll probably shoot her an e-mail asking her explicitly. It's a bit concerning, but I think that I'm in good hands with the team so I hope they will be helpful in crafting the technical detail. Moreover, my team's manager recently passed away so it really left a somber atmosphere in the office. I'm still excited to be there and am glad that the team is excited to see what I complete in my internship. The team has been extremely friendly and supportive. One of the rather fun moments of this week was when the VP of [...] gave an interview in which he shared career advice. He had powerful and simple things to share, which I share below.

Analysis:

I've learned that communication is key. No matter what, honest and frequent conversations with my host and team members will help me grow here. It's my favorite part about going to the office really. This communication is largely missing from the

university curriculum. It's one my semi-strengths luckily, and makes up for some of my technical ability. Yet, I notice that not all interns are as capable of communicating their ideas compared to their incredible technical skills.

So far, I've applied my ability to trace code and formulate a class structure, most of which I honed in my [on campus] classes. Yet, the difference is large. Logic is simple and one-directional in college while most of the code I encounter here has many pieces coming together at once. Different architectures and frameworks all used in one place, and it can be a little bit difficult to follow. My biggest challenge right now is completing something specific each day. I'm in the exploration stage so a few days, I didn't complete much other than understand my project a little bit more. It'll take time, but I plan on setting specific goals each day the night before from now on. I think that will really help in my productivity. Talking about productivity, I'll also have to take a 2:00 p.m. nap each day, otherwise, my productivity just goes down the drain at that time.

The same student's complete (anonymized) reflection from week 9 is:

Description:

This week, I've been preparing for my product interviews coming up. It has strongly impacted the way I think, what I think about, and my understanding of my own project. Questions cover topics like design an alarm clock for blind people, estimate the servers you would need for a photo messaging service, etc. And in preparation for these questions, I've begun reading Techcrunch, Wired, Hackernews, etc. I've started seeing products and companies in a completely different light. Take for instance, the current PR fuss at Amazon. In summary, a reporter collected opinions from 100 pre-selected employees about their work culture, and used their testimonies to completely berate the work atmosphere there. Though clearly an exaggeration, it brings up the topic of how important a work culture is to development. Tech companies are hailed as the best places to work because of their perks, while for instance, hospitals ironically serve really bad hospital food and lack exercise facilities.

Analysis:

So the question is how I want my professional work to affect others around me. I'd break down it into a few specific areas: 1) facilitate 2) cure 3) grow. Technology has often made life a little bit easier. I think that is the constant trend in nearly all products—they make life easier, even if just a bit. Then, you have ideas that try to change the world—save humanity. This is where I'd like to be. Solving problems that people never imagined technology could solve (life sciences, death). Then you have products that help humanity grow, that help us understand one another and ourselves better. So, Medium as a storytelling platform helps share people's stories, and personal assistants i.e. Siri, Now-ish provide insight into ourselves that even we didn't know.

I'm very excited about the potential of technology to change the world. Just think about it. Five, ten years from now, the world will not be the same. The internet will have completely changed. Companies like Tesla claim that autonomous driving cars will be

out by then. Homes are becoming a place of technology, with smart thermostats. Virtual reality is the next big wave of excitement. What's next!

These reflections were scored:

Table 2

	Week 2	Week 9
Connections to Experience	1.5	3.5
Connections to Discipline	1.5	2.5
Transfer	1.5	2.5
Integrated Communication	2	2.5
Reflection and Self Assessment	2	3.5
Total	8.5	14.5

Discussion

Even though there was no active coaching on reflection or writing skills over the summer, the data shows improvement in these skills. The immersive internship experience, including mentorship and feedback from internship supervisors, reading and writing of technical documentation, and personal maturation may have played a role in facilitating students' transformative learning. In many of the student responses, later written reflections exhibited greater connections to experience and an overall improvement in integrating and synthesizing their learning.

Transformative Learning and Metacognition

The student reflections gave glimpses into attitudes, perspectives, and insights that students may not otherwise have the opportunity to articulate and share because they do not fit naturally into the standard undergraduate computer science curriculum. The open-ended prompts allowed students to integrate their experiences in the workplace and reflect them back to their academic goals and future careers. This was a catalyst for transformative learning, wherein some students described the development of their professional and personal perspective. One student wrote:

I grew this week by just realizing something. It is too early in my career to decide on a specialization, like networking or computer vision . . . I remember that famous quote about known knowns, known unknowns, and unknown unknowns. I need to eliminate my unknown unknowns, the stuff that I don't know that I don't know (2014 Student # 212t, week 9).

One of the weekly prompts asked students to assess their work's impact on society: "How would you like your work and professional activities to impact the world around you?" This prompt led to reflections that challenged students' preconceptions and invited them to dig deeper. Many students wrote about wanting to make a difference in the lives of the consumers of the products they were building. Others discussed the value they could bring their company through strategic recruiting suggestions or helping other engineers do their jobs more efficiently. Some, especially those working in companies in the defense or health sectors, talked about

ethical consideration of the impact their work could have on society. This prompt also elicited some of the more revealing posts, with some students sharing personal dilemmas about how they can (or should) make a difference in the world.

I would like to help make people's lives easier/more efficient in some way, preferably doing something more meaningful than enabling speedier food delivery or writing boring corporate software. Besides my colleagues having their days endlessly greatedened by my cherubic presence, the company having to pay an intern, the subways and trains being subjected to a large white man twice a day, and a midtown sandwich shop line being made one person longer I cannot think of any real ways in which my job affects the world aside from the products I am building. The product I am building, however, will directly influence millions of lives, helping patients receive better, more attentive and thorough care, being able to reduce their healthcare bills, and of course, helping save our company tons of money in government fines . . . (2015 Student # 04qc, week 9).

But really, I feel like my work isn't as big as I'd like it to be . . . I like the idea of doing something that feels important, even if only a small way, as long as I can witness the kind of effect it has on a community of people . . . I suppose that everyone wants to feel important, like they mean something. . . . [I]t is still important for one to feel as if they at least have *some* ambition in life, otherwise they wouldn't really be living; they'd just be, like, a blob of human jelly staring blankly at a TV screen eating copious amounts of ice cream. I mean that's just fine, I do that on certain nights, but... well, yeah (2015 Student # 64qm, week 9).

Connections between Academic and Internship Learning

The sub-item of the Integrative Learning rubric that saw the most improvement was “Connections to Experience.” Student reflections over the summer ranged from the “Benchmark” level (“Identifies connections between life experiences and those academic texts and ideas perceived as similar and related to own interests”) to the “High Milestone” (“Effectively selects and develops examples of life experiences, drawn from a variety of contexts . . . to illuminate concepts/theories/frameworks of fields of study”). Since internships serve as apprenticeships to facilitate the transition between university studies and professional life, it is not surprising that reflecting on these experiences could increase students’ appreciation of the connection between their studies and future careers.

Some students interpreted the academic context very narrowly. They identified concrete links between on-campus opportunities and finding “real-world” work, for example the on-campus recruiting fairs, the social network of students and alumni (especially when the alumni become recruiters for companies), and the industry connections of instructors who can recommend a student for an internship positions. Students realized that they used concepts (programming languages, software engineering principles) from specific courses in their internship projects. Some students recognized that the emphasis on strict coding style and documentation on campus makes sense after their experience with industry practices. Indeed, some wistfully wished that the coders who had developed their company’s large codebase had followed these academic guidelines for readability and extensibility.

Several students wrote about learning *how to learn*. For example, 2014 Student # 64nu

(week 2), “I applied the skill of absorbing knowledge at a quick pace that I honed [at university] to this week's work because there was constantly more information to be absorbed about the databases, about the analysis as well as SQL.” Others wrote about the importance of *iterating and refining*, “Something that was applied that I learned from my classes was refactoring. Refactoring and constantly refining the elements of your code is important because it's like revising a paper, the first draft isn't always that good” (2014 Student # r2is, week 2). These metacognitive skills often appear in the learning objectives of courses and curricular but may be hard to measure and assess authentically in the academic setting. The students' written reflections demonstrate that this learning is indeed happening.

In both the quantitative results and the writing samples that support it, we see a positive answer to the research question: regular reflective writing exhibits transformative learning associated with internship experiences, and in particular, demonstrates students' increased appreciation for the connections between the academic and non-academic learning contexts.

Possible Limitations and Further Work

The overall mean improvement was found to be larger in the second year for which data was collected (2015 rather than 2014). Some of this may be attributed to increased awareness among the student population of the value of reflective writing due to the first student cohort's experiences. In addition, some of the instructions and prompts for the course were refined between the two years. For example, the general format for weekly reflections for 2015 included a prompt for students to discuss issues related to “Ethical and professional: Dilemmas, conversations, insights.” It may be that this framing invited students to dig deeper into the connections between the academic and the professional contexts. In future work, additional analysis into the relationship between the prompts and student writing will be done. In particular, is there a correlation between the extent to which students specifically address the given prompt and the extent of their transformative learning over the summer? Would prompts focusing on resiliency in the workplace, debriefing failures and missteps, and explicitly referencing co-curricular components of the academic context lead to even more integrative learning over the summer?

In informal conversations with students following their summer internships, some suggested that the platform for written reflections offered a supportive community from which they could draw encouragement and self-affirmation. Future work will explore the extent to which students give peer feedback on their group members' reflections, and the effect of this feedback. Moreover, different group models may be explored: is it helpful to have large, diverse groups so students are exposed to multiple perspectives? Do students in small groups develop closer relationships and are able to mentor each other more effectively?

Feedback from the instructor or from more experienced students may help students dig deeper in their writing. Students can explicitly be encouraged to explore more abstract connections between their internship experiences and their education to date. They can be invited to link multiple approaches and perspectives in forming their professional self-image, especially when challenges arise in their internships. Does a more active discussion facilitator lead to greater gains in depth of writing? Can near-peer mentors achieve similar effects?

Within the cohort of students working through the course in a single year, there is significant variation. While each student is only allowed to enroll in the course once, students may choose to do so at any time during their academic program: in each cohort, students ranged

from freshmen to seniors, some working at their very first internship experience, while others returning to a company at which they'd worked for multiple years. Moreover, some students were working at large software firms with well-established internship programs (with significant institutional support and mentoring), while others were at start-ups or at other companies that had never hosted interns before. These variables may significantly change both the experience of the internship and the extent to which students are exposed to positive role models of reflection and written documentation.

Internal factors may affect students' reflective writing as well. The university at which this study occurs serves many English language learners, for which writing in English may pose specific challenges. Moreover, previous work has suggested that women may experience engineering internships very differently from men (Seron, Silbey, Cech, & Rubineau, 2016). While the data sampled for this study was calibrated to reflect the proportion of women in the program, future work will analyze any gender differences in the reported internship experiences and resulting reflections.

Conclusion

In this study, engineering students in summer Computer Science internships were invited to reflect weekly on their growth and professional development, and on the connections between their experiences on the job with their academic preparation. This regular reflection required students to express themselves in writing and enhanced the standard engineering curriculum. The written reflections showed measurable, significant improvement over time as indicators of integrative learning. Evidence of transformative learning that helped students conceptualize themselves as professionals was seen. This work suggests a space in the undergraduate engineering curriculum where authentic reflection can deepen core academic foundations and help build essential career skills. Future work will study the role of peer and instructor feedback on student writing, as well as variations across students from different demographics and backgrounds.

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