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Hybrid Delivery of College Instruction in the Skilled Trades: Supporting Apprenticeship Completion

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Executive Summary

We set out to determine whether hybrid delivery of a college program could facilitate completion of an apprenticeship. We found unanticipated complexity in the answer. The hybrid program delivered completion rates and average student grades that were comparable to those in a program delivered entirely in the classroom, but in only half the required time. However, we found that performance in the in-class portion of the program was not always linked to apprenticeship completion. The factors affecting completion are varied, in part because different stakeholders place a different value on completion.

The motivation for our study was to determine whether shifting the design and delivery of a college-based program for apprentices in the Industrial Mechanic Millwright (IMM) trade to a hybrid model could facilitate completion of apprenticeship. Our study was designed to collect data from the stakeholders in the IMM apprentice program to better investigate factors that impact aspects of apprentices' progress to journeyperson status unrelated to their college training. We developed the hybrid program to allow our IMM student-apprentice cohorts to take advantage of the added flexibility provided by online delivery in the hopes of increasing retention in the college program. As apprentices work full-time (sometimes with one day a week off to attend school), making the theory component of the course accessible online could prove particularly helpful to them.

Our study was carried out over a three-year period with apprentices enrolled in the Industrial Machinist Maintenance (Millwright) (IMM (Millwright)) program at two community colleges in Ontario. At one college, the theoretical component of the course material was delivered in a classroom setting, while at the other an online resource was used for theory instruction. Both colleges offered classroom-based practical sessions. Results from an anonymous survey of the cohorts from the two colleges indicated that the cohorts in our study shared demographic characteristics similar to those reported for Canadian apprentices as a whole. The most striking aspect of the survey results was the lack of difference between our cohorts. Students in the classroom cohort showed slightly higher levels of satisfaction with their instruction. However, overall, the cohorts reported a high level of satisfaction and engagement with the program, with equal satisfaction and engagement from student apprentices in both program types.

Comparing student achievement, we found that the cohort of students who were taught theory in the classroom had generally higher academic achievement, as determined by their marks. However, since our two cohorts were located at different institutions and other factors unrelated to the study may have affected student achievement, we cannot attribute this change to the mode of delivery. Since our cohorts were located at two different institutions, other factors unrelated to the study may have led to the differences in academic achievement. We also found no difference in retention or completion between the cohorts.

The primary differences in the interview data with student apprentices were situational and related to access to the program. Interview findings confirmed overall satisfaction with the program. A number of

suggestions emerged to improve the programs at the respective colleges, such as making changes to the scheduling of course and making available in-person review sessions for online content.

Interview data with other apprenticeship stakeholders provided rich observations about the apprenticeship ecosystem and the reasons for which apprentices might choose not to complete their apprenticeship program or journeyperson qualification. Some apprentices have difficulty getting on-the-job experience in all aspects of the IMM trade. The challenge apprentices face in managing their time to balance course work with a full-time job was acknowledged by all stakeholders. Many employers described paying journeyman's wages to apprentices, which could reduce apprentices' motivation to complete their journeyperson designation. The stakeholders were aware that doing so made apprentices less mobile to pursue employment elsewhere. Many aspects of the IMM apprenticeship were perceived by stakeholders to be disconnected; we found considerable lack of communication between the stakeholder groups in the IMM apprenticeship program, which is unlikely to be a positive factor for completion. Aside from the apprentices, no one stakeholder in our study claimed ownership of the apprenticeship program. Taken together with student achievement and how employers view and incentivize completion, this leads us to ask how apprentices and the apprenticeship community value completion.

The Pedagogy of Apprenticeship – A Critical Need

While much has been said about the perceived or predicted shortage of apprentices in certain trade areas, rarely is the role of pedagogy invoked as part of the solution when it comes to increasing completion rates. Questions about the best way to train apprentices are seldom asked or researched. Yet the education and training of apprentices presents a number of important challenges for the various stakeholders involved. While many apprenticeship programs are offered by community colleges, industry dictates the theoretical and practical requirements of training, and apprentices often continue to work full-time in their chosen profession while studying at a college or other training delivery agent. The responsibility for pedagogy is thus shared by many but, at the same time, owned by none.

Literature on best practices in pedagogy for student-apprentices is scarce. The apprentices' educational goal – to obtain, process and apply knowledge – is not dissimilar from that of other programming in the college sector, but the context is different, as student-apprentices are also full-time employees learning material that is directly related to their everyday experience in the workplace. Apprentices often are not in search of a career; they are already established within one. As a result, factors such as access, appropriateness and affordability all become paramount in the decision making of both the students and the employers.

The data point to enthusiasm for entering the trades, but challenges remain for trainees looking to complete their apprenticeship. This study was motivated both by a desire to understand this gap and to improve the quality of apprenticeship education. Our aim was to identify factors that might increase student-apprentice retention and improve apprenticeship completion rates. Specifically, we evaluated the possibility of delivering the theoretical portion of in-class training using a hybrid model in the IMM (Millwright) program at Sault College. Our hope was that the hybrid model might provide apprentices with the flexibility they need to complete the in-class portion of their training while working full-time.

Literature Review

A Closer Look at Apprenticeship Completion Rates

On the one hand, much research has been conducted in an attempt to understand the reasons behind low apprenticeship completion rates. On the other hand, however, apprenticeship completion rates are difficult to calculate, since apprentices cannot easily be tracked from the beginning to the end of their training, and the pace and direction of the apprenticeship pathway can vary considerably. Any apprenticeship completion rate will at best be an approximation, one informed by particular assumptions. With this in mind, we review some of the literature relevant to completion rates below.

The National Apprenticeship Survey (NAS) collected data in 2007 on about 30,000 individuals who were registered as apprentices between 2002 and 2004. Laporte and Mueller (2010) report that 64% of apprentices captured by the NAS completed their apprenticeship. Twenty-three per cent were long-term

continuers and only 13% self-reported discontinuing their apprenticeship. Dostie (2010) showed that, while many apprentices proceed through the program in three or four years, a significant number are considered to be long-term continuers (those in the program for longer than its average duration) or discontinue then re-entered apprenticeship. Similarly, Empey relates that 60% of those who identified as discontinuers in 2004 had returned to an apprenticeship by 2007. This finding prompted Empey to coin the term 'delayer.' These apprentices may leave the apprenticeship program for a period of time and return at some later date to complete their training. The findings from the NAS data demonstrate that apprentices can follow a number of indirect paths to completion, and that many take longer than the prescribed time to complete their training.

Identifying ways to improve the quality of education and increase completion rates could also benefit apprentices. Work by Laporte and Mueller (2012) using the NAS cohort estimated that completers earn 20% more per hour than those who are non-completers. Employers also benefit from higher completion rates, realizing the benefits of their investment in apprentice training. General economic benefit to Canada should also result from filling vacant positions within industry.

Factors Impacting Apprenticeship Completion

Apprentices tend to be older than most college students, with an average age over 30 (Laporte & Mueller, 2010), and Canada's apprentices tend to be older than in other countries (Sharpe & Gibson, 2005). Dostie (2010) found that apprentices in their mid-20s are most likely to complete. Not being married, having children, aboriginal or minority status, disability and low education levels are all negatively correlated with completion (Dostie, 2010; Laporte & Mueller, 2010). Having relatives in the trade has no impact on completion.

External factors correlated with completion include working in a large firm (which favours completion), union membership (for which studies report mixed results), and time of program entry relative to economic downturns (Dostie, 2010; Laporte & Mueller, 2010).

Reasons cited by apprentices for leaving their program vary and are typical of career-changers, such as job availability, dislike of work or working conditions, and personal circumstances of self or family (Empey 2010). The Canadian Apprenticeship Forum conducted a series of focus groups with a broad cross-section of stakeholders to investigate reasons for non-completion and to solicit suggestions about how completion could be enhanced (Canadian Apprenticeship Forum, 2011). Reasons for non-completion included lack of fit with the workplace environment, lack of variety in work, a younger generation that wants to explore various career options, unreported harassment and fear of failure. The Canadian Chamber of Commerce (2013) focuses on the difficult financial situation apprentices may face as a reason for discontinuation. Apprentices are paid while at work but they must pay for schooling and do not have to be paid by their employer while at school. These observations of external factors that correlate with apprenticeship completion motivated us to include an investigation of all aspects of apprenticeship in our study, to provide rounded observations of the determinants of apprenticeship completion.

We also looked closely at studies of the NAS data that spoke to the type of training apprentices undertook to identify whether differences in completion rates existed. In this context, technical training would include a college program like ours or any other off-the-job source of supplemental instruction. Although 43% of completers report having no technical training, 70% of non-completers had no technical training. This suggests that technical training is not critical for completion but that those who do have technical training are more likely to complete an apprenticeship.

Technical training can take many forms. Long-block release consists of apprentices leaving their jobs for a period of weeks or months to pursue college-based studies. It is contrasted to day release or self-paced learning. Looking in more detail at the link between type of technical training and completion, Laporte and Mueller (2010) report that a higher percentage of completers than those who discontinued or dropped out had followed long-block release technical training, while day release or self-paced learning is more prevalent in those who complete than those who are non-completers. Dostie (2010) suggests that learning by block release could help increase completion rates. These findings on the impact of training on apprentice completion provide intriguing suggestions about the role and nature of educational programs in apprentice completion.

Hybrid Learning and Apprenticeship Completion

Encouraged by the suggestion that the nature of the education and training program can influence apprenticeship completion rates, we speculated that we could create a program that improves academic outcomes and increases retention by increasing the flexibility of the program.
We thus created a hybrid apprenticeship educational program that uses online technology to deliver learning materials more efficiently and to provide the learner with added flexibility (Bonk & Graham, 2006). When implemented correctly, the hybrid model can combine the strengths of online and face-to-face approaches to optimize student engagement. It also allows us to tailor the mode of delivery to the content. In our case, we chose to put the more theoretical components of training online, as students could spend as much time as they needed on these areas that tend to be more reflective in nature or to require individual inquiry, such as calculations of torque. Similarly, the face-to-face interactions with instructors and fellow students can be used for topics that benefit from interactive exploration, such as maintenance of a drill press.

One of the study investigators has had considerable success with a hybrid instructional nursing program, which resembles apprenticeship in that both programs include manual aspects and applications of theory. The nursing program was designed according to the progressive (scaffolding) theory of self-learning. In this view, students require an increasingly challenging environment with educator support, and novice learners acquire and retain knowledge better in a blocked, customized environment than through random experiences. An exemplary study that provides a framework for this concept was conducted by Guadagnoli and Lee (2004). Their framework also suggests that block practice produces better acquisition of knowledge, while intermittent practice results in better retention. They predict that intermittent practice is superior for

learning simple tasks and to perfect skill, and block practice is better for learning harder tasks and to introduce new challenges.

Garrison and Vaughan (2008) offer a complementary hybrid learning success story from a nursing program. The course provided continuing education in clinical practice and had previously been offered in a traditional classroom style to 30-40 students. The students found it a challenge to attend the class since they were working. The instructor noted difficulties engaging students in discussion of content. The course was redesigned to begin with a weekend workshop, as an intensive introduction to both course content and fellow students, followed by monthly seminars and various online activities including live-streamed lectures and student-moderated discussions. The outcome was a significant increase in access to the class (i.e., better attendance), higher student satisfaction and an increase in the quality of student discourse.

Optimizing the student-apprentice program can be done on three fronts. As suggested in the example above, access is an important variable in course delivery. The apprentices work full-time (sometimes with one day off per week to attend school), so making the theory component of the course accessible online provides a great deal of flexibility and convenience for them to fit it into their schedules. Tailoring the content by providing the theory component that requires more reflection online should allow each learner to work at their own pace. Finally, the practical aspects of the training create a community of learners, where motor skills can be acquired and theory applied in an environment that utilizes progressive, scaffolded learning techniques.

Research Questions

The goal of this study was to identify factors that impact apprentices' progress to journeyperson status. Since there are data in the literature assessing the influence of various demographic, environmental and other quantifiable factors on apprenticeship completion rates, we focused our exploration on the role of the college education program on completion rates. To the best of our knowledge, the impact of this parameter has not been systematically investigated in such a population.

As outlined above, the availability of digital technologies for delivering education has proven effective in other fields of study, so we hypothesized that this method of instruction might increase apprenticeship completion rates by providing apprentices with more accessible, flexible education. Furthermore, though there are plenty of studies of pedagogy in the community college setting, the pedagogy of apprenticeship is a relatively under-studied field and there is no reason to believe that the results from cohorts of students enrolled in academic pursuits should be relevant to apprentices.

Thus, the research questions articulated at the beginning of this study were:
a) What factors influence retention or completion rates of apprentices in the IMM program?
b) What are the differences in student satisfaction and engagement between the traditional and the hybrid mode of delivery implemented in the IMM apprenticeship programs?

Methodology

Our qualitative case study approach used a variety of tools to identify the factors that directly influence student-apprentice retention and completion in the IMM program, including group interviews with students, employers, advisors and other stakeholders. This approach was validated and approved by the study sponsors through a HEQCO research advisory panel.

Study Subjects and Data Collection Tools

The study was carried out over a three-year period, from September 2011 to November 2014, with apprentices enrolled as students in the IMM (Millwright) program at two community colleges in Ontario. The program consisted of an apprenticeship placement with an employer, as well as studies in various subjects at the college, delivered over three levels of the program. Three cohorts of students were included in the study: one from Durham College, which participated in traditional face-to face delivery over a three-year period, with apprentices completing one level annually; and the other two cohorts from Sault College, completing the program through hybrid delivery in consecutive semesters, thereby allowing for completion of the in-class portion of their apprenticeship training in 16 months instead of the three years typically required using face-to-face instruction. The first Sault cohort completed the program in December 2012 and the second in May 2014.

The course content was the same at both colleges, whether it was presented face-to-face in the classroom (as it was at Durham College) or in a hybrid model that combined online and in-class components (both Sault College cohorts). When material is presented in the classroom, content will be influenced to some extent by class discussion and student questions, when they occur. The curriculum followed the Industrial Mechanic (Millwright) Construction Curriculum set by the Ontario Ministry of Training, Colleges and Universities. The course titles for the three levels of the program are listed in Appendix 2. Student assessment was conducted slightly differently for the two groups, with a greater use of multiple-choice questions for the online cohorts. This may have affected student grades.

Although the class sizes remained relatively constant (25 students in the Durham College cohort and about 12 in each of the Sault College cohorts), there was a dynamic equilibrium. A few students in both the Durham and Sault College programs left after completing the first level. Level 2 classes were composed of those coming directly from level 1 and apprentices who re-entered the program after one or more years of absence.

Students worked full-time during their college program, with a variable amount of flex time provided by their employers for study in their college program. The employers ranged from small companies to multinationals and represented diverse industries, including metal refineries, industrial manufacture and maintenance service. At Sault College, one cohort had a majority of students from a single employer, while the other cohort and the group from Durham College all had different employers.

Students from the various cohorts completed an anonymous, online survey consisting of 70 questions. The survey was generated using Durham College's established satisfaction and student engagement tools, previously created by the institution for apprenticeship groups and based on provincially mandated Key Performance Indicators (KPI). Our instrument was tested for fitness with college students outside the program under study. The survey questions are included in Appendix 4.

The student-apprentices in our study cohorts also participated in group interviews, with the primary goal of discovering factors that facilitate or impede program completion. Employers were also interviewed. Other stakeholders in the apprenticeship process, including college instructors, college administrators from both colleges, and a relevant ministry representative, were interviewed and will be referred to as stakeholders to protect their anonymity. The objective of interviewing stakeholders was to establish factors that influence their ability to support apprenticeship and therefore identify environmental or other factors that influence apprenticeship completion.

Interviews were all conducted by the same researcher, who was not involved in the apprenticeship program prior to the beginning of this study. Questions were designed to be open-ended, such as "Tell me about your previous term" for the students, or "Tell me how the program is progressing" for the stakeholders. Topics arising during the interviews were explored with similarly open-ended questions, such as "Tell me a little more about this." The interviewer took notes during the interviews. Results from the apprentice group interview showed data saturation, as responses and comments quickly coalesced around similar themes.

The interview notes were later analyzed by a different investigator with experience in Grounded Theory analysis (Dulhanty & Vibert, 2009). A list of prepared interview questions can be found in Appendix 5.

Ethics approval was obtained for the study from the Durham College Office of Research Services and also covered interviews done at Sault College. We obtained permission from the research ethics board of the investigators' institution and from Sault College administration to view personal information of the student-apprentices, such as their grades, demographic information and completion rates. This information is presented in such a way as to protect the identity of the individuals. Informed consent was obtained from all study participants to ensure that they understood all aspects of the study, its expectations and the nature of the inquiries being made.

As mentioned above, approximately 25 students from each of the colleges participated in the study. Generally, all the students enrolled in the program participated in the surveys, as class time was allowed for survey completion. All cohorts, their employers and the stakeholders were invited and participated in interviews. The exception to this was with students in the cohort from Durham College, who did not complete the survey at the end of the program, and only a small portion (30%) attended the group interview in May 2014. Details of the number of individuals who participated in each study format are shown in Appendix 3.

Survey Data

For survey analysis, all responses from student-apprentices from Durham College were pooled, as were all responses from those who were part of each Sault College cohort. Responses are represented as a percentage of the total number of surveys that were completed. For example, if 76 people took the survey but only 72 people responded to a particular question, the total of all category responses will be 72/76 = 95%. Because the survey presented respondents with frequency responses, such as 'always,' 'usually,' 'occasionally,' 'sometimes' and 'never,' no statistical analysis was carried out to determine the significance of the difference between numbers of responses. Instead, responses were examined for trends in response differences between cohorts. As the survey responses were blinded, there is no way of linking the survey responses to particular groups of student-apprentices, such as completers or non-completers, although the cohorts were coded for identification, so the college where the respondent was enrolled was known.

The survey questions were divided into nine topics. Each topic was analyzed as a group and then compared to each other to identify general trends, least and most satisfactory components of the program experience, and least and most important aspects of the program. Differences between the responses from the Durham College and Sault College groups were also identified. There were four open-ended questions in the survey. The analysis of these responses was performed within the framework of Grounded Theory, as described below.

Student Achievement Data

We obtained the grades and GPAs for each of the student cohorts from the respective college programs. Analysis of these data was conducted by simple statistical methods, such as determining the mean, standard error and comparing groups with a Student's t-test. Information on completion (obtaining journeyman's papers) was obtained from public registries of the College of Trades in Ontario (http://www.collegeoftrades.ca/public-register) and presented as percentages of the group.

Analysis of Interviews, Open-ended Survey Questions and Survey Summary Data

While we began the study with the intention of measuring the influence of a hybrid learning model on apprenticeship completion, early results from interviews with the apprentices and other stakeholders suggested that there were other important factors that should be explored and included in our study. This desire to use interview data to understand a real-world situation rather than test a hypothesis led us to interpret interview data within the framework of Grounded Theory (Allan, 2003).

Grounded theory is well suited to amalgamating the results of different forms of data into one coherent conclusion. Martin and Turner (1986) suggest that Grounded Theory is suited to 'embracing the complex' and particularly useful in large human organizations and cultures. The IMM apprentices certainly exist in a unique learning culture. As suggested by Walters and Williams (2003), individuals have different identities that may influence their observations, so breaking the apprenticeship system down into its stakeholders may reveal much about its behaviour as a whole. Grounded Theory would allow us to better analyze the apprenticeship system as a whole, with all its stakeholders, and develop new theory that would resonate with those familiar with the culture of apprenticeship. This choice aligned with the overall goal of our study, which was to suggest ways of improving apprenticeship completion rates.

We followed a traditional approach to Grounded Theory, coding each of the interview notes. Coding was done as quickly as possible to analyze the data on an intuitive level, extracting meaning from the responses without bias. Once coding was complete for all data sources, concepts and themes were extracted from the data and analyzed. Where categorization led to inconsistencies, dualities or discrepancies, the original data were reassessed. Then categorization proceeded. Finally, theory construction followed categorization. The Grounded Theory analysis was performed by an independent research assistant who did not attend the interviews or participate in program development or delivery.

Data Presentation and Analysis

Overview

The compelling feature of our results is that both groups of students have very similar levels of success despite the two different teaching models used. At the very least, this suggests that it may be possible to complete the in-class portion of apprenticeship training using a hybrid model in half the time (16 months

instead of three years) without negatively affecting student success. We also identified a number of other factors that either facilitate or impede apprenticeship completion. Details of our findings are presented below, where we first present data comparing the two delivery models for the college program and then our findings on the range of factors that influence apprenticeship completion.

Survey Responses

Durham College had one cohort that consisted of 21 students in Level 1 and 23 students in Level 2. Level I and 2 saw a 100% completion rate of the survey. By Level 3, only 8 of the 23 students completed the final survey. Sault College saw two cohorts complete the surveys associated with the research project. Cohort 1 consisted of 11 students and cohort 2 started with 7 students and finished with 12, demonstrating an addition of apprentices throughout the term that is common in apprenticeship education. Sault College had 100% survey completion as we scheduled it with the focus groups and class schedules to ensure access to all students. The study thus included 46 students in total from both institutions.

Responses to the survey questions were examined to address the research question: What are the differences in student satisfaction and engagement between the traditional and the hybrid mode of delivery implemented in the IMM apprenticeship programs? We focus our discussion on the differences between the traditional and hybrid programs. The timing of survey administration for each cohort is described in Appendix 3.

Population Characteristics

The demographic survey questions established that there were no significant differences in age, gender, first language or other characteristics between the Durham and Sault cohorts. The responses highlight how different the student apprentices are from a typical postsecondary student: all were working full-time, at least half cared for dependents, none were involved in extracurricular activities at the college, and their average age was 30 years. Our study cohorts have similar demographic characteristics to those in the NAS study (Laporte & Mueller, 2011).

While the students in the face-to-face program most often reported spending 1 to 2 hours per week doing classwork outside of class, the students in the hybrid program most frequently reported spending 6 to 10 hours. This is consistent with the online theory component of the program for these cohorts. The usability of the online platform that delivered course materials was rated as good to excellent by 82% of participants, equally from Durham and Sault, even though the platform delivered different things to the two groups – supplementary materials for the Durham students and hybrid course content for the Sault students.

Differences Between Face-to-face and Hybrid Program Cohorts

The most striking feature of the survey results was the similarity between the cohorts. Students in both the Durham and Sault groups were satisfied that the program provided them with useful resources for their

apprenticeship. There was agreement among the groups that the learning outcomes of the practical sessions related to their goals. There was agreement that the least important aspect of the program was the learning of computer skills. The highest dissatisfaction was with important albeit external factors to the college program: the support of employers for the program and the cafeteria services, followed by the sequencing of practical sessions.

Despite these similarities, a few differences between the two cohorts could be identified. Sault students were more positive about their instructors, specifically instructor subject-area knowledge, feedback and responsiveness, and encouragement of academic dialogue. Sault students interacted with their instructors more frequently, discussing ideas rather than performance. We cannot extract from our data whether the interaction with the instructors results from the perception of high quality or if the high quality leads to more interaction. Durham College students were more positive about manuals and class organization. Sault students reported asking more questions in class, but also less participation. Working in groups was more stratified at Sault, with one subset reporting that they always worked in groups and another group reporting that they never did, while the Durham student-apprentices were sometimes or usually group workers. Sault attendees rated their overall college experience more highly than did Durham students and also reported a higher level of perceived concern for their success from college personnel.

To identify any differences in survey responses between the two cohorts that relate directly to teaching model, we consider those survey questions that assessed student satisfaction with the theory component of the course. None of the differences observed were greater than a 10% difference in the mean response value between the two groups. Students in the face-to-face program found the course information and lesson materials to be clearer and more accessible. They also found that the lessons were better reinforced by the quizzes, and a higher percentage of Durham students found the support material to be useful. There was no difference between the hybrid and face-to-face cohorts in terms of their appreciation of how engaging the lessons were or in the perceived fairness of marking. Interestingly, the hybrid cohorts were more likely to rate the online platform as easy to use.

Overall Satisfaction with the Program

An overview of the survey responses indicated a generally high level of satisfaction with all aspects of the program. When students were satisfied they were quite satisfied, with 80-90% of respondents indicating that they were satisfied or very satisfied. The cohorts were similar in their satisfaction with the program, with little difference based on teaching model.

Other Observations from Survey Responses

To reinforce the statement that there are many other factors important in determining apprenticeship completion, we highlight results from the survey that suggest such general trends.
All cohorts scored the teachers as effective in the practical sessions, with greater than 80% (37/46) of student-apprentices satisfied or very satisfied with instructor effectiveness and with the delivery of program

content. The degree of respect and courtesy shown by the instructors to the student-apprentices was perceived to be very high.

Student-apprentices self-reported a high degree of commitment to the program, with greater than 80% reporting always or usually completing assignments, attending class and generally being interested. Over 70% (33/46) of students in all cohorts were excited about the learning opportunity the program provided them and were motivated to come to class. Student-apprentices were generally satisfied with the workload in the program.

The participants' expectations of the program focused on relevance to their trade. It was important to the respondents that the program provide them with skills and abilities relevant to their apprenticeship. It was seen as very important that the practical sessions were related to the learning outcomes, or in other words that they were useful. Generally, all aspects of the practical sessions were rated as important (more so than theory) and the levels of satisfaction with the practical sessions were high (37/46, or 80%, satisfied to very satisfied). Interestingly, there were a few aspects of the program deemed less important to the students. They did not consider it important that the program teach them to work with others and, particularly with Sault College respondents, that the program provide opportunities for further education. These lower priorities are in keeping with the student-apprentices' focus on their trade and learning skills useful to them on the job.

Even more telling about external factors affecting completion, there was some dissatisfaction with the quality of on-the-job training in both the Durham and Sault College populations, with about 30% (13/46) dissatisfied or neutral in cohorts at both colleges and overall. Similarly, the apprentices were more polarized in their response regarding the company's support for participation in the college program, with 18 or 40% very satisfied and 25% of the participants (11) dissatisfied. It should be recalled that the student-apprentices for the most part had different employers. Challenges with employers are frequently reported as a reason for discontinuation of apprentices (Dostie, 2010). In the survey, there was a question that invited respondents to provide comments about any aspect of the program. These comments were primarily about the apprentice's employer or employment, including the logistics of attending the college program.

In our cohorts, 90% of respondents (41/46) were satisfied with their overall college experience, while 90% of the Sault cohort (20/23) and 80% of the Durham group (18/23) were satisfied with the instruction in the practical sessions. Eighty-seven per cent found the training useful to their jobs and about 65% of our cohorts were satisfied with their on-the-job training. This comparison suggests that both the Sault and Durham college programs are perceived as high-quality, with little impact on overall satisfaction from the hybrid delivery model compared to the traditional model.

In summary, the survey responses from the student apprentices who experienced the face-to-face theory and those who had theory delivered online were more similar than different. The overall satisfaction with the college program in both groups was high. The lack of substantive differences between the two cohorts is consistent with the conclusion that the hybrid program, delivered in half the time, is as satisfactory to the students as the traditional classroom program.

Student Achievement

Individual course grades and cumulative GPA scores for all three levels of the program were compared using a simple *t*-test. While the average GPAs for all of the cohorts rated as excellent, there was a statistically significant difference between the cumulative GPA of the Durham College cohort and two Sault College cohorts, with the Durham College students obtaining higher marks (p=0.0002 and p=0.026 for the two cohorts). The two Sault cohorts were also statistically significantly different from each other (p=0.019). In order to determine if this might be attributed to the online learning component of the program, the grades from individual courses were examined, sampling some that are primarily theory-based and therefore delivered online, such as Drawing and Schematics, and some that are primarily based in practical instruction and therefore face-to-face, such as Welding. No consistent trend in average class grades was found. In some theory-based courses, the Durham cohort had higher marks; the Sault cohorts had higher marks in other courses. Also, in the practice-heavy courses, there was no clear trend, with the Durham students sometimes achieving higher marks and the Sault cohorts sometimes having the higher average marks. Therefore, we cannot conclude that either course format delivers better academic performance. However, these observations could be pursued to guide development or refinement of both online and face-to-face theory instructional resources. The high level of achievement in all of the cohorts suggests that the hybrid program did not adversely affect student academic performance.

Ninety-eight per cent of the student-apprentices in level 3 successfully completed the program. As noted previously, these are not all the same students who entered the program in level 1, as students come and go from the program. There were no differences between the Durham College and Sault College cohorts with respect to students leaving or joining the program. Both the Durham and Sault programs seem to be associated with a high degree of student-apprentice retention in level 3.

In early December 2014, the names of the level 3 students from all three cohorts were entered into the College of Trades online registry to determine how many of those who had completed the college program had obtained their journeyperson status or obtained their Certificate of Qualification in IMM. Of the Durham College cohort, 56% had journeyperson status in IMM, while only 8% of the pooled Sault cohorts had attained their IMM Certificate of Qualification. Many retained an active apprenticeship status: 54% in the pooled Sault cohorts, and 24% who were enrolled in level 3 at Durham College. The completion rates for the Durham cohort are comparable to the 64% observed for the NAS population (Laporte & Mueller, 2011). Other factors may have influenced the Sault population completion rate, such as monetary incentives prior to completing the Certificate of Qualification and the desire to live and work in their community. We report on these factors in greater detail below.

Stakeholder Interviews

To look at the college education program in isolation ignores the fundamental nature of apprenticeship, which involves a host of stakeholders. As a result, interviews with student-apprentices and apprenticeship stakeholders – employers, college administrators, instructors and ministry representatives – were

conducted to directly address the research question: "What factors influence retention or completion rates of apprentices in the IMM program?" Participants discussed a wide variety of topics related to the apprenticeship experience and management of the entire program.

We began by comparing interview data from the Durham and Sault students. As expected, the Sault students commented on specifics of the online program and those at Durham had comments specific to the logistics of their courses. The Sault students were frustrated by technical errors in the online system (for example, broken links) but became more comfortable with the system as the course progressed. Several suggested that an in-person review session would be a good complement to their online theory courses. Some students described themselves as 'hands-on' learners and questioned their ability to succeed in an online course. The Durham students were frustrated with the scheduling of their classes and the difficulties of attending the courses. Some Durham student-apprentices travelled more than 100 km to get to the college, while the entire Sault group were local to the area. While the cohorts spoke of program characteristics unique to their circumstances, these factors could all be considered issues of access – access to the online program, access to classes and access to the college.

There were a number of themes that were common to all cohorts of student apprentices and therefore, consistent with established qualitative research practices, we chose to examine the interview responses from all stakeholders with the responses from the apprentices and apply Grounded Theory to code and categorize the collective responses. These have been grouped and linked; a representation of the organization and inter-relationships found between these categories is in Table 1.

Table 1: Themes Derived from Stakeholder Interviews

Theme	Influencing Factors	Components
Variability	Cost of program[1]	Apprentices Employers Trade Career
Disconnection	Administration Cost of program	Apprentices Employers Trade Career
Program delivery	Postsecondary institution	Online course delivery 'Likes' Improvements
Ownership	Definition of Completion	Apprentices Stakeholders

[1] 'Cost of program' encompasses costs of all types, including financial, personal and reputational costs.

Emergent Themes about Apprenticeship Variability

Variability, or differences between individuals or individual experiences, was noted in many aspects of the apprentices' path to completion. These included:

- the degree of rotation of apprentices through different sub-trades during their work experience
- the various routes to journeyman status (just work, just apprentice, apprentice with college training program)
- the fact that postsecondary institutions view apprentices as students while employers view them as employees
- the various natures of apprentice placement (large or small company, unionized or not, various industry sectors, company culture)
- the employer's degree of experience with apprentices, from those who hire an apprentice once in a while to those who run elaborate recruitment programs
- the various degrees of employer support for apprentices taking college programs, from granting time off to paying for all aspects of the program)
- employer incentive to complete, from discouraging completion to incentivizing it with bonuses and promotion
- unionization, and the perceived increased job security and rate of pay associated with unionized work (though it is important to note that not all IMM tradespersons belong to the same union)

While variability in career goals and work environment is to be expected in any cohort of students, student-apprentices must reconcile their different experiences and collaborate in their college program. Their degree of success in doing so can impact how and what they learn as well as the dynamic in the classroom or shop, though our analysis of academic achievement data suggests that, if anything, it often has a positive effect on learning.

Costs of Apprenticeship

The costs of the apprenticeship training program were cited as a concern by the apprentices themselves, their employers and the institutions that deliver the programs. Animosity over costs develops between apprentices who do and those who do not have their college programs reimbursed by their employers. Apprentices also cite many accessory costs for the program, such as travel time, parking and textbook costs. For both employers and apprentices, the college program takes the apprentice off the job for one day per week. This may present scheduling issues for the employer. Other stakeholders see that employers are incentivized to hire apprentices through tax rebates, and apprentices are incentivized to complete, while apprentices are often surprised to discover that their tool allowance is a taxable benefit. The educational institutions report shortages of equipment and competition for practical facilities and cite a limitation to their ability to innovate within the program because the curriculum is set by industry. Employers suggest that the three-year program absorbs their resources for a prolonged period of time. It is difficult to judge from our data whether the costs of the apprenticeship program – to employers, apprentices or colleges – are a factor in completion. However, it is a source of variability, as discussed above.

Disconnection

The influencing factors in the disconnection theme are administrators, specifically government, and industry associations. This theme centres on communication between the various stakeholders. We were surprised more than once by a lack of relevant knowledge by one stakeholder group about another stakeholder group. For example, college stakeholders had no knowledge of completion rates, employers lacked knowledge of changing requirements for fulfilling apprenticeship requirements, and apprentices were unaware of ministry incentives that existed for them. Apprentices did not have a good understanding of why employers would support the apprenticeship program. With the introduction of the College of Trades at about the midpoint of our study, there was understandable confusion about this new body's role in apprenticeship. Most importantly, there is little knowledge on the part of some employers and many of those involved in program delivery about the challenges of apprenticeship completion. Most stakeholders viewed certification as the apprentice's responsibility, and college stakeholders did not hold the Certificate of Qualification to be the endpoint of their program. While the colleges do engage employers in program development, they do not have great latitude in recruiting students into the apprenticeship programs and therefore have little incentive to build the program, viewing the promotion of apprenticeship as government's role. We also found some confusion about the roles of the various stakeholders at an operational level. It is easy to imagine that lack of communication could alienate apprentices and turn them away from completion.

Program Delivery

Program delivery was a significant theme that emerged from interview analysis. Both institutions in our study reported providing high-quality instruction, using instructors with IMM millwright designations and work experience, as well as high-quality facilities and equipment. Student-apprentices affirmed the quality of instruction for the most part, as was seen with the survey results. Instructors were dedicated to helping their students succeed. Some issues were cited with respect to the relationship between the theoretical and practical elements of training, and scheduling of program components. Positive aspects of the program were mentioned in the interviews, consistent with the student surveys. Apprentices appreciated the instructors and the financial support of their employers, gained confidence in their abilities and enjoyed the flexibility of the program. Positive feedback about the program from employers reflected that it was useful for apprentices. The interviews confirmed the quality of instruction at both Durham and Sault Colleges. All stakeholders had suggestions for improving the training program and the overall apprenticeship experience, in the following categories:

- With respect to the college program in general: Program logistics, such as scheduling, could be improved. The theoretical and practical elements of the program could be better linked, and specific areas of the program, such as hydraulics and welding, could be revisited to better prepare students for assessment. Additional resources might allow for the purchase of better equipment at postsecondary institutions.

- With respect to the online component piloted in this study: While instructors and students could not agree on whether more classroom time was necessary, students did emphasize the need for in-class review sessions to revisit material covered online. Some employers suggested that they could provide facilities at the workplace for the apprentices to work through the online component, and that might allow interaction with the local journeyperson for better understanding. Not all employers could provide such facilities, however.
- With respect to the structure of apprenticeship: Some stakeholders suggested that apprenticeships should be shorter, requiring fewer hours of work. The IMM designation could be further divided into sub-trades to facilitate training. Opinions varied as to whether college training in the block release format was desirable or not.
- With respect to on-the-job training: New ways are needed to ensure that apprentices experience all aspects (or sub-trades) of their profession. It would also be helpful if students practiced at the college on equipment that resembled that used in the workplace.

Looking specifically at the hybrid program, it was generally acknowledged that the students found it difficult to manage their time for independent study. Some student-apprentices suggested that they preferred face-to-face instruction and said that, at the very least, a review session in class would be beneficial. One respondent emphasized that he was a "hands-on person" and that those who choose a career in a mechanical trade might be expected to learn better by doing. Particular attention might be required to ensure that the online, theoretical component has plenty of interactive, demonstrative elements.

Ownership

An important theme that emerged from the interview analysis was ownership, and specifically ownership of completion. With the wealth of stakeholders involved in apprenticeship, it is often difficult to ascribe accountability. One stakeholder called apprentices "the lost trainees," others questioned who owns apprenticeship – is it a labour market or postsecondary education concern? It was suggested that completion – obtaining the Certificate of Qualification – be used as a performance indicator for the college program. While some employers encouraged their apprentices to complete, others did not. Employers are gatekeepers in this regard, as their signed approval is required to allow the apprentice to write the qualifying exam.

Components of the Complex Apprenticeship Ecosystem

On Apprentices[2]

We confirmed significant dedication and drive among apprentices to achieve competency in their trade, including proactive approaches to learning such as forming study groups. Students were acutely aware of the expectations of their employers in relation to the level of ability they anticipated once the apprenticeship education was complete. A quote from one student expresses this concern: "Employers don't care about how good you are with a hacksaw." All stakeholders expressed concern about the many competencies that were expected of IMM professionals and questioned whether apprentices experienced all the sub-trades (for example, hydraulics, bearings, electrical) at their place of employment. Everyone recognized the time management challenges for apprentices regardless of the teaching model used. The challenges of the current administrative environment, with shifting requirements (hours of experience vs. competencies) for qualifying to write the exam a Certificate of Qualification, were noted. Apprentices' motivation appeared to be strong within our cohorts and concerns focused on receiving high-quality training. Completion did not seem to be a concern among the apprentices interviewed.

On Employers

Regarding the apprentices' employers, a telling comment was: "At work, work comes first." While the employers were generally supportive of the apprentices and understood the benefits to their business of hiring apprentices, they were clear that the apprentices had to fit into and contribute to the bottom line. One of the challenges within the business environment is ensuring that the appropriate journeyman supervisor is available to supervise the apprentices. Turnover, loyalty and migration to opportunities in Alberta are concerns, but sometimes more hypothetical or transient than real. While employers provided what they could to support their apprentices attending the college program, the apprentices were aware of the varying levels of support provided by different employers. Employers placed specific demands on the apprentices. If these have a direct impact on completion, it is unclear how.

IMM Career

Factors identified by the interviewees related to the IMM career included the versatility required of a journeyperson, who had to be a "jack-of-all-trades" and possess the skills to deal with a variety of tasks in the shop or on the factory floor. Many have multiple trade tickets and are older when they enter the program, although some are recruited out of high school. Some employers begin to compensate apprentices at journeyperson rates after they finish the second of the three program levels, while others encourage their apprentices to obtain their Certificate of Qualification and offer bonuses, which include a supervisory

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[2] These categories reflect the topic discussed, not the origin of the comments. Most stakeholders had comments related to other stakeholders. For example, all stakeholders had observations about apprentices.

position for success. It was recognized that encouraging employees to obtain a Certificate of Qualification increases their career mobility, which may not benefit the employer, although generally mechanical workers are less mobile than those in other trades, such as electrical workers. Location was identified as a factor that affected the career goals of the apprentices. Those who studied at Sault College were more focused on quality of life, while the Durham cohort did not express such interests. Consistently, from the survey responses, the Durham group were more concerned about the program providing them with additional career opportunities. The availability of various incentives from employers either to support or discourage completion could be seen to impact apprenticeship completion rates. A sub-theme that emerged from the interviews, which might apply to all trades, was the obligation an apprentice might feel to an employer who has supported his or her apprenticeship to completion.

Overview of Findings

In our study, the role of industry, which encompasses both economic elements and specifics of the business type, was less frequently discussed. This may be because the apprentices were employed in a broad spectrum of businesses, unionized and non-unionized, small organizations to multinationals, and in industry areas as varied as cosmetics, food and beverage, heavy equipment, construction and natural resource refineries. The most significant impact of the employer was in determining the apprentice's exposure to the range of activities required in the trade.

The apprentices in our study are a highly motivated group with specific goals, and since they already have an employer with a vested interest in their success and their program, they have additional expectations placed on them. Certainly, a strong apprenticeship program is a source of corporate pride to some employers. There are emerging questions about the new College of Trades, its role and what it means to be a self-regulated body. The variability between the trades, with the Red Seal program bestowing varying degrees of inter-provincial mobility, was questioned. There was no consistent opinion as to whether IMM journeypersons were migrating to jobs in the west.

There were few discrepancies between the survey responses and the interview results. Dissatisfaction with some aspects of on-the-job training was expressed in the survey, and this was perhaps translated during interviews into criticism about apprentices' lack of exposure to all aspects of the IMM trade. Also, the degree of dissatisfaction with the online resource for delivery of theory, mentioned by a majority of survey respondents in the Sault cohorts, was not reflected in the interviews. Overall, enthusiasm for the program, learning and relevance to the job came through from the student-apprentices at both colleges, as did specific challenges and suggestions for improving the program.

In summary, our analysis of the interviews conducted with apprenticeship stakeholders revealed a fragmented ecosystem, with differences in many aspects of apprenticeship, most notably the value placed on completion and progression to journeyperson status.

Discussion

College Program

Our survey results indicate a similar degree of satisfaction and engagement in all of our cohorts – those enrolled in the traditional, classroom-based program or the novel, hybrid program that delivers the theory component of the program online while maintaining the practical components in a traditional, face-to-face setting. Although all cohorts achieved excellent grades, we do note a difference in academic achievement between our cohorts, with those in the traditional, classroom-delivered theory achieving higher overall grades than the cohorts who learned their theory through the online resource. However, analysis of class averages does not support a consistent difference in performance in theory or practical courses between cohorts, which suggests that factors other than the mode of theory delivery may be responsible for the difference in academic performance. Considering that there is no difference in satisfaction and engagement between our cohorts, and no difference in completion of the college program, we conclude that the hybrid program may be a viable approach to delivering the IMM college education program. Furthermore, it has benefits in terms of access and scheduling flexibility for the students. Our online hybrid program also allowed the student-apprentices to complete their program in approximately half the time of those in the traditional delivery program.

The difference in marks between the cohorts is interesting, although inconclusive. It is tempting to suggest that it resulted from the online delivery of the theory material being a less effective means of teaching than face-to-face. The literature confirms that identical courses, delivered online compared to face-to-face, rarely produce clear answers regarding student achievement. In a study of nursing students, the students in an online delivery condition achieved higher grades than a group of students taught traditionally (Holland et al., 2013), while comparisons of online and classroom delivery of educational psychology course (Deli et al., 2010) and business application software courses (Wagner et al., 2011) demonstrated no difference in achievement between student groups. A comprehensive study of students in Washington State, which looked at online learning in a variety of disciplines, found that students did less well that under traditional instruction methods in most subjects, including applied professions (Xu & Jaggers, 2013). In a study of an introductory sociology course, the difference in achievement between the online learners and in-class learners was found to be due to external variables, rather than the method of delivery of the material (Driscoll et al., 2012). There are many factors that impact the grade a student obtains, including the subject matter, examination style, the instructor's practices and expectations, institutional culture, TA or other marking assistant, and the student group. We did not have sufficient data nor was it within the scope of this study to delineate factors that lead to the grade differential in our cohorts. However, this observation suggests that further investigation into this question might be warranted.

Completion Rate

While our interviews with various stakeholders in the apprenticeship arena provided a rich picture of the challenges of apprenticeship, they did not point to specific unrecognized factors that might affect

completion rates. However, the various incentives from employers to either support or discourage completion are noteworthy.

We have used the term 'variability' to characterize the apprentice experience, indicating the variety of variables in their training. The variability in experience may make it difficult to determine factors that affect completion rates. Many of the factors that constitute this variability are inherent in employment in the trades (unionization, size of company, industry of employment) and will need to be considered in any intervention to increase completion rates.

A clear area of concern in the apprenticeship system is communication among stakeholders. Although there is no direct effect on completion that can be suggested, lack of communication in any system leads to frustration and in this case may cause apprentices to discontinue or not seek their Certificate of Qualification. The creation of the College of Trades may address these communication or connection issues.

Further Program Development

Various suggestions were made to optimize delivery of the training program, but these were primarily minor augmentations rather than large modifications. A suggestion from one stakeholder was to change the program to deliver a similar experience to all IMM millwright training in Ontario by delivering all theoretical aspects online and rotating the apprentices through various work experiences to ensure exposure to all sub-trades. Several employers suggested that if training was delivered in this way, they could arrange for facilities in the workplace where the apprentices could work on their theory component with each other and under the supervision of a journeyperson. This might help address some of the disadvantages that accompany online study. Schmidt and Ford (2003) suggest that when people are left alone to learn from online materials, they can fail to use learning resources effectively and stop before mastering the subject matter. Key predictors of knowledge acquisition from computer-based training are choices of study time and practice, and our results pointed to a clear challenge for the apprentices as being able to manage their time.

Apprentices who complete the required on-the-job hours and classroom training – in the context of this study, at a college – receive a Certification of Apprenticeship (CoA) from the Ministry of Training, Colleges and Universities. However, in order to obtain their journeyman's papers and practice as a licensed tradesperson, apprentices must still challenge and pass the Certificate of Qualification (CofQ) exam. Why does the postsecondary training program have a different endpoint than the apprenticeship program overall? Or, as the literature asks, 'Is apprenticeship the concern of the labour market or the educational system?' The question might be considered from another perspective: who is taking responsibility for making the apprenticeship program as efficient and effective as possible? Answers to these questions might constitute a major move toward addressing the issue with low completion rates. A single administrative focus, perhaps by one stakeholder or a coordinated group of stakeholders, could put in place a unified system to oversee and incentivize the progress of apprentices through their program to successful writing of their Certificate of Qualification. We are optimistic that the new College of Trades might fill this role.

A very successful example of a centralized training program already exists and might serve as a model for the IMM and other apprenticeship programs. Durham College's Critical Care Nursing Graduate Certificate Program[3] follows an innovative education model that provides all nursing students across Ontario with education. In this program, six theoretical courses are delivered online so that every student in the province has the same instructor and instruction. This is complemented by simulation labs held in various locations. The result is standardized delivery across the province. This aligns well with the suggestion from stakeholders in our study that the IMM program be delivered as a homogenous, distributed program, whereby each apprentice completes the same educational program concurrently with a rotation through various employment experiences.

Conclusion

This study examined the effects of a hybrid apprenticeship program in the IMM millwright trade on student satisfaction and achievement. The hybrid program delivered theoretical aspects online and practical sessions in-person. As there was no difference in satisfaction and engagement between cohorts in our study, no consistent difference in academic performance that can be attributed to the hybrid program and no difference in completion of the college program, we conclude that the hybrid program may be a viable approach to delivering the IMM college education program. Furthermore, it has benefits in terms of access and flexibility of scheduling for students.

Before beginning the study, we had assumed that completion was the most important aspect of apprenticeship. However, both our results and the qualitative data gathered from stakeholders led us to question this assumption. At least one stakeholder suggested that the college program certificate was more valuable to them than the Certificate of Qualification for journeyperson status. Our data forced us to conclude that there is considerably variability in the value stakeholders place on completion. Taking our results collectively, we suggest that low completion rates may reflect this realization on the part of apprentices.

As technology makes possible new modes of delivering educational content, college programs have the opportunity to change, to become more relevant and to strive for greater efficiency and accessibility. Our work suggests that the IMM program could be offered as a more unified experience to IMM apprentices in Ontario by delivering theoretical aspects online and rotating the apprentices through various work experiences to ensure exposure to all sub-trades. This might address many of the challenges to completion identified by the stakeholders interviewed in our study. Along with added administrative oversight, this new model might facilitate the movement of more apprentices to journeyperson status and better support growth in those sectors of the economy suffering from a shortage of qualified tradespeople.

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[3] See www.durhamcollege.ca/academic-schools/school-of-health-community-services/future-students/critical-care-nursing-graduate-certificate-program

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