Niagara College Canada
APPLIED DREAMS.

LAURIER
Inspiring Lives.

WILFRID LAURIER UNIVERSITY
WATERLOO | Brantford | Kitchener | Toronto

Niagara College Photonics Diploma & Laurier Bachelor of Science in Photonics

Project 2014-08: Photonics Engineering Diploma to Bachelor of Science – Photonics Pathway with Bridging Semester

PROJECT EXECUTIVE SUMMARY

Authors: John Fraser (WLU Project Lead), Sally Heath (WLU Project Consultant), Jeffrey Post (NCC Project Co-Lead)

Date: December 15, 2015

Project Chronology

This project originated with a meeting between Laurier and Niagara faculty at Niagara College in September 2013. At this time Laurier was interested in exploring transfer pathways with Niagara in hopes of recruiting more students to the BSc Photonics program. Laurier faculty received a tour of the Niagara College facilities and learned about the two diplomas offered: the Photonics Engineering Technician Diploma and the Advanced Diploma in Photonics Engineering Technology. There was enough mutual interest to hold a second meeting in October 2013. During that meeting, we discussed submitting a proposal in response to ONCAT's fall 2013 RFP.

Photonics is a branch of physics that studies light. It includes the generation, emission, transmission, modulation, processing, switching, amplification and detection/sensing of light. As such, it has many technological applications in industries such as telecommunications, medicine, biotechnology, manufacturing, aviation, renewable energy, and quantum computing. At most universities, the study of Photonics is embedded within Physics and/or Electrical Engineering programs. There are relatively few college and university programs in Ontario which focus primarily on Photonics.

Laurier and Niagara were both aware of the collaborative program operated by Carleton University and Algonquin College in Ottawa. Although we recognized that an integrated program of this kind would not be possible because of geographic barriers, we believed that it was worth exploring a pathway through which Niagara students could add a BSc to their college diploma. The promise of such an arrangement was that graduates of the diploma to degree pathway would enter the workforce with a highly marketable mix of practical skills and theoretical knowledge. Laurier's Photonics program had never attracted a large number of majors and the program was in the midst of a diversification strategy. Recent 2+2 agreements with Chinese universities had resulted in a steady flow of students and it was hoped that the Niagara pathway could further grow program enrolments.

We were successful in securing ONCAT funding to develop a pathway with the goal of allowing students to complete the Niagara Photonics diploma and the Laurier Bachelor of Science in four calendar years.

Because of the focus of this project was on an outcomes-based approach to pathway development, we began with an intensive analysis of the curricula of the two programs to determine the match between learning outcomes. Learning outcomes at both the program and the course level were considered. The full description of the curriculum analysis is contained in the December 2014 report, included as appendix 1.

At the same time as Laurier was beginning this project, the university was engaged in a program prioritization exercise called Integrated Planning and Resources Management (IPRM). The IPRM initiative was multi-pronged and called for the evaluation of all academic and administrative programs and the development of a new resource allocation model. Academic programs were evaluated by a committee and placed into one of five categories: enhance; transform with additional resources; maintain or transform without additional resources; transform with fewer resources; and phase out or minimize. The final program categorizations represented a set of recommendations that were then. When the recommendations were released in January 2014, both the BSc in Physics and the BSc in Photonics were placed in the "phase out or minimize" category. The Department of Physics and Computer Science, which offers both programs, was forced to reflect on its programs and consider which program it should focus its efforts on preserving and strengthening. Following deliberation, the department made the decision to focus on strengthening the BSc in Physics by closing the BSc in Photonics. This was a difficult decision, but one that was ultimately considered necessary for the department to be able to focus its efforts on a single program.

The result of this decision was that the planned pathway between Laurier and Niagara would no longer be possible. The deans of the two institutions discussed whether another pathway, such as from NCC Photonics to the Laurier BSc Physics, would be possible, but they determined that without the Photonics connection the pathway would not be distinctive enough to attract students.

In the next two sections of the report, we discuss the successes and challenges that we encountered as we explored the pathway and note the lessons that might be useful to others working on similar projects.

Successes & Challenges

General

The greatest success of the project was that we were able to create and agree on a 3+2 pathway with bridging semester that would have facilitated students completing in five years two credentials that would normally take seven years.

The exploration of the pathway was also a valuable learning experience for both Laurier and Niagara. Engaging to such an extent with the goals and methods of another program was illuminating; it fostered a greater appreciation of one another's programs, as well as a greater understanding of our own programs. Additionally, it initiated new relationships and opened conversations between the two institutions which could prove valuable in the future in establishing other new pathways.

Learning Outcomes (Laurier)

The Laurier Department of Physics & Computer Science was relatively new to learning outcomes when the project started. They had articulated a set of learning outcomes for each of their programs as part of a 2012-2013 cyclical program review, but the department was still in the process of fully operationalizing their program learning outcomes and using these to inform assessment and curriculum decisions.

In this context, a significant success of the project was that the department refined the learning outcomes for the Physics and the Photonics programs. They created a curriculum map for the Photonics program to understand the development of knowledge and skills over the four years of the program and to capture the interplay between courses in mathematics, physics, and computer science.

One of the challenges for the department in adopting a program learning outcomes approach was that the outcomes themselves were not sufficiently granular to capture the particular mathematics background necessary to determine an appropriate entry point for Niagara students into the Laurier curriculum. It was also challenging for the department to think of their program curriculum purely in terms of learning outcomes, when the program had in fact evolved in response to many different factors and considerations. For example, the fact that the department is host to programs in both Physics and Computer Science meant that the first year of the program was then common for all majors (this has since been changed). The common first year led to the inclusion of significant physics content in the computer science program, and vice versa. This was an obstacle to a learning outcomes analysis, because the Laurier program featured learning outcomes in the early part of the degree which were not essential to later advanced study of Photonics.

Mathematics

The difference in mathematics preparedness between Laurier and Niagara students was a constant source of challenge in mapping out an efficient pathway that would ensure students were equipped for success when they came to Laurier. The final two years of the BSc Photonics consist of advanced courses in physics which rely on highly developed mathematical skills. The two institutions wrestled with this challenge and ultimately arrived at a program that graduates of Niagara's advanced diploma could complete in four terms with a bridging semester to augment students' mathematics background.

Incommensurability of Program Learning Outcomes

In trying to use a learning outcomes framework to establish equivalencies, areas of overlap and entry points, the different goals and philosophies of the two programs became apparent. The program learning outcomes for the Photonics Engineering Diploma reflected the applied, hands-on nature of those programs; for example, the ability to design and test laser devices. In contrast, the program learning outcomes for the BSc in Photonics program reveal its theoretical focus; rather than design and test lasers, students are asked to interpret problems into mathematical form and demonstrate computational skills for algorithm development. The curriculum analysis revealed that while the learning outcomes for the two programs were complementary, this did not necessarily result in a logical or straightforward transfer or pathway from one program to another. While this type of comparison may be possible when comparing accredited programs or disciplines, in many cases, program learning outcomes are a mechanism for expressing differentiation between programs.

The other outcome-related challenge that this project's curriculum analysis highlighted was that of retro-fitting pathways into established programs rather than designing these pathways intentionally into new program developments. Some of the incommensurability discussed above could have been reconciled if the pathway was being designed from the establishment of the programs.

Learnings / Lessons

As identified elsewhere in this report, the pathway project was cancelled primarily because of the cancellation of Laurier's Photonics program. At the time the project stopped going forward, we had successfully worked out a plan that allowed students to complete both programs in five years with the addition of bridging semester to address the mathematics gap discussed above. Despite the fact that the project was not completed, there were several valuable lessons learned as a result of engaging in the conversations and processes to map out the relationship between the two programs:

- In order for an outcomes-based framework to be used to create a pathway, it is important that both programs recognize the value of program learning outcomes and have engaged with them in a meaningful way;
- Not all programs will be a natural fit for a pathway project; as discussed elsewhere in this document, the different foci of these two programs made it challenging to find an efficient linear pathway for students;
- Relatedly, while comparing program learning outcomes can be a useful starting point for determining a pathway between programs, analysis at the course level is also necessary in order to determine content and course

equivalencies. As this project revealed, program learning outcomes can be conceived differently by different groups and convey as much about the philosophy or orientation of a program as they do about the skills and knowledge taught and assessed within the curriculum.

- Lastly, while already a practice in place in certain faculties (e.g. Laurier's new Bachelor of Social Work program which was designed with pathways for graduates of college Social Service Worker and Child and Youth Worker diploma programs), Laurier should be looking to identify potential partners and pathways in its new program developments so that these transfer opportunities can be designed and integrated into the program development from the beginning. This approach offers perhaps the best chance of an efficient, linear pathway for students that wish to pursue credentials at both institutions.

Both Laurier and Niagara believe the lessons learned through the process will allow both institutions to more efficiently identify new pathway programs as well as leverage the framework created during this project and apply that to future conversations, pathways or projects.