PERSONAL LEARNING JOURNALS IN A CAPSTONE DESIGN COURSE AS A TOOL TO ENCOURAGE LIFE-LONG LEARNING

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ABSTRACT

Engineering curricula is generally a very busy one filled with many assignments, labs and projects that are designed to train the engineer to work quickly, either individually or in teams, to efficiently analyse and solve problems. Because of the number of contact hours and heavy workload, there is little if any time for reflective learning for engineering students and there are few, if any, courses that include a personal learning journal as part of the course deliverables. This paper describes the pilot use of a personal learning journal in an eight month capstone design course as part of the assessment criteria to meet the Canadian Engineering Accreditation Board (CEAB) graduate attribute for life-long learning. The personal learning journal took the form of a weekly entry, a meta-reflective piece completed thrice in the course, and a mid-year class playlist. The entries are analysed for changes in language and focus throughout the year using word clouds which illustrate changing feelings during the course.

KEYWORDS

Standard 7 Integrated Learning Experiences, Program Case Study
CDIO syllabus: 2.4: personal skills and attitudes

INTRODUCTION

In response to pressures from industry, universities are being encouraged to graduate students who are not only technically strong, but also prepared in soft, business and, communication skills. The Canadian Engineering Accreditation Board (CEAB) as well as the CDIO organization, have adopted graduate attributes/learning outcomes upon which engineering schools can evaluate their progress and/or be accredited against. Five of the CEAB graduate attributes are focussed on easily defined and assessed technical skills (knowledge base for engineering, problem analysis, investigation, design and, use of engineering tools) but seven of the attributes are more difficult to define and to assess within the bounds of traditional engineering curricula. The most difficult graduate attribute to build curriculum around and to assess is life-long learning defined, as *"An ability to identify and to address their own educational needs in a changing world, sufficiently to maintain their competence and contribute to the advancement of knowledge CEAB and GA".* This is particularly difficult to measure as students graduate and the ability to determine if they, indeed, have developed a mindset that includes life-long learning is lost. In Canada, professional engineers must report to their governing/licensing body professional

development hours in order to maintain their professional designation, but reporting hours and actively engaging in life-long learning are two different things.

BACKGROUND

The Schulich School of Engineering at the University of Calgary, like all Canadian universities requires that students in their final year complete a two-term capstone design project. The projects come from industry and are open-ended real-world problems that should take a minimum of 200 hours per student to complete over two, four-month terms. The groups and projects vary from department to department and group size can be as small as four and as large as twelve students. Each project has a faculty advisor and industry advisor who together provide guidance but not direct technical support. The Department of Civil Engineering groups generally fall into the large category with groups as large as twelve and projects can range from very specific, such as design of a pedestrian bridge to multi-disciplinary as greenfield subdivision development plans. A major component of the grade is project management with groups rotating the project manager from month to month over the course of eight months. One of the first deliverables for the course is a terms of reference wherein they define the scope, goals and objectives of their project, but also the deliverables they will produce at the end (drawings, conceptual plans, etc.). Because of the scope of the capstone projects, prototyping is generally not one of the deliverables. Course assessment was comprised of five components:

1.   Initial terms of reference (5%)
2.   End of Fall term report (20%)
3.   End of project report and poster (60%)
4.   Two presentations (end of fall term and end of winter term) (10%)
5.   Personal learning journal. (5%)

PERSONAL LEARNING JOURNAL

Using a practice from the consulting industry, the 2013-2014 course included a weekly personal learning journal (PLJ) and reporting of 'billable hours'. Students were given guidance in terms of how a journal could provide them with opportunities for reflection and life-long learning.

> *"Developing your capacity to reflect effectively and critically is an important life long and professional development skill. Reflection helps deepen and integrate your learning. Keeping a learning journal is one of the most important ways to develop your reflective skills. Developing a habit or discipline of reflection helps you to become a "reflective practitioner." As engineers, we tend to think of ourselves as 'doers' and to some extent this is true, but we should always be open to reflection and learning from past experiences. Documenting those experiences and feelings can become part of general project management (aka. 'lessons learned'), but frequently, the time pressures reduce the formal capturing of those lessons. In this component of the course we'll explore what this concept means for you as a student, and as you develop as a professional engineer—your learning journey from novice to expert."*

In addition to the above, the students were given suggestions for the structure of their weekly entry including four main areas for reflections: observations, personal reactions, notes to self and key learning points. They were also encouraged to include comments about what they had accomplished/learned, what they failed to do and/or, what they need to do to stay on

track for the following week. Each entry had to include 'billable hours' which was a direct reference to industry practice and one for which many students are not familiar. Hours were categorized under the major tasks (research, analysis, design, etc.) of their self-identified work plan from their Terms of Reference document and it was designed to not only help them keep on track but also made them aware of how much (or how little) time they were spending on their project. Billable hour reporting also gave them a sense of how well they had estimated the effort to accomplish some tasks (writing and compiling the final report in particular) which kept them aware of looming deadlines and deliverables. In consulting, all work is accounted for on a sub-hourly basis and daily logging in a journal can save many headaches at the end of the week when it has to be reported: the PLJ was designed to start that life long habit.

The PLJ Process

Using an electronic learning management system (Blackboard) students were invited to participate in two discussion groups: one project group which was used primarily as a communication tool for the group and a second PLJ group that comprised of only three members, the student, the teaching assistant (TA) and the professor. Over the twenty-six weeks of the course, students were to submit a free-form PLJ entry by noon on Friday at noon in order to receive credit, and they were given two 'mulligans' before penalties were assessed on a sliding scale: if a student missed more than six entries, they had effectively lost the 5% grade assessment. If a student chose not to submit any PLJ entries, then they were aware that they were giving up 5% of their overall grade. The TA did not participate in PLJ discussions, but accessed the groups only to log that at student had submitted on time and to calculate penalties if any.

Weekly Entries

Weekly the professor read each entry and occasionally commented to a student if they had brought to light serious issues with group management (such as disputes developing within the group) or faculty advisement (such as lack of response from a faculty and/or industry advisor that was hampering progress). Some students embraced the PLJ and wrote lengthy 'dear diary' entries that were a complete window into the frustrations and fears of a soon-to-be graduating engineer:

> *"I'm finding it hard to focus on school this semester. Not just 570, but all of it in general. …….. there are always things to do that are way more fun than school. That being said, we were productive this week and had a team meeting to clarify and remind everyone of their roles for the next deliverables. I think going over it made me feel a lot better about how much we still have left to do. We are aiming to have the report and poster complete by the end of march, to really free us up in April for our other courses and projects. I am going to have to put a lot of time into 570 over reading week to make this happen (less snowboarding, sad haha)"*

Other students wrote 'just-the-facts Ma'am' entries listing task completed and billable hours, as follows:

> *"Meeting: We had one meeting on Monday finalizing the presentation and another meeting on thursday to practice for the presentation.*
> *Research, Design and report: This week I mostly worked on writing and editing the final report and presentation.*

> *Chargeable hours: Total chargeable hours for this week is 10 hours. Winter semester to Date: 116 hours"*

Some students complained about having to complete a weekly task and of the 111 students who were in the course, three did not participate in the PLJ at all and a further eight students faded out during the course. One student succinctly voiced his/her frustration through a poem in week five of the course:

> *"Trying to get up to speed,*
> *with what this new project might need.*
> *These journals are a pain,*
> *They've driven me insane,*
> *which is why I wrote a poem…*
> *The End"*

Compiled PLJ Entries

Three times in the course, the students had to look back on their journal entries and submit a compiled personal learning journal to assess their individual and/or group progress and identify any personal weaknesses or gaps in their abilities. The compiled PLJ was an exercise in meta-cognition and students were given free-range in the format of the submissions. Students took full advantage of the freedom and compiled PLJ entries included haiku, cartoons, music videos, songs, artwork, personal letters to themselves (either in the past or the future) as well as the more traditional format of technical memoranda to the instructor. One student created an iMessage text string to his sister that encapsulated all the frustrations and triumphs of the previous six weeks. Figure 1 presents two compiled PLJ entries from the final submissions.

Figure 1: Sample Compiled PLJ Entries for the Final Submission

The Playlist

A fun twist to the second compiled PLJ was the creation of a music playlist. Rather than having students write a reflective piece, they were asked to select a song that encapsulated their experience at the two-thirds point of the course. At this point in the term, the crunch was on and students were feeling frustrated, stressed and worried not only about the amount of work yet to be completed, but also about the final outcome (grades, always grades). The students submitted the title and artist of their song and they were also asked to explain why they had chosen the song. There were 106 unique songs on the final list, which was returned to the students to vote on within one week. The final playlist (top ten songs) were used to create a playlist that became the sound track for the final design fair celebration. There were many ties in the voting which resulted in more than ten songs being part of the

playlist, but regardless, the selections provide some insight to how the students were feeling at a very stressful time. The voting results and top ten songs reflected optimisim ('Up'); a desire for it to be over ('The Final Countdown' and 'It's 5 O'clock Somewhere'); fatigue ('I'm so tired'); despair ('In too deep') and finally, satisfaction ('Takin Care of Business' and 'We are the Champions'):

> 10: With 6 votes: *'Up!' (*Shania Twain); *'Shot through the heart' (*Bon Jovi); *'Bit by Bit'* *(*Mother Mother); *'I'm so Tired (*The Beatles); *'Here For A Good Time' (*George Strait)
>
> 9: With 7 votes: *'Mad World'* (Gary Jules); *'Satisfaction'* (The Rolling Stones); *'Boulevard of Broken Dreams'* (Green Day); *Feeling Good'* (Michael Bublé); *'The Song That Never Ends'* (Hannah and Viola); *'Stayin Alive'* (The Beegees); *'Wake Me Up'* (Avicii)
>
> 8: With 8 votes: *'Thriller'* (Michael Jackson); *'Don't Worry; Be Happy'* (Bob McFerrin); *'Bicycle Race'* (Queen); *'Livin' on a prayer'* (Bon Jovi)
>
> 7: With 9 votes: *'We are the Champions'* (Queen); *'Time Is Running Out'* (Muse); *'Ain t No Mountain High Enough'* (Marvin Gaye with Tammi Terrell); *'Harder; Better; Faster; Stronger'* (Daft Punk); *'Happy'* (Pharrel Williams)
>
> 6: With 10 votes: *'Let it be'* (The Beatles);*'Wrecking Ball'* (Miley Cryus); *'Drink in My Hand'* (Eric Church); *'Don t Stop Believin'* (Journey); *'Over And Over* (Hot Chip)
>
> 5: With 11: *'Highway to Hell'* (AC/DC); *'One Step Closer'* (Linkin Park)
>
> 4: With 12 votes: *'It s 5 O Clock Somewhere'* (Alan Jackson)
>
> 3: With 15 votes: *'In Too Deep'* (Sum 41)
>
> 2: With 16 votes: *'The Final Countdown'* (Europe)
>
> 1: With 17 votes: *'Takin' Care Of Business'* B.T.O. (BACHMAN-TURNER OVERDRIVE)

Learning from the entries – Word Clouds

The PLJs are a treasure trove of information about the inner workings of groups and inner mind of young engineers. To analyse them, the full entries were downloaded from Blackboard, stripped of all names and randomly numbered to remove the student identity. Only one person saw the raw entries and in the processing maintained only two attributes of each file: gender and project group name. Weekly entries were then copied into an excel spreadsheet where they were additionally edited to remove personal or group names and thereby further detach the comments from any identifiable attribute. A total number of 103 PLJs were included in the spreadsheet.

Once cleaned, ten students were randomly selected from the excel spreadsheet and the entries from four time periods collated into one entry that was used to create word clouds using the online generator http://www.jasondavies.com/wordcloud. Word clouds count and rank words according to the number of times a word is used. Based upon the ranking, the font is sized with the most frequently used word having the largest font. The four time periods that were selected were: Weeks 2-4, Weeks 12 and 13, Weeks 19 and 20 and, Weeks 25 and 26 as they reflect the beginning, end of first term, middle of second term (and crunch time) and final two weeks of term.

Figure 2 presents the word cloud for the first time period when the students have been assisgned to a project team, are first meeting their group members and are developing the terms of reference for the project. This is a time of new beginnings and uncertainty not only in what work has to be done, but also in terms of new working relationships. The compiled

PLJ entries for this time period added up to 1782 words and with removal of pronouns, articles, conjunctions, and some adverbs distilled down to 842 words for the cloud. As can be seen, in Figure 1, the dominant words are 'project', 'group', 'team', 'advisor', 'academic' and 'member' which is what one would expect at the beginning of a group project. Other strongly present words are 'understand', ' deliverables', 'great' and 'experience' with 'midterm' already looming in the conscious of the student writers.

Figure 2. Sample word cloud of PLJ entries for first three weeks term.

The second time period is presented in Figure 3. Weeks 12 and 13 are the final weeks of the fall term and at this point, the groups have completed the research phase and are not only studying for final exams, but are also putting the finishing touches on their fall term report. The totally word count for this period is 2667 with 1322 words in the cloud, which is somewhat surprising considering how busy the students are during the final two weeks of the term. The most frequently used words are 'meeting', 'group', 'working', 'include' and 'report' with 'project', 'design', 'mark', 'everything' and 'done' being secondary words.

Figure 3. Sample work cloud of PLJ entries for weeks 12 and 13 of term.

Figure 4 presents the word cloud for the third time period which is two thirds of the way through the course and at which time most groups have completed the technical design phase of their project and are moving into the final writing and compilation stage. This is a very busy time of the term and the word count for the students is reflected in the total word count – 720 words – of which 337 are in the cloud. They are just too busy to get wordy! Having just completed the term break (Reading Week), those two words are strongly present in the cloud but secondary words such as 'group', 'meeting', 'design', 'detailed' and 'completed' indicate the focus of their efforts at that time. 'Working' and 'report' are also repeated words in the entries.

Figure 4. Sample work cloud of PLJ entries for weeks 19 and 20 of term.

The final word cloud is for the last two weeks of term when the focus has been on presentations, submission of the final report and the end of the project. Words that dominate reflect that focus but included in the cloud are words that reflect their feelings: 'amazing', 'people', 'great', 'end', 'fun', 'awesome', 'experience' and 'happy'. The total number of words in the entries 1829 of which 827 are in the cloud. Within the cloud, there are very few negative words and sufficient students used 'ha ha' and 'happy' to have them register with a larger font (indicating more than one use of the word).

Figure 5. Sample work cloud of PLJ entries for weeks 25 and 26 of term.

Tracking one student

An example of how one student progressed throughout the course is presented in Figure 6, below. These two clouds are the first (on the left) and last (on the right) entry for the student

Figure 6. One student's progress from week one (on the left) to the final week (on the right)

At the beginning of the project, this student most frequently mentioned 'skills', 'project', 'group', 'team' and 'meeting'. By the end of the course 'project' is still a strong word, but, 'experience'. 'team' and 'think' in the PLJ entry indicates less emphasis on the technical side of the project and more on the experience as a whole.

CONCLUSION

The use of personal learning journals is not unique to engineering workplaces, but it tends to be used more for work planning and reporting and less for reflection. Design journals are intended to capture ideas, calculations and brainstorming, but reflection is a much-needed skill for engineers working in multi-disciplinary teams and the logbook can become a valuable part of project records but it is not necessarily considered a life-long learning tool. Including personal learning journals within an eight-month, multi-disciplinary capstone design course was meant to set a life-long habit of daily journaling and 'billable hour' reporting. Requiring

personal reflection within the journal entry not only provided a window into the minds of young engineers as they embarked on an open-ended design project within a multi-disciplinary setting but also gave them a taste of how important it is to look back on the project and take lessons learned into the next project.   This life-long skill is summed up in the final entry of one of 106 personal learning journals:

> *"First off, I learned how much of a difference it makes to have a team that gets along well and communicates."*

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BIOGRAPHICAL INFORMATION

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