


Integrating Technology with Instructional Frameworks to Support All Learners in Inclusive Classrooms

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Abstract

According to the People for Education (2019), approximately 17% of elementary students and 27% of secondary school students in Ontario require special education support. This made the transition from integrated to inclusive classrooms challenging for some teachers as inclusion means, “All students actively participate and learn with their peers in the same classroom with adaptations and accommodations made for all to succeed” (Canadian Research Centre on Inclusive Education, 2021, par. 1). However, this study explored how eight elementary school teachers addressed these obstacles in their successful transitions to inclusion through the integration of technology, Universal Design for Learning (UDL) and the Response to Intervention (RTI) frameworks in both online and physical classrooms. Through online interviews and classroom observations, the teachers orally shared and demonstrated how technology could increase student engagement, differentiate instruction, provide students with alternative instruction and assessment methods, and build teacher capacity within the classrooms. Yet inconsistencies and limitations were revealed in screening approaches to identify the needs of students. A discussion examined these barriers with proposed technology-based considerations that may assist other teachers in their transitions to inclusive classrooms.

Keywords: inclusion, technology, UDL, RTI, online, screening, assessment, intervention



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Introduction

Since 2005, after the release of Ontario's *Education for All* report (OME, 2005), the Ontario Ministry of Education (OME) mandated school boards across the province to move from integrated to inclusive classrooms; however teachers have encountered challenges in achieving this goal due to limited professional development, funding, resources, time, and large class sizes (Froese-Germain et al., 2012). These challenges continue as the students requiring special education have steadily increased over the last 20 years; with approximately 17% of elementary school students and 27% of elementary school students currently requiring special education support (People for Education, 2019). Inclusion and integration are sometimes erroneously interchanged but they are distinct. According to the Canadian Research Center on Inclusive Education (2021), inclusive classrooms are where "students participate and learn with their peers in the same classroom with adaptations and accommodations made for all to succeed. This differs from integrated classrooms where students are "placed in the same classroom as their peers, but they are expected to conform" to a standardized curriculum (par. 1).

This study was founded on the premise that all students can be successful learners in inclusive classrooms when technology is integrated into the Universal Design for Learning (UDL) and Response to Intervention (RTI) frameworks. Further to the *Education of All* report in 2005, the OME (2013) established guidelines derived from RTI and UDL in the educators' resource, *Learning for All: Guide of Effective Assessment and Instruction for All Students, K-12*.

RTI, referred to in Ontario as the Tiered Approach to Early Intervention, is a three-tiered framework to identify learning needs early and implement interventions at increasing levels of intensity depending on student needs (NCLD, n.d.). The essential components within each tier are screening to identify needs, implementing interventions, and monitoring students' progress (National Center on Response to Intervention, 2010). One objective of RTI is to first address the learning needs of the majority of students within tier one of the RTI framework using universal instructional strategies which may result in less students requiring intensive support. These strategies are developed through the Universal Design for Learning framework (UDL) (Preston, et al., 2016).

UDL is a "theoretical instructional framework to guide the design and development of learning environments that represent materials in flexible ways and offers a variety of options for learners to comprehend information, demonstrate their knowledge and skills, and be motivated to learn" (Hall, T et. al., 2014, p. 10). UDL offers a variety of options for students to receive information and demonstrate their understanding of the content through its three principles of providing; multiple means of engagement, multiple means of representation; and multiple means of action and expression (Cast, 2018). Spencer's (2011) review on the merits of UDL indicated UDL can reduce behaviour issues in students when their learning needs are met, and allow students to learn through their strengths making lessons accessible for all types of struggling learners.

Despite the benefits of the RTI/Tiered Approach and UDL frameworks, these frameworks may be challenging to execute if teachers have limited time or lack of classroom support. Cowan and Maxwell's (2015) study indicated the RTI process was too cumbersome in terms of paperwork. One teacher stated, "There are too many steps to get to where you want to get to" and another teacher said "It's too time consuming" (p. 6-7). Technology may help teachers maximize efficiencies and support the unique needs of students (Basham et al, 2010; Sharpe, 2019). Basham et al. (2010) indicated that "through proactive instructional design and the use of modern technology, the learning environment can become more accessible to a

number of learners utilizing specific multimedia design principles within digital environments” (p. 244). The benefits of combining the Google suite technology with UDL was also evidenced in Sharpe’s (2019) study where students’ had increased access to features to help them with reading, writing, group work, organization, and engagement. Some of these features included text-to-speech, speech-to-text, word prediction software, collaborative word documents (Google Docs) and presentation slides (Google Slides). Therefore, my study examined ways some teachers were employing technology to engage students with diverse learning needs in inclusive classrooms using the principles of UDL within tier one of the tiered approach. The questions guiding this study were:

- *How were teachers using technology and UDL to identify learning needs, implement instructional strategies and monitor students’ progress within the tiered approach?*
- *How were teachers building capacity in implementing technology and UDL within the Tiered Approach?*

Literature Review

My study was grounded on Carl Rogers’ humanistic theory which was a client centered approach of educating the whole person by bringing together cognitive learning with affective-experiential learning. This implied that if the teacher focused on each learner as an individual, the maximum potential of every student could be realized. In the humanistic concept of inclusion, classmates adapt to each other in alternative ways so that every student becomes a full, active participant in the educational system. Rogers (1995) also believed that students who learned through their strengths and interests were more engaged and motivated to learn.

One example of a humanistic approach is the adoption of interactive technologies that were universal for all learners but adapted for individuals (Nabiullina, 2015). Keeping in mind the challenges of teachers in transitioning to inclusive classrooms, the literature explored these challenges and examined how teachers have been utilizing technology to address some of these obstacles. The research also indicated that technology alone is not the answer, but the integration of technology, UDL and the tiered approach may need further investigation.

Teachers Challenges in Transitioning to Inclusive Classrooms

Some of the key challenges of inclusion expressed by teachers were lack of training, time and support in the classrooms (Alahmari, 2019; Brackenreed, 2011; Dolighan & Owen, 2021; Goodrow, 2016). In Goodrow’s (2016) study of middle and high school general education teachers, Interviewee 1 stated, “I have zero training. I don’t remember the last time I had training in inclusion. I have no experience with strategies and supports in regard to inclusion of students with autism” (p. 52-53). Technology may assist with some of these challenges, however, teachers in Dolighan and Owen’s (2021) study on online learning reported a low efficacy score; between “very little” to “some” ability in teaching online instruction and requested the need for more professional development. As teachers engaged in more technology training, teachers’ efficacy scores increased (Dolighan & Owen, 2021).

Other obstacles teachers faced in transitioning to inclusive classrooms were limited time and the lack of support received in the classroom (Alahmari, 2019; Brackenreed, 2011). Brackenreed’s study (2011) of 269 elementary and secondary teachers from north-eastern Ontario revealed that the teachers generally promoted the idea of inclusion, but they were stressed due to lack of support in the classroom. In a teacher Stress and Coping Questionnaire, factors expressed by the teachers contributing to their stress of teaching in

inclusive classrooms included; interference with a teacher's instruction time, increased paperwork, general workload and insufficient teacher preparation (Brackenreed, 2011). These concerns were further evidenced in Alahmari's (2019) review of the general educator's role of implementing inclusive practices into their classrooms, as teachers found this process strenuous when they were not provided with appropriate support from their administrators. However, supplemental research illustrated how technology increased support within the classroom, built teacher capacity and considered students' needs (Bjekic et al, 2014; Coy, 2013; Greenwood et al., 2016; Nepo, 2016; Ok & Rao, 2019; Smith et al., 2017).

Adoption of Technology to Build Teacher Capacity and Consider Students' Needs

Greenwood et al. (2016) found when teachers used technology to supplement teacher-led instruction; teachers could build capacity by working with multiple students in the classroom while simultaneously increasing student self-efficacy. In Greenwood et al. study on the effects of a technology-assisted, storybook interventions, some students were less intimidated using technology with multiple opportunities to respond, than participating in small-group instruction delivered by a teacher. Therefore, when teachers feel more comfortable with technology, they can implement technology-based solutions that consider the needs of all students using the principles of UDL (Smith et al., 2017).

In Smith's et al., (2017) examination of a training program which integrated technology with UDL, upon completion, participants felt more comfortable using technology and wanted to implement more technology-based interventions in their classrooms. Some of the software the teachers learned included, *Inspiration*, *Wordle web-based software*; *Texthelp's Read & Write Gold*, *digital text*, *Intel Reader*, and *SMART Response*.

Technology can be effective in both physical and online classrooms (Bjekic et al, 2014; Coy, 2013; Nepo, 2016; Ok & Rao, 2019) using differentiated instruction. Differentiated instruction is teaching students with differing abilities in the same class by adapting elements of the curriculum (content, process, product, and environment) based on students' abilities and interests (Tomlinson, 2014). Nepo (2016) and Ok & Rao (2019) found technology devices in the classroom benefitted students with and without disabilities because of accessibility adaptations already built into them such as text to speech, magnification, or auditory output. Text-to-speech allowed struggling readers to listen to words that were difficult to decode and read text at a variety of reading levels. The speech recognition feature which transcribed spoken words into text could support learners who had difficulties in expressive writing. Google Chrome browser was ideal because it worked among many common platforms and aligned with UDL guidelines enabling multiple ways for teachers to represent instruction and students to express understanding.

Coy's et al. (2014) research further evidenced the benefits of technology in online classrooms for students with diverse needs because the same UDL principles can be applied online and in the physical classroom. Coy et al. (2014) described the scenario of Sarah, a seventh grader with learning disabilities (LD) in reading, writing, and math and Attention Deficit Hyperactivity Disorder (ADHD). Prior to learning online, Sarah—was often perceived as disruptive in the physical classroom due to her hyperactive learning style. Sarah's online education led to significant improvements as she collaborated effectively online with other students in the small group sessions, and used the online technology and materials at home to be able to move, write, and think all at the same time. According to Bjekic et al. (2014), students with disabilities learn better when content is presented to them both verbally and graphically so they can form parallel mental models and engage multiple perceptual system reception. They also need opportunities for peer-to-peer collaboration to avoid isolation, which can be achieved through synchronous online sessions (Bjekic et al. 2014).

Teachers also found technology effective in monitoring students' progress. In a collaborative project at the Simcoe County District School Board, four elementary school teachers partnered to explore the impact of using Google suite to enhance formative feedback to their students in the physical classroom setting (OTF, 2016). The teachers observed each other's classrooms and provided feedback to each other's students using interactive Google applications. The teachers stated it was easier to connect with all students digitally especially those with special education needs who benefited from timely feedback (OTF, 2016). Despite the benefits of adopting technology to support the needs of diverse learners, technology alone may not be enough to overcome the obstacles some teachers faced in teaching in inclusive classrooms, as the needs of the students also have to be considered within the UDL and RTI frameworks.

Technology Alone is not Enough

In the Ontario's Learning for All guide, the OME (2013) has outlined the importance of incorporating UDL and RTI into inclusive teaching practices using; 1) class profiles to screen students and identify needs, strengths and interests, 2) UDL to design instructional strategies that support most learners, 3) differentiated instruction to adapt instruction for diverse learners, and 4) methods to assess student learning and progress. However, the integration of technology within UDL and the tiered approach has not been well documented. In fact, there has been little documentation at the board and ministry levels of an effective process to transition from integrated to inclusive classrooms in Ontario while addressing the challenges encountered by teachers (Parekh, 2013).

The literature indicates that approaches aligned with the UDL framework and tiered approach may support the diversity of learners in inclusive classrooms (Cast, 2018; Preston, et al., 2016; Spencer, 2011) but the processes may be challenging to implement for some teachers (Cowan & Maxwell, 2015). Technology may help increase teacher capacity (Coy et al., 2014; Greenwood et al., 2016; OME, 2013; OTF, 2016; Smith's et al., 2017) and provide more choice for students in what, how and where they learn (Bjekic et al, 2014; Coy, 2013; Nepo, 2016; Ok & Rao, 2019); but unless the needs of both teachers and students are addressed, the beneficial outcomes may not be realized.

Therefore, my study aimed to address the gaps in research by exploring how some teachers are using technology in their inclusive classroom to meet the needs of diverse students through UDL and the tiered approach while considering teachers' challenges of limited time, and lack of training and support in the classrooms. The most appropriate methodology to achieve this outcome was a qualitative case study.

Methodology

A case study was completed in 2020 during the first year of the COVID-19 pandemic with eight elementary school teachers who exhibited exemplary inclusive practices in their physical and online inclusive classrooms. The study was bounded by one school board in Ontario that was transitioning to inclusion classrooms.

The teacher participants were recruited through the Special Education department and their school principal, using purposeful sampling, for having demonstrated exemplary inclusive practices. Data collection was gathered from multiple sources for the purpose of triangulation as suggested by Yin (2018). These sources included one semi-structured online interview with each of the five teachers from the physical classroom; and two semi-structured online interviews and one online classroom observation with each of the three online teachers. The interviews were audio recorded and field notes were created for the observations of the teachers' instructional practices within their classrooms. A document analysis of the ministry and school

board inclusive education policies and processes was also conducted. A consent form was completed by all participants to ensure confidentiality, voluntary participation and anonymity through the use of pseudonyms.

The data was analyzed using provisional, descriptive, *in vivo* coding and pattern matching which emerged into themes. Provisional, research-generated codes were initially identified deductively prior to the data collection under the broad categories of training, screening, interventions and progress monitoring to align with the components of the RTI framework. Then, after the data was collected, an inductive approach was utilized to assign descriptive and in vivo codes to the data uncovered in the interviews and observations. Descriptive coding, which assigns a label to a word or short phrase, was used to organize data from the field note observations (Miles et al., 2014). Descriptive and in vivo coding, which uses short phrases from the participants' own language, were used in the interviews to capture the personal views expressed by the teachers (Miles et al., 2014). As codes were repeated patterns emerged, and a final list of five themes were established.

Findings

The findings of this study are based on the guidelines set out in the OME (2013) *Learning for All* guide on inclusive practices. Themes emerged related to the three components of the tiered approach; approaches to screening, intervention and progress monitoring to determine how teachers were using technology and UDL to identify student needs, implement instructional strategies and monitor students' progress in the tiered approach. These themes included: 1) building student relationships; 2) identifying instructional needs; 2) increasing engagement with collaborative learning through technology; 3) differentiating instruction through the process and environment of learning; 4) providing choice of evaluation methods; and 5) recognizing the impact of formative and summative assessments.

Approaches to Screening

According to OME's (2013) *Learning for All* guide, screening involved getting to know students through '*assessments for learning*' to identify the students strengths, needs and interests. Two themes which emerged from the approaches to screening included: building student relationships and identifying instructional needs of students.

Building Student Relationships

Teachers expressed the importance of building relationships in the screening process and they described a variety of ways they built relationships with students and their families. The teachers said that building relationships enabled them to better understand the student's strengths and their challenges. In addition to reviewing previous formal school documentation such as report cards and the Ontario Student Records (OSR), and completing diagnostic assessments; Quinn, Karen and Anne said the informal conversations with students and their families from the first day of school were the most valuable way of getting to know their students. Since Karen taught over 30 students in her online classroom, she distributed Google form surveys to the students to learn about their strengths, interests, learning preferences and even their technology and accessibility needs. Edward, one the teachers from the physical classrooms, stipulated that he built strong relationships with students by first focusing on the student's strengths to encourage students to maximize their potential.

Identifying Instructional Needs of Students

In relation to identifying students' instructional needs, some assessment tools were only available to teachers with a special education designation resulting in delays in special education support received by some students. Although the OME (2013) *Learning for All* guide encouraged the use of class profiles to keep track of students' needs, strengths, and interests, these profiles were not mandatory. Therefore, the teachers in my study indicated class profiles had not been implemented in their school board so they had to maintain data in their own ways. Vicky said teachers were previously required to record the students' reading levels on a centralized report but this was no longer mandatory. However, Vicky said the teachers were still expected to complete the reading assessments twice a year and maintain their own records. Vicky found the previous centralized reporting useful as it provided her with a base of where to start without having to reinvent her own tracking systems. The second element of the tiered approach is approaches to intervention.

Approaches to Interventions

Approaches to interventions involved providing multiple means of engagement and representation which unfolded into three themes; creating opportunities to increase student engagement, accommodating students' needs, and differentiating instruction through the process and the environment of learning.

Creating Opportunities to Increase Student Engagement

The UDL guidelines consider many factors when measuring a student's engagement and motivation to learn including the optimization of individual choice of learning, the minimization of distractions, the opportunity for collaboration, and a variety of resources to optimize, challenge and differentiate the learning of each student (Cast, 2018). Teachers indicated engagement was an essential element within inclusive classrooms.

Karen and Quinn indicated that engagement contributed to their successes in managing inclusive classrooms but also indicated engagement was one of the most difficult challenges in teaching a large online classroom of diverse learners. Karen and Quinn addressed this obstacle using the technology features of Brightspace and Google Classroom which included cameras, microphones, screen sharing, breakout rooms, chats and interactive whiteboards (D2L, n.d).

Google Suite also provided options to increase engagement and collaborative learning through technology. In my classroom observations of Karen and Quinn, the teachers conducted lessons using Google Slides for presentations and Google Forms for peer-to-peer evaluations. Due to the physical distancing limitations of the pandemic, Edward set up small tables in his classroom where students physically distanced while collaborating on shared Google documents. Edward maintained that Google Doc was a fantastic tool and said, "It's amazing when I asked students to write something and then when I asked students to type something, how much more I could get through typing." The second theme uncovered in the teachers' approaches to intervention was accommodating students' learning needs with an individual education plan (IEP).

Accommodating Students' Learning Needs

One accommodation Lucy and Edward said they always considered in the development of the IEP was access to technology as they stated technology enabled more ways of accessing the content. Lucy stated technology levelled the playing field for students with disabilities but should be available to all students. She said "It is like the idea of a ramp, the ramp is there for people that need it, but I enjoyed the ramp and I also enjoy the automated doors." Edward included technology, specifically the use of Chrome books, in the IEP of each student because a lot of accommodations for reading and writing are embedded into Chrome book laptops and tablets.

Eden, Barb, Lucy and Vicky said they consider accommodations in the IEP that would benefit all students in their class. Lucy said “Why can't everyone have extra time? Why can't everyone use visuals? Why can't everyone have access to a good anchor? If everybody's accessing universal accommodations then less IEPs are needed.” Although the teachers were receptive to accommodating the needs of individual students with an IEP, they shared ways they considered universal accommodations and adaptations through differentiated instruction.

Differentiation through the Process and Environment of Learning

Consideration of universal accommodations aligns with the UDL principle of providing multiple means of representation and relates to how students perceive information in different ways. Factors to consider for an equitable inclusive learning environment include customization of the way information is displayed in auditory and visual formats, illustration through multimedia, guiding information processing and maximizing the transfer of the content (Cast, 2018). The use of technology offers numerous ways of differentiating instruction through the process and environment of learning. The teachers shared unique ways of adapting instruction to consider the needs of all learners.

Eden and Barb used technology to provide choice in the way students received instruction. They said with Google classroom, it was easy to post a document and add a visual picture, record and post a Google slide show lesson, post videos, record interactive manipulative demonstrations. They also used creative online games like *Flip Grid*, *Jeopardy*, *Kahoot*, and *Jamboard* to keep the students engaged. Eden and Barb sometimes created step by step instructional videos or templates of the content so all students could access the same content but process the information at their own pace.

Edward stipulated that differentiation enabled students to keep up with the content at the classroom grade level so he allowed the students to use the various extensions on the Chrome book when completing a research assignment. He said the student could either gather information by reading text, watching videos or using the read aloud feature on the pdf reader to read along with the text. Edward stated a student should not be punished if they couldn't read the text as he specifically said “you're still getting it through reading, you're just watching along. This is not a reading assessment and it's just to make sure they get that knowledge.”

When Vicky completed a novel study, she tried to find a version of the book that could be read aloud. Vicky then gave the students the choice to read the book on their own or read and follow along with the audio book. She said, “Sometimes you're thinking it's for the kids that may be struggling a bit with reading or have an IEP. And it's interesting because it's not always the kids you anticipate who will choose the audio option.” Vicky also used the pdf reader to help learners who struggled with writing by hand, as the tool provided students with the option to type answers or highlight text directly on the online pdf document.

Karen found creative ways to set up smaller break out rooms. The students depended on these breakout rooms as they looked forward to collaborating with their peers or obtaining more support from their teachers in this format. Karen said “breakout rooms are like magic.” Karen said it's easier to differentiate in the online classroom than the physical classroom because when the teacher differentiates in the physical classroom, the teachers' actions are more obvious as the other students can see how the teacher is supporting students who may require special education needs. In breakout rooms Karen can give more attention to those who need it or more enrichment activities to those who need that extra stimulation. The final stage in the tiered approach process was monitoring the student's progress to assess students' learning. The teachers shared a variety of approaches for progress monitoring.

Approaches to Progress Monitoring

The teachers monitored the student's progress through the use of technology and UDL by providing multiple means of action and expression for students to demonstrate their understanding. According to the UDL guidelines, action and expression enables learners to express what they know in alternative ways that work best for them. This can include varying the methods in which learners respond, using multiple media for communication, using multiple tools for construction and composition, and enhancing the capacity for progress monitoring (Cast, 2018). The types of assessments teachers utilized included formative feedback as students were learning, as well as summative assessments of their learning. The themes which emerged from progress monitoring were: providing choice of evaluation methods with technology, and conducting formative and summative assessments with technology.

Providing Choice of Evaluation Methods with Technology

The teachers provided alternative choices of evaluation using technology. All of the teachers used Brightspace or Google Classroom and other technologies to enable students to demonstrate their knowledge in multiple ways. Teachers could create practice or grade quizzes and tests in multiple formats including multiple choice, short answer and fill in the blank (D2L, n.d.; Google, n.d.). Differentiation could be added with extended time options and countdown timers. Assignments could be submitted as a visual piece through the portfolio or as text, audio or video file. Teachers could use the grading portal to help students monitor their progress by sending students automatic reminders of any missing work.

Barb, Eden, Edward and Quinn also found other technology helpful to determine a student's understanding of the content learned. Barb, Eden and Edward used game based technology such as *Kahoot* and *Jeopardy*. Edward permitted a student, who exhibited performance anxiety, the opportunity to record a video on the student's YouTube channel instead of doing a presentation in front of the class. Edward played the YouTube video for the class, but the student preferred to wait in the hall while the other students enjoyed the video.

Quinn used the recording feature in the online *Raz Kids* reading program to initiate formative feedback by recording student's reading every other week and he said, "It's amazing for them to see the difference between each month." Providing multiple ways for students to demonstrate their understanding meant teachers were required to evaluate the work using different methods for formative and summative assessments. This sometimes reduced the teacher's capacity in assessing learners so the teachers had to find ways to overcome this obstacle.

Conducting Formative and Summative Assessments with Technology

Brightspace and Google Classroom provided varying options for collecting, reviewing and evaluating student's work. Barb and Eden stated the rubric and feedback options allowed teachers to easily grade work and provide meaningful formative feedback and summative assessments by text, audio or video. Barb and Eden said they liked to embed a rubric in Google Classroom and used the comment section to record a mark and provide feedback which could then be exported as a spreadsheet for the class. They also used the rubric functions in Google Classroom to mark other assignments together as a class. Google Form was used as an assessment tool as the answers could be incorporated and tests automatically marked. Peer-to-peer feedback using Google Forms was also implemented by one teacher to reduce marking time and provide opportunities for students to learn from one another. Overall, the teachers were receptive to utilizing a variety of automated evaluation methods, but all teachers were not fully utilizing all the assessment features in Google Classroom and Brightspace.

In summary, teachers were able to use technology and the principles of UDL to identify student needs, to implement instructional strategies and to monitor the progress of students

within tier one of the Tiered Approach. They did this by building relationships to identify students' needs, strengths, and interests; and developing universal and differentiated instructional strategies that align with their learner profiles. Teachers also explored technologies through the principles of UDL by providing students opportunities for multiple means of engagement, representation and action and expression for both formative and summative assessment. The discussion further interrogates the teachers' inclusive practices to gauge how these experiences might support more teachers in managing the diverse needs of students in inclusive classrooms.

Discussion

The components of the discussion were assembled into three categories; screening to identify needs and build relationships, adopting technology in universal and differentiated instructional strategies, and opportunities and challenges in the assessment of learning.

Screening to Identify Needs and Build Relationships

All teachers used unique approaches to get to know students including informal discussions with parents and students, reviewing documents in student files and Google Form surveys to understand students' needs as well as their strengths, and interests. Some of these methods were more time consuming than others but all teachers agreed this initial step was critical to understanding and supporting the needs of students in inclusive classrooms. These approaches aligned with Rogers (1995) humanistic theory which specified that teachers focus on understanding and educating the whole person so the learner's full potential could be achieved. Rogers (1995) also believed that students who learned through their strengths and interests were more engaged and motivated to learn.

The needs of students were identified through a variety of assessment tools, but it appeared the teachers with special education designations had more access to assessments than other teachers. This meant the needs of some students were identified earlier than others and sometimes not at all. These findings contradicted Alahmari's (2019) research on the importance of early identification which indicated that if the needs of students were identified early and appropriate intervention implemented, some students may not need additional intensive support. If all teachers were now expected to teach in inclusive classrooms, it seems like all teachers should at least have access to the information within the students' assessments.

Another process which hindered the teachers' capacity in screening students was the collection and maintenance of class data. While the OME (2013) encouraged school boards to use centralized class profiles to manage this process, the board in my study did not implement them. This resulted in the teachers creating their own manual reporting systems to keep track of the student data which precipitated an additional administrative burden. The automation of these class profiles, which some school boards in Ontario successfully implemented, may generate efficiencies in the screening process (OME, 2013). Despite the limited use of technologies employed by teachers in the screening process, the teachers adopted multiple uses of technologies to increase student engagement and accommodate the diverse needs of students through the principles of UDL and differentiated instruction.

Adopting Technology in Universal and Differentiated Instructional Strategies

The teachers in both the online and physical classrooms shared in their interviews and demonstrated through their classroom observations, multiple ways they used technology to increase student engagement. This included a variety of tools within Google Suite and many features within the synchronous online platforms of Google Classroom and Brightspace. The

collaborative online options were especially important for the diverse students in the teachers' classroom. This paralleled Coy's et al. (2014) study which indicated that students with and without disabilities benefitted from online learning when teachers used a variety of technology features to enable multiple options for learning. Despite the teachers' effective strategies to increase student engagement in online classrooms, some literature stipulated engagement in online classrooms was more difficult for some teachers but that collaborative technology such as Google Suite, Google Chrome and breakout rooms in online classrooms made this easier (Coy et al, 2014; Nepo, 2016; Ok & Rao, 2019). These collaborative technologies align with the humanistic theory which proposed that interactive technologies were universal for all learners but could be adapted for individual learning needs (Nabiullina, 2015). Therefore, in addition to using technology to increase engagement, teachers also found technology beneficial in accommodating the needs of students requiring special education support.

All teachers expressed the importance of including technology as an accommodation in their students' IEP as they believed technology levelled the playing field. Several teachers also maintained that the accommodations in IEPs should be universal and available to all students in the classroom should they need them. They indicated that universal accommodations may also reduce the need for intensive support through IEPs which was supported by the literature on the benefits of implementing appropriate universal strategies to reduce the need for intensive support (Alahmari, 2019). In addition to universal accommodations, teachers were also able to consider the needs of all learners through differentiated instruction.

Tomlinson (2014) described differentiated instruction as teaching students with differing abilities in the same class by adapting elements of the curriculum based on students' abilities and interests. The teachers shared multiple ways they differentiated instruction through the process of learning, and the environment of learning using technology based strategies including; Chrome books, audio books, online games, interactive websites and breakout rooms in synchronous online learning platforms. Regardless of the strategies utilized, all teachers in the study embedded online instructional resources into their teaching practices to benefit as many students as possible. It seemed clear from my interviews and observations and through evidence from the literature that the combination of technology, UDL and differentiation empowered teachers to offer universal strategies and differentiated strategies enabling students to learn in the ways they learn best (Basham et.al, 2010; Greenwood et.al., 2016; Hall, T et. al., 2014; Nepo, 2016; Ok & Rao, 2019; Smith & Okolo, 2010; Tomlinson, 2014). UDL and technology was also integrated into the assessment of learning when teachers monitored the progress of students.

Opportunities and Challenges in the Assessment of Learning

Offering students choice to demonstrate their understanding in the assessment of learning presented opportunities as well as challenges for the teachers. The features in technology devices provided students with the opportunity to express their knowledge in multiple media formats such as through text, visuals, audio, video or in any combination that works best for them. Yet, the more choices offered to students meant teachers also had to instill multiple formats of marking which could be timing consuming. However, some teachers found efficiencies in the automated rubrics available in the Google technologies and the adoption of peer evaluations through Google Forms. Although current literature stipulated that technology devices such as Chrome books and assistive technology provided more opportunities for students to demonstrate their understanding with embedded features such as text to speech, magnification and auditory output; there was proportionate technology available to increase teacher capacity as well (D2L, n.d., Google, n.d.; Greenwood et al., 2016; Nepo, 2016; Ok & Rao, 2019). There may also be benefit in teachers observing colleagues in their classrooms to determine how they are using technology for assessment just as the teachers did in the Simcoe

County District's School Board collaborative project exploring technology to enhance formative feedback (OTF, 2016).

Limitations

Due to the unstable deployment of teacher resources during the pandemic, my research included a small sample of eight teachers.

Conclusion

The findings from this study suggest that the learning needs of students in both physical and online inclusive classrooms could be met through the amalgamation of technology, the UDL framework and the RTI tiered approach. However, this assumption was dependent on how teachers implemented the approaches of screening, interventions and progress monitoring.


Despite the various techniques employed by teachers to identify the needs of students, inefficiencies occurred in the inconsistent access to assessments and manual processes required to maintain student data. Increased access to students' assessments and the implementation of automated class profiles may fill some of these operational gaps. The multiple strategies shared by the teachers illustrated the possibilities of combining technology and UDL to increase student engagement and provide universal and differentiated learning options which consider students' diverse learning needs. These strategies may serve as a useful guide for teachers who are facing barriers in successfully transitioning to inclusive classrooms. Finally, teachers provided students with numerous options to demonstrate their understanding of learning, but this flexibility also created challenges because of the additional marking requirements. However, technology features in Google Classroom, Google Suite and other technologies evidenced in the literature were adopted by the teachers to overcome some of these obstacles.

Although the COVID-19 pandemic compelled teachers to rapidly shift to online learning, some teachers maximized this opportunity to increase inclusive practices in their online classrooms with the experimentation of various technologies. However, technology was not limited to online classrooms, as some teachers in physical classrooms also demonstrated the benefits of integrating technology with UDL in their inclusive classrooms. It seemed evident that the teachers were well versed in identifying and applying appropriate technology-based solutions in the intervention and progress monitoring stages. Yet, future studies are required to determine if automated class profiles, increased access to assessments or other technology options could reduce the challenges in teachers' capacity to identify early the learning needs of diverse students and align these needs with appropriate instructional strategies.

Author's Contributions

Cut from original submission for anonymity

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Conflict of Interest

The authors do not declare any conflict of interest.

Data Availability Statement

The data generated and analyzed during the current study are not publicly available due to ethics requirements. They are available from the corresponding author on reasonable request

References

- Alahmari, A. (2019). A review and synthesis of the response to intervention (RTI) literature: teachers' implementations and perceptions. *International Journal of Special Education*. Vol. 33, No.4, 2019.
- Basham, M.I, Graden, J, Poth, R. & Winston, M. (2010). A comprehensive approach to RTI: embedding universal design for learning and technology. *Learning Disability Quarterly*. Volume 33, Fall 2010. <https://doi.org/10.1177/073194871003300403>
- Bjekic, D., Obradovic, S., Vucetic, M. & Bojovic, M. (2014). E-teacher in inclusive e-education for students with specific learning disabilities. *Science Direct. Procedia - Social and Behavioral Sciences* 128 (2014) 128 –133.
- Brackenreed, D. (2011). Inclusive education: Identifying teachers' strategies for coping with perceived stressors in inclusive classrooms. *Canadian Journal of Educational Administration and Policy*, Issue #122, June 23, 2011.
- Canadian Research Center on Inclusive Education. (2021). *Understanding inclusive education*. Western University. <https://www.inclusiveeducationresearch.ca/about/inclusion.html>
- CAST (2018). *Universal design for learning guidelines version 2.2*. <http://udlguidelines.cast.org>
- Cowan, C., & Maxwell, G. (2015). Educators' perceptions of response to intervention implementation and impact on student learning. *Journal of Instructional Pedagogies*, 16.
- Coy, K., Marino, M., & Serianni, B. (2014). Using universal design for learning in synchronous online instruction. *Journal of Special Education Technology*. Volume 29, No. 1. <https://doi.org/10.1177/016264341402900105>
- Desire to Learn (D2L) (n.d.). *Brightspace core*. <https://www.d2l.com/k-12/products/core/>
- Dolighan, T. & Owen, M. (2021). Teacher efficacy for online teaching during the COVID-19 pandemic. *Brock Education Journal*. 2021 Vol. 30. [HTTPS://DOI.ORG/10.26522/BROCKED.V30I1.851](https://doi.org/10.26522/BROCKED.V30I1.851)
- Froese-Germain, B., Riel, R. & McGahey, B. (2012). Class size and student diversity: Two sides of the same coin. *Canadian Teacher Federation*. January 12, 2012.
- Goodrow, M. A. (2016). A study of teachers' challenges with the inclusion of middle and high school students with autism. *Walden University Scholars Works*, pg. 65-66.

- <https://scholarworks.waldenu.edu/cqi/viewcontent.cgi?referer=&httpsredir=1&article=3760&context=dissertations>
- Greenwood, C.R., Carta, J.C, Kelley, E.S., Guerrero, G., Kong, N. Atwater, J., & Goldstein, H. (2016). Systematic replication of the effects of a supplementary, technology-assisted, storybook intervention for preschool children with weak vocabulary and comprehension skills. *The Elementary School Journal Volume 116*, Number 4.
- Hall, T., Vue, G., Strangman, N., & Meyer, A. (2004). Differentiated instruction and implications for UDL implementation. *National Center on Accessing the General Curriculum*.
<http://aem.cast.org/about/publications/2003/ncac-differentiated-instruction-udl.html>
- Miles, M.B., Huberman, A.M., and Saldana, J. (2014). *Qualitative data analysis: A methods sourcebook*. 3rd Edition. Thousand Oaks, CA: Sage.
- Nabiullina, R.K. (2015). The principle of humanism- The fundamental principle of inclusive education. *Review of European Studies; Vol. 7*, No. 4; 2015 ISSN 1918-7173 E-ISSN 1918-7181.
- National Center for Learning Disabilities (NCLD). (n.d). *Progress monitoring within a response to intervention model*. <http://www.rtinetwork.org/learn/research/progress-monitoring-within-a-rti-model>
- National Center on Response to Intervention. (2010). *Essential components of RTI*. American Institutes for Research. <https://rti4success.org/essential-components-rti>
- Nepo, K. (2016). *The use of technology to improve education*. Child Youth Care Forum. Springer.
- Ok, M.W., & Rao, K. (2019). Digital tools for the inclusive classroom: Google Chrome as assistive and instructional technology. *Journal of Special Education Technology, Vol. 34*(3) 204-211.
- Ontario Ministry of Education. (2005). *Education for all*. Expert Panel on Literacy and Numeracy Instruction for Students With Special Education Needs
<http://www.oafccd.com/documents/educationforall.pdf>
- Ontario Ministry of Education. (2013). *Learning for all: A guide to effective assessment and instruction for all students, Kindergarten to Grade 12*. Queen's Printer for Ontario.
<http://www.edu.gov.on.ca/eng/general/elemsec/speced/LearningforAll2013.pdf>
- Ontario Teacher's Federation. (2016). *The meaningful collaborative assessment and feedback strategies*. <https://www.otffeo.on.ca/en/learning/tlc/report/the-meaningful-collaborative-assessment-and-feedback-strategies>
- Parekh, G. (2013). *A case for inclusion*. Toronto District School Board. Toronto, Ontario.
- People for Education (2019). Annual report on schools. What makes a school?
<https://peopleforeducation.ca/report/2019-annual-report-on-schools-what-makes-a-school/#chapter5>
- Preston, A.I., Wood, C.L. & Stecker, P.M. (2016). Response to intervention: Where it came from and where it's going, *Preventing School Failure: Alternative Education for Children and Youth*. 60:3, 173-82, DOI: [10.1080/1045988X.2015.1065399](https://doi.org/10.1080/1045988X.2015.1065399)
- Rogers, C. R. (1995). *Way of being*. Houghton Mifflin.
- Sharpe, S. (2019). *Examining Google Classroom capabilities to help to provide principles of*

- universal design for learning*. <https://research.library.mun.ca/13935/1/thesis.pdf>
- Smith Canter, L., King, L., Williams, J., Metcalf, D., & Myrick Potts, K. (2017). Evaluating pedagogy and practice of universal design for learning in public schools. *Exceptionality Education International*. Vol. 27, No. 1, pp. 1–16. <https://doi.org/10.5206/eei.v27i1.7743>
- Spencer, S. (2011). Universal design for learning: Assistance for teachers in today's inclusive classrooms. *Interdisciplinary Journal of Teaching and Learning*, Volume 1, Number 1.
- Tomlinson, C. A. (2014). *Differentiated classroom: Responding to the needs of all learners*. ASCD.
- Yin, R. (2018). *Case study research and applications: Design and methods*. Sage Publications. 2018. 6th Edition.