Investigate learning outcomes from online asynchronous vs synchronous instructional delivery in Technology Trades during the COVID-19 2019 -2022

by

Benjamin W Stewart

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Declaration of Committee

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Degree:	**Master of Education**
Title:	**Investigate learning outcomes from online asynchronous vs synchronous instructional delivery in Technology Trades during the COVID-19 2019-2022**
Committee:	**Chair: Daniel Laitsch** Associate Professor, Education **Michelle Pidgeon** Supervisor Associate Professor, Education **Tina Fraser** Committee Member Adjunct Professor, Education **Rebecca Cox** Examiner Associate Professor, Education

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Abstract

Learning during COVID-19 was an abrupt change for both instructors and students. However, long-standing traditions of in-person, hybrid, and online learning allow us to understand the advantages and disadvantages of each learning medium. This research project sought to understand the student experience, the strengths and weaknesses of these models, and ultimately, what the research notes as best practices for teaching with different online simulators and Learning Management Systems (LMS) systems. Students from two different technology-related programs at the College of New Caledonia (CNC) were surveyed via Simon Fraser University (SFU) online survey monkey. Fifty-one students responded to the survey. Data analysis compared program responses and also domestic and international student responses. The 25-item survey was analyzed using the yes/no, multiple choice and Likert scale. The key findings from this research were in line with much of the literature review on similar eLearning studies where there was a measurable change in online delivery.

Keywords: COVID-19; Asynchronous; Synchronous; Hybrid learning model; Information Technology Trades; LMS; Simulators

Dedication

   I dedicate this work to the students in the two programs at College New Caledonia (CNC) that I directly instruct in the present or future. Improve student retention and learning outcomes that ultimately get them a better start in a lifelong Information and Technology Trades career.

Acknowledgments

I like to take the time to acknowledge the gift I am about to obtain with my Education Leadership Masters from Simon Fraser University (SFU) and the financial support from the College of New Caledonia (CNC). Grateful to work, learn and grow on this traditional territory of the Lheidli T'enneh, the first people to occupy this land. I also like to thank my family, who has supported me on my journey over the last two years during the difficult time with COVID-19 and the challenges it brought with adapting to learning and instructing online while at the same time being a full-time student. To my stepdad, Donald B Stewart, who raised me as a young lad and instilled good human qualities and ethics in my life to be a good citizen.

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List of Acronyms

AACA	American Association of Clinical Anatomists
AMS	Academic Motivation Scale
ANOVA	Analysis of Variance
ARPEP	Acceptable Program Resource Entry Policy
CBTF	Computer Based Testing Facility
CCNA	Cisco Certified Network Administrator
CCRC	Community College Research Center
CNC	College of New Caledonia
CNET	Computer Network Technician
COVID	Coronavirus Disease
CSI	Cognitive Strategy instruction
FC	Flipped Classroom Model
HAPS	Human Anatomy and Physiology Society
HFC	Hybrid Flipped Classroom Model
HYFLEX	Hybrid flexible
LD	Learning Disabilities
LMS	Learning Management Systems
LHIQ	A learning-habit analysis questionnaire
MOOC	Massive open online courses
MOODLE	Modular Object-Oriented Dynamic Learning Environment
OSI	Open Systems Interconnection Model
PDIT	Post Diploma Information Technology
RDP	Remote Desktop Terminal Services
SFU	Simon Fraser University
VCC	Vancouver Community College

Introduction

Learning during COVID-19 was an abrupt change for both instructors and students. However, long-standing traditions of in-person, hybrid, and online learning allow us to understand the advantages and disadvantages of each learning medium. The research literature backs up some of my observations of asynchronous learning benefits that can be bought into the synchronous/hybrid learning model. The quantitative research was performed on students at The Hague University of Applied Sciences between 2014-2020 from a classroom-only model to a flipped-classroom approach (Veldthuis, Alers, Malinowska, & Peng, 2020) discussed that some adolescents might find regulating their behaviour difficult based on long-term abstract goals, struggling with planning and anticipating skills, prioritizing, and focusing. Semi-synchronous learning can help students develop planning skills. I believe this is one place where two other colleagues and I did very well. Before becoming infrastructure information technology instructors, we supported K -12 and post-secondary educational technology for 15 to 20 years

First, this literature review provides an overview of definitions and concepts that guide this study. Secondly, I presented research related to learning delivery models through a review of research that has sought to understand the student experience, the strengths and weaknesses of these models, and ultimately, what the research notes as best practices for teaching.

This study methodology focused on a few items similar to what I performed, and I expanded the data collected in my proposed survey. (Arima, Yasui, & Okawa, 2021), the virtual event studied the same learning model features I had implemented over the entire year of COVID-19 from spring 2019 to fall of 2022 that I was unaware was now considered the Hybrid Flipped Classroom Model (HFC) of the future. This proposed study looks at the measurable benefits for student learning in the Information Technology Trades sector.

Literature Review

In reviewing this literature by (Mladenova, Kalmukov, and Valova, 2020) from the University of Ruse, Bulgaria and (Veldthuis, Alers, Malinowska, and Peng, 2020), I took note of the methodological approaches they used to help inform my own research design for my masters project. They also used a quantitative survey of seven questions about students' online experiences using the Likert scale from 2019 to 2020. Both studies concluded that e-learning and being digital-ready are significant factors in student learning success. Furthermore, teaching and learning could not be effective when using synchronous or asynchronous approaches. Both should be implemented. The authors presented a detailed comparative analysis of three eLearning types and traditional onsite learning. As expected, motivation influences attendance allowing students who work in companies to attend classes "while" working, creating a higher attendance during COVID-19 semesters. Mladenova, Kalmukov, and Valova (2020) research found the following:

- Each student has received more personal attention and help from the instructor.
- The achieved results from eLearning were of students who were forced to isolate at home during the lockdown, suggesting they spent more time studying.
- Students have had more possibilities to share and cheat during online examinations.
- The students in 2020 are better in general than those in 2019 as most of the eLearning system had been converted to a digital environment, and testing new products for delivery was refined.
  (p. 1166)

Their research outcomes investigated the sample data and supported some of the conclusions other researchers found (Chen, West, and Craig 2019; Beth-Marion, Saporta, & Caspi 2005; Mladenova, Kalmukov, & Valova 2020); Fidalgo-Blanco, Sein-Echaluce, and García-Peñalvo 2020; Straub and Vasquez III 2015). Their study also found that

extensive work in front of a computer screen led to dangerous implications for eye stress, health, and general condition Mladenova, Kalmukov, & Valova (2020) (p. 1169).

Several studies found that pedagogically blended asynchronous and synchronous learning was the best model (Beth-Marion, Saporta, & Caspi, 2005; Mladenova, Kalmukov, & Valova, 2020). Beyth-Marom, Saporta, and Caspi (2005) surveyed 288 students attending the Open University of Israel about factors that affect students' preferences regarding tutorial modes. A learning-habit analysis questionnaire (LHIQ) with four parts "time management," "ease of access to learning materials," "positive aspects of interaction," and "negative aspects of interaction" (p. 245). They found that 48.1% of respondents indicated a preference for managing their learning time. Similarly, Mladenova, Kalmukov, and Valova (2020) found that better time management helped to cope independently. Although there, 68.8% of the students preferred the synchronous form of learning as it provided real-time communication with the teacher (p. 1165). There seems to be a common finding between the two studies that student time management is a valued part of online learning.

Researchers from the University of Ottawa, Ramnanan, Gabrielle, Dong, Victor, and Visva (2021) sought to "compare first-year M1(n=101) and second-year M2 (n=66) medical student perceptions and exam performance between ASYNCH and SYNCH-delivered anatomy content" (p.1). The study was performed on groups of sample students organized into two learning groups (M1 and M2.) The M1 content was delivered in an asynchronous format; the M2 group content was delivered in real-time Microsoft Teams 365 lectures. Final examinations were compared, and found a slight preference for the asynchronous format. The two different findings that students generally remained satisfied with both approaches, but the M1 model was slightly preferred over M2 could result from the response rate of M1 (62%) and M2 (40%).

Chen, West, and Craig (2019) from the University of Illinois hypothesized that "that stronger students tend to take asynchronous exams earlier than weaker students and that this is primarily responsible for the decline observed in the average score over the exam period for asynchronous exams" (p. 576). They collected student data over the

spring 2015, fall 2015, spring 2016, and fall 2016 semesters. The asynchronous exam data were taken from exams held in the Computer-Based Testing Facility (CBTF) and administrated via the Prairie Learn system. The corresponding instructors provided the synchronous exam data. The quantitative data collected 31,673 exam records over four semesters from six undergraduate engineering and computing courses that had both synchronous exams (all students at the same time) and asynchronous exams (students choose a time) Chen, West, & Craig (2019). The analysis of the exams found lower scores the researchers "observed score decline, where student's average performance drops over the exam period in asynchronous exams, can be attributed to weaker students electing to take exams later in the exam period" (p. 587). The study of 26,139 asynchronous exam records from 81 asynchronous exams and 5,634 exam records from 15 synchronous exams observed a score decline. This study found that the hybrid learning model has the best overall outcomes related to academic achievement.

Giesbers, Rienties, Tempelaar, and Gijselaers (2014) explored student motivation using data collected from an online course with 155 students in the Netherlands with a completion rate of 110. It investigated the question of the best online learning design with blended synchronous and asynchronous communications over time. When this study was conducted in 2013, there was a reference to developments in computer-assisted learning tools that offer more resemblance to face-to-face. The Academic Motivation Scale (AMS) used in this study at the Maastricht University consisted of 28 items on a 7-point Likert scale divided into seven sub-scales (p. 35).

1. Motivation to know the need to understand something new.
2. Motivation to accomplish something.
3. Motivation to experience stimulation.

Their investigation s of the 1742 codable messages posted to the discussion forums showed significant differences between individual contributions (p. 35). The overall implications suggest that synchronous communications would mainly benefit control-oriented learners and only have a few class members as contributors in the forums.

The study by Fidalgo-Blanco, Sein-Echaluce, and García-Peñalvo (2020) explored Hybrid Flipped Classroom: adaptation to COVID-19 and compared data from group T1 (submissions of face-top-face) and groups T2+T3+T4 (submissions of work in the online period. Sampling data used for sampling T1 % submitted works /total enrollers Fidalgo-Blanco, Sein-Echaluce, & García-Peñalvo (2020) (p. 408)

Table 1: Submission of work in the face-to-face period

% submitted works /total enrollers	Experimental	Morning	Afternoon
T1	49,33	34,23	49,41

Table 2: Submission of works in the online period

% submitted works /total enrollers	Experimental	Morning	Afternoon
T2+T3+T4	59,11	26,23	50,20

The study used a Likert scale of 1 to 5 for student grades and challenging courses watching videos compared to face two face learning. The new Flipped Classroom model (FC) is used in face-to-face classes to make students more active, even to go as far as to call this the "new academic normality" (p. 405). The study indicated that although faculty had to support making changes, a large majority were not ready to handle online technologies. This study indicated a new model proposed by the Hybrid Flipped Classroom model (HFC). The context of this research data was done on a first-year university course called "Computer Science and Programming" at the University of Madrid.

Straub and Vasquez III (2015) found the HFC model also supports learning with students with learning disabilities (LD). They found in their survey that four students that met the criteria (a) students were adolescents and (b) had prior diagnoses with an LD that affects their language skills. Data reflected that asynchronous online learning benefits

increased retention, and the ability to work at their own pace and re-watch classroom lectures and demonstration videos increased student retention. It was noted in this study that a personal computer with internet access, digital camera, headphones and software would be a contributing factor in a synchronous online learning environment (p. 221). The cognitive strategy instruction (CIA) prior to the start of this research to after the HFC model was introduced indicated there was an increase in overall change in the standard score of the four students studied Test of Written Language = +13.5 (p. 219) and Psotmean Holistic Quality Score = +1.98 (p. 218).

Harmon et al. (2021) explored educators' experiences in their use of asynchronous and synchronous anatomy courses. They conducted an online quantitative survey of 13 questions. Professional social media distributed the survey invite to multiple professional associations of anatomy educators that included members from both United States and international locations. The professional associations included the AAA, the American Association of Clinical Anatomists (AACA), and the Human Anatomy and Physiology Society (HAPS). In addition, the DR-ED listserv, an online discussion group for medical educators, was used to obtain responses (p. 134), with only 67 respondents. The conclusion also pointed out how many educators had to develop alternate strategies to traditional in-person lectures rapidly. "The present study represents an important time point in anatomy education, and future studies will need to determine whether the findings characterized here were transient pandemic-related shifts or if they represent a long-term change in the delivery of anatomy education." (p. 144)

Researchers in Germany, Arima, Yasui, and Okawa (2021), conducted a study about redesigning graduate school classrooms into massive open online courses (MOOC). They indicated that due to the influence of COVID-19, the higher-education environment is rapidly shifting to an online environment in many institutions. Forty-one students completed the questionnaire, and the interview was conducted with one instructor and five students. The study reflects on some questions (short videos, articles, discussions, and social interactions). They had workshops to help prepare lecturing instructors who had never experienced MOOC features. Arima, Yasui, and Okawa (2021) "The timing at which students need what they learn in class is different." and "Students

must have the opportunity to look back easily when they think it is necessary; I can offer the opportunity using MOOC-like content." (p. 302)

The following quote from Manning's (2018) book "Spiritual intelligence" makes a good point "These are human qualities for which organizations must make room – indeed must nurture – if they want to unleash the full potential of human creativity and productivity" (p. 182). A visionary look at the two programs, creating collaboration from the coordinator level even if there is conflict (positive or negative), empowers both faculty and students to fulfill and improve retention and retention and outcomes. Having a common delivery system mandated in a higher education organization for the future is also crucial for students that might miss class due to being sick (isolations), family emergencies that have them away for a week or two, and still be able to find the resources for the course material and access to learning lessons at any time the internet and faster communications.

Cox (2005) reiterates the importance of understanding the implications of Web-based education requires a detailed description of current structures, conditions, and practices. To document community colleges' involvement with newer, computer-based technologies and to understand the implications of that involvement, the Community College Research Center (CCRC) at Teachers College recently conducted a national field study of community colleges and incorporated online education as a key topic of investigation. (p. 1756) Dr. Cox looked at a few negative sides of online learning at the time. Only privileged students would have the tools to enter higher education, at least at the university level, compared to the college environment of post-secondary. The possibility of a diploma mill is offered to many with the resources to pay for it. Time has shifted since 2005 for high-speed access resources, the cost of computers is much lower, and internet speeds and access are widely available now in 2022. Rural access to any advantages gained by asynchronous and synchronous online learning delivery options is still an issue.

Practitioner Perspective & Context of Study

Being an instructor of two programs, Post Diploma Information Technology (PDIT) and Computer Network Technician (CNET), we were not set up using tools like Canvas and Blackboard during the March spring semester of 2019 when COVID-19. We were unexpectedly forced to implement emergency remote learning strategies like many educational colleges and universities (Veldthuis, Alers, Malinowska, & Peng, 2020). We were given three days to learn and find solutions to deliver online by program heads. Many of us were introduced to the Microsoft Teams 365 learning environment for the first time, an already paid-for software suite by CNC. Zoom was unavailable at the time, but there was an infrastructure for the BIG BLUE button video conference. Still, the capacity overwhelmed the CNC delivery system and did not work most of the time. I paid for Blue Jeans for an entire year until zoom was introduced and paid for by CNC organizational-wide.

In Spring 2022, I wrote a paper supporting a new concept that hopefully changes future program requirements—the "Acceptable Program Resource Entry Policy" (ARPEP). One item I did not read about in the literature was the expectation for the minimum equipment requirements purchased as a student in an online IT eLearning environment. I found I was spending much of my time supporting and setting up most students' equipment they were attempting to use for remote learning. Many of them had unacceptable entry equipment and weak internet connections. Students need the minimum equipment and textbooks for what they need to succeed in programs to evaluate educational learning outcomes. Many students are not as successful in our program due to not having the correct equipment and resources to work on their course material either in person or online, creating a need for a policy supported by CNC, registration, program administration, and faculty.

The research study of students would have a unique perspective that not much technical trade delivery instructing international students not yet in Canada. Many students did not have the equipment or data plans in their country of origin, creating unique learning environment challenges that I think would be good data to collect. I spent

the start of fall 2020 setting up a learning environment with tools like Remote Desktop Terminal Services (RDP) on the Microsoft data center 2019 in-house office data center. I created a learning environment with the domain "BENN.TV" virtual classroom experiences for students that did not have access to our typical synchronous face-to-face lab experience. Furthermore, as instructors at CNC, we also have a unique setup of our physical labs, equipment like routers, switches and data centers, and servers environment, along with special equipment like data cable, fibre optic fusion splicers, and separate internet sources into the CNC from an independent internet sourced by Shaw Cable. We did not have any way to access this equipment under the current setup outside the very complex physical CNC environment we created—my home office setup of "BENN.TV" RDP terminal broker service virtual classroom environment allowed me to shadow or control each student's login experience to reach and guide the student's questions and learning experience. All equipment was purchased by me and was part of my investigation to help facilitate all students with the same account environments and my unlimited business bandwidth to complete their lab tasks. As instructors, we found a product called TestOut (TestOut Corporation, 2021) that was somewhat helpful with virtual simulators to support some course objectives in writing the CompTIA (CompTIA IT Certifications, 2021) industry exams. Students had to pay for the additional costs to participate in these canned Learning Management Systems (LMS) courses that we administrated via instructor-level access. Between these tools and building course material on the fly to support unique labs to meet the CNC course objectives and maintain student outcomes and validity.

I also used the CNCs Moodle platform and Microsoft Teams 365 to create the asynchronous platform for reference if students missed classes. Microsoft Teams 365 was the instrument I used to store all video lessons that could be watched asynchronously. I dedicated myself to starting at 5:00 AM hybrid three-hour lectures close to 9:00 - 10:00 PM student time in their home countries.

Since 2021, I have rebuilt all the courses I deliver and material in a Hyflex / Hybrid learning environment using Moodle as the primary delivery medium. I started using a new company's online LMS / Simulators called MindTap by Cengage (Cengage,

2022) and my own BENN.TV virtual classroom. The next section of this report outlines my research purpose, questions, design and analysis.

Research Methodology

Researcher Positionality

I'm an instructor at CNC in two Technology Trades programs with seven years of instructor experience. Before becoming an instructor, I worked in IT for 27 years. These experiences give me a unique perspective to undertake this research during COVID-19.

Research Design

Given the CNC student population in Information and Technology Trades and the desire to learn from them about their experiences during COVID-19, I decided to use an online survey quantitative research design. The survey had 25 mixed questions from yes/no, Likert scale, and multi-selection responses. *See Appendix D* for the survey questions. The SFU Survey Monkey used anonymized unique identifiers.

Participants

One hundred and eighty-three PIDT/CNET CNC students had both asynchronous and synchronous learning experiences from spring 2019 to fall 2022 during COVID-19. All students enrolled in the PIDT/CNET programs during this period were invited to complete the survey. Fifty-one participants responded, translating to a 27.8% response rate for the survey data collected with a 25.1% completion rate.

Procedures

This study was supported by a third-party individual who has agreed to assist with recruiting participants by sending an invitation to this study via email. The letter of invitation (See *Appendix B* – Letter of invitation) provides all the relevant information to ensure students are fully informed about the goals and purpose of this study, what they were being asked to do and their rights as research participants.

Following this procedure, the third `party emailed these participants a link to the SFU secure survey monkey (See *Appendix C* - for email script). The participant had to

agree with the terms of the survey, or they could quit anytime, stop or refuse to be part of the survey (see *Appendix B* - email invitation). Upon clicking the URL embedded in the email invitation, participants were taken to the consent page for the survey - upon review of this page, they had to click YES- I agree to participate or NO- I do not wish to participate. If they agreed to participate, they were bought to the survey began (see *Appendix C* - for the survey). Participants were fully aware that upon clicking SUBMIT - their responses are anonymized, and they will not be able to withdraw their survey responses from this study. Upon submitting their survey, participants were given the option in a second and separate survey (not attached to their responses) to enter their email to be eligible for a random draw of 3 x 50$ gift cards.

Ethical Considerations

No participants' names or IP addresses will be collected for this survey. This survey intends to have all anonymized responses with unique identifiers. All data will be securely stored on the SFU Survey Monkey within Canada, and any downloaded data will be stored on SFU Vault. Creating a knowledge base of student learning experiences benefits from asynchronous and synchronous environments that will enhance our programs being offered synchronously for years before COVID-19. Overall the results will be considered in establishing new program policies based on the quantitative data that will benefit the students' interests in our programs offered in Information Technology Trades at CNC. Creswell (2012) suggests it is best to mediate qualitative data through human instruments. Overall this survey will support quantitative data to reflect eLearning environments and move toward an (HFC) learning model.

Limitations and Delimitations

The research study only focused on capturing data from international and domestic students in a small window in time from two Information and Technology Trades programs. Participants were from asynchronous and synchronous learning environments starting September 2019 and ending September 2022 within the PDIT/CNET programs at CNC. The survey participants did not include other trades or

academic programs in this research. The survey focused on a few questions that may support positive or negative reflections on students within particular programs to ensure that the recommendations are relevant to the programs I teach at CNC. To ensure that our sample accurately represents the population and enables us to make future educational delivery. The sample data was only as good as the quality of the survey designed and the number of students contributing to the survey.

Data Storage

Data was collected via SFU Survey Monkey. Any other data used in the analysis was stored on my password-protected personal computer. The data for five years and then destroyed.

Analysis

I performed a comparative analysis of domestic and international students. I used stratified sampling, breaking the two groups into international and domestic. Variables were numerical, summarizing the counts of sample data or categorical by the quality of the laboratory tools or experience with learning outcomes using several LMSs. Therefore, depending on responses, the analysis provided an overview summary (e.g., descriptive statistics). I looked for validation in completing CompTIA certification over the three years to see if there is a performance trend in either program. I projected the next year based on HFC delivery. I also investigated the quality of tools and resources used by students in an asynchronous online environment.

The initial data analysis shows a 27.8 % response rate throughout the three reminders over the four weeks of the survey. Data responses were analyzed and averaged, then converted to a percentage, and a basic statistical analysis was performed on the quantitative data. The number of respondents in each survey is identified as *n. (*See *Appendix E –* Table*)*

Figure 1.   Participant survey results
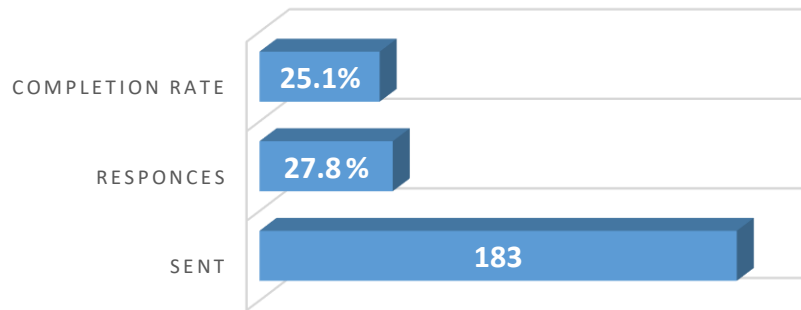
The quantitative data were analyzed for statistical and potential correlations between the benefits of different programs and using Hybrid or LMS, resulting in higher student success and more certificates completed. Then, an analysis of the qualitative data was performed. The process for analyzing the qualitative data was as follows:

1) Initial read-through for initial survey responses

3) Export raw data for data analysis based on survey questions and participants' responses and build a master table with summative count and averages along with percepts.

4) Examining labels and categorizing them into major themes, graphs, and sub-themes showing the benefits/disadvantages, create crosstab data comparisons and projected outcomes based on the 2019 to 2022 results.

Findings

The survey focused on the student's perspective, understanding, and experiences working in an Asynchronous and Synchronous during 2019 to 2022 COVID-19 learning experiences. Ninety-two percent (n=46) indicated they preferred face-to-face learning over online learning. When asked the question about the preference of online asynchronous (n=4) vs to face to face synchronous (n=46), this leads to 92% of students preferred Face to Face instruction.

Additionally, participants indicated that during this time of COVID-19, students that took classes online were in Canada at n=35 and n=11 representing students outside Canada. That translates to 76.1% of this quantitative data directly influenced by online student experiences. Another identifier of the comprehensive survey data is the number of students that took more than one class 100% online. (See *Appendix E* – Table*)*

**Figure 2.   Participants that had taken 100% of classes online**
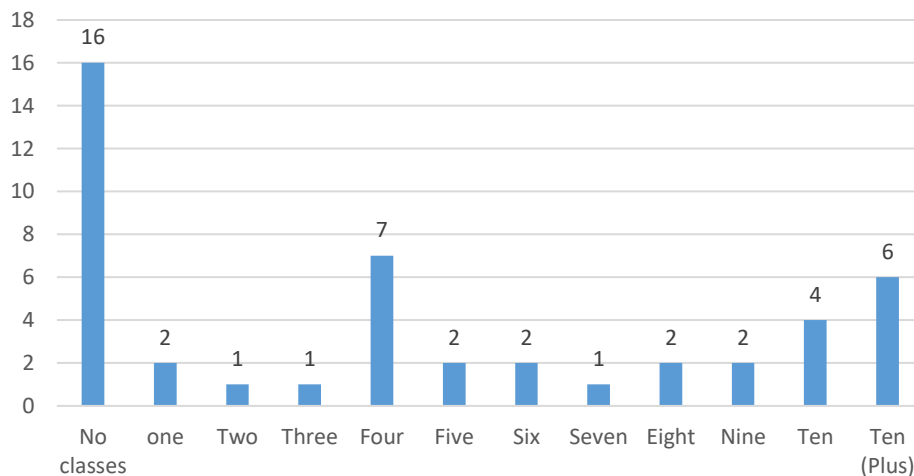
Other contributing factors for student success noted from the survey results is the data refection on students' laptop age was newer than three years while 23 participants' computers were older than three years. Fifty-four percent (54%) of students have an up-to-date laptop. Additionally, this survey results indicated that n=29 students used their

cell phones as a primary learning device in online environments, translating to 58% (n=21) representing students that did not use a laptop or desktop computer. Furthermore, students ranked the reliability of their internet (1 bad and 5 great), the average response was 4 (good), indicating 75% of participants had a reliable internet connection.

Students in these programs were exposed to various simulators during their studies. Their feedback on these online simulators used in hybrid environments during 2019 to 2022 (1 bad and 5 great) (as seen in Figure 3) showed that: Packet Tracer was the best experience (95% approval)' TestOut simulator environment (75%) and MindTap by Cengage (68.6%). One of the reasons MindTap may have been least preferred might be that it is a current product still working on several development bugs. Packet Tracer and TestOut have been more established products for a few years. (See *Appendix E* - Table*)*

Figure 3.   Participant online simulator feedback
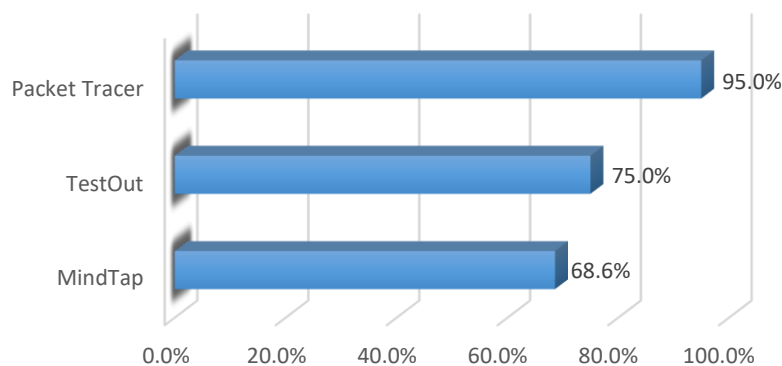
Student feedback on online asynchronous delivery model preferences is represented by (1 bad and 5 great). The data analysis indicates that the average daily event reminders in Moodle/Teams 365 was n=4.3 or 83%. The student data rated outline/Syllabus in Moodle at n=4.2 or 81.3%. The surprising results of the survey data were watching recorded online lectures later was a benefit to learning at n=3.5 or 65%. The low approval rate could be related to large recordings with no timeline indexing where each lab object/lecture starts and ends.

Figure 4. **Participant online LMS feedback**

Legend:
- Daily events reminders in Moodle/Teams 365
- Ouline/Syllabus in Moodle
- Watching recorded online lectures later
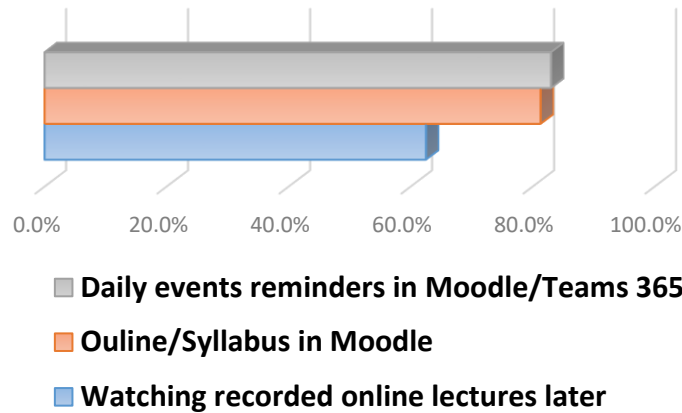
It is worth discussing these interesting facts revealed by the results of certificates written and passed by our students. Survey data supports that since our two programs switched to a hybrid or HFC model, student certification completion has greatly improved. Using a crosstab analysis of the year of certificate obtained and program, we can also see an increase with projected future growth. Certificates are represented in the figure below as follows. CNET 2020 n=4 or 8.75%, 2021 n=2 or 4.3% n=21 or 45.7% of the sample data collected. PDIT 2019 n=0 or 0%, 2020 n=13 or 28.3%, 2021 n=12 or 26.1%, 2022 or 4.2% of the sample data collected. (See *Appendix E - Table)*

Figure 5. **Participant certificates completed by the program**

|	2020	2021	2022	FG
PDIT	13	12	2	10
CNET	4	2	21	
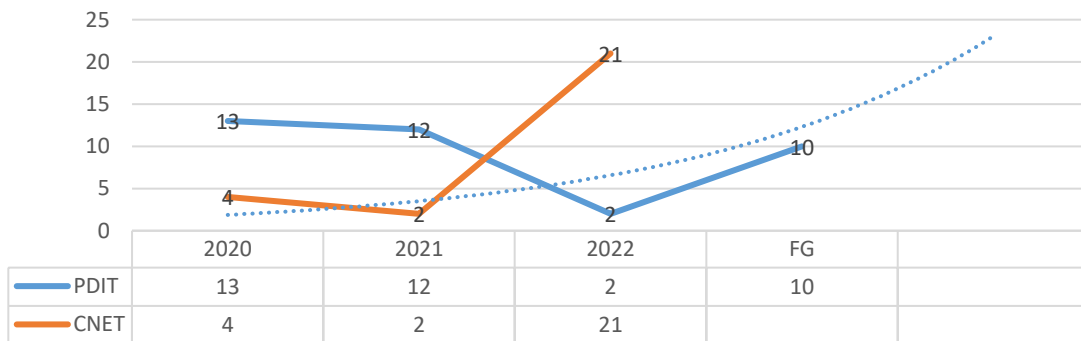
The number of PDIT students did go down in 2021, but this can also be explained by the number of students intakes getting a student visa into Canada over COVID-19 compared to the numbers we had in previous years. The two programs CNET for 2020

n=15 or 8.2%, 2021 n=10 or 5.5% and 2022 n=20 or 10.9% of the sample data. Representing the PDIT program at 2019 n=28 or 15.3%, 2020 n=66 or 36.1%, 2021 n=34 or 18.6% and 2022 n=10 or 5.5% of the sample data collected. (See *Appendix E* - Table*)*

Figure 6. **Participant breakdown by program and year**
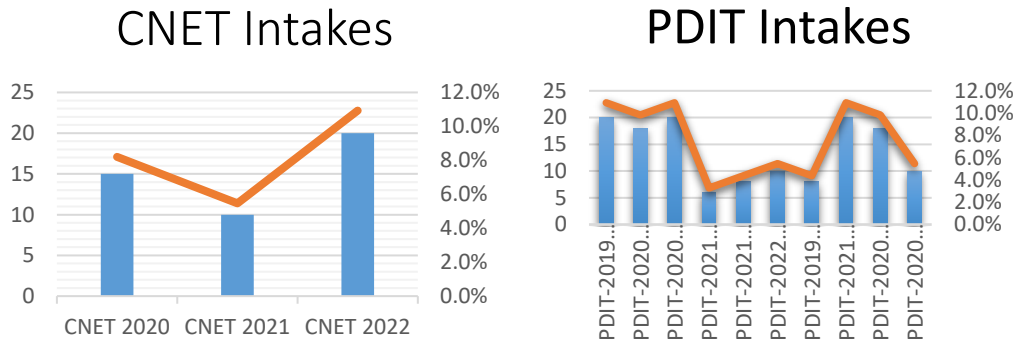
The number of certificates written is sorted by personal laptop age used in the asynchronous elearning environment. Newer than three years (n=51), older than three years (n=26). The indications in this comparative graph would support that newer learning tools affect certificates completed. Hypothetically it could also support that students that are driven to have high success invest in the best tool to complete their goals. (See *Appendix E* - Table*)*

Figure 7. **Comparison by the age of laptop to certificates**
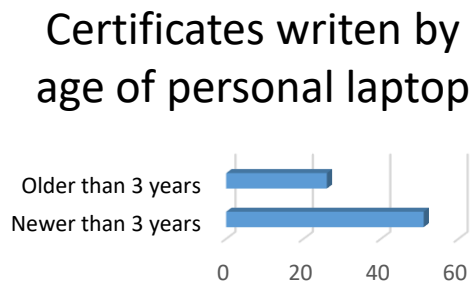
Discussion

Good quality design is significant for quantitative surveys and questionnaires. For example, using Moodle LMS as our overall online student experience will benefit staff at

the same time. This survey's carefully constructed questions and questionnaires will rank or score options using closed-ended questions.

Furthermore, staff training events for our two programs' results will benefit students, in their opinion, and may help shape future HFC model delivery in our two programs. The benefits to instructors will be that student-informed data will help improve pedagogical practices in our program and identify potential areas of further professional development that support excellent learning outcomes in Technology Trades.

The implications of these data from this survey align with some of the findings documented in the literature and reflect students' retention success. Compared to the literature, this examination and findings validate recommendations for the course and program improvements. Also, there may be an online asynchronous weakness by not having an APREP policy for student success. A similar pattern of results was obtained in the (Chen, West, & Craig, 2019) study indicated that asynchronous allowed the student to study on their own time, which is also related to academic achievement (e.g. sick, missing class).

From the results, it is clear that was also indicated by Mladenova, Kalmukov, and Valova (2020) that both synchronous and asynchronous eLearning should be used. Additionally, in line with previous studies by Beyth-Marom, Saporta, and Caspi (2005), the pedagogical blending of synchronous and asynchronous strengthens individual teaching/learning, as did some of this study. Additionally, students in their study did improve after using an eLearning system by the second year of this study.

The findings of this research project support the notion that some programs and courses might be true but not as infective in the trade's field of study. Results demonstrate relationships to other studies similar to Fidalgo-Blanco, Sein-Echaluce, & García-Peñalvo (2020) have even gone so far as to indicate Flipped Classroom Model (FC) is the "new academic normality." (p. 405). This study also indicated similar findings by Beth-Marom, Saporta, & Caspi (2005), Giesbers, Rienties, Tempelaar, & Gijselaers (2014), Mladenov, Kalmukov, & Valova (2020), blending synchronous + asynchronous

learning has advantages for student success. This data can be seen in the overall increase in CompTIA certificate completion rate since moving to a hybrid eLearning environment.

Recommendations

This final report shows that the educational delivery of online asynchronous and synchronous instructional delivery in a hybrid environment correlated to the student certificate success. The result of this analysis is a key factor in hiring grad students into Information Theology Trades career based on our external advisor yearly surveys.

As we move forward, the survey results supported the colleagues' future development in our two programs. If adopted, the two programs have a baseline for the future common delivery process. The results confirm that this is a good choice moving toward a common Hyflex model that CNC is started investigating. Before resources are spent, it would be prudent, as indicated by the academic article discussed by Cox (2005). CNC needs to be thoughtful about the big picture in understanding web-based education. Even though Dr. Cox's article is from 2005, it remains relevant as new web-based simulators and LMS are introduced and marketed every two years.

One extra consideration about the findings of laptop age and cell phones used as primary learning devices online would be to look at the APREP proposed policy so students have the right equipment to support students when working online in asynchronous mode with LMS systems online offsite.

Future Research

While this research has been informative, I believe there would be value in deploying these surveys again to try to capture more data. There was some limitation to the design of the survey. I would have liked to have added disadvantages and questions on limits/barriers to online. I had originally designed a few questions to be open-end but could not get them approved through the CNC Ethics Approval process, being these at one time were my students or maybe again. Now that a baseline has been established and

would be prodigious whether this is equivalent across additional surveys at a future date. I also like to have thought about at the time pulling anonymized data from our private Pearson VUE Test Center, Person VUE (2022). It would have shown data from the last six years of testing that could indicate the relevant data analysis to show how many students wrote their CompTIA certificates and passed the first time or second time or did not reattempt.

Conclusion

The value in Hybrid delivery for students would appear to be a major contributor to students' validity and success as defined by the final report and the questions asked in the survey from the sample group that contributed. This study also had correlations to Chen, West, and Craig (2019) study opportunity to study asynchronously is related to academic achievement. This study also indicated a motivation to learn new things and increased student achievement since moving to the new delivery model over COVID-19 at CNC. Much like Mladenov, Kalmukov, & Valova (2020), more time spent in eLearning improves student grades.

CNC is developing their version of Hyflex synchronous program development in the organization that will be offered in the future will be a very economical-driven process. Research ahead and planning and implementation every two years will be necessary for hybrid web-based success. I think this is where the study by Cox (2005) is very relevant in our IT Trades as it evolves so fast compared to other traditional trades, e.g. carpentry, electrical and welding.

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Appendix A - Third Party Consent form

July 21, 2021

Re: Research proposal - The research to study measurable learning outcomes from asynchronous vs synchronous instructional delivery in Information Technology during the COVID-19 2020/2021 years?

I _____ consent to act as a third party to contact research participants on behalf of Benjamin Stewart, MEd Candidate, Faculty of Education, SFU.

I agree to send initial email invitations and follow-up reminders, as directed by Benjamin Stewart, for the purpose of recruiting participants for this research study. Invitations will be sent to instructors and PDIT/CNET students who participated in asynchronous and synchronous learning at CNC during the 2020-21 academic year. The purpose of this study is to explore the perspectives of students and faculty in a post-secondary information technology setting who have experienced both learning environments.

Sincerely,

Insert name and signature and title.

Appendix B - Participants survey consent form

Project Title: "What modes of instructional delivery did students find the most helpful in their online learning?"

Thank you for considering participating in a survey about asynchronous vs synchronous. Before you decide whether to participate, please take time to review the following information. If you have any questions or need additional information, please contact me at benjmain_stewart@sfu.ca.

I, Benjamin Stewart, am conducting this survey as part of a research project exploring the experiences of College of New Caledonia PDIT and CNET students during the Convid-19 spring 2020 to fall 2022. I am an Information Technology Instructor at the College of New Caledonia, and this project is a requirement for the Masters in Educational Leadership program at SFU. This research is being supervised by Dr. Michelle Pidgeon. I will present the results of this research in the form of a written report to my faculty supervisor and a public poster session at the 2022 Summer Institute at SFU. This research aims to learn more about investigating benefits or disabilities related to asynchronous vs synchronous learning in Information Technology. If you choose to participate, you will be asked to complete this online survey that will take you an estimated 10 to 15 minutes to complete. The survey explores tools needed for Information Technology learning and experiences using online simulators and hands-on simulators. You may choose not to answer any of the questions, and you may also end your participation in the survey at any point in the process.

Risk/Benefits. This is a **minimal risk study**. The stress involved in completing the survey will be no more than the stress you encounter in your daily work. This survey collects data anonymized. **Anonymized:** Anonymized means I will know who participates in the survey but will not be able to match participants' responses to you as an individual name. I will be keeping any information I have about you or your participation confidential. I will not release your name or describe your participation in the survey in such a way that you could be identified.

This survey will have benefits in improving the overall two Trades and Technology programs with a better hybrid online asynchronous vs synchronous delivery model based on your student feedback.

Your responses are anonymized, and if you choose to enter into the prize draw- your email is not attached to your survey responses. I will just know that you participated in the survey but not know your responses. I will be keeping all responses confidential in that I'm only reporting a summary of results (not individual responses).

Data will be downloaded and stored on a local device or SFU server. The downloaded data related to this research study will be on a **password-protected** personal computer.

The anonymized participant data collected will be included in a final report. After completing all of my MEd degree requirements, other conferences and publication opportunities from this research may be presented at academic conferences and published in higher education peer-review journals. I will destroy the raw data after five years.

Participation in this research is voluntary. You can decide to stop participating at any point in the process for any reason. Your decision to participate (or not) will not be shared with anyone. There are no negative consequences for withdrawing your participation, if you choose to withdraw from this study – please simply close this browser window. Once you have submitted the survey, I will not be able to remove that data because I will not be able to differentiate or identify your responses from others.

A separate voluntary anonymized survey link will be offered at the end of the primary survey if you wish to enter a draw for three random draws of $50 London Drugs gift cards.

"This survey is hosted by SurveyMonkey, a US company. Any data you provide may be transmitted and stored in countries outside of Canada, as well as in Canada. It is important to remember that privacy laws vary in different countries and may not be the same as in Canada."

I can be reached at xxx@sfu.ca or ###-###-###. If you would like to talk to my faculty supervisor, you can reach Dr. Michelle Pidgeon at xxx@sfu.ca or ###-###-###.

If you have any concerns about your rights as a research participant and/or your experiences while participating in this study, please contact the Office of Research Ethics (SFU).

I have read the information provided and agree to participate:

Appendix C - Email Script for the third party send to participants

Greetings,

As a student in PDIT/CNET programs at CNC, you are being invited to participate in an anonymized online survey. You will provide guidance and feedback into what you feel would be valuable components and beneficiation experiences in both online and in-person learning environments to help make our programs better in the future

In this anonymized survey (hosted by SFU Survey Monkey), you will be asked questions about curriculum content, learning preferences, and other matters to help us design this program.

If there are any questions, please contact either Tara Lutsiak (CNET), lutsiakt@cnc.bc.ca, Anna Russell (CNET), russella10@cnc.bc.ca or Alika Rajput (PDIT), rajputa@cnc.bc.ca, both Administrative Assistants from CNET and ACE at the College of New Caledonia. Each person is my third-party contact and will be replying on my behalf of me, so participants remain anonymized.

I, Benjamin Stewart, am conducting this survey as part of a research project exploring the experiences of College of New Caledonia PDIT and CNET students during the COVID-19 spring 2020 to fall 2022. I am an Information Technology Instructor at the College of New Caledonia, and this project is a requirement for the Masters in Educational Leadership program at SFU. This research is being supervised by Dr. Michelle Pidgeon. I will present the results of this research in the form of a written report to my faculty supervisor and a public poster session at the 2022 Summer Institute at SFU. This research aims to learn more about investigating benefits or disabilities related to asynchronous vs synchronous learning in Information Technology. If you choose to participate, you will be asked to complete this online survey that will take you an estimated 10 to 15 minutes to complete. The survey explores tools needed for Information Technology learning and experiences using online simulators and hands-on

simulators. You may choose not to answer any of the questions, and you may also end your participation in the survey at any point in the process.

This is a minimal risk study. The stress involved in completing the survey will be no more than the stress that you encounter in your daily work. This survey collects data anonymized.

Anonymized: Anonymized means I will know who participates in the survey but will not be able to match the participant's responses to you as an individual name, only a unique identifier. I will be keeping any information I have about you or your participation confidential. I will not release your name or describe your participation in the survey in such a way that you could be identified.

The data related to this research study will be on a password-protected personal computer or other devices (such as SFU's Survey Monkey online survey system). Any list of participant information will be stored separately from the raw data. The Survey Monkey application data collection process is hosted and stored in Canada by a commercial provider external to SFU.

The anonymized participant data collected will be included in a final report. Results will be presented during the 2022 summer SFU institute (where MEd candidates present their research to peers and evaluators). After completing all my MEd degree requirements, other conferences and publication opportunities from this research may be presented at academic conferences and published in higher education peer-review journals. I will destroy the raw data after five years.

Participation in this research is voluntary. You can decide to stop participating at any point in the process for any reason. Your decision to participate (or not) will not be shared with anyone. There are no negative consequences for withdrawing your participation, and I will erase/destroy any information already collected from you. In the case of anonymized collected data, I may not be able to erase or destroy that data because I won't be able to identify it as yours.

If you have any concerns about your rights as a research participant and/or your experiences while participating in this study, please contact or you would like to talk to my faculty supervisor, you can reach Dr. Michelle Pidgeon at xxx@sfu.ca or ###-###-###.

At the end of the completed survey, you will be redirected to an additional web page that will allow you to enter your name into three random draws of $50 each in London Drugs gift cards. Please know that your survey responses are anonymized, and if you choose to enter your email for the prize draw, it is a separate link and can not be connected to your survey responses. Email reminders will be sent two weeks after starting date (April 17th and April 31st).

To Access Survey https://www.surveymonkey.ca/r/ben-Stewart.

Sincerely,
Benjamin Stewart
Masters of Educational Leadership, Simon Fraser University

Appendix D - Survey questions

1. I have read the information provided and agree to participate before moving on to the survey questions? (Approve/Disapprove) You will need this option to say **YES** to start and activate the next part of the survey. Participants can quit at any time, and no data will be recorded.

2. Given the opportunity, would you prefer an online or face-to-face learning environment? (online/face-face)

3. Have you ever used your cell phone as your primary learning device in an online environment? (yes/no)

4. Did you own a laptop as a study tool when attending one of the programs at CNC? (yes/no)

5. If you did own a laptop that you used for online learning at the time of your studies at CNC, was it older than three years or newer than three years? (two options) (not required)

6. How reliable was your internet connection during your learning? (scale 1 – 5)

7. Rate your overall experience using the TestOut simulator environment? (scale 1 – 5)

8. Rate your overall experience using the MindTap simulator environment? (scale 1 – 5)

9. Rate your overall experience using the Packet Tracer simulator environment? (scale 1 – 5)

10. Given a chance to take more courses in the future, would you prefer the online asynchronous delivery model? (scale 1 – 5)

11. Online chat/message boards discussions with other students in my online class are important to me from a learning perspective. (scale 1 – 5)

12. Would you prefer the face-to-face hands-on equipment environment versus an online simulator environment? (scale 1 – 5)

13. Did you find the ability to watch a recorded lecture/demonstration at a later date a benefit to your learning outcome? (scale 1 – 5)

14. The course outline/syllabus in Moodle helped you understand the learning objectives? (Scale 1 – 5)

15. A daily events reminder in Moodle or Teams 365 helped me stay on track in my courses (Scale 1 – 5)

16. Class discussions were a positive way to engage with others in my class. (Scale 1 – 5)

17. Group discussions improved my understanding of the course content. (Scale 1 – 5)

18. Are you an international student or a domestic student? (two options)

19. What program did you take at the College of New Caledonia? (two options) (PDIT or CNET)

20. Did you complete your program? (yes/no)

21. What year did you graduate from your program? (Four options/number or still a student)

22. Did you ever attend online classes outside of Canada with the College of New Caledonia? (yes/no)

23. How many courses did you take 100 percent online during your studies at the College of New Caledonia (number)

24. When taking courses online during your 2020/2022 years, were you living in Prince George? (yes/no)

25. Did you write any certificates associated with your program? (pick all that apply)
    - Computer A+ (CompTIA Certificate) Both Hardware and Software
    - Network + (CompTIA Certificate)
    - Security + (CompTIA Certificate)
    - Linux + (CompTIA Certificate)
    - LPI 1 (Linux Essentials Certification)
    - Server + (CompTIA Certificate)
    - CSS (Customer Server Specialist Certification)
    - CCNA (Cisco Certified Network Associate)
    - FOA (Fiber Optics Certificate)
    - MTA (Microsoft Technology Associate)
    - CWS (Certified Wireless Specialist)
    - CWT (Certified Wireless Technician)
    - CWNA (Certified Wireless Network Administrator)

Appendix E - Sample data table

Q1 = I have read the information provided and agree to participate		
Sent emails of invitation	183	
Responses	51	27.8%
Completion rate	46	25.1%
Q2 = Prefer an online or face-to-face learning environment		
Online	4	8.0%
F to F	46	92.0%
Q3 = Used a cell phone as your primary learning device in an online environment		
Yes	29	58.0%
No	21	42.0%
Q4 = student owned a laptop when attending		
Yes	46	92.0%
No	4	8.0%
Q5 = Used a cell phone as your primary learning device in an online environment		
Yes	29	58.0%
No	21	42.0%
Q6 = Laptop age		
Newer than 3 years	27	54.0%
Older than 3 years	23	46.0%
Q7 = How reliable was your home internet		
Average response (bad to good)	4.0	75.0%
Q8 = TestOut online simulator environment experience		
Average response (bad to good)	4.0	75.0%
Q9 = MindTap online simulator environment experience		
Average response (bad to good)	3.7	68.6%
Q10 = Packet Tracer online simulator environment experience		
Average response (bad to good)	4.9	95.0%
Q11 = Prefer the online asynchronous delivery model		
Would not prefer (Averaged)	3.4	60.0%
Q12 = Online chat/message board discussions were a benefit to learning perspective		
Liked the ability (averaged)	3.5	62.5%
Q13 = Face-to-face hands-on equipment environment versus an online simulator environment		
Face-to-face preferred (averaged)	4	75.0%
Q14 = Found the ability to watch a recorded lecture/demonstration at a later date as a benefit to learning outcome		

Was a benefit (averaged)	3.5	62.5%
Q15 = Course outline/syllabus in Moodle helped you understand the learning objectives		
Was a benefit (averaged)	4.2	81.3%
Q16 = Daily events reminders in Moodle or Teams 365 helped me stay on track in my courses		
Was a benefit (averaged)	4.3	83.0%
Q17 = Class discussions were a positive way to engage with others		
Was a benefit (averaged)	4.6	91.2%
Q18 = Group discussions improved my understanding of the course content		
Was a benefit (averaged)	4.5	87.5%
Q19 = International or Domestic student		
International (PDIT)	32	69.6%
Domestic (CNET)	14	30.4%
Q20 = Graduated from programs		
PDIT	32	69.6%
CNET	14	30.4%
Q21 = Did you complete your program?		
Graduated	35	76.1%
Still a student	11	23.9%
Q22 = Years Graduated		
2020	12	26.1%
2021	13	28.3%
2022	11	23.9%
Future	10	21.7%
Q23 = Attend online classes outside of Canada		
Outside Canada	11	23.9%
In Canada	35	76.1%
Q24 = How many courses did you take 100 percent online during your studies at the College of New Caledonia		
No classes online 100 Percent	16	34.8%
one	2	4.3%
Two	1	2.2%
Three	1	2.2%
Four	7	15.2%
Five	2	4.3%
Six	2	4.3%
Seven	1	2.2%
Eight	2	4.3%
Nine	2	4.3%
Ten	4	8.7%
Ten + (Plus)	6	13.0%
Q25 = Courses online during your 2019-2022, living in Prince George or other places in Canada		
Was in Prince George	32	69.6%

Was not in Prince George	14	30.4%
Q26 = Did you write any certificates associated with your program		
Computer A+ (CompTIA Certificate) Both Hardware and Software	24	52.2%
Network + (CompTIA Certificate)	8	17.4%
Security + (CompTIA Certificate)	4	8.7%
Server + (CompTIA Certificate)	2	4.3%
Linux + (CompTIA Certificate)	0	0.0%
LPI 1 (Linux Essentials Certification)	0	0.0%
CCNA (Cisco Certified Network Associate)	11	23.9%
CSS (Customer Server Specialist Certification)	3	6.5%
FOA (Fiber Optics Certification)	10	21.7%
MTA (Microsoft Technology Associate)	0	0.0%
CWS (Certified Wireless Specialist)	0	0.0%
CWT (Certified Wireless Technician)	1	2.2%
CWNA (Certified Wireless Network Administrator)	1	2.2%
Additional - Breakdown by program and year (Certificates)		
PDIT 2020	13	28.3%
PDIT-2021	12	26.1%
PDIT-2022	2	4.3%
PDIT-FG (Future Grad)	10	21.7%
CNET-2020	4	8.7%
CNET-2021	2	4.3%
CNET-2022	21	45.7%
Additional - Breakdown by participants by number of students year in each program during COVID-19		
CNET 2020	15	8.2%
CNET 2021	10	5.5%
CNET 2022	20	10.9%
PDIT-2019 (Group-1)	20	10.9%
PDIT-2019 (Group-6B)	8	4.4%
Sub Total 2019	28	15.3%
PDIT-2020 (Group-2)	18	9.8%
PDIT-2020 (Group-3)	20	10.9%
PDIT-2020 (Group-5C)	18	9.8%
PDIT-2020 (Group-6C)	10	5.5%
Sub Total 2020	66	36.1%
PDIT-2021 (Group-4)	8	4.4%
PDIT-2021 (Group-4C)	20	10.9%
PDIT-2021 (Group-6)	6	3.3%
Sub Total 2021	34	18.6%
PDIT-2022 (Group-5)	10	5.5%
Total Participants	183	