CO-DESIGNING CURRICULUM: FIRST-HAND EXPERIENCES OF UNDERGRADUATES CREATING EXPERIENTIAL LEARNING ACTIVITIES FOR THEIR PEERS

Allan MacKenzie and Jan Boer
McMaster University, W. Booth School of Engineering Practice & Technology
mackenza@mcmaster.ca; jan.boer@mcmaster.ca

Abstract – *The Bachelor of Technology (B.Tech.) program at McMaster University, W. Booth School of Engineering Practice and Technology differentiates itself through its experiential and industry-driven approach to teaching and learning. The B.Tech program initiated a pilot faculty-student co-design project for the Project Management course delivered to third-year engineering technology students. In the past, the faculty has struggled to find a major project assignment that gives students workplace readiness skills in project management in a real-world context. The faculty and a fourth-year undergraduate student worked together to co-design a term long project, which treated their personal educational deliverables (e.g. course work, assessment deadlines, financial accountabilities), as a project to manage. The paper will bring together key perspectives from this pilot co-design experience, namely, the undergraduate course developer, faculty liaison, as well as feedback from the students in the course. The authors found that while students appreciated the accompanying project documentation, the co-design team must continue to demonstrate the usefulness of working with MS Project as software enabling workplace readiness.*

Keywords: Project management education; co-designing curriculum; self-directed learning; experiential learning; professional skills; engineering technology program.

1. INTRODUCTION

The Bachelor of Technology (B. Tech) program at McMaster University, W. Booth School of Engineering Practice and Technology differentiates itself through its experiential and industry-driven approach to teaching and learning. The program combines traditional instruction methods with hands-on practice in high-tech modern labs, along with real-world industry experience obtained through 12-months of workplace co-op in one of three areas of program specialization: Automotive and Vehicle Technology, Biotechnology, and Process Automation Technology. The B.Tech program also uniquely blends engineering technology with management and society courses to explore the human side of engineering. The outcome is graduates equally savvy in technical as well as management skills, and who have breadth of perspective to tackle broad-based engineering issues in creative and practical ways [1].

One of the mandatory courses within the B.Tech curriculum is Project Management (GENTECH 3MT3). The course is only offered during the fall term, with approximately 170 - 200 third year students enrolled each year. Intended learning outcomes for this course include the ability to understanding the fundamental knowledge, terminology and processes of project management to be able to pursue the Certified Associate in Project Management (CAPM). The CAPM is a valuable entry-level Project Management Institute (PMI) certification for project practitioners. In an effort to meet this objective, faculty have sought to develop a project assignment that applies course material in a real-world context. In the past, faculty have facilitated numerous student-driven community-based projects; however, the faculty wanted to find an alternative option that would lessen the administrative burden on faculty members teaching and supporting the course.

The faculty in the program tries whenever possible to consider opportunities to involve students in the management component of the program. Having a student take on a course developer role seemed like an interesting professional development and learning opportunity with the added benefit of providing a constructive impact for the end-user project management students. In a recent article, Havergal stated co-designing curriculum goes "beyond the idea of listening to the "student voice", (…) [and instead] aims to engage teachers and learners in a much more meaningful, and more equal, relationship; one that, per proponents of "students as partners", leads to better teaching, more effective learning and graduates who are better prepared for the workplace" [2].

Within the literature, there are various rationales for students participating in curriculum design, especially since active and participatory approaches are thought to enhance and support learning [3,4,5,6,7]. Bovill, et al stated "the process of co-creation implies that staff will need to be more self-aware, highly flexible, knowledgeable and sensitive to respond to student learning needs and the direction in which the students want to take the curriculum. This negotiated curriculum design process would also be affected by any professional standard requirements, regulatory frameworks and

personal views of how a subject should be taught" [8]. If this is required of the facilitators of learning, why allow students design curriculum? According to Prensky, try as teachers may, the facilitators do not understand the minds of today's students and the co-design approach addresses this gap [9].

In line with this meaningful pursuit and the focus of an 'industry-ready graduate', the B.Tech program initiated a pilot faculty-student co-design project for the Project Management course. The first-author became the 'faculty liaison' and the second-author, a fourth-year Process Automation undergraduate student became the 'course developer'. Together they developed the "Schoolscape" Project Assignment, in which the third year students enrolled in the course were asked to treat their personal educational responsibilities, such as course work, assessment deadlines, financial accountabilities, etc. as a project to manage. The assignment deliverables were integrated throughout the term with 10 associated labs, which required the application of Microsoft Office and Microsoft Project productivity software tools. In these labs, the students were given tasks that required them to assimilate and apply the key principles from the course, such as project tracking, resource management, costing and risk management. The project also required the students to develop and use personal improvements strategies and tools, such as S.M.A.R.T. goals, effective brainstorming and periodic reflection. These weekly lab exercises built throughout the semester into final Schoolscape Project Report due at the end of the term.

In what follows, the authors describe the project assignment design, the faculty liaison and student developer collaboration process, as well as feedback and insights gathered from the project management course student focus group which was facilitated at the end of the fall 2016 term.

2. CO-DESIGNED PROJECT FRAMEWORK

2.1 Background

For several years, the B. Tech program has included an experiential group project deliverable along with regular course material for the project management course. This experiential project consisted of five students working in preassigned groups to plan, manage and execute a project that would benefit a local charity. The course instructor delivered and provided resources for the planning phase of the project before shifting into more of a supportive role, taking on the industry-like "upper manager" role for each of the project groups. Undergraduate teaching assistants provided on-going assistance and feedback to the groups. However, the course instructor carried the full responsibility and administrative logistics for the planned student events. Course instructor responsibilities ranged from the challenges of booking various venues across the campus, such as the pool for 'cardboard boat races' or large lecture hall for 'movie night', to ensuring the printing of posters to help announce the events across the campus. In a typical course offering it was estimated that the instructor interacted and negotiated with approximately 10 different departments, ranging from room booking, parking, legal, athletics, etc. across the campus. Before the start of the fall 2015 term, the course coordinator – the Management Chair – questioned the sustainability of such an approach due to the growing rate of enrollment that would generate close to 30 different student teams and projects. In addition to the teaching team, departmental administrators were also drawn in to support student initiatives, thus putting strain on their already overtaxed fall term. In response to the need to find a less resource-heavy project, the course coordinator sought to find a more manageable solution that met the intended learning outcomes for future offering of the course.

2.2 The Schoolscape Project

To create the Schoolscape Project, the faculty liaison hired an undergraduate student within the school to help create a scalable and manageable solution to replace the pre-existing experiential-based project. This fourth-year undergraduate student had successfully completed the project management course with the experiential-based project format in third year and was also one of the teaching assistants for the same course.

The student course developer came up with the idea of using the students' current educational accountabilities in their third year 'framed' as project to be planned, organized, and manage a project using Microsoft Office and Microsoft Project productivity software tools. This solution was seen to be more manageable from the instructor point view and gave the students the opportunity to demonstrate their ability to develop, consider and implement the complex details required to be successful in project planning.

Weekly "Follow-Me Guides" were developed and written to guide the students through the completion of their Schoolscape Project. These Follow-Me-Guides were comprehensive, step-by-step instructions with outcomes typical of industry project deliverables. The Schoolscape project was scaffolded – meaning all the deliverables build and coalesce from weekly course lab exercises and outcomes. These deliverable components were compiled into two progress reports which were due and graded throughout the term. Students received extensive feedback on their work from the course teaching assistants. Finally all of the earlier progress report deliverables (with incorporated student revisions based on feedback provided) were compiled into a final Schoolscape Project Report due at the end of the term worth a total of 35% of the final course grade.

2.3 Associated Schoolscape Project Labs

The labs were synchronized with the Schoolscape Project deliverables to provide the students with a complete set of instructions (Follow-Me Guides) and reference materials for individualized learning. Faculty decided on this approach since the students were asked to treat their personal educational deliverables as their own personal project to manage during the semester. Each week students received a new lab that required them to integrate and apply the key principles and learning from the materials taught, such as project tracking using software, resource management, costing and risk management. As shown in Table 1, labs were designed to match the teaching track of the course.

Table 1: GENTECH 3MT3 Labwork Blueprint

Lab	Title	Phase
1	Introduction & Setup	Phase 1
2	WBS, Scope & Semester Course Layout	
3	Costs, Baselines & Resources	
4	Baseline Adjustments & PERT	Phase 2
5	Risks & Integration of Slack	
6	Resource Leveling & Priority Matrices	
7	Time Value of Money	Phase 3
8	Contracts & Document Revisions	
9	KPI's and Time Tracking	
10	Stakeholder Analysis	

The lab Follow-Me Guides employed a standardized layout with learning outcomes, an introduction, description of the task, followed by step-by-step instructions to achieve the required outcomes. The learning outcomes aligned with the course content and were correlated with the Project Management Body of Knowledge principals. Lastly, exemplars were provided for the students to illustrate and help them understand the overall expectations and requirements for each lab.

The Schoolscape project was developed to be an individualized experience, requiring students to develop and use personal improvements strategies and tools, such as S.M.A.R.T. goals, effective brainstorming, and periodic reflection. To facilitate the group experience in line with typical project management practices activities such as brainstorming, risk identification and assessment was completed in groups within the lab period. Students were asked to regularly review their projects and compare their progress with their classmates. This approach allowed students to individually experience the pressure of project management while also facilitating group interactions that resulted in 'teachable moments' among student peers. This approached fostered a better understanding of the theoretical content.

To facilitate regular reviews and to balance assignment worth, three submissions (phases) were required. Phase one report and phase two report were worth 10% each and final phase (three) report– the culminating project - was worth 15%. The students were provided with feedback between the submission of phase two and three to enable student learning throughout and help ensure overall success of the Schoolscape project assignment.

3. RESULTS AND FEEDBACK

With any new course initiative, there are challenges in terms of design and implementation. In this section feedback is provide by a select group of students who participated in a confidential focus group after completing the Schoolscape Assignment Project and accompanying labs. Following this data, both the undergraduate student course developer and faculty liaison provide their experience with this co-design process.

3.1 Student Focus Group Feedback

Students from the fall 2016 offering of the project management course were asked to participate in a focus group to get their feedback on the Schoolscape project assignment and associated labs. Participation in this focus group was voluntary and was conducted by researchers at McMaster's institution for teaching and learning excellence, the MacPherson Institute. Data collected during this focus group were anonymized and returned to faculty liaison and student course developer after the grades for the course was submitted.

The participation rate was 7.6% of the class with a total of 12 students in the Project Management course participating in the focus group. In the sessions, participants discussed the strengths and areas for improvement in the course. The session was 75 minutes in length of which they students spent the first 15 minutes providing responses to a survey, followed by 60 minutes of open discussion.

Overall, the majority of students stated that the MS Project software provided a good way to visualize the timeline of a long-term project. Students also commented positively that using lab time for assigned work was a useful way to structure the lab. Many students appreciated that MS Project allowed them to see the project in pieces. Lastly, during the focus group, the students stated the exemplars provided for the labs as very helpful.

Most of the students identified the selected project topic (i.e. their student schedule) as problematic because school schedules do not align with a typical project flow. The students, instead, suggested that future iterations

should incorporate a generic project with shared data and the same schedule could be used. The students felt this generic project would be more realistic and would help address some of the communication and assessment issues they experienced (see below). The students also identified communication between the course instructors, student developer and the teaching assistants as a key area for improvement. More specifically, the students noted that, at times, their instructor and teaching assistants did not share the same understanding of the assignment goals, methods of assistance or assessment requirements.

Students also identified a difficulty when accessing MS Project software. At issue was that some students had obtained copies of the software, but many found it incompatible with their devices (Apple computers). This proved difficult and inconvenient when trying to find time to learn the software on the campus computers in the labs.

The students also completed a short survey during the focus group which asked for their level of agreement of 13 statements listed in the appendix. A Likert scale ranging from strongly agree (5) to strongly disagree (1) was used. Boxplots and table of survey responses are given in Table 2 and Figure 1, summarized by the median and interquartile range (IQR) for ordinal data.

Table 2: Summarized Student Statement Responses

Variable	N	Median	IQR
1	10	2.00	1.25
2	10	2.50	3.00
3	10	2.50	2.25
4	10	2.00	1.25
5	10	2.50	2.25
6	10	1.50	2.00
7	10	1.00	1.00
8	10	2.00	1.25
9	10	2.00	3.00
10	10	2.00	1.25
11	10	2.50	2.25
12	10	4.00	1.25
13	10	4.00	1.50

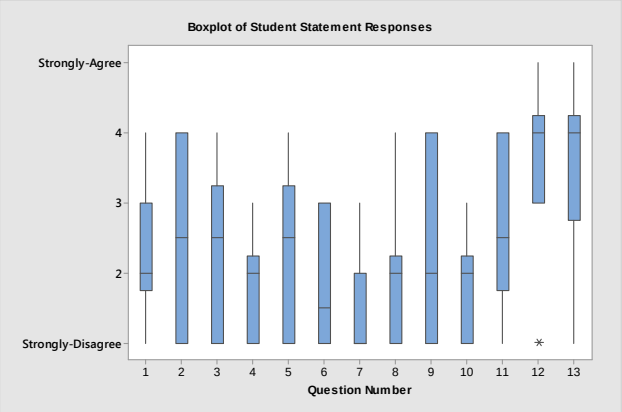

Figure 1: Boxplot of Student Statement Responses

The survey data feedback provided by the students was not that surprizing as several students gave real-time feedback throughout the term that there was lots of room for improvement. These survey responses provided (1) a realistic perspective on learning about MS Project, (2) a deeper understanding of how students put theoretical content into practice, and (3) insights into the helpfulness of the project exemplars and templates.

For the data, three questions in particular provide interesting insight. The majority of students strongly disagreed that they will be using MS Project in future courses with very little spread in responses (question 7, Median=1.0 IQR=1.0). These results prove interesting because B.Tech students will be required to use skills developed through MS Project, such as creating a project plan and Gantt charts in future capstone design courses. A majority of the students appreciated having the exemplar documents to complete the weekly labs with very little spread in responses except one person who strongly disagreed (question 12, Median = 4, IQR=1.25). The student developer was relieved to see that the work involved in creating the supporting documentation for the software labs did not go unappreciated. Students were generally dissatisfied with their ability to learn MS Project. The students were split with 3 out of 10 strongly agreeing and 7 out of 10 disagreeing or strongly disagree (no "neutral") (question 9, Median = 2.0, IQR= 3.0). Overall, these results provided insight into the challenges of creating content the majority of students would feel comfortable using. However, the student developer indicated it was the same when they completed the project management class for the first time - never expecting to use the MS Project software in the future classes.

Table 3 and Figure 2 and shows aggregated responses for (1) perceived value of the MS Project software, (2) the value of the documentation provided for the Schoolscape project labs, and, (3) the value of the topic (project management). Again, boxplots and summary statistics (median and IQR) are used.

Table 3: Aggregated Student Value

Variable	N	Median	IQR
MS Project Software Value	90	2.00	2.00
Documentation Usefulness	30	3.00	2.00
Value of Topic (Project Management)	10	2.50	2.25

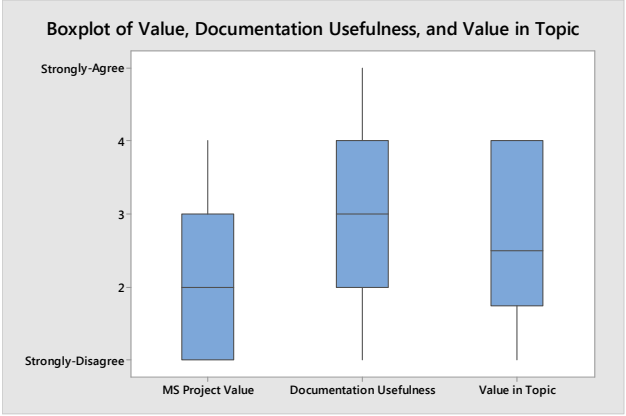

Figure 2: Boxplot of Aggregated Student Value

From the focus group we learned that students did not find value learning about MS Project software. Most students did not think they would use MS Project in the future. Some respondents found that there were other tools that they found more useful, while others speculated that MS Project is not used in industry. Other participants noted that because MS Project software is not compatible with Apple computers, they would never use it.

The perceived value in the Schoolscape project lab documentation materials (i.e. Follow-Me Guides, templates and exemplars) was uniform across all values on the scale with students both liking and disliking it proportionally. Unfortunately, this feedback is not helpful in assessing the documentation usefulness.

3.2 Student Course Developer Experience

In the last section, the student and faculty liaison provide their unique perspective of the co-design experience.

As a student developer, it was challenging creating content, such as layouts and even a simple structure because there was no immediate feedback from my intended audience – the third year students. However, to bridge this gap, several classmates provided key ideas to consider and incorporate into the design of the project, as well as assisting with the layout that represented their understanding the material.

Unfortunately, the development of the Schoolscape project assignment and labs started about a month and half before the start of the fall term which did not afford much time for scope revision and further idea exploration. This pushed the bulk of the lab design process into the fall term, with the student developer having to create Follow-Me Guides, exemplars and templates on a week by week basis throughout the term. Due to this truncated timeline errors appeared in documentation, which lead to several students approaching the student developer directly for instruction and direction on their projects, rather than the course instructors or teaching assistants.

This quick development schedule also resulted in unclear expectations between the student developer and the teaching staff. Several times the teaching staff was unsure of the process and/or software steps. This miscommunication also led to occasions where students contacted the student developer directly to clarify project/lab expectations and in some cases, the developer spent extra time outside the scheduled lab and class time to actively tutor students on areas that had been miscommunicated or misunderstood.

The course developer personally found the co-design experience to be very educational. Their understanding of the project management material grew exponentially despite their previous experience taking the course and working as its teaching assistant. The experience of designing course content led to elevated respect for faculty who provide meticulously crafted content that is easy to understand and absorb all the while focusing on connecting with students at an individual level.

3.3 Faculty Liaison Experience

The Schoolscape project and associated labs, although originally developed to lessen the administrate load of the faculty and support staff, did not in effect have this intended outcome. As the course coordinator, an equal amount of time was spent meeting with sessional faculty, addressing critical issues as they arose, along with continued management of student expectations and the needs of the course developer.

Further, the past instructors of the project management team were sessional faculty members. Therefore, and in response to their anecdotal feedback about time constraints and the lack of understanding of the Schoolscape project and associated labs, it became apparent that there was a need to ensure sufficient preparation time for future teaching staff for any large-scale course design changes such as this. It is also clear that in future versions of the course that the instructional team will require advanced experience in working with MS Project due to the complexity of the software and at times, intuitive interface. The importance of the use of this software in industry was not sufficiently conveyed to students or perhaps even the instructional team; therefore, this message needs to be more clearly articulated to students in the future.

To meet these needs, future iterations of the documentation (i.e. Follow-Me Guides, etc.) will include

more accessible visualizations to help with project comprehension and to help students conceptualized the arc of the project. In so doing, students should be better equipped to understand the usefulness of project management software and learning about its importance. Our future goals include having students identify the role of this software as a means to differentiate them from other potential job candidates.

With future offerings of the project management class, the faculty liaison will need to consider two legacy issues. due to the small nature of the B.Tech program. Due to the small nature of our program, past students typically speak to incoming students before a course begins. In the fall 2016 semester, incoming students were under the impression that they would take part in a community-based project of their choosing. When this did not happen, and coupled with the issues of the new course project, students' expectations were flattened. Further, on account of the tepid student experience of the pilot project, the course coordinator will wait a full academic year before running a revised version of the Schoolscape Project again. With this the year gap, faculty and instructional staff will have time to edit the project documents for consistency. Further, in the next iteration, concerns about the documentation and coordination of tasks will be standardized to encourage greater student buy-in at the beginning and throughout the semester. Finally, the course coordinator will develop a set of standard operating practices for future instructors and teaching assistants to ensure consistency and sustainability of this project.

6. CONCLUSION

To summarize, the B.Tech program initiated a pilot faculty-student co-design project for the Project Management course delivered to third-year engineering technology students. The project topic afforded students first-hand experience of MS Project software on a well-known topic to students, that is, their personal educational deliverables (e.g. course work, assessment deadlines, financial accountabilities). The authors found that while students appreciated the project documentation, the co-design team must continue to demonstrate the usefulness of working with MS Project as software enabling workplace readiness. Future iterations of this course will integrate the experiences from key collaborators and student feedback.

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APPENDIX: FOCUS GROUP SURVEY

Listed below are the student focus group survey statements which used a Likert scale for participant responses.

1. I feel comfortable using MS® Project software.
2. I appreciate the value of learning about MS® Project software as a skill to be used in industry.
3. I could help someone else use or learn about MS® Project software.
4. I intend to use MS® Project software in future work placements.

5. I feel confident telling potential employers about my ability to use MS® Project software.
6. I would recommend other students learn MS® Project software.
7. I intend to use MS® Project in future B.Tech courses.
8. I intend to use MS® Project in future large-scale B.Tech projects (e.g. TR or Capstone projects).
9. I felt satisfied with my ability to learn how to use MS® Project software.
10. I appreciated the level of detail included in the Guides.
11. I saw the value in the topic (namely, what you receive for your education here at B.Tech) where we applied MS® Project software.
12. I appreciated having exemplar documents to complete the weekly labs.
13. I appreciated having templates to complete the weekly labs.