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Digital Leadership: How Can Instructional Leaders Support Northern Alberta Students and Teachers in Online Classrooms?

by

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Abstract

The closing of the Alberta Distance Learning Center combined with the COVID-19 pandemic resulted in a situation where rural and remote school divisions in Northern Alberta had to develop virtual education programs to serve their student population online. This study explored the perceived requirements and practices in developing an effective online Science, Technology, Engineering and Mathematics (STEM) classroom for rural and remote Northern Alberta schools. Questions asked of participants were centred around three themes: (a) student engagement, (b) technology, and, (c) best practices. This study drew on qualitative phenomenological and interpretive research design, conducting semi-structured, open-ended interviews with three STEM teachers who had a minimum five years of teaching experience, and had also taught at least two STEM courses online. An analysis of the data generated a fourth theme centered around student connection through face-to-face meetings. The findings of this study show teachers and digital instructional leaders should strive to engage students in short visually interesting lessons while encouraging students to engage with the material through active participation. Digital instructional leaders should also press to ensure students have access not only to all the technology required, such as a workstation instead of a single laptop, but push those higher up in leadership to ensure students also have access to high speed internet wherever they may need to access it. Digital leaders should also be supporting teachers in developing best practices suited for the online classroom, such as building engaging material and videos from the start. Such best practices can also be in the form of a complete pedagogical change from teacher-centered lecturing to student-centered flipped classrooms. Lastly, teachers and digital instructional leaders should strive to meet their online students in person within the first week of school as this face-to-face student connection was highlighted by participants as being a key to an effective online classroom.

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The Alberta Government's phase-out and dissolution of the Alberta Distance Learning Center (ADLC), combined with the COVID-19 pandemic, which caused 90% of schools worldwide to be closed, have caused school divisions, and schools, to develop different strategies to provide digital courses to their students (An et al., 2021; Edwardson, 2020; UNESCO, 2020). This has been especially difficult for rural and remote schools and school divisions, as they have a limited student population base and lack the staffing expertise to offer the requested specialized science, technology, engineering, and math (STEM) programming to all of their students in physical classrooms (Barbour, 2010; Barley & Beesley, 2007). From general science courses such as Science 20 and 30 to specialized math courses such as calculus and computer science, the reality facing Northern Alberta students in rural school divisions wanting access to specific STEM programming is they have to seek it out in an online format or platform.

For teachers to properly develop online classrooms, they require support not only from the school division, but digital instructional leaders who are working within the digital online teaching environment (Hartman et al., 2019; Hunt-Barron et al., 2015; Ogodo et al., 2021). The Alberta Leadership Quality Standard (LQS) (2020) provides a framework for digital instructional leaders to use in supporting their online teachers. Digital leaders can focus on the following LQS competencies in their support of online teachers: LQS #9(c) "engaging local community partners to understand local contexts" (Alberta Education, 2020, p. 5). With the loss of ADLC, and with decreasing school populations in rural and remote Northern Alberta school divisions, school leaders need to work with the community and online teachers to help make the transition to online learning for students who need access to online STEM teachers easier. It is becoming increasingly more difficult for rural high schools

to supply in class teachers given the small class sizes some STEM courses are attracting. The second competency digital leaders can use is LQS #8(e) "...access to appropriate technology and digital learning environments" (Alberta Education, 2020, p. 5). In conjunction with competency 9(c) above, school divisions and educational leaders can support teachers in developing their digital classrooms in order to support rural and remote Northern Alberta students with quality STEM teaching from centrally supported teachers who are experts in their teaching disciplines. In this model, students can access technology and the internet from divisional hubs throughout the region. By focusing on these two LQS competencies, digital leaders satisfy LQS competency #6 "ensur[ing] that every student has access to quality teaching and optimum learning experiences" (Alberta Education, 2020, p. 4).

Significance of the Study

The reality facing many rural and remote school divisions is they cannot attract, or maintain specific staff due to their distance from central urban centers (Barley & Beesley, 2007). Tied with the defunding and closure of the ADLC by the provincial government, rural and remote Northern Alberta schools will have to implement alternative methods to deliver content by curricular experts in STEM fields to provide continuity of programming (Edwardson, 2020). To meet these needs, school leadership is challenged to develop and deliver the required curricular content in multiple ways, such as online blended learning, and not only by way of the traditional classroom delivery model.

Through this study I hope to provide insight to digital instructional leaders who are implementing, participating in and overseeing virtual education programs. Digital instructional leaders have a responsibility, outlined by the LQS competencies (Alberta Government, 2020), to support their teachers. This support is not only in the development of their online classrooms, but in support of a teachers pedagogical development, and by presenting in different ways to engage students. Digital instructional leaders can also help

teachers by helping them improve their implementation of different technology and programs in their classrooms, and by presenting evolving best practices in the digital online learning environment.

The significance of this study is to explore what teachers working in online settings perceive as important to the development of online classrooms. This study fills a gap in the current research by focusing on how teachers perceive online education in rural and remote Northern Alberta. Most research concerning online education focuses on high density regions, such as provinces, states or countries. When research of online education does focus on rural regions, they tend to be larger rural regions, such as rural China, or rural Georgia (Wang et al., 2019; Williams et al., 2018). This pilot study's focus on Northern Alberta schools will bring a different perspective to the table of low enrollment schools in rural and remote Northern Alberta. In a practical sense, this study will give online classroom teachers and digital instructional leaders some insight, as well as some of the necessary tools in developing an effective online classroom.

Purpose of Study

The past two years of the COVID-19 pandemic has increased the demand for online education options (Ogodo et al., 2021). Students have become accustomed to accessing classes through a digital medium. As COVID-19 restrictions continue to relax and schools return to pre-pandemic in-class learning, access to virtual classes for students who have developed the aptitude and desire to learn in this manner has become a necessity. As a result, teachers are being tasked with developing and teaching high school classes online. This study aims to explore teachers' perceptions, feelings and practices on what makes an effective online STEM classroom.

Research Problem & Sub-Problems

To better understand high school teachers' thoughts, feelings and perspectives regarding the effectiveness of online teaching, this study explores the perceived requirements and practices in developing an effective online STEM classroom for rural and remote Northern Alberta schools. The following questions helped guide this study: (a) How do we engage students in learning in online STEM classrooms? (b) What technology is available from schools and school divisions for teachers and students to improve the online learning experience for stakeholders? And, (c) what are the best practices for an online STEM classroom?

Literature Review

Though research suggests there is insufficient evidence of the effectiveness of digital online learning, (Farmer & West, 2019; Harris-Packer & Segol, 2015; Ogodo et al., 2021) there is evidence certain online delivery methods show strengths over other approaches. Swarm et al. (2013) studied how combining technologies for the delivery of content to remote locations can be effective. They looked at different ways instructors deliver sessions to remote off-campus locations. Swarm et al. found face-to-face classroom sessions were the most effective way to deliver content, but due to multiple remote locations, much like in Northern Alberta, this is not always possible. By looking at various online methods, they determined a blended hybrid model involving online tools to participate in the course and the inclusion of video or audio instruction, with the added display of the instructors' desktop to show what they were discussing, was optimal (Swarm et al., 2013). This could be advantageous to more rural Northern Alberta schools if school divisions could accommodate a group of educators teaching from a centralized location for students to access their learning online. Other benefits of online learning are flexible learning opportunities for students, allowing them to learn anywhere at any time. Student can also learn at their own pace while

differentiating and personalizing their learning (An et al., 2021; Barbour & Harrison, 2016; Zheng et al., 2020)

Teachers in this centralized role will have to already have, or quickly expand the requisite skills needed for developing and teaching in an online classroom, as these skills are different from those for onsite, in-person classroom teaching (Bryson & Andres, 2020; Leech et al., 2022; Ogodo et al., 2021). Three major themes emerge from the literature in relation to online learning; student engagement, access to technology, and best practices in developing and teaching in an online classroom (An et al,, 2021; Bryson & Andres, 2020; Farmer & West, 2019; Harris-Packer & Segol, 2015; Hartman et al., 2019; Hunt-Barron et al., 2015; Leech et al., 2022; Ogodo et al., 2021; Williams et al., 2018). Each of these themes are examined in more detail below.

Student Engagement

In moving to online blended classrooms, Northern Alberta high schools may have an issue with student engagement. For the purposes of this study, an online blended classroom is defined as,

> Education being delivered in an online environment through the use of the internet for teaching and learning. This includes online learning on the part of the student that is not dependent on their physical or virtual co-location. The teaching content is delivered online and the instructors develop teaching modules that enhance learning and interactivity in the synchronous or asynchronous environment (Singh & Thurman, 2019, p. 302).

Vanslambrouck et al. (2018) studied university students' motivation to learn online through a blended learning model. They found students who willingly enrolled in an online blended learning program were intrinsically motivated to do well in the course, while those placed in online blended learning programs were not motivated to do as well as their counterparts

(2018). This study highlights a difficulty for many Northern Alberta schools. The option to be a part of an online blended classroom is rarely the student's choice, it is normally the school or district offering the course in this fashion due to low enrollment numbers and budgetary constraints. Vanslambrouck et al. (2018) show the lack of choice for students forced to take online blended courses might have an impact on their achievement. Scott-Weber (2021) supported Vanslambrouck et al.'s findings stating "[h]ow one experiences learning is critical to the level of engagement in their learning process" (p. 12). With this as a reality for Northern Alberta students, it is imperative for divisions, schools and teachers to determine effective ways of engaging their online students in different ways to ensure students can have success in their online STEM learning.

Once students are in an online classroom, teachers have to be able to engage students in their learning in this medium. Scott-Webber (2021) stated "learning should be student-centered and the design of the built space, [online classroom], should support user needs" (p. 12). The question becomes, how do teachers support student needs in an online classroom? Teachers in an online environment will have to engage students through active participation in the learning process. Though, "[a]ctive learning, and the authenticity it provides for learners, is not easy to deliver" (Scott-Webber, 2021, p. 24). This will require teachers to discover, or develop, online lessons and resources to engage student learning (An et al., 2021). "... online… student engagement in an authentic way is critical for their learning progress and technology and spatial designs play important roles here" (Scott-Webber, 2021, p. 25).

Access to Technology

The COVID-19 pandemic illustrated hidden issues potentially arising in online classrooms. The digital divide encountered by students can be a massive disadvantage to those without adequate access to technology or the internet (An et al., 2021; Tawfik et al.,

2021). As such, school divisions wanting to move to an online format for educating a portion of their population in STEM classes have to make sure not only teachers, but students are supported with access to technology and the internet. School divisions moving students into online classrooms need to have a plan in place for one-to-one technology roll out, and repair and maintenance concerns (Curry et al., 2019). School divisions will also need to ensure students have access to the internet. This can occur in two different ways. The first way is by providing access to local schools, which are still being used as primary and middle schools, as a hub for students to get online (Curry et al., 2019; Williams et al., 2018; Tawfik et al., 2021). High speed internet access is already available at these hubs, and as long as schools and school divisions can ensure some adequate means of student supervision, these sites are more than sufficient to accommodate students' online learning needs (Tawfik et al., 2021). As Tawfik et al. (2021) further discuss, not all online learning occurs at a hub school locations. Many online learners take advantage of the opportunity to learn from home, where high speed internet access may still be a barrier to learning (Tawfik et al., 2021).

Not all communities have access to quality high speed internet (Cullinan et al., 2021; Tawfik et al., 2021). Rural and remote Northern Alberta is not different, and as such, school divisions should ensure they are advocating on behalf of students to the provincial and federal governments to provide access to high speed internet. As Cullinan et al. (2021) state, the "variation in the quality of broadband access may impact the type of online/blended model that staff can deliver and constrain how students can engage with online content" (p.17). To meet rural and remote Northern Alberta students' need for online education, access to quality high speed internet is of the utmost importance.

Best Practices

Teachers have not been taught how to integrate technology into their everyday teaching (Hartman et al., 2019; Nicol et al., 2018). This was made apparent during

COVID-19 when teachers had to quickly pivot from classroom instruction to online learning (An et al., 2021; Ogodo et al., 2021; Scott-Weber, 2021). As some teachers transition to teaching virtually full-time to fill a virtual educational need, digital leaders need to develop different methods for supporting their online teachers. A part of this will be done by directing teachers to specific professional learning on how to build online classrooms, as they are not built the same as in person classrooms (Bryson & Anders, 2020). Digital leaders will also need to help online teachers determine which pedagogical approaches are best suited for their online environment, such as synchronous or asynchronous classrooms. Digital leaders should also be a support in the development of video lessons and what best practices look like for this. Đordan (2019) suggests video lessons be no longer than fifteen minutes to avoid student disengagement. This is the type of best practice digital leaders can bring to their colleagues in a virtual education program. Students can use video lessons which are found or developed by their teachers. Eventually for some STEM courses, a pedagogical shift in a teachers approach to online education may need to be supported, with the transition from synchronous online teaching to asynchronous approaches to teaching, such as flipped classrooms (Deng, 2019; Đordan, 2019; Weinhandl et al., 2020). Digital leaders can also support new online teachers by simply providing them with strategies to help make the transition from in-person learning to online blended learning easier.

Summary

In summary, a students' choice to participate in an online classroom plays an important role in how they will engage in their learning. Also, once in the classroom, how a teacher engages students to ensure they are actively participating in their learning. These two ideas lead into the first research sub-question of how do we engage students in learning in online STEM classrooms? The ideas which lead to the second sub-question, what technology is available from schools and school divisions for teachers and students to improve the online

learning experience for stakeholders, are those of accessibility. Student access to quality high speed internet and good technology are the starting points for an effective online classroom. The second sub-question focuses these ideas to what technology is really needed for online classrooms to be effective learning environments for teachers and students? Lastly, pedagogical practices, such as flipped classrooms, to increase a students active participation leads into the third sub-question of what are the best practices for an online STEM classroom?

Method

This study aimed to provide teachers and digital instructional leaders with strategies to implement and improve their online blended learning classrooms. I drew on different qualitative methods to develop this study and selected a regionally located respondent group to interview to collect and analyze data with respect to teachers perceptions, feelings and practices on what makes an effective online STEM classroom.

Type of Study

Drawing on qualitative phenomenological and interpretive research design (Clark & Cresswell, 2015; Merriam & Tisdell, 2016), qualitative data were collected using open-ended, semi-structured interviews with respondents having access to the questions beforehand to give them the opportunity to reflect on their practices. Using phenomenological and interpretive techniques provided a thorough understanding of the selected teachers' perceived effectiveness of content delivery methods in rural and remote Northern Alberta school divisions to low enrollment STEM classes in an online blended learning model.

Respondent Group

This study, due to specifically looking at the perceived requirements and practices in developing an effective online STEM classroom for rural and remote Northern Alberta schools, targeted teachers from this region who have taught STEM classes online. Access

was further restricted to teachers in one rural Northern Alberta school division because of time restrictions, delimiting this study. Using purposeful sampling strategies, three teachers were selected to be interviewed (Merriam & Tisdell, 2016). Eligibility was restricted to teachers who had taught STEM courses online between 2019 and 2022. Teachers chosen were selected because of their experience teaching in a virtual classroom setting, either having experience teaching in a blended online classroom, or because of recent emergency remote teaching resulting from the COVID-19 pandemic. Teachers also had to have taught at least two STEM courses online, and had to have taught for a minimum of five years.

Table 1
Description of Participants

Pseudonym	Gender	Years Experience	Career Experiences	STEM Courses Taught
Beru	F	15-20	9-12 teacher. Taught online blended STEM classes during COVID-19 pandemic.	Science 9 Math 9 Biology 30
Owen	M	5-10	10-12 teacher. Blended learning STEM teacher.	Science 10 Physics 20/30
Ben	M	10-15	10-12 STEM teacher. Taught online blended STEM classes during COVID-19 pandemic. Current blended learning STEM teacher.	Chemistry 30 Biology 30

I received approval for this pilot study from both the University of Alberta's ethics body, via a general consent given through our EDPS 509 course, as well as the deputy superintendent of the selected school division charged with approval and oversight of all studies conducted within the school division, before reaching out to the selected respondents. I talked with the first respondent in person to formally invite her to participate in the study. At this time I also gave her the introduction letter, see Appendix A, explaining the study, as

well as the consent form, see Appendix B. Beru accepted the invitation to participate in the study and signed the consent form at this time as well.

For the other two respondents in the study, I emailed asking them to participate in the study, explaining what the study was about. In these emails I also included the letter of introduction to the study and the consent form. I quickly received approvals from the two respondents via email, as well as their signed consent forms. I also ensured consent with all three respondents at the beginning and ending of their interviews, where all three respondents also verbally consented to participating in the study.

Data Collection

Data for this study were collected via an open-ended, semi-structured interview. The interview schedule, see Appendix C, consisted of ten questions supporting the overall research question, and three sub-questions helping to inform the researcher's understanding of the overall research question. The three interviews were conducted and recorded online via Google Meet. Interviews were then transcribed using a transcription program. I was then able to review the transcripts for correctness by rewatching the video of the recorded interviews.

Data Analysis

For analysis, the collected data from the open-ended interview questions were examined, coded and inductively analysed to bring out common themes from the respondents' answers to the research questions and sub-questions. As the themes solidified, a deductive approach was taken to support the final themes which had emerged. This study also used open-ended interview questions to collect as much data as possible in support of the research question and sub-questions. Qualitative content analysis coding was used to collect thematic evidence together to analyze the data in support of the themes which had emerged.

Trustworthiness

Credibility. Credibility was maintained by recording and transcribing interviews, as well as observing the online classes of two of the participants. Participants were also given the research question and sub-questions ahead of time so they could provide in-depth responses and thick descriptions to their perceptions, feelings and practices of the effectiveness of online classrooms. Member checks were also conducted with the participants to ensure credibility of the study. This was done by sending the participants statements they had made during the interview process, as well as the findings related to those statements, to ensure they were not misrepresented.

Transferability. To increase transferability, a thick description of the participant's thoughts and feelings, with regard to the interview questions and findings, is discussed. Careful attention was also payed in the selection of participants. Though there were only three participants selected, a range of years and experience with online teaching, as well as a mixture of STEM courses taught, provides a variation of interest among the participants.

Dependability. Multiple methods were used for data collection in this pilot study. Interviews were conducted with all three participants, and two participants were observed while teaching in an online environment. Use of these multiple methods increased the dependability of the study as the findings between the three participants were consistent.

Confirmability. Though the topic of online education is of interest to me, I attempted to keep my bias out of my research. To do this, I asked questions which offered participants the opportunity to honestly discuss their positive and negative feelings about online education. I focused on these participant responses to the interview schedule to guide the inductive analysis of the emerging themes. I also kept notes during the interview process, outlining the steps I was taking to generate and link the themes which emerged from the participant interviews.

Analysis

Coding of the data from the three respondents showed the emergence of themes related to the studies' three research sub-questions, as well as a fourth theme which emerged outside of the studies' questions. The themes related to the research sub-questions were a) student engagement, b) access to technology, c) best practices, and the fourth theme which emerged from the research was d) face-to-face connection. All four themes led to a greater understanding of the overall research question of teachers' perceptions, feelings and practices in developing an effective online STEM classroom for rural and remote Northern Alberta.

Student Engagement

The theme emerging from the first sub-question, how do we engage students in learning in online STEM classrooms, was one of active participation of students in an online classroom. Respondents indicated to engage students, a variety of strategies and programs are required. Various programs were listed such as enhanced video conferencing services, like Google Meet which has access to breakout rooms, and formative online quiz programs, such as Quizizz, Kahoot, and personally developed Google Forms quizzes as important to keeping students actively participating and engaged in their learning. For Beru this meant lessons should be

> "... pretty short and definitely something visual and engaging. [Lessons] should be an opportunity for kids to either go into breakout rooms in smaller groups, or use [programs] like Jamboards… where they actually have to do something and not just sit there."

Ben looked at active engagement of students as "having the assignment pulled up in Google Classroom and … cycling through the kids [work] … in real time so I can intervene if they are having troubles." Beru, Owen, and Ben also reported engaging with students in small breakout groups was beneficial to encouraging students in active participation through

discussions and questions about the lesson. Owen reported he found success "working with small groups as opposed to the whole class fitting in with the idea of the blended or flipped classroom." Ben also stated if he "began noticing a pattern and it's something I need to correct verbally, … I pull them into a breakout room right away and we talk about it…"

Respondents also reported because they could not be physically present in the room with students, they needed to use a variety of strategies to ensure students were engaged with the learning. Some of these strategies included encouraging students to keep their cameras on, and bringing students into breakout rooms within the video conferencing program. Once in the breakout room, teachers could discuss issues and have students verbalize their answers to keep them actively engaged in their learning. Ben and Owen also noted they encouraged students who were not comfortable with speaking up in the online classroom to actively participate with the class by using the chat functions available in the video conferencing program to ask or answer questions in real time. Beru noted "some kids are more engaged online … and are more comfortable to communicate over the screen in chat."

Beru, Owen and Ben also tried to use non-verbal communication by having students use the non-verbal communication tools available in the video conferencing program such as raised hand symbols, or thumbs up symbols. Beru and Owen reported their success in the use of thumbs up and thumbs down by students visually on camera. Two reasons they felt this was a success was it confirmed for them students understood a concept, and it also helped ensure students were participating with the lesson. Owen would specifically ask students for a "quick formative check…[asking] can you give me a thumbs up, thumbs down? [and] they will flash the camera on showing a response." This would allow Owen to quickly ascertain if he needed to "pull some aside and work with them one-on-one."

Access to Technology

The theme emerging from the second sub-question, what technology is available from school divisions and schools for teachers and students to improve the online learning experience for stakeholders, showed a lack of urgency on this topic. Beru, Owen and Ben all agreed that technology, though needed, is not at the forefront of teachers' thought in developing their online classrooms. Beru and Owen indicated for the most part, the technology available to them is suitable, with Beru indicating the importance of internet access. “Having good internet … kids that are not living in a place where they have access to good internet, … either because they live … in a rural area, and despite having internet connections, it doesn’t always work very well.”

Beru, Owen and Ben also stressed the importance of easy to use programs for both students and teachers, such as Google Classroom or Kami. Beru stated “Google Classroom and Google Meet [are] both user friendly, they are easy [to use] and the kids are familiar with them.” Technologically, all three mentioned having access to one-to-one technology and laptops or Chromebooks with a touchscreen were better suited for online students as it gives them the ability to write on the screen if needed. Though Ben did note “every student has a touch screen Chromebook and a stylus and a headset and that has worked very well. For many kids, many students, the writing on the Chromebook screen is [a significant] barrier to participation.”

Also, with respect to technology, all three expressed the importance of having good cameras, microphones and headsets for teachers and students. Ben indicated how, if possible, student workstations with an extra monitor would be a preferable setup, as it would allow the student to use one screen for the video conferencing program, and the touch screen for any work they may need to be doing as they follow along in the lesson. Agreeing with Ben’s opinion on technology, Beru further confirmed “[students] need to have a good device.”

Best Practices

From the third question, what are the best practices for an online STEM classroom, the emergent theme was one of online classroom structure. Beru, Owen and Ben all stated lessons needed to be well prepared and organized in a learning management system for all stakeholders. Beru went further by emphasizing "[students] need to know what the norms are, and [whether] lessons were asynchronous or synchronous." Owen and Ben also stressed the importance of establishing routines and expectations of how an online classroom operates. This includes teaching students how to use the learning management system and how to download and upload lessons, assignments and assessments. Lessons also need to be structured differently than a traditional classroom. Lessons need to be short, visual and engaging, with opportunities for students to actively participate in discussions about the material with other students.

Owen and Ben discussed the use of short formative quizzes to determine a students understanding of the material or lesson was important, and allowed them as teachers to determine which students need further instruction one-on-one or in small groups in separate breakout rooms to get extra help. One of Owen's strategies in Science 10 was to "have a Quizizz and … I'll make them all do it… quick. Then I will pull aside everyone who gets less than seventy [percent] and we… work through some practice problems together and then they get to redo it."

Another best practice, or pedagogical approach, Ben used fully in some units, and Owen was in the process of developing, was flipped classrooms. A "flipped classroom is a pedagogical method in which students learn new knowledge through short videos, …outside class and consolidate what they acquired through classroom activities with the help of classmates and teachers" (Deng, 2019, p. 1350). Ben indicated it worked really well with his last Chemistry 20 unit stating "the kids did really really well on their last unit exam." Owen

however noted the difficulty in developing video resources for students in a flipped setting. “The big drawback in how labour intensive it is. It’s really difficult… it usually takes me at least an hour to do a twenty minute video… so it's really hard to create that time.”

Face-to-Face Connection

The fourth emergent theme was the importance of in person student connection. Beru, Owen and Ben all emphasized the importance of relationships, with two of them, Beru and Owen, indicating it was the most important factor in developing an effective online classroom. Owen found this theme of connection to be “the most important part. I don’t think the tech stuff really matters compared to [the relationship building and the social, emotional learning].” Beru also found it important to “establish a connection with kids first.” Beru, Owen and Ben felt meeting students face-to-face to help build relationships was important. All three stated meeting students at least once in order to introduce themselves and begin to get to know the students is of the utmost importance. Owen and Ben relayed meeting students face-to-face after teaching them online for a period of time, helped reduce behavioral issues and resistance to learning in the online classroom dissipated. Ben stated

> ... the day after we had them sitting down, you know, right beside them, getting to know them, visiting with [them], doing some work [together]. The next day, totally different kids, totally different interactions now that we had established more of a relationship.

Ben and Owen outlined how though the initial plan for their virtual program was to be fully online, as the year progressed this changed. Teacher site visits were encouraged to be completed around the division, with one or more teachers going to visit a school site for some face-to-face time with students. Students were better behaved and engaged in the online classroom after getting the opportunity to meet their teacher face-to-face. Owen emphasized the importance of connections with students by stating “the reason we haven’t been replaced

by VHS, or DVDs or black and white film or Google Classrooms is because it is just about relationships."

Discussion and Findings

Analysis of the four themes generated from the data showed numerous different practices emerging for the development of effective online classrooms. The four themes discussed are a) student engagement, b) access to technology, c) best practices, and d) face-to-face connection. Each of these themes are discussed in more detail below.

Student Engagement

Looking first at how online STEM teachers can engage their students in active participation, the data show online classes are not the same as in person classes. Teachers cannot simply look over a students shoulder when the need arises. This is in line with Bryson and Andres' (2020) conclusions that successful online courses are designed as online courses and not just face-to-face classes conducted in an online environment. This is supported by Minasian and Kidder's (2020) assertion "engagement is as important as consistency and connections in the remote classroom" (p. 23).

It also takes time to develop online classes developing quick formative quizzes and assessments mimicking or replacing the physical space interactions that in person normally take no time at all. This makes sense, as teachers need to continue checking on student progress to see if they are actively learning the material. Without being able to look over a students shoulder, online STEM teachers need to reproduce this in-class interaction with suitable online substitutes. This can range from online formative quizzes quickly letting the student and the teacher know how students are progressing on the material, to using interactive whiteboards allowing students to show their progress to their teacher. All of this requires the active participation of the student.

In an effort to engage students in their learning, online teachers need to develop instructional habits to replace the in-class teacher-student interaction, such as Beru and Owen did when asking students to actively acknowledge understanding on screen with a thumbs up or down, or through responding positively through chat. Engagement has to start from the moment a student enters their online classroom (Minasian & Kidder, 2020). Driggs and Brillante (2020) emphasize how "learning materials take on a whole new importance. The materials you present synchronously or asynchronously are central to supporting students engagement and learning" (p. 63) Teachers need to be able to use everything from music and sound cues, to in-program interactive gestures, such as hands up emojis to visual thumbs up, sideways or down from students on camera, to have students visually show they are actively participating in the lesson and are engaged with and understanding the material. Beru and Owen used thumbs up or down, and the online chat function to show active participation. Driggs and Brillante (2020) also suggest students can show fingers to show how much more time is needed and have students type ready into the chat when finished with a problem. This is consistent with Owen's practice as he noted how he would use the chat to check on student engagement, by using short key words linked to the learning having just occurred. STEM teachers in online classrooms have to actively participate and be engaged in the class just as much as the students need to actively participate in their learning in online STEM classrooms (Driggs & Brillante, 2020; Tawfik et al., 2021)

Access to Technology

Analyzing the second theme of available technology, it was interesting to see both Beru and Owen thought the technology component as not as important to the effectiveness of teaching students in an online classroom. This is an interesting outcome with all of the day-to-day interactions in an online classroom requiring technology. At the end of the day, technology is nothing more than a tool, but it is a tool that is decidedly required in an online

classroom. Many teachers simply use what is put in front of them as they have not been taught how to properly implement technology into their teaching practices (Hartman et al., 2019). As a result of this, few teachers think about how they can implement new technology or programs into their practice. Looking at all three respondents we see three teachers each at different levels of technology integration.

Integration of technology, in this instance, not only means the integration of the technology at a teacher's disposal, but the integration of their personal skills in using and communicating with technology (Williams et al., 2018). For the purpose of this pilot study, technology integration has three levels. Introductory, teachers use the technology right in front of them and are using videos to expand lesson concepts from sites such as YouTube, but are not creating their own digital content. Teachers at this level teach similarly online as they would in a physical classroom. At the intermediate level, teachers are using different forms of technology, such as digital scribing programs, for instance Kami, while also beginning to develop classroom videos for some of their lessons. Teachers at this level have begun to use and implement technology into their teaching practice, but have not had the time or the opportunity to fully implement technology into their everyday practice. Lastly there is the advanced level. At this level, teachers are using multiple tools in their online classrooms, while also having video lesson access for most if not all of their lessons, as well as some fully flipped learning in some of their online STEM units.

Beru is a classroom teacher who had to teach remotely due to COVID-19 and used what was in front of her. Beru is at an introductory technology implementation level. She integrated technology into her online teaching as much as she could to ensure student learning was occurring during the pandemic. She relied on other teachers for help, and followed a script for teaching the material online, much as she would teach it in a classroom. During the pandemic, many teachers did this, as there was very little time to convert from the

traditional in person setting to one online. Teachers in this circumstance did what they knew how to do (Bryson & Andres, 2020; Leech et al., 2022; Ogodo et al., 2021).

Looking at Owen, he is a blended learning teacher with limited experience teaching online. Owen is at the intermediate integration level for technology. He is still trying to figure out how to teach online with very little extra time to fully implement new digital programs or pedagogical practices, such as a flipped classroom. Currently, Owen is not only developing his STEM courses as distinctly online classes, he is also recording some of his lessons to ensure students always have access to the lessons to review when they need it, but not for all of his classes. Owen simply does not have the time to properly evaluate and implement new digital programs and pedagogical practices into his online classroom, but instead is trying as many different online programs as possible to find a starting point. Owen is going a step beyond Beru and other onsite teachers by using a plethora of other programs in order to diversify and engage his students online.

This is contrasted by Ben. Ben is an advanced technology integration teacher. Ben has had the time to develop his courses in full, and has the time to figure out how to implement other digital programs and pedagogical approaches not only for his use, but the use of his students, in order to expand their learning environment. Ben has shifted fully online in his practices to the point where students hand in all assessments to the Google Classroom and then he marks and returns everything digitally. Ben has also been able to integrate his previous course development with digital pedagogical practices by flipping some of his units in the courses he teaches.

Getting to the advanced stage of technology integration takes time. The difficulty with implementing videos for all lessons in all courses for student access, similarly to a flipped classroom, is time (Đordan, 2019; Weinhandl et al., 2020). Administrators and educational leaders need to help teachers to find a way to build this time into their schedule. Access to

technology also means access to the internet. While the Alberta and Canadian Governments program to ensure access to rural, remote and indigenous communities in Northern Alberta is a good start, it will take time. Until this program is finished, the quality of high speed internet can affect student learning. As Cullinan et al. (2021) state, “variation in the quality of broadband access may impact the type of online/blended model that staff can deliver and constrain how students can engage with online content” (p.17).

Best Practices

Analysis of the third theme of best practices comes back to online classrooms being fundamentally different from brick and mortar classrooms. As Leech et al. (2022) state, teachers cannot “create the same experience online that they could in the classroom” (p. 260). For online courses to be successful, they need to be designed as online courses, not traditional lecture-type courses delivered online (Bryson & Andres, 2020; Leech et al., 2022). When developing an effective online classroom, teachers cannot simply lecture and hope students will understand the concepts, as is done in many on-site STEM classrooms. Online STEM classrooms need to be built differently. As indicated by the data, online STEM classrooms have to be built with the idea of lecture components being short (Đordan, 2021). The use of visuals to explain concepts is much more important in engaging students in the material for deeper learning and understanding (Weinhandl et at., 2018). The inclusion of video is important as well, be it a video produced by an educational platform describing concepts in a different manner, or a simple video of the lesson produced by the teacher who is developing the online classroom (Đordan, 2021, Weinhandl et al., 2018). Different ways of delivering the lesson need to be used. These are all strategies used in a brick and mortar classroom as well, but in an online classroom these are the foundational ideas an engaging online classroom needs.

The use of an enhanced video conferencing program, such as Google Classroom, is of the utmost importance as it allows online classrooms to have small working groups in breakout rooms to have discussions on the lesson at hand or to interact and help each other with problem solving which occurs naturally in the classroom. Beru, Owen and Ben all indicated the use of breakout rooms in some of their online classes has helped to engage students and ensure they are on track in their learning. Breakout rooms also offer an opportunity for teachers to have short discussions with students in private away from the entire class, much like teachers would do in a traditional classroom. The use of breakout rooms can also promote cooperative learning to support student centered learning (Minasian & Kidder, 2020). Enhanced video conferencing programs also supply teachers with data as to how long students were logged in to the synchronous classroom. Though this data gives online teachers an idea of how long students were in the virtual classroom, it does not provide them with how engaged students were in the class. This data in concert with strategies to keep students engaged in the lesson can provide teachers with meaningful information about how their students participate in their online classrooms.

Face-to-Face Connection

Lastly, the fourth theme, face-to-face student connection, emerging from all three respondents' data was somewhat of a surprise. This result was expected coming from Beru, as she is a classroom teacher who had to shift to remote instruction during the COVID-19 pandemic. The interesting outcome from the data was how Owen and Ben, both online only teachers, noted how important the theme of connection is. Owen and Ben also indicated the use of small breakout rooms helped with making teacher-student relational connections, but these relationships only really developed after meeting face-to-face. They both shared how meeting students face-to-face, even just once, helped with reducing the behavioral issues and improved the students' attitudes and motivations toward learning online. This data supports

Vanslambrouck et al. (2018) findings that student motivation impacts how they learn online, and Austin et al. (2017) findings which state "face-to-face meeting, planned and managed by the teachers, deepens… engagement…(p. 335). It also supports Rugani and Grijalva (2020) statements which indicate teachers need to establish a connection so kids feel both accountable and connected to the class. Once students in Owen and Ben's online classroom felt a personal connection to their teachers, their attitudes and motivations toward learning in an online classroom changed. Students were no longer put in a digital classroom, but were a part of a digital classroom once these personal connections were made.

Overview

The findings of this study on teachers' perceptions, feelings and practices on what makes for an effective online STEM classroom with regard to student engagement are for teachers in online classrooms to make use of short engaging lessons, mixed with videos to further elaborate key lesson points and for students to refer back to. Teachers should have students respond with visual or chat cues to ensure active participation. Beru pointed out that she

> ... really stressed active participation. Whether that was putting an answer in chat or… speaking out loud, but I think giving them a chance to actually put an answer in the chat as opposed to making them speak, … [encouraging them to] engage in the chat positively.

To confirm active participation, teachers should also make use of short formative assessments to ensure that students are engaged in and understanding the material.

Technologically, for an effective online classroom, students should be provided with more than just a simple device. Providing the appropriate technology to allow students to write, communicate and show their understanding to teachers, who are not in the same room as them, is important. As Ben indicated,

> ... I think… every student having a little bit of a workstation, kind of like what we have in our offices. … it doesn't need to be quite as elaborate… but a dedicated input device for their writing, a good camera, good microphone, a good device to support Google Meet… I think having a secondary monitor is also huge. Kids need to multitask just as much as [teachers] need to multitask. I think…sometimes more.

On top of access to good technology, students also need access to high quality internet. This is available at hub schools, but there needs to be a continued push by educational stakeholders for improved internet access throughout rural, remote and Indigenous communities in Northern Alberta. Access to quality high speed internet everywhere in Northern Alberta will allow students to access and actively participate in their online learning, without any barriers to prevent learning from occurring.

When it comes to best practices, teachers and digital instructional leaders should be building their online classrooms, lessons and presentation materials with student engagement in mind. Pedagogically, some STEM teachers should look at implementing a flipped classroom model. A flipped STEM classroom, though a time commitment in the beginning, would give students the opportunity to learn the material at their own pace, while allowing teachers to work with students on concepts they are struggling with. As Owen stated, "with [the] idea of the blended or flipped class…I'll have a main meet…then I pull people out in small groups, …the benefit is kids can work at their own pace, to a point."

Lastly, teachers and digital instructional leaders should strive to meet their online students in person within the first week of school. All three participants noted how important the face-to-face connection to students is, and if this occurs sooner rather than later, this can result in more active participation and engagement from students early on, giving students a greater opportunity for success. This is evident from Ben's experience after having met his

students in-person stating, “Now, starting second semester, we already know all of the kids we are teaching. We have established relationships with them [and]...are hitting the ground running.” The earlier teachers can meet their students face-to-face, the sooner the entire classroom as a whole can start to run.

Conclusions and Recommendations

Through this study I aimed to provide insight into teachers' thoughts, feelings, and perspectives regarding the effectiveness of online teaching. By exploring these themes, this study offers an introductory understanding into the requirements and practices involved in developing an effective online classroom for students. Many did not choose to learn in an online environment in Northern Alberta. This study also offered practical insight, with concrete ideas of how teachers can develop their online classrooms as an effective learning space acting as an active learning environment for students, as well as a safe space where students are welcome and encouraged to learn.

Student Engagement

Due to most students in rural and remote Northern Alberta virtual education programs being placed in these programs and not choosing them, teachers and digital instructional leaders need to engage students online differently than they would in a physical classroom. As the findings show, teachers should encourage active participation by students. This can take on many forms. Small engagement checks, such as thumbs up or down, or chat responses help keep students engaged in the lesson, and at the same time, lets teachers know which students are engaged in the classroom. These small engagement pieces paired with what Beru referred to as “short… visual and engaging” lessons will give students the opportunity to actively engage and participate in their learning. To keep lessons visually engaging, teachers can use a variety of programs already at their disposal. Programs such as PearDeck allow teachers to make their Google Slides interactive. Teachers can also build

simple formative quizzes, using Google Forms, Kahoot, or Quizlet, to ensure students are engaged with and learning the material.

This is also where digital instructional leaders can support teachers. Teachers cannot access these programs in full without paying for the service. Digital instructional leaders can not only provide access to programs, such as PearDeck and Quizizz, but take the time to seek out other such programs. By seeking out and gaining access to programs like this, digital instructional leaders can save online teachers time they would otherwise spend searching for engaging programs, and spend this time developing visually engaging material. It is imperative for school divisions to invest in the necessary licensing for teacher and student access to engaging online programs and materials to support engaging and effective online classrooms.

Access to Technology

Available technology and the internet are the two main tools needed for an online classroom. To make an online classroom effective requires more than the basics. To build an effective online classroom, not only teachers, but students should have access to an appropriate workstation. As Ben noted, “[students] have a touchscreen Chromebook, stylus and headset” but further emphasized students should have “two displays” as it “would be huge for student learning” as “kids need to multitask just as much as [teachers]... sometime more.” An ideal student workstation should include a device, either a laptop or Chromebook, with access to a headset, stylus and a second monitor. If the device is not a touchscreen, the second monitor should then be replaced with a tablet-type technology. If school divisions are to implement virtual education programs, they need to be willing to invest in supplying all of the technology students and teachers will need to build and participate in an effective online classroom.

The second piece of technology needed is access to the internet. Though students should be able to access hub schools in their communities where internet access is available, this is not always the case with online learners. As such, digital instructional leaders, as well as divisional leaders need to act as advocates for their students and their communities to ensure high quality internet access is available for everyone. The governments of Alberta and Canada have announced a joint initiative to supply access to broadband internet to rural, remote and Indigenous communities of Northern Alberta (Government of Canada, 2022). Announcing this initiative is not enough, digital instructional leaders and divisional leaders need to continue to push both levels of government to ensure this broadband internet initiative is fully implemented to ensure students can access high quality STEM learning anywhere in the north.

Lastly, in order for teachers to integrate technology effectively in their online classrooms, and become an advanced technology integration teacher, such as Ben, professional learning and training are required. It is simply not enough to supply teachers with technology and expect them to use it effectively. This is where digital instructional leaders can make a difference. If digital instructional leaders are already advanced in their technology integration into their classrooms, they can work with and teach newer teachers to the online environment what programs to use, and how to effectively integrate technology into their online classrooms and pedagogy. Training and learning take time, but if teachers are to implement an effective online classroom, this is a necessary step to ensure the quality of learning online can keep pace with the learning in a physical classroom.

Best Practices

With regard to best practices, there are many different approaches online teachers can take. Digital instructional leaders need to provide teachers not only with options in adjusting or changing their pedagogical practices, such as with flipped classrooms, but also schedule

different ways to provide their online teachers with the necessary time to develop and implement these initiatives. To this end, teachers and digital instructional leaders should be building online classrooms, lessons and presentation materials with student engagement in mind. The use of short engaging material, with shifting pedagogical focus was instrumental in keeping the participants' students engaged, and actively participating, in class. Instead of long online lectures, teachers should incorporate short lessons, short videos, interactive assessments with immediate feedback into their lessons to keep students engaged. STEM teachers should also look at incorporating a flipped classroom model for some of their learning outcomes, allowing students to learn at their own pace. A flipped classroom model also allows the teacher the opportunity to work with students who are struggling with certain concepts during the class period, as opposed to the student struggling at home without the teacher as a resource.

Though implementing visually interacting lessons and flipped classroom models will take time, it is in the best interest of the students, and the teacher. Teachers building their best practices, be it interactive lessons or flipped classrooms, with student engagement in mind will find increased student engagement. To support the pedagogical shift to flipped classrooms, school divisions and administrators should look at changing how they schedule a teachers timetable. If school divisions and administrators can hire one or two more teachers than absolutely required, it would allow administrators to distribute teacher timetables with larger preparatory periods in order to develop and film the necessary material for student learning. This can come at a great initial cost, but a positive result of putting in the time and money to build these materials, while allowing teachers to develop their best practices, is these videos and materials can be used in subsequent classes in the future, only making minor adjustments when needed.

Face-to-Face Connection

It is worth noting the importance of teachers and students meeting face-to-face in developing and maintaining an effective online classroom. Even one or two short in-person meetings can impact an online student's perception of an online classroom, and modify their behavior making them more amenable to learning and conducting themselves better online. The idea behind online education is for students to access learning and material from a distance without a teacher in the room. But, as Ben stated, "... the day after we had them sitting down, you know, right beside them, getting to know them, visiting with, doing some work with them right? The next day, totally different kids, totally different interactions." This need for connection, not only from students but teachers as well, seems to have a large impact on how teachers perceive the effectiveness of an online classroom. This is shown through Beru's statement "... if there is a way to establish connection with kids first, I think that would be the most ideal way to have a successful online classroom."

The practicality of how to embed site visits is a challenge suited to digital instructional leaders. The large area some school divisions cover in Northern Alberta make this type of face-to-face connections difficult. Owen and Ben both indicated they travelled to hub schools to meet and interact with their students. It is here digital, and educational leaders can support their online teachers and students. By budgeting and allowing for travel to sites across their division, educational leaders can support the important development of personal connections between teachers and students to bridge the gap between in-person and online learning, keeping online students actively engaged in their learning. Making time to travel to meet students face-to-face is especially important for students who did not choose to learn online, but were forced into online classes due to the realities of small rural and remote Northern Alberta class sizes.

In keeping with the idea of connecting to students, it may also be advantageous being able to meet with parents of online students. Instead of typical parent-teacher conferences, perhaps multiple town-hall type meetings would be better suited to the stakeholders of a virtual education program. Bringing parents and students together with teachers at hub school locations gives the opportunity not only for students to meet their teachers face-to-face, but affords parents the same opportunity. To keep this parental connection going, teachers could also offer set office hours where students and parents can reach out and discuss any concerns they are having with their learning. When it comes to maintaining t0his interpersonal connection between teachers, students and parents, multiple approaches need to be taken, especially if students, and by extension parents, were placed into a virtual education program due to the loss of their rural or remote Northern Alberta high school.

Conclusions and Recommendations for Future Research

Several recommendations can be made further this study in the future. The first recommendation would be to include more than three teachers from the same school division in the study. At the beginning of this study, there was a gap in the literature with regards to online education in rural and remote Northern Alberta and the development on effective online classrooms for this reagion. This gap still remains, as this study was delimited to one school division, and three teachers in Northern Alberta. To get a broader idea of how to develop an online STEM classroom for rural and remote schools in Northern Alberta, casting a wider net, and interviewing teachers from multiple schools in multiple school divisions around Northern Alberta would be beneficial to the study.

Secondly, this study focused on the perceived effectiveness of online high school STEM classes. In the future using a mixed method study looking at effective online classroom practices, and how they relate to student success could be conducted. Including a quantitative component in order to further evaluate the effectiveness of teaching STEM

classes online could be very beneficial to the results. In this sort of mixed methods study, the qualitative component can continue to enrich the data with what has already been done, while the quantitative component can help support the qualitative data by showing the improvements in student grades backing up what researchers could find.

Finally, this study showed there was improved engagement and active participation in the online classrooms after teachers met their virtual students in person. As such, there is a need to further investigate the in-person connection for teachers and students that seem to improve the online classroom experience, not only for students and their learning, but for teachers and their behavior management and effectiveness in teaching in an online STEM classroom.

References

Alberta Education. (2020). *Leadership quality standard.* (pp. 1-6). Alberta Queen's Printer.

An, Y., Kaplan-Rakowski, R., Yang, J., Conan, J., Kinard, W., & Daughrity, L. (2021). Examining K-12 teachers' feelings, experiences, and perspectives regarding online teaching during the early stage of the COVID-19 pandemic. *Education Tech Research Dev, 69*, 2589-2613. https://doi.org/10.1007/s11423-021-10008-5

Austin, R., Rickard, A., & Reilly, J. (2017). Face-to-face contact in blended learning for intercultural education: *The role of teachers. Irish Educational Studies, 36*(3), 323-340. https://doi.org/10.1080/03323315.2017.1327364

Barbour, M.K., & Harrison, K.U. (2016). Teachers' perceptions of K-12 online: Impacting the design of a graduate course curriculum. *Journal of Educational Technology Systems, 45*(1), 74-92. https://doi.org/10.1177/0047239516637072

Barley, Z. A., & Beesley, A. D. (2007). Rural school success: What can we learn? *Journal of Research in Rural Education, 22(1)*, 1-16. Retrieved from http://www.umaine.edu/jrre/22-1.pdf

Bryson, J.R., & Andres, L. (2020). Covid-19 and rapid adoption and improvisation of online teaching: Curating resources for extensive versus intensive online learning experiences. *Journal of Geography in Higher Education, 44*(4), 608-623. https://doi.org/10,1080/03098265.2020.1807478

Budhai, S.S., & Skipwith, K.B. (2020). *Best practices in engaging online learners through active and experiential learning strategies* (2nd. ed.). Routledge.

Clark, V.L.P., & Creswell, J.W. (2015). *Understanding research: A consumer's guide, Enhanced Pearson eText with loose-leaf version -- Access Card Package* (2nd edition). Pearson Higher Education.

Cullinan, J., Flannery, D., Harold, J., Lyons, S., & Palcic, D. (2021). The disconnected: COVID-19 and disparities in access to quality broadband for higher education students. *International Journal of Educational Technology in Higher Education, 18*(26), 1-21. https://doi.org/10.1186/s41239-021-00262-1

Curry, J.H., Jackson, S.R., & Benchic, M.L. (2019). Four more years? A longitudinal study of one high school's 1:1 iPad implementation. *TechTrends, 63*, 53-61. https://doi.org/10.1007/s11528-018-0351-0

Deng, F. (2019). Literature review of the flipped classroom. *Theory and Practice in Language Studies, 9*(10), 1350-1356. http://dx.doi.org/10.17507/tpls.0910.14

Đordan, A. (2019). Going digital: Flipping the foreign language classroom. *Professional Communication and Translation Studies, 12*, 121-128.

Driggs, C., & Brillante, J. (2020). Culture of attention and engagement. In D. Lemov (Ed.), *Teaching in the online classroom. Surviving and thriving in the new normal.* (pp. 36-56). Jossey-Bass.

Duignan, P.A. (2020). *Leading educational systems and schools in times of disruption and exponential change: A call for courage, commitment and collaboration*. Emerald Publishing Limited.

Edwardson, L. (2020, March 3). Block funding for Alberta Distance Learning to be phased out over next two years. *CBC News*. Retrieved from: https://www.cbc.ca/news/canada/calgary/block-funding-for-alberta-distance-learning-to-be-phased-out-over-next-two-years-1.5483262

Farmer, T., & West, R. (2019). Exploring the concerns of online K-12 teachers. *Journal of Online Learning Research, 5*(1), 97-118. https://doi.org/10.1177/0047239516637072

Government of Canada (2022, April 26). *Government of Canada invests over $5 million to bring high-speed Internet to 7,339 households in Alberta*. Luka Vujic. Retrieved July 11, 2022 from: https://www.canada.ca/en/innovation-science-economic-development/news/2022/04/government-of-canada-invests-over-5-million-to-bring-high-speed-internet-to-7339households-in-alberta.html

Harris-Packer, J.D., & Segol, G. (2015). An empirical evaluation of distance learning's effectiveness in the K-12 setting. *American Journal of Distance Education, 29*(1), 4-7. https://doi.org/10.1080/08923647.2015.990768

Hartman, R.J., Townsend, M.B., & Jackson, M. (2019). Educators' perceptions of technology integration into the classroom: A descriptive case study. *Journal of Research in Innovative Teaching & Learning, 12*(3), 236-249. https://www.emerald.com/insight/content/doi/10.1108/JRIT-03-2019-0044/full/html

Hunt-Barron, S., Tracy, K. N., Howell, E., & Kaminski, R. (2015). Obstacles to enhancing professional development with digital tools in rural landscapes. *Journal of Research in Rural Education, 30*(2), 1-14.

Leech, N.L., Gullet, S., Cummings, M.H., & Haug, C. (2022). The challenges of remote K-12 education during the COVID-19 pandemic: Differences by grade level. *Online Learning, 26*(1), 245-267. DOI: 10.24059/olj.v26il.2609

Merriam, S.B., & Tisdell, E.J. (2016). *Qualitative research: A guide to design and implementation* (4th. ed.). Jossey-Bass.

Minasian, K., & Kidder, D. (2020). *Distance learning workbook: Hands on approach to virtual teaching*. Amazon.ca.

Ogodo, J.A., Simon, M., Morris, D., & Akubo, M. (2021). Examining K-12 teachers' digital competency and technology self-efficacy during COVID-19 pandemic. *Journal of Higher Education Theory and Practice, 21*(11), 13-27.

Rugani, J., & Grijalva, K. (2020). Dissolve the screen. In D. Lemov (Ed.), *Teaching in the online classroom. Surviving and thriving in the new normal.* (pp. 36-56). Jossey-Bass.

Scott-Weber, L. (2021). Row-by-column, plexiglass & Zoom, oh my! A K-12 COVID-19 storm / a pilot. *Journal of Education and Learning, 10*(2), 9-27. https://doi.org/10.5539/jel.v10n2p9

Seldon, A., & Abidoye, O. (2018). *The fourth education revolution: Will artificial intelligence liberate or infantilise humanity?* The University of Buckingham Press.

Singh, V., & Thurman, A. (2019). How many ways can we define online learning? A systematic literature review of definitions of online learning (1988-2018). *American Journal of Distance Learning, 33*(4). 289-306.

Swarm, D.J., Vincent, K.K., Gordon, L.C. (2013). A case study for combining technologies for the delivery of information literacy and community to students at remote locations using live synchronous video-conferencing. *Journal of Web Librarianship, 7*. 215 - 230. doi:10.1080/19322909.2013.785228

Tawfik, A.A., Shepherd, C.E., Gatewood, J., & Gish-Lieberman, J.J. (2021). First and second order barriers to teaching in K-12 online learning. *TechTrends 65*, 925-938. https://doi.org/10.1007/s11528-021-00648-y

UNESCO. (2020). *Education: From disruption to recovery.* Retrieved April 11, 2022 from https://en.unesco.org/covid19/educationresponse

Vanslambrouck, S., Zhu, C., Lombaerts, K., Philipsen, B., & Tondeur, J. (2018). Students' motivation and subjective task value of participating in online and blended learning environments. *The Internet and Higher Education, 36*. 33-40. doi:10.1016/j.iheduc.2017.09.002

Wang J., Tigelaar, D.E.H., & Admiraal, W. (2019). Connecting rural schools to quality education: Rural teachers' use of digital educational resources. *Computers in Human Behavior, 101*, 68-76. https://doi.org/10.1016/j.chb.2019.07.009

Weinhandl, R., Lavicza, Z., & Suss-Stepancik, E. (2018). Technology-enhanced flipped mathematics education in secondary schools: A synopsis of theory and practice. *K-12 STEM Education, 4*(3). 377-389.

Williams, L., Green, R., Tsemunhu, R., Truby, & W., Grimes, L. (2018). Professional educators' perception of implementing virtual education in a rural Georgia school district. *National Teacher Education Journal*, *11*(2), 15-22.

Zheng, B., Lin, C., & Kwon, J. (2020). The impact of learner-, instructor-, and course-level factors on online learning. *Computers & Education.* https://doi.org/10.1016/j.compedu.2020.103851

Appendix A - Letter of Introduction

UNIVERSITY OF ALBERTA

Letter of Introduction - Individual Interview - Adult Participant

Hayden Gust
hgust@ualberta.ca

February 1, 2022

Recipient Name
Recipient City, Province Postal Code

Dear <Recipient Name>,

I am a graduate student in the Master of Education in Educational Leadership and Administration program at the University of Alberta. The purpose of this letter is to you to take part in a research assignment for my EDPS 509 Research Design and Data Analysis course. My assignment is intended to examine the perceived effectiveness of content delivery methods in rural and remote Northern Alberta school divisions to low enrollment STEM classes in an online blended learning model. Your participation would involve a one-hour interview conducted and recorded over Google Meet. Your participation is voluntary; there will be no consequence to you should you decline to participate or decide to withdraw from participating.

In order to gather data for my research assignment, I will be conducting semi-structured interviews over Google Meet. The interview will be audio recorded and transcribed. Please note:

- You may choose not to answer any question.
- You may opt out of this research assignment once responses have been submitted. To do so, please submit your request by email by May 27 and I will destroy all data.
- I will send you a transcription of the interview as well as a summary of the main points I understood you to make by email; you will have the opportunity to verify the accuracy of the transcription and my interpretation of it.

Should any concerns, complaints, or questions arise from your participation, you may contact me or my instructor, Dr. Jose da Costa (jdacosta@ualberta.ca).

Educational Policy Studies

7-104 Education North • University of Alberta • Edmonton • Canada • T6G 2G5
Telephone: (780) 492-7625 • Fax: (780) 492-2024

All data will be handled in compliance with the University of Alberta Standards for the Protection of Human Research Participants:

- Participant names will not be revealed. To protect confidentiality, pseudonyms or numerical coding will be used in all written representations of the data.
- Hard copy data will be locked and will be destroyed on my completion of my graduate program.
- Digital data will be stored on my computer under a secure password-protected system and will be destroyed on my completion of my graduate program.
- Data will be used to complete my EDPS 509 course, my graduate program, and may be used in future presentations and publications in educational contexts.

Thank you for considering this invitation to participate in my research. If you wish to participate, please sign the attached consent form and return it to hgust@ualberta.ca by February 4, 2022. I have included two copies of the consent form: one is to be signed by you and the other is for your own records.

The plan for this research has been reviewed for its adherence to ethical guidelines and approved by Research Ethics Board 1 at the University of Alberta. For questions regarding participant rights and ethical conduct of research, you can contact the Research Ethics Office at (780) 492-2615.

Should you wish a copy of my research findings, I would be pleased to provide one on your request.

Sincerely,

Hayden Gust
Graduate student in the Master of Education in Educational Leadership and Administration program
Faculty of Education, University of Alberta
780-625-8520
hgust@ualberta.ca

Appendix B - Participant Consent Form

UNIVERSITY OF ALBERTA

Adult Participant Consent Form

EDPS 509 Research Assignment: Examination of the Perceived Effectiveness of Online STEM Classrooms in Rural and Remote Northern Alberta Schools

Researcher: Hayden Gust

Date Range of Research: February 3, 2022, to August 1, 2022

I, _____ (name of participant), hereby consent to participate in the research, Examination of the Perceived Effectiveness of Online STEM Classrooms in Rural and Remote Northern Alberta Schools I understand that my participation includes:

- A one-hour interview via Google Meet with Hayden Gust
- The video will be recorded.

As per the Letter of Information, I understand that:

- My participation in this research is voluntary.
- I may withdraw from the research without penalty until May 27, 2022.
- All information gathered will be treated confidentially.
- No identifying information will appear on written representations of the data: pseudonyms or numerical coding will be used to convey the data.
- The data will be used for the purposes of completion of the Master of Education in Educational Studies (MES) program and may be used in future presentations and publications in the educational context.
- The plan for this research has been reviewed for its adherence to ethical guidelines and approved by Research Ethics Board 1 at the University of Alberta. For questions regarding participant rights and ethical conduct of research, I can contact the Research Ethics Office at (780) 492-2615.

_____ _____

Signature of Participant Date

University of Alberta Ethics ID# Pro00096710

Educational Policy Studies

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Appendix C - Interview Schedule

1. How do you engage students in learning in an online classroom?
2. Describe the successes and barriers to developing relationships with students in your online classroom?
3. What are the benefits and/or drawbacks to the technology you are using in your online classroom?
4. What changes to technology or programs do you feel would help students in their access with their online learning?
5. Describe your process for real-time feedback on student practice work?
6. What do you think a successful online classroom looks like?
7. In an ideal situation, money and policy not being a factor, what would your ideal online classroom look like?
8. Describe different pedagogical practices that you have used in your online classroom that have successfully or unsuccessfully increased student engagement?
9. Describe your most successful online lesson.
10. Describe an unsuccessful online lesson you have taught.