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Article

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Remote learning during COVID-19 and transformative learning theory: tendency towards Quadruple Helix model for future post-secondary education in Indigenous contexts

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Abstract

This paper aims to examine UCN (University College of the North) students' remote learning experience during the COVID-19 pandemic to provide a reference for future remote education in Indigenous contexts. Survey data are used for empirical analysis of the five themes: socio-demographic contexts; social activities, stress, and well-being; academic performance; course delivery; and student support services. Transformative learning theory and Quadruple Helix Model are used as a framework to explore the breadth and depth of such five themes. As the descriptive study shows, the majority of UCN students are over 25 years old and study in their first and second year with major challenges such as Internet connectivity, private space, and interruption. Mean values reveal that the remote learning performance is determined by concerns about COVID-19 infection, mental and physical health, isolation and lack of socio-cultural activities, students' self-preparedness and motivation, and support services. The regression analysis shows that students' concerns about COVID-19 infection interference with course completion are directly affected by their worries about themselves or someone in their families who could be exposed to COVID-19, their mental health, and blended course delivery. Therefore, students' remote learning performance and their well-being will be enhanced if we take into consideration improving social distancing, educational technology, and course delivery with community–university culturally responsive collaboration. The research findings and the reviewed literature attest that transformative learning theory fits UCN's remote learning practices to meet educational goals through the university–community collaboration, which is supported by the Quadruple Helix model. As a result, such remote learning practices engage students, particularly Indigenous students, and the practices will help upgrade universities with similar attributes globally into Mode 3 universities, contributing to community economic development.

Keywords: Indigenous students, UCN remote learning practice, University–community collaboration, Transformative learning theory, Quadruple Helix model, Mode 3 university

Introduction

In Canada, the COVID-19 pandemic has forced education at all levels to shift toward remote teaching and learning as it is adopted across the globe. Such an unplanned shift from the classroom to remote teaching and learning has dramatically impacted educators' teaching and students' learning experiences. Because of remote communications and lack of physical human contact, the pandemic has also affected students' mental health around the globe (Chang et al., 2020; Gadi et al., 2022; Plakhotnik et al., 2021). Studies have also shown that school closures during the COVID-19 pandemic negatively affected Indigenous students' learning quality because remote learning modes challenge their oral culture, collective and social lifestyle, lower income, and inadequate infrastructure (with remote learning facilities) such as the internet connectivity in their remote communities (HRW—Human Rights Watch, 2020). Likewise, the institutional education system has encountered many challenges in adapting to pandemic-related educational paradigm changes.

Most of the instructional technologies were unavailable in most of the Indigenous communities when COVID-19 started (UN-United Nations, 2020). With inadequate technological and other infrastructures, and financial and social supports, the pandemic has had more profound impacts on the mental health of Indigenous learners in Canada due to the lack of teachers' physical presence, sense of community belonging, and social gatherings affected by the lockdown. Consequently, Indigenous students show a lack of desire to continue with their schooling due to loneliness, anxiety, and depression, which results in their decreased well-being (Indspire, 2021). In turn, such lower levels of students' mental well-being put them under more stress in their learning activities and decreased satisfaction with coursework, self-efficacy, and sense of fitting into the university (Capone et al., 2020). Moreover, Indigenous communities in Canada have long faced historical and constant colonial violence, which caused various communities, even in the same province disproportionately improvise to cope with their schooling during the COVID-19 pandemic (Galloway et al., 2020). As such, the impacts of the COVID-19 pandemic differ based on the conditions of Indigenous communities in Canada. For example, many communities face poor housing conditions, a lack of clean drinking water, and the challenge of adhering to public health guidelines which prevent people from keeping social distancing and self-isolation (Thompson et al., 2020). Moreover, Indspire (2021) points out that Indigenous post-secondary learners in many Indigenous communities in Canada encounter varying extent of essential physical challenges, such as lack of Internet access or space for their remote learning at home, all of which lead to mental and emotional negative impacts on Indigenous students during the COVID-19 pandemic. Most post-secondary students with varying conditions in Indigenous communities of Northern Manitoba attend the University College of the North (UCN), which comprises 75 percent Indigenous students (UCN Report, 2021; UCN-ARP, 2020–2025). Therefore, the negative impact of the COVID-19 pandemic on UCN students is greater than on students of other universities in Manitoba. Thus, remote learning becomes a big challenge for UCN students, particularly those who live in remote Indigenous communities. Indeed, to overcome such learning challenges, it is essential to make collaborations between educational institutions, government at various levels, private sectors, and community leaders suggested in the Quadruple/Quintuple Helix model that

offers a pedagogic innovation and rationale in higher education (Morawska-Jancelewicz, 2021). UCN's programs and curriculums have been designed to meet the local job markets and to respond to the demands of the Indigenous students and communities, which may further be improved by applying such Quadruple/Quintuple Helix model.

UCN produces knowledge graduates who promote local socioeconomic development by integrating their cultural values, reflecting students learning goals (UCN Report, 2021; UCN-ARP-Academic and Research Plan, 2020–2025). Thus, most UCN courses are designed to train students to respond to various cultures, particularly northern cultures. Such courses were delivered online in a culturally responsive pedagogy, with hands-on training and lab work conducted in person during COVID-19. Jack Mezirow's (1991) transformative learning theory helps better understand how UCN's teaching plan and methodology focus on capturing revised knowledge and leading to future action for Indigenous students. Many research and organizational reports have demonstrated the impacts of COVID-19 on post-secondary education, most of which focus on two areas: online education and mental health effects on students' learning during the school closure (Galloway et al., 2020). However, there is not enough research on the COVID-19 impacts on Indigenous post-secondary students, particularly on students living and learning in their remote Indigenous communities during the pandemic. Therefore, this study examines those students' remote learning experience during the COVID-19 pandemic and its implication in improving UCN's teaching and learning outcomes. The supposedly analyzed findings from the five themes (socio-demographic contexts; social activities, stress, and well-being; academic performance; course delivery; and student support services) would enable the scholars to suggest how UCN or other similar institutions can improve post-pandemic remote learning. This study reflects at least UCN Indigenous students' views, helping to work towards creating a conducive Mode 3 or third-generation university remote learning environment based on Mezirow's (1991) transformative learning theory and Carayannis and Campbell's (2009, 2010) Quadruple/Quintuple Helix model. By analyzing the implications of our findings in such theories as frameworks with the World Bank's (Rodriguez et al., 2020) remote learning approach as a reference, we believe that the findings can also be implemented in the global Indigenous contexts. Our first-hand data's analytical result helps readers better understand the Indigenous students' perspectives on remote learning experiences during the COVID-19 pandemic. This paper contains the theoretical foundation for analyzing the factors influencing remote learning, study results, discussion of the findings, conclusion, policy implication, and study limitations.

Previous related studies and dynamics of UCN's approach

Remote learning is a knowledge-sharing process where teaching and learning occur through instructional technology online rather than classroom face-to-face learning. Such remote learning displays two distinct features: firstly, no matter whether it is synchronous or asynchronous, remote learning helps maintain social distancing during the COVID-19 pandemic while instructors and students can carry out their teaching and learning by virtual interacting (Dong et al., 2020); secondly, the prerequisite for the effectiveness of remote learning is two folded as the effectiveness depends on both the instructor's and student's ability to use the required technology for interactions and

the readiness of suitable infrastructure, facilities, and the financial condition of the students (Rusli et al., 2020; Saleem et al., 2022). As such, Padmanabhanunni and Pretorius (2022) outline that teaching satisfaction is critically a protective factor for teachers, and improving such satisfaction may help them to promote an adaptive teaching role for remote learning. Pham et al. (2021) find that online learning outcomes are affected by students' learning characteristics, perceived usefulness, course design, course materials, ease of use, and instructors' teaching capacity. Remote learning outcomes are also influenced by the administration of online delivery from teaching institutions, including online learning infrastructure, teaching skills, academic interaction access, learning support, and learning expectations (Laksana, 2020). Thus, the administration of online course delivery has a great impact on students' perception of learning. However, the effectiveness of engaging students with remote learning also depends on their mental health condition and well-being level. As Plakhotnik et al. (2021) state, students' mental health conditions and well-being determine their engagement and performance level in curricular, co-curricular, and additional activities, inherent inspiration for learning, and completion of the course taken.

Remote teaching and learning come to most students as an academic disruption due to the COVID-19 pandemic. The disruption has increased students' anxiety, depression, drug, and alcohol consumption, and eating disorder symptoms (Kohls et al., 2020; Wang et al., 2020), which decreases their well-being. Such health outcomes are particularly eminent for students with inadequate social support (Cao et al., 2020). As such, frequent lockdown during the COVID-19 pandemic limits Indigenous students' social gathering, and the lack of teachers' physical presence and cultural activities negatively impact their mental health, thus further increasing depression, anxiety and loneliness in Canada (Indspire, 2021). Youngmann and Kushnirovich (2021) find in their research that the less powerful ethnic minorities encounter a depletion of already insufficient resources during the COVID-19 pandemic, which added more stress to their emotional well-being compared to the majority populations. Resources for remote Indigenous communities have never been sufficient, not to mention adequate infrastructure for remote learning.

Generally speaking, the readiness of Indigenous communities for suitable infrastructure, facilities, and financial support leading to successful remote learning is impaired by many barriers and challenges. Based on the research by HRW (2020) on the Indigenous communities in Canada, the USA, New Zealand, and Indonesia, the researchers believe that Indigenous communities and their learners have inadequate access to the Internet, electronic learning devices, and other connectivity issues due to their remote locations, household conditions, financial issues, and many other barriers. Likewise, Lee et al. (2021) outline that the severity and frequency of domestic violence and the school and public outdoor space closures have created barriers to maintaining physical health, negatively impacting students' learning and social development among marginalized groups, particularly Indigenous people in Canada. Such a vicious cycle leads inexorably to worsening students' learning outcomes and well-being, especially Indigenous students, who predominantly have housing issues. Moreover, historical colonial discrimination and violence against Canadian Indigenous communities impairs their educational progression, limiting their schooling capacity to deal with remote learning challenges during the COVID-19 pandemic (Galloway et al., 2020). Post-secondary

students from Northern Manitoba's Indigenous communities that predominantly lack educational facilities, resources, and support services prefer to study at UCN because UCN is a locally oriented institution with its mission to serve the northern communities in an Indigenous culturally responsive pedagogy. Therefore, remote teaching and learning are very challenging for UCN instructors and students, particularly those living in remote Indigenous communities during the COVID-19 pandemic.

As the only post-secondary institution in Northern Manitoba, long time before the pandemic, UCN had provided distance teaching via video-conferencing from its two main campuses in The Pas and Thompson to its 12 regional centers located in remote areas of Northern Manitoba. UCN provides student housing and daycare for Indigenous students who choose to study on the two main campuses. UCN offers certificate, diploma, and bachelor's programs in arts, education, business, nursing, and trades. Northern culture and Indigenous traditions, values, beliefs, and experience are integrated into UCN's programs and curriculums, reflecting Indigenous ways of knowing and learning and guiding Indigenous students to contribute to their community development (UCN Report, 2021; UCN-ARP-Academic and Research Plan, 2020–2025). Such teaching and learning result in the features of a Mode 3 or third-generation (G3) university, which transfers knowledge to social and economic developments. As Klein and Pereira (2020) and Carayannis and Campbell (2021) point out, a Model 3 university has unique programs and topics, which fit the diversity of the local socioeconomic developments and the labor market while integrating principles of knowledge creation and knowledge application. UCN provides suitable education programs to meet the demands of Northern Manitoba employment markets that reflect its students' prior experience and learning goals of acquiring culturally responsive skills and contributing to their community development. This is consistent with Jack Mezirow's (1991) transformative learning theory, which focuses on apprehending reviewed knowledge and helps learners execute future development actions. With its unique features, UCN is governed by tri-councils: the Governing Council, the Learning Council, and the Council of the Elders directly from communities (UCN Report, 2021; UCN-ARP, 2020–2025).

The negative impact on UCN Indigenous students is unimaginable: Indigenous students who moved to The Pas and Thompson for their schooling before the pandemic had to go back to their communities during the school closure; Indigenous students who preferred to stay in The Pas and Thompson had no access to their social gatherings. On UCN campuses, there are two centers for Indigenous students' gathering and socialization: the Ininiwi kiskinwamakewin Centre (the people's place of learning) on the Thompson campus and the Mamawechetotan Centre (let's all work together and help one another) on The Pas campus. The centers provide support for cultural activities which nurture their well-being; however, they were closed during the pandemic period (UCN Report, 2021; UCN-ARP, 2020–2025). This study analyzes the effects of the COVID-19 pandemic on UCN students' remote learning, including students from the two main campuses and the 12 regional centers. The study uses the World Bank's (Rodriguez et al., 2020) remote learning approach as a reference to UCN mainly because of the similar underdeveloped economic situations in most remote communities in Northern Manitoba. There can be many reasons why those remote communities are underdeveloped in a developed country such as Canada. Many Indigenous communities and businesses

cannot fully participate in the Canadian economy due to barriers such as unrecognized Indigenous jurisdiction, inadequate infrastructure, inadequate access to capital and federal procurement opportunities, and bureaucracy (RSCI-NA-Report of the Standing Committee on Indigenous and Northern Affairs, 2022). As a result, an unequal relationship exists between the Indigenous and the general population, Indigenous peoples in remote communities cannot compete in the job market due to the significant education gap between Indigenous and the general population in Canada (Nelson, 2019; Sisco & Nelson, 2008). In such a case, UCN's innovative remote teaching and learning model may reduce the education gap because it integrates Indigenous culture and community participation considering the university's community-based participatory research outcomes. As noted earlier, the argument is applicable and supported by the Quadruple/ Quintuple Helix model by Carayannis and Campbell (2009, 2010). UCN's remote teaching and learning model could generate the same features of a Mode 3 or third-generation university. Considering the remote learning environment, we compare the theme, measure, and outcome between the World Bank's approach and consider the World Bank's approach (Rodriguez et al., 2020) as a reference to the approach of the current study (see Fig. 1).

Theoretical framework

Transformative learning theory and dynamics of UCN's approach to remote learning

As long as 40 years ago, Jack Mezirow (1978) introduced the transformative learning theory: "learning is understood as the process of using a prior interpretation to construe a new or revised interpretation of the meaning of one's experience in order to guide future action" (Mezirow, 1996). Such a transformative theory offers insight into adult learning motivation and the significant changes after their completion of school education. Transformative learning theory is applicable to the dynamics of UCN's remote

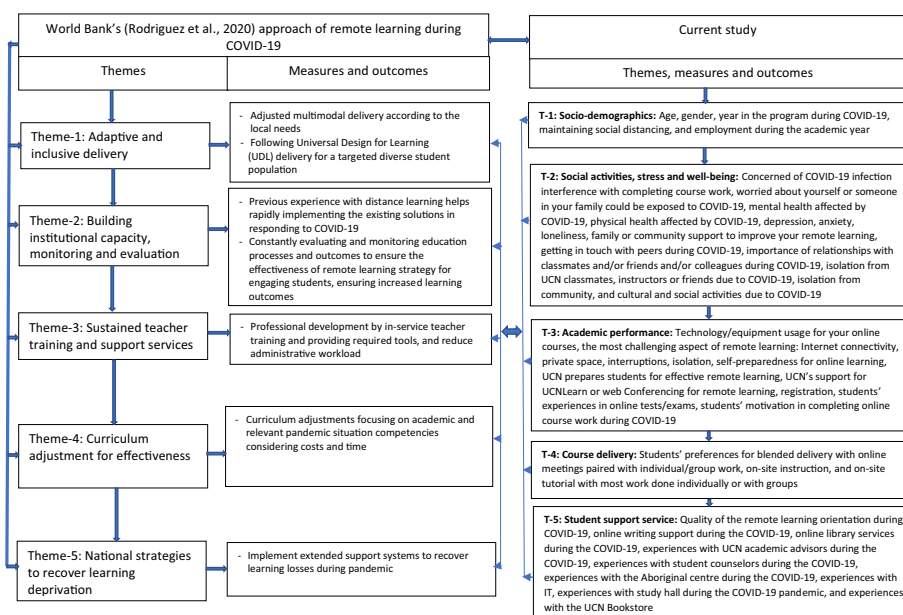


Fig. 1 The World Bank's approach of remote learning and the themes and variables of current study

learning approach with integrating Indigenous contents to teaching and learning as well as collaboration between the university and its remote learning centers in the communities because most UCN students are adult learners with motivations to transform their lives through education. They have lived on the reserves for most of their lives and raised their children by full-time working before entering university. They believe that UCN can offer them better employability skills so that they will change their own and even their children's futures. Most Indigenous students go back to work for their own communities after graduation. As such, the transformative learning theory supports the Indigenous students' learning motivation. Of course, learning about Indigenous tradition and culture, knowledge and history is part of the contents of UCN's programs and curriculums.

Integrating Indigenous knowledge into various programs and curriculums has been UCN's tradition and practice. Perso (2003) revealed that meaningful and relevant concepts relating to culture, family, relationships, land, nature, and familiar events with symbolic presentation are all conducive to Indigenous learning. Additionally, collaborative and work-based learning within an Indigenous setting develops Indigenous students' communication, problem-solving, and conflict-resolution skills (OECD-Organisation for Economic Co-operation and Development, 2019). Very recently, Moran and Moloney (2022) applied ten phases of transformative learning of Mezirow (1991) to explore how respondents' beliefs, values, views, insights, opinions, and experiences impact their achievement in learning. They found that personal circumstances and growth, qualifications, career, and confidence also have impacts on the achievement of transformative learning among mature students during COVID-19. The study by Moran and Moloney also agrees with the study by Christie et al. (2015), which outlined that belief systems and social structures influence student learning as it develops their value systems, and disorienting dilemmas often challenge the validity of one's values. Eschenbacher and Fleming (2020) explored such challenges for lifelong learning in their findings that critical reflection, disorientation, and disorienting dilemmas are the components of such learning in this COVID-19 pandemic. Oppositely, by applying transformative learning theory to his study on adult learning, Code et al. (2022) found that students' decreased communication, motivation, and engagement harshly challenge their 'making and doing' during the COVID-19 pandemic. These researchers also found that the sharp disproportion in access and equity makes students most vulnerable and at-risk, which was the most concerning issue for educators. The findings of Code et al.'s study align with HRW (2020), which states that remote learning delivery challenges Indigenous students' collective oral culture and social lifestyle, along with their lower income and inadequate infrastructure, such as the internet connectivity and free space at their homes in remote communities, negatively affecting their learning quality during the COVID-19 (HRW, 2020).

Based on the literature revealed above, the ten phases of Mezirow's (1991) learning model can confirm our concerns in this study—disorienting dilemma can shake Indigenous students' beliefs and values in their own culture, influencing their experience of remote learning during COVID-19. This study shows that Indigenous students' beliefs and values of their own culture, as well as their experience of remote learning, are in the wake of the COVID-19 crisis because they fear that COVID-19 infection might affect

their education, which fits Mezirow's model of the disorienting dilemma as a catalyst for transforming the learning process. If we follow Mezirow's self-examination phase to interpret how students overcome the challenges of their uncertain beliefs and confidence in their education, we can understand why students prefer to live with family or in relations during their remote learning as alternative ways of surviving the crisis in beliefs and values during COVID-19. Once adult learners take a critical review of their learning, they are more willing to improve their learning conditions by adapting themselves to the existing condition and continue with their remote learning, which is an alternative way of acquiring knowledge so that they can put it into practice in Indigenous contexts. As such, creating innovative remote learning tools can promote Indigenous culturally responsive knowledge acquisition. Such a proposition is supported by Cochrane and Maposa (2018), who found that addressing Indigenous students' technological issues, barriers to personal interaction and educator support, and cultural suitability would increase their successful course completion in distance education. Through the current study, we see that the provisional learners build their self-confidence and competence from the COVID-19 crisis. Students' recommendation for remote learning in the survey proves that the respondents rejuvenate themselves by offering various suggestions to improve UCN remote teaching and learning in the post-pandemic era. Such research structure is completely supported by Mezirow's transformative learning theory. Thus, this study constructs the questions with the mentioned five themes as a framework to explore the impacts of COVID-19 on UCN Indigenous students' remote learning and well-being.

Before the pandemic, UCN had already provided remote teaching via video conferencing from its two campuses in Thompson and The Pas to students in the remote communities of Northern Manitoba. Indigenous students received lectures in UCN regional centers. Instructors also visited students in the regional centers. Even after the pandemic, UCN still offers remote teaching and learning for some of the programs in certain remote communities. Mezirow's transformative learning theory is pertinent in remote learning both during and post-pandemic. Receiving post-secondary education in their home communities provides Indigenous students with a culturally safe space for learning, and they are highly motivated firstly because most students are adults from the communities, and secondly, band leaders and Elders provide guidelines and support to integrate Indigenous content into their programs and curriculums. Even during the pandemic, students from communities were able to take courses within their cultural environments through remote learning, which helped them maintain their well-being. If such remote teaching and learning could continue in the post-pandemic era, community students would be able to learn more effectively.

The Quadruple Helix model, Mode 3 university and dynamics of UCN's approach

Etzkowitz and Leydesdorff (1995, 2000) developed the Triple Helix innovation model as the interaction among university, industry and government, which is adaptive to innovation, entrepreneurship and economic growth in the k-economy. The Quadruple Helix was later associated with the Mode 3 knowledge production concept (Carayannis & Campbell, 2006). Thus, in 2009 and 2010, the Triple Helix model was conceptualized as the Quadruple and Quintuple innovation model by including civil society and

environment in which the society is influenced by media and culture (Carayannis & Campbell,). Furthermore, scholars symbolically integrate and contextualize the Triple Helix in the Quadruple Helix, and the Quadruple Helix integrates and contextualizes in the Quintuple Helix (Carayannis & Campbell, 2021). As such, Cai and Lattu (2022) outlined that the Triple Helix and Quadruple Helix models are complementary and competing concepts, but the former excludes civil society as its analytical efforts. Thus, Nordberg et al. (2020) used the Quadruple Helix instead of the Triple Helix model as a conceptual framework in their study on community-based social innovation in a rural area. Universities generally have three core functions: teaching, research, and a third mission as outreach actions and initiatives such as democracy, civic education and innovation (Campbell & Carayannis, 2013). As a result, UCN's approach of adopting the viewpoints of several government agencies, and Indigenous communities to sustainable teaching and learning aligns with the Quadruple and Quintuple Helix in the discussion.

As is known, universities strive to produce scientific knowledge. However, the way in which knowledge is produced has undergone three modes. The Mode 1 universities exhibit the traditional teaching of prevailing knowledge that derives from philosophy without precise attention to the real-world use of knowledge and innovation, Mode 2 universities aim at knowledge creation for solving problems by using research outcomes for acquiring, transmitting and integrating new knowledge (Carayannis & Campbell, 2021; Gibbons et al., 1994; Klein & Pereira, 2020). The Mode 3 university is technologically innovative, which transfers knowledge to science and acts as a hub to implement knowledge and science to entrepreneurs, businesses and industries. These universities integrate diverse ideologies of knowledge creation and knowledge application with cheering diversity (Carayannis & Campbell, 2021). Such scientific knowledge is optimally utilized when a set of guiding principles is followed and carried out by knowledgeable actors (Stier & Smit, 2021). Thus, the Mode 3 university benefits from research-based innovative knowledge networking, products and technologies while maintaining traditional university functions (Campbell & Carayannis, 2013; Skribans et al., 2013). As such, a G3 or Mode 3 university significantly relates its academic functions to social and economic development with greater involvement in society and increasingly generating social, intellectual and human capital, making it an economically self-generating institution, which is also called an entrepreneurial university (Campbell & Carayannis, 2013; Henry, 2001). However, a recent study by Abidi et al. (2021) found that the national institutional framework, continuity of interconnections with local organizations, university's supportive organizational infrastructure and accessibility of funding influence the university's entrepreneurial engagement during COVID-19. As such, UCN uses inputs and processes to assemble all of its resources, aptitudes and competencies to produce culturally respectful and responsive skilled graduates who can contribute to their communities' developmental goals. Such inputs include resources, cultures and university-community relations; and processes include blended and hybrid teaching, community-based participatory research and innovation; and the output includes producing skilled graduates with compelling research capabilities focusing on Indigenous community needs, innovations and networks. The outcomes meet the demands of Mode 3 university knowledge creation in Quadruple Helix innovation systems outlined by Carayannis and Campbell (2012). The features of UCN teaching and learning outcomes also align with the findings

of a study by Salamzadeh et al. (2011), who outline that an entrepreneurial university applies its inputs and processes to produce desired outputs to fulfill its third mission, the mission of meeting the demands of the current job markets.

Moreover, UCN's university-community based participatory research, connections and support from various government agencies and stakeholders all focus on the Indigenous community's development, which is supported by the findings of Marta et al. (2022). Their study found that research in university-industry associations and the entrepreneurial capability of a university is becoming very prevalent within the literature on entrepreneurial universities. Thus, it can be deduced that UCN's dynamic model aligns with the Mode 3 or entrepreneurial university model. As such, UCN's programs and curriculums reflect and satisfy UCN students' learning needs, in addition to Indigenous communities' social, cultural, economic, technological and innovational developmental requirements. Such multidimensional education outcomes meet with the "Mode 3 innovation ecosystem" proposed by Carayannis and Campbell (2021), who have also turned universities and commercial firms into knowledge creators and practical users.

The Canadian Association of Schools of Nursing (CASN) and the Aboriginal Nurses Association of Canada (ANAC) conceptualize cultural awareness as a reflection of differences and consider recognizing and respecting cultural differences as cultural sensitivity. Meanwhile, ANAC considers cultural awareness and sensitivity as empathy for others and their cultures (Hart-Wasekeesikaw, 2009). The US Office of Minority Health (OMH) defines cultural competence as the measurable and enforceable attitudes, behaviors and strategies in a cross-cultural workplace (OMH, 2001). Indigenous Physicians Association of Canada (IPAC) and the Royal College of Physicians and Surgeons of Canada (RCPSC) both outline that cultural safety provides Indigenous people with self-reflection competencies to develop a remedial atmosphere (IPAC-RCPSC, 2009). Reflection is a culturally safe practice for learning, development, and growth that helps professionals decolonize and move toward innovative cultural safety, enabling them to be transferable and adaptable to reflective, respectful Indigenous cultural practice (Thompson & Taylor, 2021). This agrees with Carayannis and Campbell's (2021) Quadruple Helix because it includes media and cultural influence on innovation and democracy. However, the above concepts of cultural elements suggest that Indigenous cultural awareness, competence, sensitivity and safety are mutually affected. Such a conclusion is supported by Australians Together (2023), which includes the critical interrelated features of land, family, language and law of Australian Aboriginals illustrated in Fig. 2. A framework model in Fig. 2 explains the linkages of UCN's education, Manitoba northern indigenous communities, employers, students, other related stakeholders, and Indigenous cultural elements with Mode 3 knowledge creation in Quadruple Helix innovation systems revealed earlier.

Research questions

The labor market of Northern Manitoba needs an innovative and culturally responsive workforce. Therefore, it is crucial for UCN to prepare its students with knowledge through practical curriculums and programs delivered in a student-friendly mode, which meets the regionally required skills for the mainstream Indigenous population of Northern Manitoba. With such a diverse program, UCN provides online courses with remote delivery, particularly during the COVID-19 pandemic. However, UCN students,

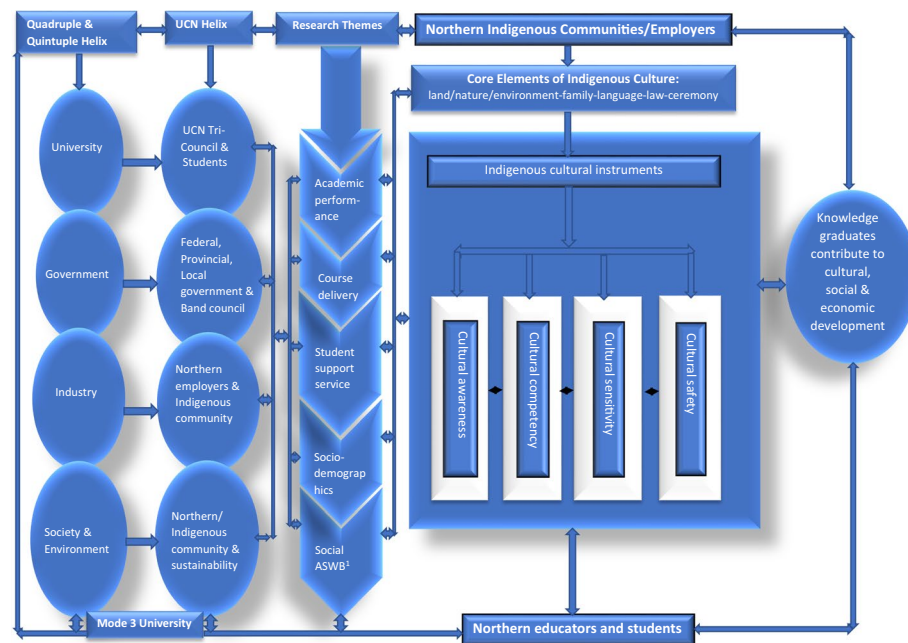


Fig. 2 Quadruple Helix and UCN Learning Approach

like Indigenous students in other universities, encounter infrastructural, technological, social, cultural and mental challenges that negatively affect their learning motivation and well-being. Thus, it is essential to understand the elements influential to UCN in making it a more innovative university. Only such an innovative university can accommodate students' learning needs in the future. Furthermore, integrating northern and Indigenous values into UCN curriculums and programs continuously improves learning outcomes. Indeed, educational and learning technology prepares UCN students with the knowledge required to meet culturally responsive socioeconomic challenges in Northern Manitoba.

The broad research questions are as follows:

- 1) What factors contribute to making UCN a more local workforce-oriented and innovative university based on its students' remote learning during the COVID-19 pandemic?
- 2) How can northern culture and Indigenous values be integrated into UCN curriculums and programs to motivate and engage UCN students in achieving learning success?
- 3) How can UCN improve its learning technology and existing programs to prepare students for future socioeconomic challenges in Northern Manitoba?

Methodology

Data

The core objective of this study is to examine UCN students' remote learning experience during the COVID-19 pandemic within the transformative learning theory frame to show the trend toward the Quadruple Helix Model for future post-secondary education.

This study applied a mixed research method comprising a quantitative study based on the obtained primary data and a qualitative study of the published research, including appropriate theories to provide an appropriate narrative to synthesize the findings of the quantitative study and interpret the findings based on both quantitative and qualitative studies. To achieve the above goal of the study, we conducted a questionnaire survey among the UCN students of its two main campuses and 12 regional centers in remote Indigenous communities to collect first-hand data. As part of UCN's research protocol, before data collection, we received approval from the Research Ethics Board (REB) of UCN. To collect data, we created a preliminary questionnaire based on our literature reviews and UCN contexts. To make the questionnaire better fit UCN students' remote learning environments, we conducted a pilot study with representatives from UCN students, teaching-support staff, faculty members, and Elders, to evaluate the preliminary questions. Based on the pilot study, we designed our questionnaire with five themes under forty close-ended questions. The five themes are socio-demographic contexts, impact on social activities, stress and well-being, impact on academic performance, course delivery, and student support service, all of which basically reflect UCN students' remote learning experience, particularly Indigenous students. Table 1 and Fig. 1 comprehensively describe the themes with their variables applied in this current study, including some previous related studies. With the UCN Seed Fund, we were able to conduct the survey. Considering the poor Internet connectivity in remote regions, we conducted the survey in two ways: mailing hard copies to regional centers and emailing the UCN student list the online access through Survey Monkey. The survey was conducted from March 1 to April 30, 2022, when the school was closed, and the community was not open to public visits yet. In the 2020–21 academic year, UCN's student structure consists of 75 percent of Indigenous, 60 percent of females, and 58 percent over the age of 30 years in credentialed programs (UCN Report, 2021). Among these students, only 133 students voluntarily completed the questionnaires that were used for analysis, and we integrate the related published research from scholarly journals and online reports of institutions and organizations into our research analysis based on the data we collected from the survey.

Method of data analysis

This study applies the descriptive study of the selected variables. The associations of each independent variable with the dependent variable were tested using the Chi-square. Variables showing significance at a 5% level were considered for the regression model. Among all the variables, 18 variables were included in the regression model. The insignificant variables were excluded (experiences with IT; maintaining social distancing; students' self-preparedness; year of the program; the importance of relationships with instructors; students' experiences in online tests/exams; isolation from UCN classmates, instructors, or friends; isolation from community, cultural and social activities; students' motivation in completing online coursework; remote learning orientation; student support service; online library services; experiences with the Aboriginal center service and experienced stress, depression, anxiety or loneliness). To perform regression analysis using the above variables, we standardize the data and create Z-variables (scores).

Table 1 Method used and findings of previous studies

Current study Authors, methods used, and findings of related published studies			
Themes	Authors and year	Methods used in published studies	Findings of the studies
T-1	<ul style="list-style-type: none"> • Amir et al. (2020) • Battisti et al. (2022) • Dong et al. (2020) • Plakhotnik et al. (2021) 	<ul style="list-style-type: none"> • Online survey data were analyzed using descriptive study, logistic regression analysis and Cronbach's alpha for reliability test • Online survey data were analyzed using Friedman's ANOVAs, Post hoc using Wilcoxon signed-rank tests and Cohens' applied to measure effect size • Online survey data were analyzed using descriptive study (mean and standard deviation) • Survey data were analyzed using descriptive study; a Chi-square test was conducted 	<ul style="list-style-type: none"> • Majorities of the students preferred blended learning with distance and face-to-face learning, and first-year students react differently than senior students • The girls perceived more stress from online lessons and use of devices than boys of special educational needs students • Parents think that virtual interaction between teachers and students, or other related parties helps maintain social distancing • University community and instructors play a significant role in building the relationship between the impact of COVID-19 and students' program completion, job prospects and well-being
T-2	<ul style="list-style-type: none"> • Plakhotnik et al. (2021) • Wang et al. (2020); Kohls et al. (2020) • Lee et al. (2021) • Leal et al. (2021) • Bashir et al. (2021) 	<ul style="list-style-type: none"> • Survey data were analyzed using descriptive study; Chi-square test was conducted • Survey data were analyzed using descriptive study (mean and SD), t-test and Pearson's correlation analysis. Data were collected from an online cross-sectional study and analyzed using ANOVA and asymptotic Kruskal–Wallis H-test • Written survey responses and interview transcripts were used to collect data and were analyzed using a double-coded phenomenological analysis • Conducted online survey and use a non-probability sampling and analyzed using descriptive statistics and inferential statistics • Data were collected by online survey with open and closed questions and analyzed the postcode data using Teaching Excellence and Student Outcomes Framework (TEF) metrics; Participation of Local Areas (POLAR) and Indices of Multiple Deprivation (IMD) 	<ul style="list-style-type: none"> • Students' mental health and well-being significantly impact their engagement in learning activities and course completion • The COVID-19 disruption significantly increased students' levels of anxiety, depression, and drug and alcohol consumption, which decreased their well-being • The frequency and severity of domestic violence due to COVID-19 closures impacted students' physical health, which negatively influenced Indigenous and other marginalized students in Canada • The COVID-19 pandemic reduces social interaction and communication, inversely affecting students' learning and university staff • A hybrid delivery that students' learning from home, and lockdown affect their mental well-being and quality of life

Table 1 (continued)

Current study			
Authors, methods used, and findings of related published studies			
Themes	Authors and year	Methods used in published studies	Findings of the studies
T-3	<ul style="list-style-type: none"> • Saleem et al. (2022) • Rusli et al. (2020) • Youngmann and Kushnirovich (2021) • Indspire (2021) 	<ul style="list-style-type: none"> • Data were analyzed using PROCESS Macro and Stepwise linear regression • Online survey data were analyzed using descriptive statistics • The national representative survey data were analyzed through confirmatory factor analysis (CFA) and root-mean-square error of approximation (RMSEA) • Survey was analyzed using descriptive study (mean and standard deviation) 	<ul style="list-style-type: none"> • Motivational factors, instructors' support, and university support predict the quality of online learning • Students use desktop PC, laptops, smartphones and a combination of smartphones and laptops with the internet • The ethnic minorities' insufficient resources during COVID-19 give a higher level of stress, affecting their emotional well-being than the majority populations • Indigenous post-secondary students' infrastructural challenges, including Internet access or space, lead to their mental and emotional negatively impacting their learning during the COVID-19 pandemic
T-4	<ul style="list-style-type: none"> • Pham et al. (2021) • Baxter and Hainey (2023) 	<ul style="list-style-type: none"> • The survey was conducted in the convenience sampling method; Cronbach's Alpha was used for the reliability test, and the Bayesian Exploratory Factor Analysis (BEFA) was performed • A case study methodology was adopted in this study 	<ul style="list-style-type: none"> • The learner characteristics, perceived usefulness, course design, course materials, ease of use, and instructors' teaching capacity affect online learning outcomes • University students view remote learning as beneficial for instant feedback and fostering a community learning practice but prefer face-to-face learning
T-5	<ul style="list-style-type: none"> • Laksana's (2020) • Plakhotnik et al. (2021) • Zhao et al. (2022) 	<ul style="list-style-type: none"> • Survey data were analyzed using descriptive statistics • Online survey data were analyzed using descriptive analysis and Chi-square test • The survey data were analyzed through confirmatory factor analysis (CFA) and structural equation modeling (SEM) 	<ul style="list-style-type: none"> • The administration of online delivery, including online learning infrastructure, teaching skills, academic interaction, learning support and learning expectations affect online delivery in minimal internet access areas • The university community and instructors play a role in building the relationship between the impact of COVID-19 on students' degree completion and well-being • A positive correlation between university students' learning satisfaction and students' support services such as management, cognitive, and emotional support during COVID-19

A stepwise multivariate regression analysis was conducted to measure the impact of covariates on the outcome variable. In this model, we included those variables that showed significant association in the Chi-square test as noted earlier. Concurrently the significant variables were included in the final stepwise multivariate regression model

which is: ‘worries about yourself or someone in your family who could be exposed to COVID-19’, ‘mental health affected by COVID-19’, and ‘blended delivery with online meetings paired with individual or group work’ as independent variables, and concerns of COVID-19 infection interference with completing course work’ as a dependent variable. The study measures the following model:

$$S_{\text{concern}} = \alpha + B_1vth_1 + B_2vth_2 + B_3vth_3 + B_4vth_4 + B_5vth_5 + B_nvth_n + \varepsilon, \quad (1)$$

where S_{concern} = students’ concerns about COVID-19 might decrease their ability to complete their coursework. α = constant. $B_1 \dots B_n$ = estimated regression coefficients. $vth_1 \dots vth_n$ = variables between theme 1 and n. ε = error term.

A reliability test is executed to assess the reliability of the collected data, and the result shows that the data are reliable, which is evident from the value of Cronbach’s Alpha 0.71. This study uses adjusted R^2 as the goodness of model fit. The Statistical Package for Social Sciences (SPSS) is used for analysis.

Results

Descriptive analysis

For descriptive analysis, refer to the section: socio-demographic contexts; social activities, stress, and well-being; academic performance; course delivery; and student support services.

Socio-demographic contexts

The description of the socio-demographic context demonstrated in Table 2 shows that 69.9 percent of the respondents are above 25 years old and are considered adult learners, which satisfies the transformation learning theory’s focus on reflective learning of new knowledge using experience. Table 2 also shows that our respondents represent as high as 75.2 percent of female students. 63.9 percent of our respondents always or most of the time maintain social distancing, indicating that UCN should accommodate students in keeping social distancing during their sickness in remote or any other mode of delivery to create a feasible environment to balance emotional and educational well-being.

Social activities, stress, and well-being

A list of 12 variables is included under the theme of social activities, stress, and well-being can be seen in Tables 2 and 3. Table 2 shows that 50.4 percent of respondents received great family support, showing the importance of their family connection during a pandemic or any other crisis situation. Table 2 also depicts that 19.4 percent of respondents received internet access from their community, indicating that poor internet connectivity is provided by the community. Previous studies revealed that concern about COVID-19 infection with course completion, mental health, physical health, depression, isolation from UCN classmates, instructors, or friends, and isolation from community and socio-cultural activities might have impacts on students’ remote learning outcomes and well-being. Therefore, these variables were included in the questionnaire and the participants were asked to express the extent of their agreement with each of the factors. The analysis of their answers is depicted in Table 3. It is seen from Table 3 that

Table 2 Descriptive analysis

Socio-demographic contexts				
Variable	Scales	Frequency	Percent	Cumulative percent
Age	18–24	38	28.6	28.6
	25–34	50	37.6	66.2
	35–44	27	20.3	86.5
	45–54	11	8.3	94.7
	55 +	5	3.8	98.5
	Prefer not to answer	2	1.5	100.0
Gender	Female	100	75.2	75.2
	Male	31	23.3	98.5
	Transgender	x	x	x
	Gender variant/Non-conforming	1	0.8	99.3
	Not listed	x	x	x
	Prefer not to answer	1	0.8	100.0
Year in the program during COVID-19	Year 1	48	36.1	36.1
	Year 2	27	20.3	56.5
	Year 3	9	6.8	63.2
	Year 4	7	5.3	68.4
	Not applicable	42	31.6	100.0
	At all times	66	49.6	49.6
Maintaining social distancing	Most of the time times	19	14.3	63.9
	Never	x	x	x
	I was not onsite	48	36.1	100.0
	Employed full-time	37	28.0	28.0
Employment during the academic year	Employed part-time	26	19.7	47.7
	Full-time student	67	50.8	98.5
	Part-time student	2	1.5	100.0
Social activities, stress, and well-being				
Family or community support to improve your remote learning	Greater family support	65	50.4	50.4
	Greater accessibility from home community	8	6.2	56.6
	Internet accessibility from within the community	25	19.4	76.0
	Emotional/social support from my home community	6	4.7	80.6
	No support	25	19.4	100.0
Getting in touch with peers	On a regular basis, like pre-pandemic	11	8.5	8.5
	Occasionally	53	40.8	49.2
	Rarely	46	35.4	84.6
	Never	20	15.4	100.0
Academic performance				
Technology/equipment used for your online courses	Tablet	2	1.6	1.6
	Laptop or Computer	124	96.9	98.4
	Smart Phone	2	1.6	100.0
The most challenging aspect of remote learning	Internet connectivity	57	46.0	46.0
	Private Space	17	13.7	59.7
	Interruptions	27	21.8	81.5
	Isolation	23	18.5	100.0

Table 2 (continued)

Social activities, stress, and well-being				
UCN's support for remote teaching	Live chat support	29	22.5	22.5
	Phone live support	33	25.6	48.1
	Messenger support	16	12.4	60.5
	Nonapplicable	51	39.5	100.0
Web Conferencing as a UCNLearn platform	Small group tutorials	45	34.9	34.9
	Individual tutorials	16	12.4	47.3
	Live chat support	20	15.5	62.8
	Nonapplicable	48	37.2	100.0
Registration	Live chat support	28	21.7	21.7
	Phone live support	33	25.6	47.3
	Messenger support	25	19.4	66.7
	Nonapplicable	43	33.3	100.0
Students' experiences in online tests/exams	Online tests were easier than paper-based	36	27.9	27.9
	Online tests were the same as paper-based	52	40.3	68.2
	Online tests were harder than paper-based	33	25.6	93.8
	Does not apply—I didn't write online tests	8	6.2	100.0
Course delivery				
Blended delivery with online meetings individual and/or collectively	Most preferred	47	37.0	37.0
	Least preferred	30	23.6	60.0
	Existing hours preferred	17	13.4	74.0
	No idea	33	26.0	100.0
On-site instruction	Most preferred	58	46.0	46.0
	Least preferred	30	23.8	69.8
	Existing hours preferred	7	5.6	75.4
	No idea	31	24.6	100.0
On-site tutorial with most work done individually or with groups	Most preferred	49	38.6	38.6
	Least preferred	30	23.6	62.2
	Existing hours preferred	11	8.7	70.9
	No idea	37	29.1	100.0
Student support service				
Students' recommendations to UCN regarding online courses	Better orientation to remote learning	11	9.1	9.1
	Instructor training with online technologies	17	14.0	23.1
	Dedicated support for online learners (e.g.: online enrollment, withdrawal, extension, probation)	29	24.0	47.1
	UCN organization of online program/course offerings	64	52.9	100.0

x = no response in our sample in Table 2

UCN students' remote learning outcomes seem to encounter all these factors, which can be clearly noticed from the reported mean values where most of the participants either very or greatly, moderately, and somewhat agreed with each of these variables. Thus, the current research outcomes suggest that remote learning activities should be created in a way in which students are encouraged to engage with their families, classmates, friends,

Table 3 Descriptive analysis

Statistics/variables	n	\bar{x}	S.E. of \bar{x}	Std. Dev	Sks	Kus	Min	Max
Impact on social activities, stress, and well-being								
Concerned about COVID-19 infection interference with completing coursework	130	2.05	0.088	1.006	0.586	-0.755	1	4
Worried about yourself or someone in your family who could be exposed to COVID-19	130	1.72	0.837	0.982	0.212	0.224	1	4
Mental health affected	130	2.02	0.090	1.030	0.515	-1.010	1	4
Physical health affected	130	2.44	0.095	1.086	0.087	-1.269	1	4
Depression	130	2.06	0.077	0.878	0.297	-0.840	1	4
Anxiety	130	1.83	0.072	0.818	0.496	-0.849	1	4
Loneliness	130	1.92	0.071	0.813	0.319	-0.957	1	4
Importance of relationships with classmates and/or friends and/or colleagues	130	1.85	0.074	0.846	0.988	0.670	1	4
Isolation from UCN classmates, instructors, or friends	130	2.32	0.088	1.006	0.335	-0.934	1	4
Isolation from community, cultural and social activities	130	2.41	0.090	1.024	0.122	-1.100	1	4
Impact on academic performance								
Self-preparedness for online learning	128	2.53	0.088	0.996	-0.161	-1.016	1	4
UCN prepares students for effective remote learning	128	2.48	0.078	0.887	-0.066	-0.710	1	4
Students' motivation in completing online coursework	129	2.02	0.070	0.795	-0.042	-1.413	1	3
Student support service								
Remote learning orientation	124	2.97	0.136	1.519	0.239	-1.467	1	5
Online Writing Support	126	3.69	0.061	0.687	-2.525	6.273	1	4
Online Library Services	125	2.54	0.085	0.955	0.093	-0.932	1	4
Academic Advising Service	126	2.30	0.096	1.083	0.371	-1.125	1	4
Experiences with student counselors	126	3.17	0.101	1.139	-0.845	-0.961	1	4
Experiences with the Aboriginal Centre Service	126	3.37	0.097	1.094	-1.348	0.116	1	4
Experiences with IT	126	3.07	0.106	1.195	-0.712	-1.193	1	4
Experiences with virtual study hall	126	3.25	0.074	0.836	-0.993	0.449	1	4
Experiences with the UCN Bookstore	126	2.20	0.107	1.200	0.512	-1.294	1	4
Experiences with Tutor.com	126	3.76	0.062	0.698	-2.939	7.618	1	4

\bar{x} = mean; S.E of \bar{x} = standard error of mean; Std Dev = standard deviation; Sks. = skewness; Kus. = kurtosis

and instructors together with community connection. UCN also should collaborate with communities to improve internet connectivity for its students.

Academic performance

A group of nine variables under the academic performance theme can be seen in Tables 2 and 3, which were presented to the UCN participants in the questionnaire survey. As Table 2 shows, 96.9 percent of respondents use laptops or computers, 46 percent encounter connectivity issues, 13.7 percent face private space problems, and 18.5 percent have isolation challenges. Table 2 also indicates that 22.5 percent and 25.6 percent prefer live chat and phone chat support for registration and remote learning, respectively. Moreover, Table 2 reveals that 27.9 percent of respondents consider online tests easier and 25.6 percent find it harder than paper-based tests.

Table 3 depicts that students' remote learning outcomes have been determined by their self-preparedness and motivation plus UCN's remote learning support. The mean values in Table 3 report the participants' agreement with each of these variables in various degrees: strongly, moderate, and somewhat.

Under the academic performance theme, both tables suggest that UCN needs to work with the communities to create a better learning environment by providing students with ample physical space, remote learning tools, and infrastructure such as internet connectivity. It also suggests that UCN motivates students by setting realistic goals to attain academic success. Such goals can be achieved by creating user-friendly and appealing learning activities through the UCN digital platform and 24/7 access to online services.

Course delivery

The delivery mode and learning instruction influence students' remote learning outcomes and well-being. In order to receive respondents' preferences for course delivery, three variables were included in the course delivery theme: blended delivery (online meetings individual or collectively), on-site (face-to-face) instruction, and on-site tutoring.

Table 2 shows that 37 percent of respondents prefer a blended delivery mode of learning, 46 percent prefer on-site instructions, and 38.6 percent prefer on-site tutoring. Under the course delivery theme, the current study suggests that UCN should continue with its blended course delivery, which includes both remote and face-to-face learning modes. Such practices become helpful during any health hazards or potential post-pandemic remote learning. UCN also needs to encourage students to achieve their academic goals by completing projects or lab work either in a group or individually.

Student support services

A list of 11 variables is included under the students' support services theme (Tables 2 and 3). Such variables include remote learning orientation, online writing support, online library, academic advising service, student counselling, Aboriginal center, IT, virtual study hall, UCN bookstore, tutor.com, and students' recommendations, which might have impacts on students' remote learning outcomes and well-being, which is revealed in previous studies. Therefore, these variables were included in the questionnaire and the participants were asked to give the extent of their agreement with each of the variables. The analysis of their answers is depicted in Table 3. It is observed from Table 3 that UCN students' remote learning outcomes seem to have impacts from all these variables. This can be noticed from the presented mean values where most of the participants agreed on excellent or very, good, and adequate with these variables. Table 2 shows that the highest percentage (52.9) of respondents recommend the need for improvement of the organization of online learning with enhanced instructors' training (14%) and dedicated service for online learning (24%). Thus, the results of this current study indicate that UCN's comprehensive support services in which students express their satisfaction should continuously be maintained and upgraded. Such support services include academic, admission, registration, IT, and other online services including different kinds of advising, counselling, and Aboriginal cultural services. Students' engagement with Tutoring.com suggests that 24/7 online tutoring is necessary for students' remote learning; the service

management should meet students' needs; academic and emotional support for students is of great help for students to complete online education successfully.

Regression analysis

The stepwise regression result is shown in Table 4. This table only shows the results of significant covariates. It shows that students' worries about themselves or someone in their families who could be exposed to COVID-19 significantly and positively influence their concern about COVID-19 infection interference with completing their course work ($p \leq 0.003$). The result shows that a 1 unit increase in the standard deviation of students' worry about COVID-19 exposure increases the standard deviation of their concern of COVID-19 infection interference with completing their course work by 0.483 unit. This result indicates that minimizing the causes of students' worry about exposure to COVID-19 will reduce their concern about course completion.

The results in Table 4 also show that mental health affected by COVID-19 has a significant impact on UCN students' concern about course completion during COVID-19 ($p = 0.014$). This variable predicts that a 1 unit increase in the standard deviation of mental health conditions gives a 0.314 unit increase in the standard deviation of students' concern about course completion. This result indicates that mental health is another cause for students' concern about COVID-19 infection interference with completing coursework.

Table 4 also shows that blended course delivery with online meetings paired with individuals or groups helps reduce students' concern about COVID-19 infection interference with completing coursework ($p = 0.042$). This variable predicts that a 1-unit increase in the standard deviation of blended course delivery might increase the standard deviation of students' concern about course completion by a 0.304-unit increase. This informs us that students need communication with the instructor and their peers individually or in a group for their well-being and better learning outcomes. However, if they meet in person, the risk of receiving COVID-19 infection will be increased. Thus, the blended delivery must be conducted online for course delivery and student meetings.

The regression results imply that the improvements in variables such as "students' worry about themselves or someone in their family could be exposed to COVID-19", "mental health affected by COVID-19", and "blended delivery with online meetings paired with individual or group work" will enable UCN to create effective and culturally responsive learning. In turn, such teaching and learning help students to reduce their concern about course completion, enhancing their remote learning outcomes and

Table 4 Regression analysis

Variables	B	t-value	P-value
Worried about yourself or someone in your family being exposed to COVID-19	0.483	3.170	0.003
Mental health affected by COVID-19	0.314	2.037	0.014
Blended delivery with online meetings of individuals or in groups	0.304	2.121	0.042
Adjusted R^2			0.350

*Dependent variable: concerned of COVID-19 infection interference with completing coursework

well-being during COVID-19 or even post-pandemic remote learning. Thus, it can be concluded that considering the above variables in designing post-pandemic remote teaching and learning will improve UCN students' remote learning experiences and eventually improve their well-being.

Discussion

As the result of the current study indicates, most UCN students are Indigenous adult learners, and UCN provides post-secondary education with its programs and curriculums that integrate Indigenous tradition and culture with their community connections, which Quadruple Helix model supports as it indicates that culture and media influence university, industry and overall society (Carayannis & Campbell,). Such teaching and learning provide students with practice-based reflective learning that updates their existing knowledge, motivating them to be employed in their communities and contribute to their family and community well-being (UCN-ARP, 2020–2025), which align with the “Mode 3 eco-innovation systems” that emphasize the knowledge creation and diffusion for real-world application (Carayannis & Campbell, 2021). This supports transformation learning theory's focal point of reflecting learning on revised knowledge using learners' points of view. UCN's higher percentage (69.9%) of adult students who prefer experience-oriented reflective learning and a high percentage (75.2%) of female students can be single mothers. Both these adult male and female students with a majority (56.1%) of them being first and second-year students who may have family responsibilities. Therefore, to improve its students' learning outcomes, UCN needs to be flexible with remote course delivery modes and face-to-face teaching with student-friendly educational technologies and support services, which is supported by Abidi et al. (2021), who outline the university's supportive infrastructure, local community connections and others play important roles of creating such supportive third-generation (Mode 3) university learning environment during COVID-19. To meet the requirements of creating such supportive infrastructure and enabling environment for online learning in remote indigenous communities, the Quadruple Helix model is better suitable as it includes government, university, the private sector and the wider community (Carayannis et al., 2012). UCN also needs to accommodate students who are unable to attend lectures on campus because of full-time employment, sickness, severe weather conditions, or lack of babysitters, etc. Such adjustments and flexibilities will help students complete their education while creating a work–life balance to improve their mental health and well-being. This learning flexibility is in line with the World Bank's adoptive and inclusive course delivery approach to remote learning during COVID-19, which meets the needs of students in different locations (Rodriguez et al., 2020). The findings of Ghaleb et al. (2021) and Amir et al. (2020) support our suggestions based on the result of the study as the former study finds that demographic factors significantly affect students' academic performance in distance learning, and the latter observes different impacts of COVID-19 on distance learning between first-year and senior students. Szemik et al. (2022) remark that an abrupt change to remote learning impacts the quality of life and learning experience of first-year students. Generally speaking, the lack of social and cultural activities due to COVID-19 closures and more stress affects students' mental health and well-being. As such, Bennett et al. (2020) concluded that active online learning creates

cultural isolation during the pandemic due to inequitable access to infrastructure in Australian Indigenous students. The current study further confirms that students' concerns about COVID-19 infection and their health affect their remote learning outcomes. Their concerns include both COVID-19 infection and its related issues such as mental health, physical health, depression, family or community support, getting in touch with peers, and isolation. Such a phenomenon aligns with disorienting dilemmas as it hinders Indigenous students' cultural practices, challenging their beliefs and value systems and learning using their viewpoints, which is in line with Christie et al. (2015). As a result, remote learning during the pandemic significantly affects students' educational experiences, well-being, mental health, and financial aspects (Houlden & Veletsianos, 2022). Furthermore, the above concerns can further be improved by integrating Quadruple Helix Model elements such as partners, co-creators, and other stakeholders, facilitating design innovation toward co-creating new value in online marketing pedagogies and curriculum design, adding values in higher education during the COVID-19 pandemic (Bustard et al., 2022). Thus, it is essential for UCN to create virtual interactions between its students with their Indigenous communities and virtual Indigenous cultural activities while offering remote teaching. Such virtual community interactions during COVID-19 can further be improved by applying the Quadruple Helix model as Zhu and Park (2021) did in their studies. Their applications can be used to conduct adequate research about web-based information sharing during COVID-19 (Zhu & Park, 2021). In return, interaction with their communities and virtual cultural activities help improve students' mental and physical health, and well-being, which enhances their learning outcomes. Such interactions align with studies by James (2022), who considers entrepreneurial universities' mission as technology and knowledge transfer with resilience and progression in university–community connections supportive of health and well-being during the COVID-19 pandemic. UCN has the opportunity to organize such socializing activities by inviting Elders as guest speakers through its Elders council and inviting knowledge keepers through regional centers to help Indigenous students overcome the isolation barriers (UCN Report, 2021; UCN-ARP, 2020–2025). Furthermore, Elders and knowledge keepers from local communities would help to create talking circles with peers, classmates, and instructors, and a friendly and healthy remote learning environment. As such, Sacher et al. (2014) observe that thoughtful and deliberate integration of local mentors and learning centers with online teaching, and synchronous tutorials using a web-based learning management system and conferencing is the key to engaging Indigenous students' learning to achieve academic success. Although technology platforms such as Microsoft Teams and Zoom allow human connection virtually, they cannot produce the same effect as actual Indigenous ceremonies (Auger & Baker, 2021). However, the integration of the above-mentioned learning contexts and cultural activities aligns with the World Bank's adjusted curriculum in the COVID-19 pandemic situation (Rodriguez et al., 2020).

It is reported that many vulnerable children and youths in Canada have faced detachment and class attendance problems during the pandemic, which decreased their educational attainment and academic achievement (Whitley et al., 2021). Thus, the COVID-19 pandemic has affected students' academic performance to varying extents (Mahdy, 2020). The current study has found that UCN students are facing challenges in internet

connectivity, private space, and interruptions, all of which may have impacts on their' remote learning outcomes during COVID-19. To overcome such complex challenges, it is essential for UCN to involve the actors of the Quadruple Helix Model such as educational organizations, government, companies, non-profit organizations and communities. Such involvement is also applicable to other institutions with similar attributes. This argument is supported by Bustard et al. (2022), who found that such collaborative efforts create new value in digital pedagogies. Students' remote learning outcomes are relatively affected by the various university support services for remote learning, students' experience in online exams or tests, and their self-motivation in remote learning. Therefore, to improve students' remote learning outcomes, UCN should also provide comprehensive support services to prepare Indigenous students for remote learning together with appropriate learning assessment tools to ensure their remote learning quality that provides an opportunity to self-assess their revised knowledge, building their competence and self-confidence, which are phases of transformative learning theory. Although UCN provides all the required technology devices and high-speed internet on campus (UCN Report, 2021), the technology and Internet connectivity in its 12 regional centers need improving especially in some of the far more remote Indigenous communities. However, before designing fully online-delivered courses, UCN should evaluate students' availability of workable technology devices, required connectivity, and free space for remote learning in their communities. A World Bank study by Rodriguez et al. (2020) supports this argument as they have outlined that it is important to evaluate internet connectivity, prior experience in remote learning systems, instructor capacity, and contents with contextual factors in designing and deploying remote learning programs. Such a remote teaching delivery focuses on Indigenous students' individualized needs and provides indispensable remote learning services (Auger & Baker, 2021). The current study also indicates that students' recommendations such as more intensive orientation, instructor training, and dedicated support for online learners reflect students' provisional learning from the COVID-19 pandemic experience, and implementing such recommendations creates a student-friendly learning environment, motivating students to engage in learning. Thus, UCN needs students' recommendations for their remote learning.

The key to Indigenous students' remote learning success is feasible remote teaching and learning plans that fit remote learning settings with adequate facilities in the regional centers and mentors with synchronous lessons using conferencing and software applications in learning management (Sacher et al., 2014), which is considered as blended teaching delivery. The current study indicates that blended delivery with online meetings either individually or in groups strongly affects students' remote learning experience. The study results also show that students prefer on-site instructions with individual or group on-site tutorials. The reason for emphasizing such blended delivery with on-site lab and hands-on training instructions and tutorials is that students in their communities usually use the regional centers' facilities for their study if they do not have learning space or Internet connectivity at home (UCN Report, 2021; UCN-ARP, 2020–2025). Therefore, UCN needs to upgrade its blended remote teaching delivery that fits each regional center's scenarios. On top of that, the remote teaching and learning plan must involve local community participation to enhance the Indigenous students' motivations so that they can carry on academic learning while enjoying their

traditions and culture during any pandemic situation or post-pandemic remote delivery. The aforesaid UCN students preferred blended delivery with online meetings and on-site tutorials while integrating Indigenous communities and culture also helped overcome family disconnections and cultural strains created by solely online delivery. Such a community-inclusive blended program delivery is further improved by innovative technology integration, knowledge production, and application through community-based participatory research and innovation outlined in the Quadruple Helix Model (Carayannis & Campbell, 2021). Sianturi et al. (2022) have found that technology integration helps increase Indigenous parental engagement in their children's learning because they observe them receiving remote learning at home, but it can also intensify the relationship between parents and their children as either parents or their children are distracted by the technology. Thus, it creates a family divide, which creates barriers or cultural strains within families in Canada, the USA, Australia, New Zealand, Mexico, Namibia, Indonesia, Ecuador, Malaysia, and Taiwan (Sianturi et al., 2022). Their study also suggests a culturally embedded and responsively adopted technology in program delivery creates a sustained partnership with Indigenous parents and communities. Thus, it can be argued that the outcomes of this current study will help upgrade the remote delivery of UCN programs and educational institutions with similar attributes globally.

Simultaneously, the remote teaching and learning plan will increase UCN's capacity to adopt effective solutions as a response to COVID-19 or any other emergent situation. Snow (2020) supports UCN's blended remote delivery by observing that such a learning model focuses on Indigenous students' academic study accompanied by their traditions and culture. Integration of such traditions and culture in academic study creates Indigenous ways of learning and knowledge transformation (Perso, 2003) for their community's well-being aligns with the transformative learning theory that focuses on learning by using one's experience to guide future action (Mezirow, 1996). Moreover, a World Bank study by Rodriguez et al. (2020) also supports such a blended learning model, stating educational policymakers have to prioritize non-academic aptitudes to support students in coping with challenging circumstances due to the COVID-19 pandemic. As part of developing such non-academic aptitudes, educational institutions focusing on developing features of a Mode 3 or third-generation university can play crucial roles in producing innovative culturally responsive remote learning tools individually or collaboratively in the global arena.

Conclusion and policy implications

In this study, UCN students offer fair estimations on 40 variables under five themes, including socio-demographic contexts; social activities, stress, and well-being; academic performance; course delivery and student support services; most of which have an impact on UCN students' remote learning success and well-being based on the results of the descriptive analysis. Under the demographic theme, variables such as age show a high percentage of UCN students are adults who are studying first and second-year levels of whom the majority are female. A high percentage of students maintain social distancing during COVID-19. Under the theme of social activities, stress, and well-being, students' remote learning outcomes and well-being are determined by variables such as concern about COVID-19 infection with course completion, mental and physical health,

depression, family or community support for remote learning, social contact, isolation from the community, and lack of cultural and social activities. In terms of the theme of academic performance, the discussion focuses on the variables that affect students' remote learning experience rather than their academic achievements, and variables of such are their access to and efficient use of technology or equipment such as a tablet, laptop or computer, smartphone, etc., physical barriers that challenge remote learning including internet connectivity, private space, interruptions, isolations, etc., students' self-preparedness and UCNLearn as platforms for remote learning, web conferencing, online registration, online exams or tests, and the last but the most important variable—students' motivation in remote learning, all of which determine student's academic performance in remote learning. Variables under the course delivery theme are blended delivery with individual or collective online meetings, on-site instructions, and on-site tutorials with most work done individually or in groups, all of which also determine students' remote learning success. The theme of student support services includes variables such as remote learning orientation, online writing support, online library, academic advising, student counselling, Aboriginal center, IT, virtual study hall, campus bookstore, tutor.com, and recommendations by students for their remote learning have impacts on remote learning outcomes and well-being. Students express their satisfaction with UCN's various support services and expect continuous improvement.

Furthermore, the stepwise regression analysis shows that the students' worry about themselves or someone in their families who could be exposed to COVID-19, their mental health, and the blended course delivery with online meetings paired with individual or group positively affects students' concern about COVID-19 infection interference with completing the course. Therefore, reducing students' worry about themselves or someone in their family who might suffer from COVID-19 infection is one way to improve their mental health conditions. Also, well-documented course lectures through blended course delivery also reduce students' concern about COVID-19 infection interference with completing the courses successfully, thus improving their well-being. Some of the potential strategies or feasible policies to upgrade the existing remote teaching delivery for any emergency crisis or post-COVID-19 pandemic teaching are as follows:

- To meet the various needs of students: courses or programs offered by remote teaching should be decided on the levels of courses: while first-year courses are offered in classrooms on campus, courses for advanced levels are offered online. While classroom teaching is conducted on campus for full-time students or part-time working students, the same courses should be available for remote learning as well for full-time working students. Both classroom teaching and remote learning should be flexible to accommodate students with special absent reasons such as sick leaves, taking care of family members and unexpected situations. Flexibility in course delivery will create a balance of emotional and educational well-being to promote a successful remote learning experience.
- To integrate Indigenous knowledge, culture, and traditions with remote learning: as part of such initiatives, careful evaluations are needed to decide whether some courses or programs need to invite Elders and knowledge keepers as guest speakers who guide Indigenous students to overcome remote learning barriers and create cul-

turally safe talking and communication between peers, classmates, and instructors, thus improving Indigenous students' mental and physical health, and well-being during their remote learning.

- To provide more technical support services while improving the existent service quality: preparing students, teaching, and support staff for the Indigenous community-oriented remote learning environment by offering training on the efficient use of laptops, computers, smartphones, etc., UCN should upgrade its teaching platforms such as UCNLearn, video-conferencing or Zoom and other teaching apps to provide a constantly stable condition for remote teaching and learning, indicating UCN's efforts towards developing features of a Mode 3 or third-generation university.
- To collaborate with communities in building the infrastructure for remote teaching and learning: Internet connectivity and limited housing space are the key barriers for Indigenous students in remote communities. UCN should maximize the benefits of its 12 regional centers by improving Internet connectivity and offering study space for local students.
- To upgrade the existing blended remote delivery mode: the existing remote course delivery is Zoom lectures blended with online meetings individually or in groups, on-site instructions, and off-site individual or group tutorials. To upgrade the existing blended remote delivery mode, UCN should build effective blended learning programs synchronously/asynchronously or both based on the instructors' capacity, learning contents, and students' needs. It is also conducive to offering remote teaching based on each regional center's circumstances.
- To maintain and upgrade all existing student support services to create a personalized learning environment: UCN needs to develop effective solutions to any unexpected interruptions of education. Integrating local community participation in traditional and cultural activities enhances UCN students' motivations and helps to build culturally responsive and constructive associations among Indigenous and non-Indigenous students, peers, and instructors in remote teaching and learning environments. This can further be improved by involving the actors of the Quadruple Helix Model.

Finally, along with the previous literature, the findings of the current study and transformative learning theory and Quadruple Helix Model are applicable to educational institutions populated with Indigenous students globally.

Limitations and further research potential

This research aims at UCN students with themes, and variables designed to fit UCN contexts. It would be significant to do collaborative research on remote learning in Indigenous contexts of other areas. To upgrade the existing blended remote delivery mode, a future study to evaluate each regional center's circumstances will be conducive to offering potential post-pandemic remote teaching and learning plans or modes in UCN. Furthermore, a future study should include specific factors such as year in the program, connectivity, space availability, etc., that may influence students' remote learning outcomes and well-being for different programs such as arts, business, education, healthcare, nursing, science, or trades to meet the needs of the local communities. Some

courses in some programs such as nursing have hands-on training that encounters different challenges, but this current study does not consider it. A further study should also consider the suitability of digital interactive remote learning tools or products produced by academic and non-academic firms for Indigenous students' success. Though we have considered 40 covariates, we have only 133 samples. The ideal procedure is to take 10 samples for each variable which implies that a minimum of 400 samples are needed. This is also a limitation of this paper.

Notes

1. When the COVID-19 crisis started, all students (students on campuses and students in remote communities) had to receive lectures at home and online teaching was mostly conducted through Zoom together with UCNLearn (D2L) as a communication platform between instructors and students. Even after UCN students returned to campus and their regional centers for face-to-face learning, UCN still takes public health into consideration and implements the "Circuit Breaker" (2 weeks of remote teaching and learning at the beginning of the fall term of 2022 and the winter term of 2023, and after Thanksgiving). Faculties and programs have their own alternative arrangements for the "Circuit Breaker" such as nursing students and students in their teaching practicum would follow their own plans. Thus, remote teaching and learning in UCN contexts indicate both the teaching modes and locations.
2. The paper prefers to use "Indigenous" as a collective term to embrace indigenous groups worldwide. The Canadian constitution recognizes three groups of Aboriginal peoples: Indians (more commonly known as First Nations), Inuit, and Metis. The term, "Aboriginal" was introduced to the 1982 constitutions. In 2016, the Congress of Aboriginal People changed its name to Indigenous. However, we also use terms such as "Aboriginal", "Indian", "Inuit", "Maori", etc., to refer to Indigenous people related to their locations or to respect scholars.

Abbreviations

UCN	University College of the North
HRW	Human Rights Watch
UN	United Nations
UCN-ARP	UCN-Academic and Research Plan
RSCI-NA	Report of the Standing Committee on Indigenous and Northern Affairs
OECD	Organisation for Economic Co-operation and Development
CASN	Canadian Association of Schools of Nursing
ANAC	Aboriginal Nurses Association of Canada
OMH	Office of Minority Health
IPAC	Indigenous Physicians Association of Canada
RCPSC	Royal College of Physicians and Surgeons of Canada
REB	Research Ethics Board

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Author contributions

AH: conceptualization, original draft written, research coordination, methodology, formal analysis, investigation, resources, data curation, revision, review and funding. YK: investigation, resources, data curation, review, editing, project communications and funding. AM: investigation, resources, review, data curation and funding.

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Availability of data and materials

According to UCN REB protocol, no data is allowed to be shared with any third party. All data collected must be kept confidential, and only the authors can use them.

Declarations

Competing interests

The authors declare no conflict of interest.

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